MANGOOLA OPEN CUT
GLENCORE

MANGOOLA COAL CONTINUED OPERATIONS PROJECT

RESPONSE TO SUBMISSIONS

DECEMBER 2019

umwelt
Environmental & Social Consultants

MANGOOLA COAL CONTINUED OPERATIONS PROJECT

Response to Submissions

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mangoola Coal Operations Pty Limited

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1.0 Introduction

The Environmental Impact Statement (EIS) for the Mangoola Coal Continued Operations Project (MCCO Project) was placed on public exhibition from 18 July to 28 August 2019. This Response to Submissions (RTS) has been prepared to address the issues raised in the submissions received during the public exhibition period.

Mangoola Coal Operations Pty Limited (Mangoola) which is owned by Glencore Coal Pty Ltd (Glencore) has identified further coal resources to the north of the existing mine and is seeking approval to extract these coal resources by continuing the existing Mangoola Coal Mine into this new mining area. The MCCO Project was developed using a detailed social, economic and environmental risk-based approach that aimed to maximise resource extraction efficiency and optimise the use of existing mining infrastructure, whilst seeking to minimise impacts on the environment and community.

A total of 334 submissions were made in response to the public exhibition of the MCCO Project EIS. This included 13 agency submissions and 321 community and interest group submissions. The 321 submissions received from the community and interest groups included 230 submissions in support of the MCCO Project. It should be noted that the Department of Planning, Industry and Environment (DPIE) Planning Portal currently identifies a total of 335 submissions on the MCCO Project EIS. The Department of Environment and Energy (DoEE) made a submission on the MCCO Project EIS which stated that no formal submission would be made by DoEE. As such the online submission from DoEE has not been included in the submission count provided in this RTS.

This RTS has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Mangoola and seeks to address the issues raised in agency, community and interest group submissions. It is noted that a separate response will be provided to the issues raised by the submission from the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC). The IESC submission was provided after the other submissions due to the timing of the IESC meeting schedule.

Appendix 1 provides a register of objecting and comment submitters for the MCCO Project. It also provides cross-references to relevant sections of this RTS which address the submitters issues or comments.

This RTS includes:

- an introduction and brief summary of the MCCO Project to provide context to the submissions (**Section 1.0**)
- an analysis of the submissions provided including the issues and themes raised (**Section 2.0**)
- a response to Government agency submissions (**Section 3.0**)
- a response to community and interest group submissions (**Section 4.0**).

The following sections include a brief summary of the MCCO Project and the changes to the project description which have resulted from the RTS process. It also includes a summary of the ongoing stakeholder engagement undertaken throughout the exhibition phase and the planned consultation for the assessment and determination phases.

1.1 Mangoola Coal Continued Operations Project

Mangoola Coal Mine is an existing open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW (refer to **Figure 1.1**). Mangoola has operated the Mangoola Coal Mine in accordance with NSW Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

Mangoola has identified further coal resources to the north of the existing Mangoola Coal Mine and Wybong Road. Mangoola is seeking approval to extract these further coal resources by continuing the existing mine into this new mining area. The MCCO Project would provide access to approximately 52 Million tonnes (Mt) of additional coal resources which represents approximately eight years of mining in the additional resource. The MCCO Project will require a new development consent under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The MCCO Project Area includes the existing Approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area as shown on **Figure 1.1**. The MCCO Additional Project Area includes the Proposed Additional Mining Area to the north of the existing mine (refer to **Figure 1.2**).

It is currently planned that operations in the MCCO Additional Project Area would commence in approximately 2022 (subject to the timing of determination of this application and commencement of the MCCO Project) which would mean that the MCCO Project will require approval to operate until 2030. This represents an extension of one additional year beyond the existing approved life of the mine.

Based on the current progression of mining and future planning of the currently approved operation, whilst approved until 2029, it is expected that mining will be completed in the Approved Project Area by 2025. The MCCO Project will extend the operational life of the Mangoola Coal Mine for approximately five years and provide for the economic recovery of coal resources using the existing infrastructure, facilities and experienced personnel.

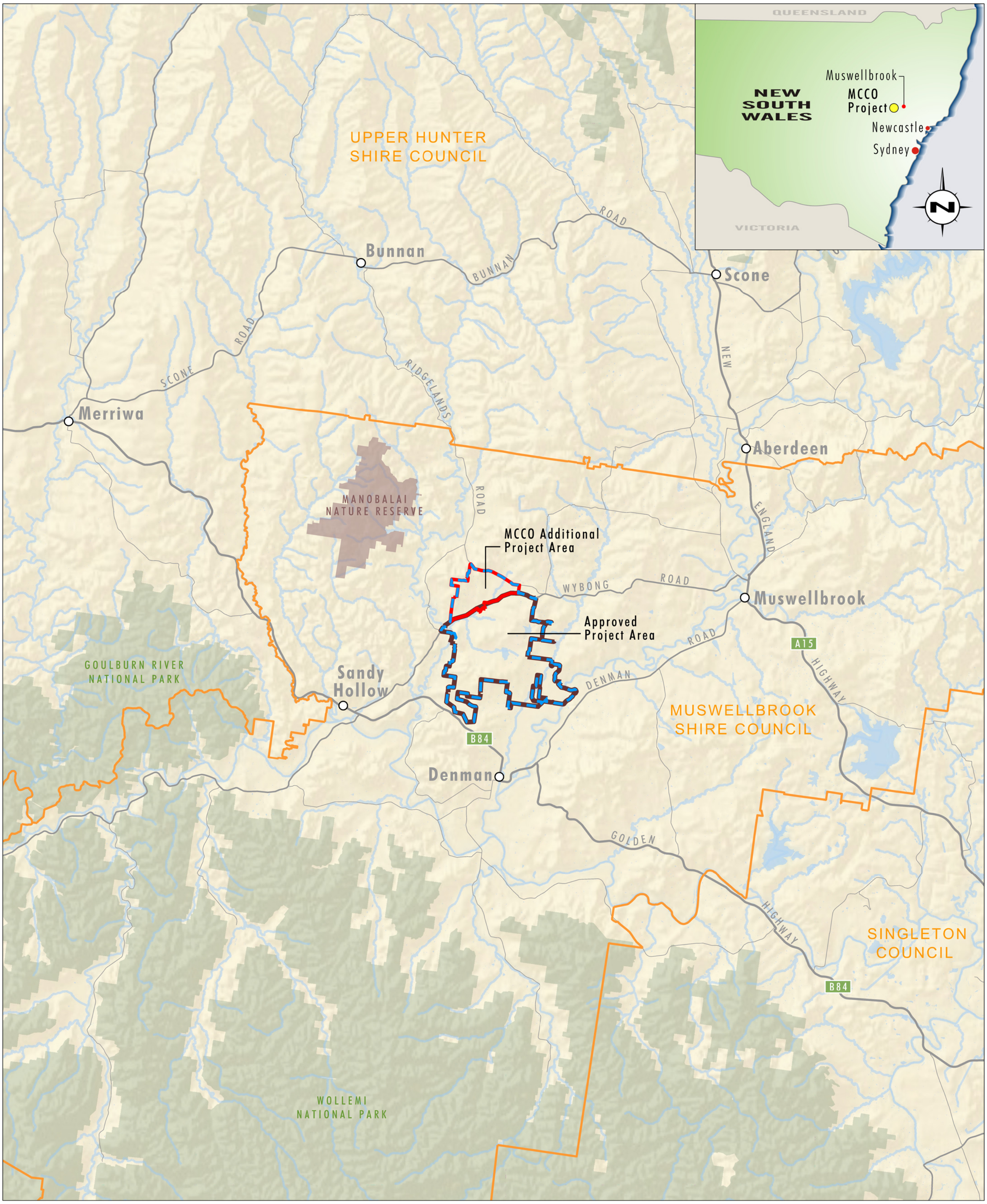
The MCCO Project is proposed to comprise the following key components:

- Open cut mining peaking at the same rate as that currently approved which is 13.5 Million tonnes per annum (Mtpa) of run of mine (ROM) coal using truck and excavator mining methods.
- Continued operations within the existing Mangoola Coal Mine.
- Mining operations in a new mining area located within the MCCO Additional Project Area, to the north of the existing mine.
- Construction of a haul road overpass over Big Flat Creek and Wybong Road to provide access from the existing mine to the MCCO Additional Project Area.
- Establishment of an out-of-pit overburden emplacement area.
- Distribution of overburden (and interburden but hereafter collectively referred to as overburden for ease of reference) between the MCCO Additional Project Area and the existing mine in order to optimise the final landform design of the integrated operation.
- Realignment of a portion of Wybong Post Office Road.
- Continued use of all existing or approved infrastructure and equipment for the Mangoola Coal Mine for the life of the MCCO Project with some minor additions to the existing mobile equipment fleet. This will include hauling coal from the MCCO Additional Project Area to the existing coal handling facilities and use of existing tailings facilities.

- Construction of a water management system to manage mine water, sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine.
- Continued ability to discharge excess water in accordance with the Hunter River Salinity Trading Scheme (HRSTS) using the currently approved discharge facility and arrangements (no changes to these approved facilities or arrangements are proposed).
- Establishment of a final landform in line with current design standards at Mangoola Coal Mine including use of natural landform design principles. A final void will remain in the north-west of the MCCO Proposed Additional Mining Area while significant volumes of overburden will be taken south into the existing approved mining area and emplaced in the mining void area to reduce the size of the void and improve the final landform, that would otherwise remain in the approved mining at Mangoola Coal Mine.
- Rehabilitation will be completed using the same revegetation techniques as currently implemented at the existing mine. These existing techniques are recognised as industry leading practice.
- A likely construction workforce of approximately 145 persons. No change to the existing approved operational workforce of the mine.
- Continued use of the mine access for the existing operating mine and access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Project Area for construction, emergency services, environmental monitoring and property management.

Figure 1.2 illustrates the key features of the MCCO Project.

umwelt



Data Source: Glencore (2019), LPI (2016)

0 5 10 20km

Legend

- MCCO Project Area
- Approved Project Area
- MCCO Additional Project Area
- Local Government Area

FIGURE 1.1

Locality Figure

File Name (A4): R23/4004_426.dgn
20191121 14.52

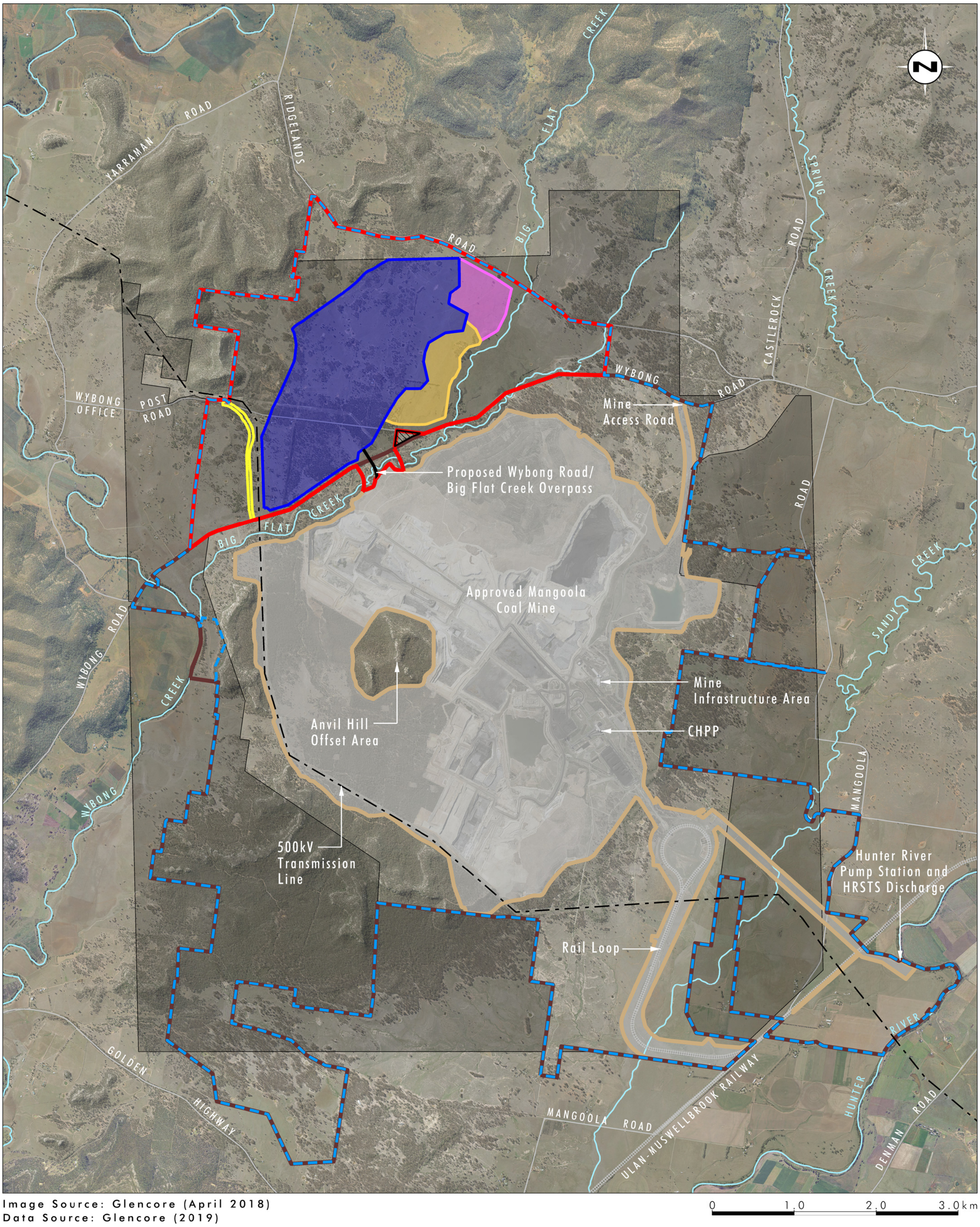


FIGURE 1.2

Key Features of the Mangoola Coal Continued Operations Project

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20190319 8.46

1.1.1 Benefits of the MCCO Project

The MCCO Project is a logical continuation of the existing mining operations at Mangoola Coal Mine and as outlined in the EIS and will provide the following key benefits:

- maximise efficient recovery of the state's coal resources
- provide ongoing employment opportunities for the Mangoola workforce of approximately 400 employees, rising up to a peak of approximately 480
- provide a net benefit to the Upper Hunter region of $92.6 Million (M) in net present value (NPV) terms
- provide a net benefit of $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project
- provide significant export earnings for Australia
- continued implementation of a Voluntary Planning Agreement (VPA) with Muswellbrook Shire Council (MSC) and continued funding of community programs
- provide for ongoing use of the existing Mangoola Coal Mine infrastructure which has an operational life beyond the life of the existing mine
- provide for a fully integrated rehabilitation program and final landform in accordance with leading practice natural landform design principles across the existing and proposed mining areas.

Through the implementation of the MCCO Project, Mangoola believes it can contribute substantial economic and social benefits at local, regional and State levels whilst continuing to coexist with the local community.

1.1.2 Assessment Process to Date

Being development for the purpose of coal mining, the MCCO Project is declared to be State Significant Development (SSD) under the provisions of State Environmental Planning Policy (State and Regional Development) 2011 and will require Development Consent under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act.

The NSW DPIE is the delegated consent authority to make decisions on SSD applications where there are less than 25 objections to the application, the local council does not object, and there have been no reportable political donations.

The NSW Independent Planning Commission (IPC) is the consent authority for SSD applications where:

- there have been 25 or more public objections to the application, or
- the local council has objected, or
- a reportable political donation has been made.

A total of 89 objections were received following the public exhibition of the EIS and therefore the IPC will be the consent authority for the MCCO Project.

The EIS for the MCCO Project was prepared to assess the environmental and social impacts of the Project and accompanied a Development Application under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act. The new development consent being sought is proposed to replace the existing Mangoola Project Approval and the MCCO Project will operate under the new SSD consent which will regulate future mining at the Mangoola Coal Mine including both the existing and proposed mining areas.

The EIS for the MCCO Project was prepared in accordance with the requirements of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000*, including the Secretary's Environment Assessment Requirements (SEARs) which were issued by DPIE on 15 February 2019 and identified specific requirements to be addressed by the EIS.

The MCCO Project was determined to be a Controlled Action (2018/8280) requiring approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) from the Commonwealth Minister for the Environment due to its potential impact on Matters of National Environment Significance (MNES). The assessment path for the MCCO Project was confirmed to be under the bilateral agreement between the Commonwealth and NSW Governments and DoEE issued its assessment requirements which were incorporated into the SEARs for the MCCO Project and addressed in the MCCO Project EIS.

As described in **Section 1.0** the MCCO Project EIS was submitted and then placed on public exhibition from 18 July to 28 August 2019 with 334 submissions received. This included 13 agency submissions and 321 community and interest group submissions. The 321 submissions received from the community and interest groups included 230 in support, 89 submissions which objected to the MCCO Project and two were noted as comments.

1.2 Project Changes Following EIS Exhibition

Section 3.0 of the EIS provides a detailed project description of the MCCO Project for which Mangoola is seeking approval. Following review of submissions received and the additional work and engagement that has been undertaken as part of the response to submissions phase, Mangoola has identified two proposed minor project changes. These changes are to address an issue raised in the submissions from MSC regarding the proposed Wybong Road Overpass and changes to make further improvements to the proposed design of the final voids as part of the conceptual final landform following further discussions with DPIE.

As discussed in the EIS, Mangoola implemented a detailed project design, stakeholder engagement and environmental and social impact assessment process for the MCCO Project. This process allowed the findings of the technical studies and consideration of stakeholder views to inform the MCCO Project design, thereby minimising environmental and social impacts. As discussed in the EIS, this process included a thorough examination of different mining options and changes that could be made to minimise impacts through project design. Due to this thorough design and assessment process, the RTS process has not identified the need for any substantive changes to the MCCO Project as described in the EIS.

The two changes proposed as part of this RTS to the MCCO Project are considered minor and do not require further assessment as they will be undertaken within the existing proposed MCCO Project disturbance areas and do not change the scope of what has been assessed in the EIS.

Further details of the proposed changes are provided in **Section 1.2.1** and **Section 1.2.2**. No other changes have been made to the proposed MCCO Project, however, further management commitments have been made as discussed in **Section 5.0**.

Further, since the exhibition of the EIS Mangoola has purchased an additional property to the north of the MCCO Project Area. In this regard updated landownership information is illustrated on **Figure 1.3**.

1.2.1 Change to Overpass Design

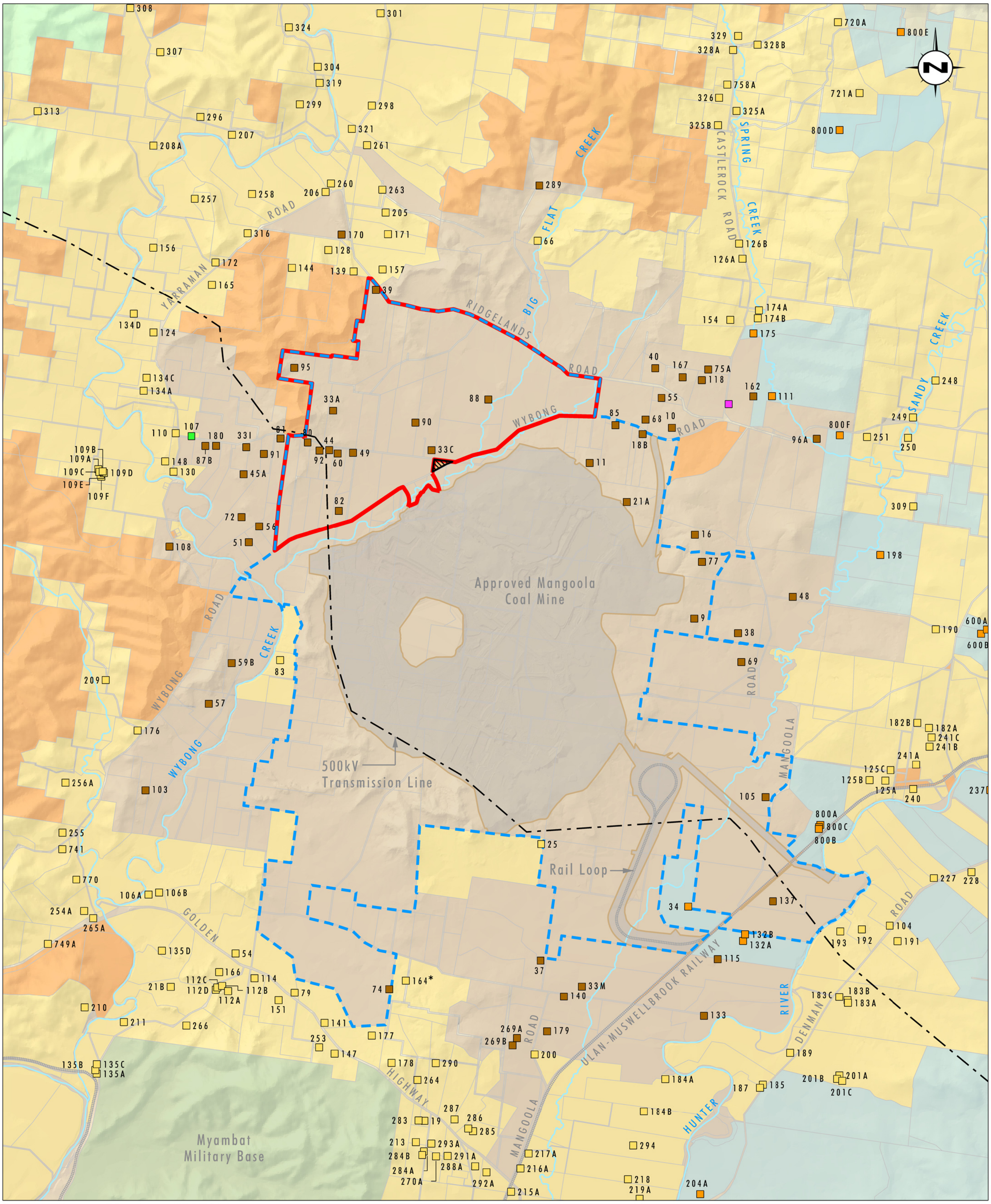
The submissions received from MSC raised concern that the clearance height of the proposed Wybong Road Overpass may not meet future use requirements for the passage of Over Size Over Mass (OSOM) vehicles. Further details with regard to the submissions are provided in **Section 3.8.8** for MSC. In response to these submissions and following further investigations and engagement with both MSC and RMS, Mangoola has revised the clearances within the concrete arch structure of the Wybong Road Overpass to account for OSOM vehicles up to 10 m in width and 6.2 m high (previously 10 m in width and 5.4 m high). It is noted that these revised clearances have been developed in consideration of the measured values of the fixed regional overhead structures located along routes that would provide access to Wybong Road including overpasses, bridges and truck monitoring camera stations.

In addition, it was noted in the EIS that during construction of the haul road overpass of Wybong Road a two-lane bypass road is proposed to be in place to enable Wybong Road to remain open. Mangoola confirms that as part of the MCCO Project, this bypass road would remain in place following construction but will not able to be used and will be appropriately barricaded off from public use during the operational phase of the Project. The bypass road will then be used, following the completion of mining, during the closure and decommissioning phases when the overpass is proposed to be removed. Following completion of the works to remove the overpass, the bypass road would then be decommissioned and the area rehabilitated.

1.2.2 Change to Final Voids Design

Following the exhibition of the EIS further discussions have been held with DPIE regarding the design of the proposed final voids. In this regard, Mangoola has undertaken further investigations to determine if it could remove parts of the retained highwall, particularly at the void margins, to improve rehabilitation outcomes in these areas. As an outcome of these investigations Mangoola has committed to undertake additional works in these areas to optimise the design of the final voids further and remove the highwall sections that occur at the margins of the voids. **Figure 1.4** and **Figure 1.5** show the areas where the proposed changes have been made for the two voids, while **Figure 1.6** shows the revised conceptual final landform for the MCCO Project.

The changes proposed further reduce the size of the final voids. The final void in the north-west of the MCCO Proposed Additional Mining Area will reduce from approximately 82 ha (proposed in the EIS) to approximately 81 ha. The existing approved final void at the Mangoola Coal Mine will reduce from approximately 48 ha (proposed in the EIS) to approximately 46 ha. There are no proposed changes to the final void pit lakes and therefore the outcomes of final void water and salt balance modelling undertaken as part of the MCCO Project EIS have not changed.



Data Source: Glencore (2019)
Note: *Subject to Negotiated Agreement

0 1.0 2.0 4.0km

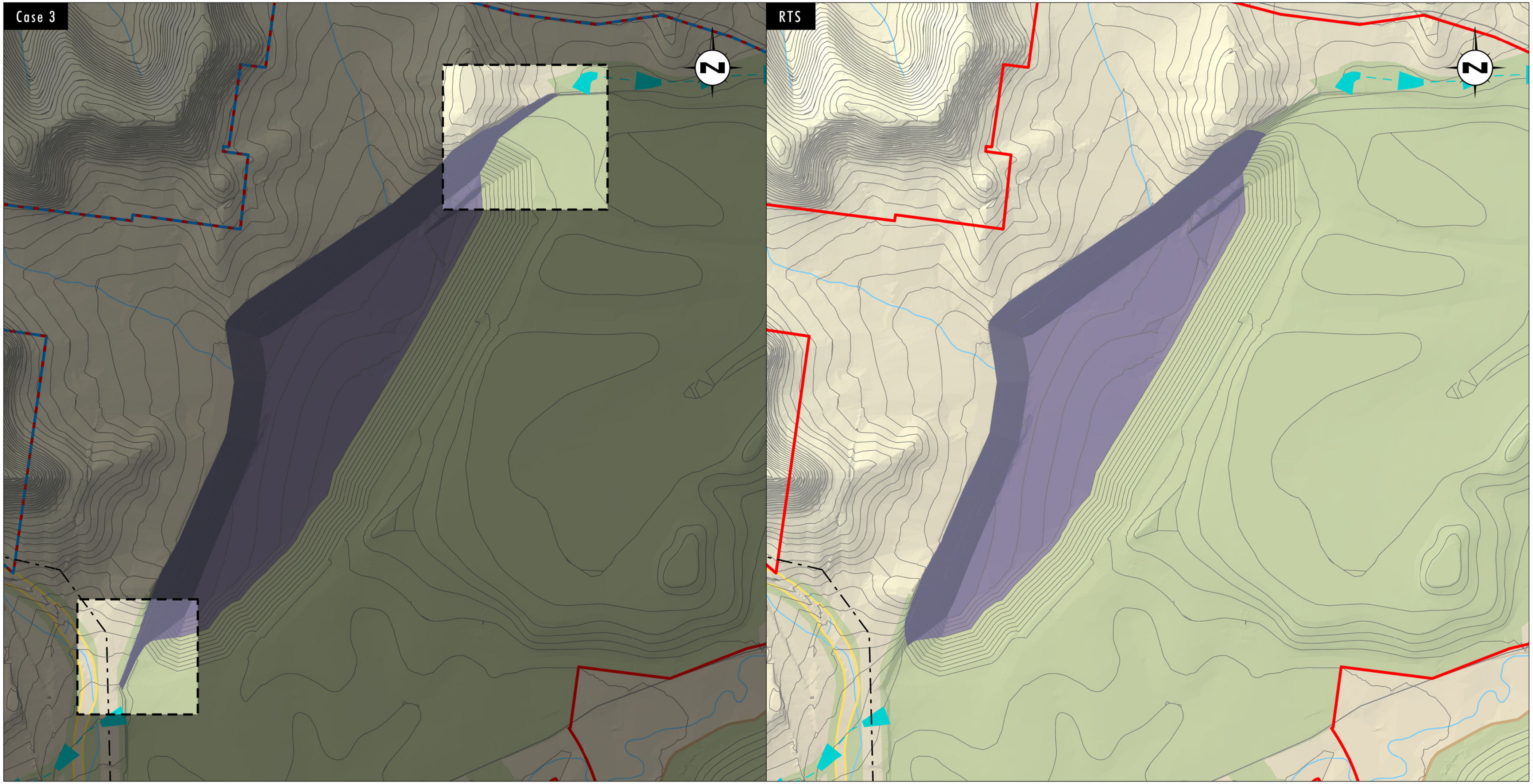
Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Crown Land (TSR) Exclusion from MCCO Project Area
- The Commonwealth of Australia
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Nature Reserve
- Private Residence
- Mangoola Owned Residence
- Other Mine Owned Residence
- Church
- Wybong Hall

FIGURE 1.3

Land Ownership

File Name: R23/4004_428.dgn
20191121 14.55



Data Source: Glencore (2019)

0 0.25 0.5 1.0km
1:20 000

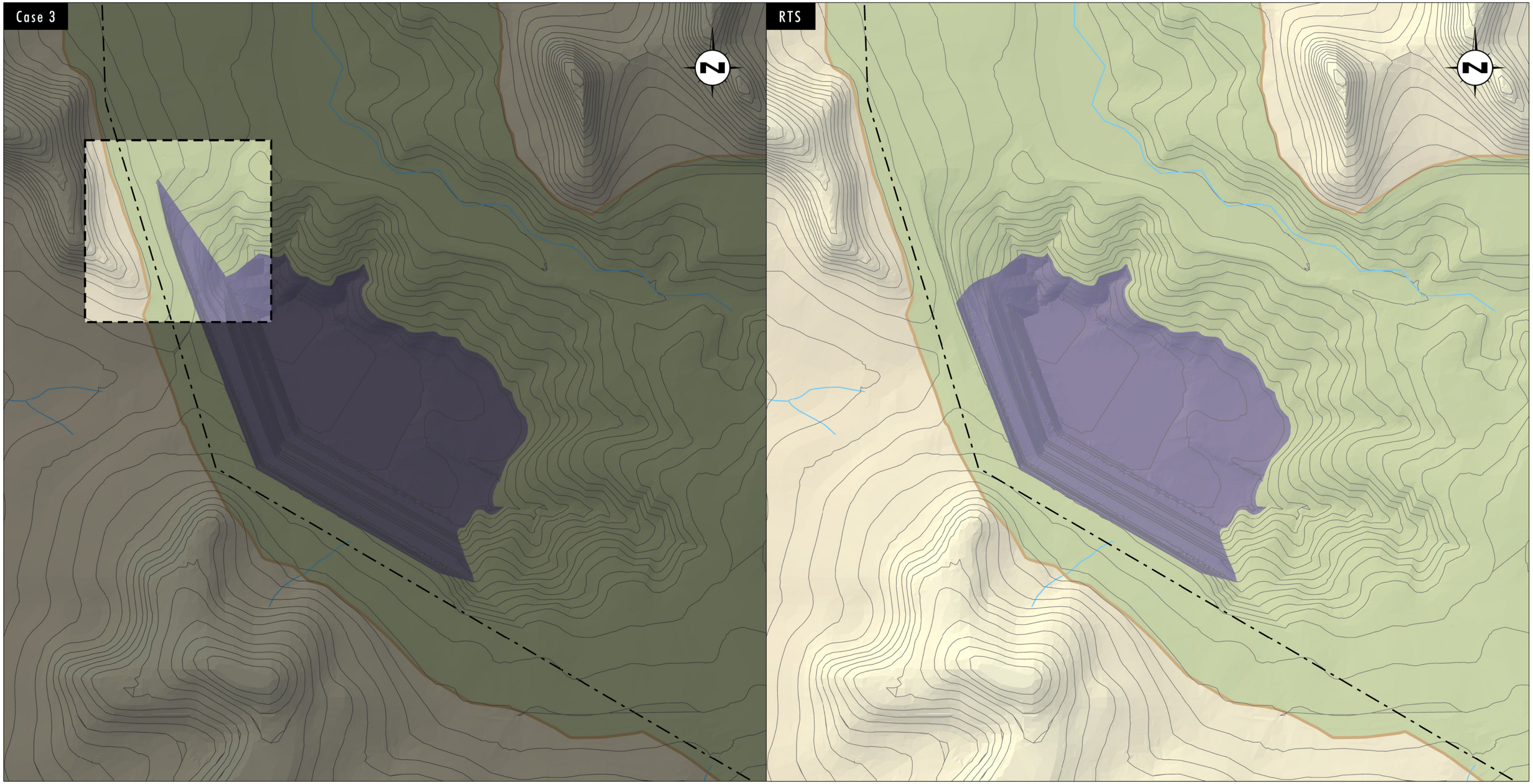
Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Rehabilitation
- Void
- Clean Water Diversion Drain
- Contour Change Area

FIGURE 1.4

MCCO Project Case Conceptual Final Landform - North Void

File Name (A4): 4004_434.dgn
20191216 13.04



Data Source: Glencore (2019)

0 250 500 750m
1:15 000

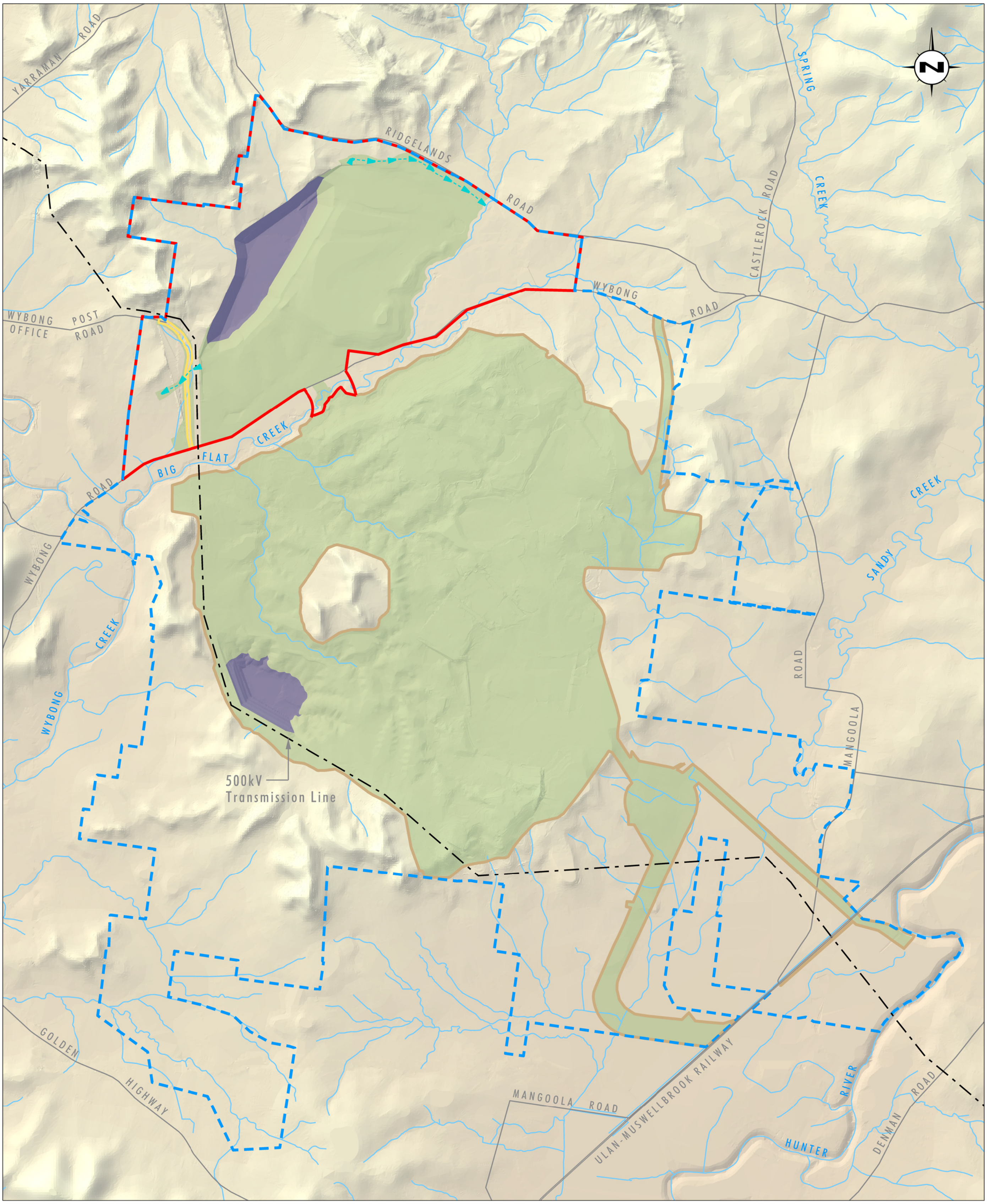
Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Rehabilitation
- Void
- Clean Water Diversion Drain
- Contour Change Area

FIGURE 1.5

MCCO Project Case Conceptual Final Landform - South Void

File Name (A4): 4004_435.dgn
20191216 13.07



Data Source: Glencore (2019)

Legend
- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Rehabilitation
- Void
- Clean Water Diversion Drain

FIGURE 1.6

Revised Conceptual Final Landform

File Name (A4): R23/4004_436.dgn
20191218 10.11

1.3 Ongoing Stakeholder Engagement

As described in the MCCO Project EIS, engagement has been an integral component of the MCCO Project and a comprehensive stakeholder engagement program has been implemented. Following submission of the EIS in July 2019 Mangoola continued its engagement program with stakeholders throughout the exhibition period. This included engagement with government agencies, members of the community, Registered Aboriginal Parties and other stakeholders. The focus of this phase of the engagement program was to seek to ensure that all stakeholders were aware that the EIS was on public exhibition, provide an overview of the key findings of the completed studies and seek to inform stakeholders as to how they could make a submission.

Engagement was undertaken using a range of mechanisms including:

- Meetings and email communication with government agencies.
- Distribution of the MCCO Project Community Information Sheet 4 (July 2019) to proximal neighbours and key stakeholders (delivered to over 200 residences surrounding the MCCO Project Area). The MCCO Project Community Information Sheet contained project information along with EIS and public exhibition details including how to provide feedback.
- Provision of EIS Summary Booklets to all proximal landowners surrounding the MCCO Project Area with over 200 delivered. The summary booklet was a 28 page magazine style document that provided an overview of the MCCO Project and a summary of the key findings of the EIS. The Summary Booklet was also available with a copy of the EIS on a USB, where requested by community members, with USB copies provided to nearby landowners in particular those to the north west of the MCCO Additional Project Area. It was prepared to provide stakeholders with ready to absorb information on the key assessment findings of the MCCO Project and was accompanied with the distribution of the Community Information Sheet 4.
- A further Community Information Session held at the Wybong Community Hall (9th August 2019).
- Ongoing one on one meetings, phone discussion and emails with proximal neighbours as requested.
- Dedicated webpage for the MCCO Project and direct contact details available for the Project Team.

Engagement has also been ongoing throughout the preparation of this RTS document including engagement with government agencies and stakeholders as relevant to clarify issues raised in submissions to help inform the appropriate responses.

Where appropriate, Mangoola make the commitment to continue to engage with stakeholders as the MCCO Project progresses through the assessment and determination process. Consultation has been undertaken with MSC during and post exhibition of the EIS. A summary of the consultation undertaken with MSC for the MCCO Project is provided in **Table 1.1**.

Table 1.1 Consultation Summary

Date	Engagement Mechanism	Purpose
28 June 2017	Meeting	Meeting to provide Mangoola site update and introduce the MCCO Project.
21 February 2018	Meeting	MCCO Project briefing including details of the key project features as proposed. Included specific discussion of MSC road interaction with the MCCO Project including: • Wybong Post Office Road proposed re-alignment of relevant portion and concept design • travel time impacts • Wybong Road overpass and construction phase, concept design and controls • site, construction phase access points • EIS traffic study being completed • recent EIS traffic count data from Wybong Post Office Road.
15 May 2018	Email	Consultation regarding the geotechnical activities associated with the location of the future realigned section of Wybong PO Road.
23 May 2018	Meeting	Consultation with MSC representatives regarding the MCCO Project interactions with existing road infrastructure, including a site visit of the MCCO Additional Project Area.
15 November 2018	Letter	Letter to MSC informing them that the predicted noise and air quality impacts were now available and that Mangoola was commencing the next round of consultation with impacted landholders.
6 December 2018	Email	MCCO Project Community Information Session notification/invitation and provision of Community Information Sheet 2 – Impacts and Assessment Summary.
24 January 2019	Meeting	MCCO Project briefing including results of stakeholder engagement, environmental assessments, Wybong Post Office Road interactions and initial VPA discussion.
11 February 2019	Email	Offer of site visit for MSC representatives and to discuss VPA. Nil response from MSC.
15 March 2019	Letter	Provision of preliminary design drawings of the MCCO Project infrastructure associated with the MSC roads and request for feedback.
10 April 2019	Meeting	MSC requested meeting - Discussed proposed revision of the MSC Mine Affected Roads Strategy, general MCCO Project/MSC issues and initial VPA discussion.

Date	Engagement Mechanism	Purpose
3 June 2019	Meeting	Discussion with MSC Roads Drainage and Technical Services representatives to discuss preliminary design drawings of the MCCO Project infrastructure associated with the MSC roads.
18 June 2019	Letter	Offer of site visit and MCCO Project update for MSC, Mayor and Councillors. Nil response from MSC.
19 June 2019	Letter	Letter seeking to progress discussions regarding the continuation of the existing VPA. Nil response from MSC.
EIS Public Exhibition		
29 August 2019	Meeting	MSC requested meeting - Meeting with the MSC Mine Affected Roads Strategy consultants and MSC representatives in relation interactions with the MCCO Project.
17 October 2019	Meeting	MSC requested meeting - Meeting to discuss the progress of the MSC Mine Affected Roads Strategy and to initiate further discussions regarding the VPA.
24 October 2019	Meeting	MSC requested meeting – Meeting with the MSC Mine Affected Roads Strategy consultants and MSC representatives to review draft consultant report. Cancelled by MSC.
30 October 2019	Phone Conference	Discussion with MSC representatives, MCCO Project representatives and consultants to clarify components of the MSC submission on the MCCO Project EIS.
1 November 2019	Letter	Letter seeking further clarification regarding elements of the MSC Mine Affected Roads Strategy and to advance VPA discussions. Nil response from MSC.
5 November 2019	Meeting	Meeting to discuss the proposed MCCO Project VPA. MSC proposed to provide feedback on VPA in early 2020.

1.4 Environmental Practice at Mangoola Coal Mine

As noted throughout the MCCO Project EIS, Mangoola is committed to maintaining responsible environmental management practices that meet or exceed industry best practice. Environmental management is an integral part of every stage of the mining process so that environmental impacts are minimised.

Mangoola has developed and implemented a comprehensive Environmental Management System (EMS) to guide the management of its activities at the mine so that environmental and social impacts are minimised and residual impacts are appropriately managed. The EMS provides a framework for managing environmental and social issues in a systematic and integrated way. It has been designed using a continuous improvement approach, so that the approach to managing environmental and social issues enables ongoing performance improvements.

The Mangoola EMS has been developed in a manner that is generally in accordance with ISO 14001, the international best-practise standard for an EMS.

As part of its EMS, Mangoola conducts regular environmental monitoring and auditing to gauge performance, compliance with regulatory requirements, and to minimise impacts on the surrounding community and the environment. During August 2019 an Independent Environmental Audit (IEA) Report (Hansen Bailey, 2019) was undertaken in accordance with the requirements of the existing Project Approval. The IEA "*identified a significantly high level of compliance with conditions of licences and approvals (only six non-compliances). The non-compliances were risk ranked. No high or medium risks were identified during the audit. Three were identified as low risk and three issues classified as administrative in nature*". Overall the IEA concluded "*that a very high standard of environmental management is being applied at Mangoola Operations*".

Additionally, rehabilitation at Mangoola Coal Mine is completed using natural landform design principles and revegetation techniques that are widely recognised as industry leading practice. Disturbed land is rehabilitated to produce a stable landform and sustainable vegetation communities that are consistent with and enhance the surrounding landscape. As stated in the 2018 Annual Review, to date, Mangoola has rehabilitated approximately 532 ha of disturbed land. The 2018 Ecological Monitoring Report found that despite the ongoing drought conditions the habitat value provided by the rehabilitation is rapidly increasing and that threatened fauna diversity in 2018 was at the highest level documented since commencement of monitoring in 2008. It also found that bird diversity is generally higher in rehabilitated vegetation than remnant vegetation. Examples of the existing rehabilitation at Mangoola Coal Mine are provided below in **Plate 1.1** and **Plate 1.2**.

The same leading practice environmental management approach and controls used at the existing operation will continue to apply to the MCCO Project. This includes integrated mine design and management to minimise dust and noise, manage water, and implementation of the same industry leading rehabilitation techniques.

In 2019 Mangoola's Coal Handling and Preparation Plan (CHPP) was awarded the Australian Mine of the Year and Coal Mine of the Year at the Australian Mining Prosecting Awards for its excellent safety record. This further demonstrates that Mangoola are committed to conducting each aspect of their operations to the highest standards.

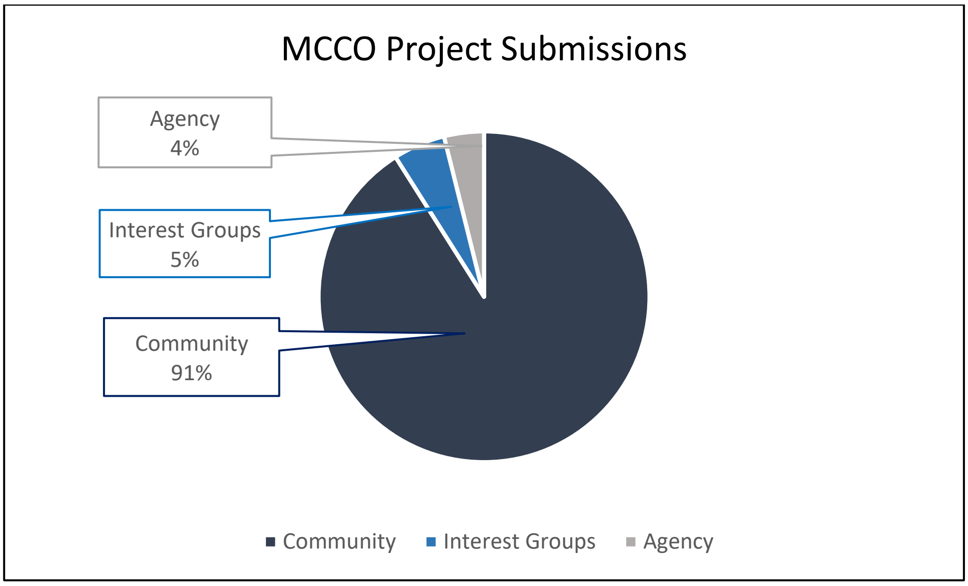
Plate 1.1 Existing Rehabilitation in Foreground with Mine Operations in the Background

Plate 1.2 Existing Rehabilitation – Recent Rehabilitation in the Foreground and Established Rehabilitation in the Background

2.0 Submission Analysis

2.1 Breakdown of Submissions

During the public exhibition period 334 submissions were made on the MCCO Project. This included 13 government agency submissions, 17 interest group submissions and 304 community submissions. Of the total number of submissions made on the MCCO Project, 91% were from community, 5% were from interest groups and 4% were from government agencies (refer to **Graph 2.1**).



Graph 2.1 Breakdown of Submission by Group

The 13 agency submissions received on the MCCO Project include:

- Dams and Safety Committee
- Department of Primary Industries – Agriculture
- Biodiversity and Conservation Division (BCD)
- Division of Resources and Geoscience (DRG)
- Lands, Water and Department of Primary Industries
- Resources Regulator
- Environment Protection Authority (EPA)
- Heritage – Department of Premier and Cabinet
- Independent Expert Scientific Committee (IESC)
- Muswellbrook Shire Council (MSC)
- NSW Health
- Roads and Maritime Services (RMS)
- Transport for NSW

Of the 13 submissions received from agencies, 12 were comments and one submission was recorded as being in support of the MCCO Project. The supporting submission was from DRG. As discussed in **Section 1.0**, it should be noted that DoEE also made a submission which stated that no formal submission would be made by DoEE. As such, the online submission from DoEE has not been included in the submission count provided in this RTS.

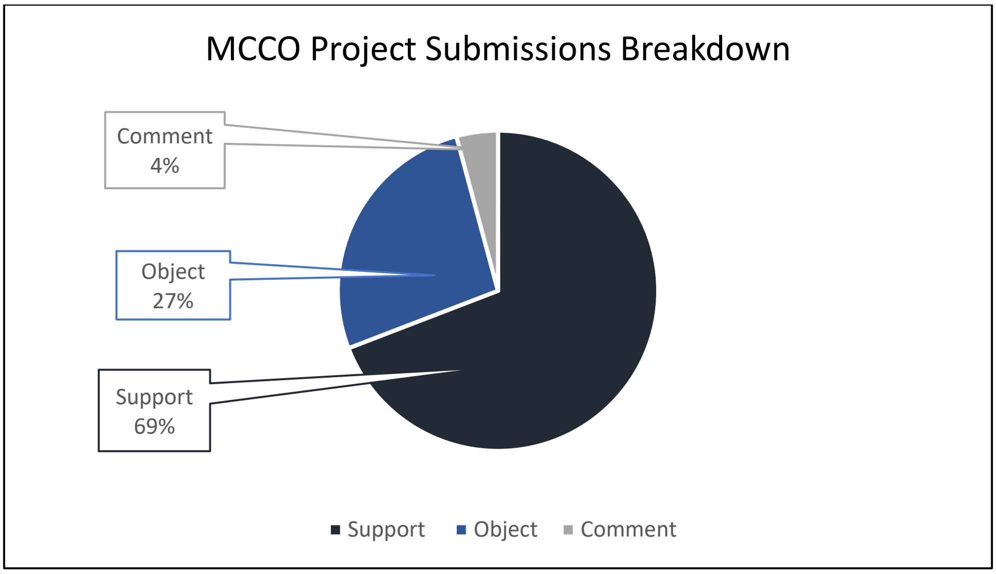
The majority of agency submissions on the MCCO Project EIS were received following the close of the public exhibition period on 28 August 2019. The IESC submission was not available at this time due to the timing of the IESC meetings and was not received until 4 October 2019. Due to the late date of receipt of this submission, a response to the IESC advice will be provided separately.

The 17 interest group submissions received on the MCCO Project include:

- AMPControl
- Ausgrid
- Denman Aberdeen Muswellbrook Scone Healthy Environment Group
- Hunter Environment Lobby Inc
- Harvey Recruitment
- Lock the Gate Alliance
- Mayfield Group
- MMS Engineering
- Morton Mining and Engineering Pty Ltd
- Muswellbrook Chamber of Commerce and Industry Inc
- Orica
- Pit Patrol Pty Ltd
- Ridgelands Residents Inc
- Sawyers Air Conditioning (two submissions)
- Tradecore Industries Pty Ltd
- Wybong Concerned Landholders Group

Of the 17 submissions received from interest groups, 11 were supporting submissions, five were objecting submissions and one was recorded as a comment.

In addition to the 13 agency submissions and 17 interest group submissions, 304 community submissions were received on the MCCO Project. Of the total 334 submissions made on the MCCO Project, 231 were supporting submissions, 89 were objecting submissions and 14 were comments. As a percentage of total submissions, this equates to 69% supporting, 27% objecting and 4% of submission as comments (refer to **Graph 2.2**).



Graph 2.2 Breakdown of Submission Type

2.2 Areas of Interest for Submissions

The 321 community and interest group submissions received on the MCCO Project were classified into areas of interest to allow for analysis on a local, regional and broader scale. Agency submissions were not classified into areas of interest as the location of agency submissions is dependent on the location of the agency office.

The areas of interest were defined by grouping submitters locations based on proximity to the MCCO Project and the closest nearby regional centre such as Muswellbrook or Singleton. The recorded submitter locations which comprise each area of interest used in the following analysis are provided in **Table 2.1**.

Table 2.1 Recorded Submitters Locations Which Comprise Each Area of Interest

Area of Interest	Submitters Recorded Location			
Direct Proximity to MCCO Project	Wybong	Manobalai	Castle Rock	Denman
	Sandy Hollow	Wybong	Hollydeen	
Muswellbrook & Surrounds	Muswellbrook	Kayuga	Hebden	McCullys Gap
	Muscle Creek	Yarrawa	Giants Creek	Martindale
Scone & Upper Hunter Shire	Moobi	Scone	Segenhoe	Rouchel
	Aberdeen	Blandford	Middle Brook	Parkville
	Warrah Creek	Merriwa	Gundy	Gungal
Singleton & Surrounds	Bulga	Bridgeman	Singleton	Darlington
	Hunterview	Jerrys Plains	Maison Dieu	McDougalls Hill
	Mount Olive	Mt Thorley	Redbournberry	Reedy Creek
	Gowrie	Wattle Ponds	East Branxton	Glendon Brook
	Glenridding			

Area of Interest	Submitters Recorded Location			
Regional Areas Beyond MCCO Project	Cranebrook	Wingham	Frazers Creek	Mudgee
	Barrington	Cobar	Crosslands	Dabee
	Oxley Island			
Maitland & Wider Region	East Maitland	Aberglasslyn	Ashtonfield	Metford
	Rutherford	Thornton	Woodberry	Lochinvar
	Chisholm			
Cessnock/Kurri Region	Kurri Kurri	Bellbird	Cessnock	Weston
	Richmond Vale			
Newcastle & Wider Region	Newcastle	Adamstown Heights	Hamilton	Charlestown
	Brightwaters	Elermore Vale	Fishermans Bay	Lemon Tree Passage
	New Lambton	Speers Point	Swansea	Tomago
	Wallsend			
New South Wales	Brunswick	North Manly	Rose Bay	Baulkham Hills
	Maroubra	Wyoming	Queens Park	
	Ulladulla	Glenhaven	Hornsby	
Interstate (WA)	Beresford	Bluff Point	Mount Tarcoola	Wandina

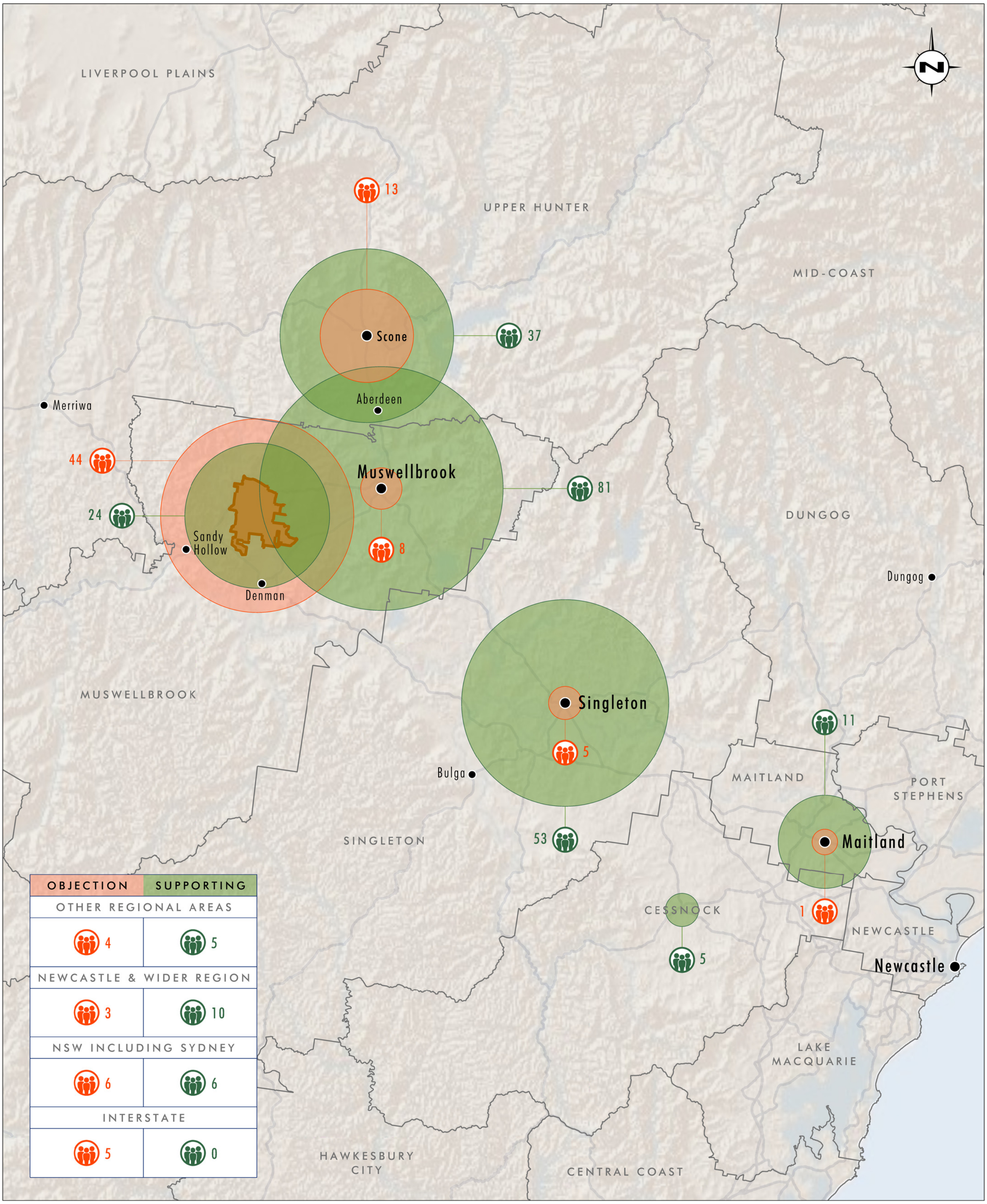
Of the 321 submissions received from community and interest groups, 68 were from areas in direct proximity (which includes the areas of Wybong, Manobalai, Castle Rock, Sandy Hollow, Hollydeen and Denman) to the MCCO Project site, 223 were from surrounding regional areas, 25 were from elsewhere in NSW and five submissions were received from interstate (all from Western Australia). **Table 2.2** summarises the number of community and interest group submissions received for each area of interest.

Table 2.2 Total Number of Supporting, Comment and Objecting Submissions from Community and Interest Groups for Each Area of Interest

Area of Interest	Supporting / Comment Submissions	Objecting Submissions	Total Submissions
Direct Proximity			
Direct Proximity to the MCCO Project Site	24	44	68
Surrounding Regional Areas			
Muswellbrook & Surrounds	81	8	89
Scone & Upper Hunter Shire	37	13	50
Singleton & Surrounds	53	5	58
Regional Areas Beyond MCCO Project	5	4	9
Maitland and Wider Region	11	1	12

Area of Interest	Supporting / Comment Submissions	Objecting Submissions	Total Submissions
Cessnock/Kurri Region	5	-	5
Elsewhere New South Wales			
Newcastle & Wider Region	10	3	13
New South Wales (inc. Sydney)	6	6	12
Interstate (beyond NSW)			
Western Australia	-	5	5
Total Submissions	**232**	**89**	**321**

Figure 2.1 illustrates the number of supporting and objecting submissions received for each area of interest. As illustrated on **Figure 2.1**, an analysis of the submissions by area of interest indicates that 65% of individuals within the direct proximity to the MCCO Project objected (44 out of 68). From all other areas in the surrounding regional areas, submissions received were predominately in support of the MCCO Project with 86% of submissions from surrounding regional areas stating support. This includes 91% in support from Muswellbrook and the residual surrounding areas.



OBJECTION	SUPPORTING
OTHER REGIONAL AREAS	
4	5
NEWCASTLE & WIDER REGION	
3	10
NSW INCLUDING SYDNEY	
6	6
INTERSTATE	
5	0

Legend

- MCCO Project Area
- Local Government Area
- Submissions - Objection
- Submissions - Supporting

0 10 20 40km

FIGURE 2.1

Number of Submissions for Areas of Interest

File Name (A4): R23/4004_429.dgn
20191202 11.08

2.3 Categorisation of Issues and Supporting Factors

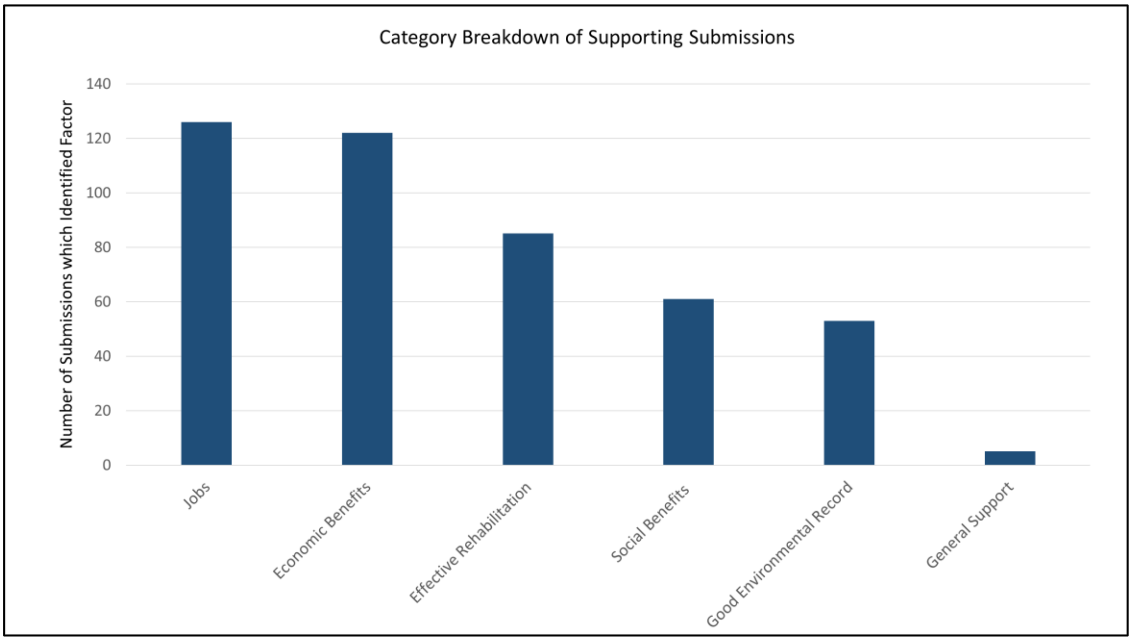
Analysis of the content of submissions was undertaken to identify the issues and themes raised by submitters. Re-occurring issues and themes within submissions were used to categorise and group submissions. This has allowed for the identification of key issues and supporting themes for community and interest groups. The detailed category analysis was not undertaken for agency submission as these submissions typically provide commentary and/or request additional information for assessment and these have been individually responded to in **Section 3.0**.

2.3.1 Supporting Submission Analysis

Of the 321 submissions received from community members and interest groups, 230 were supporting. The supporting submissions identified a number of different reasons for the statement of support. The following key categories were identified for supporting submissions from community and interest groups:

- Jobs
- Economic Benefits
- Effective Rehabilitation
- Social Benefits
- Good Environmental Record
- General Support

Graph 2.3 shows the number of supporting submissions from community and interest groups characterised according to the above categories. It should be noted that multiple categories were identified in some submissions. The five categories identified most in supporting submissions were jobs, economic benefits, effective rehabilitation, social benefits and good environmental record.



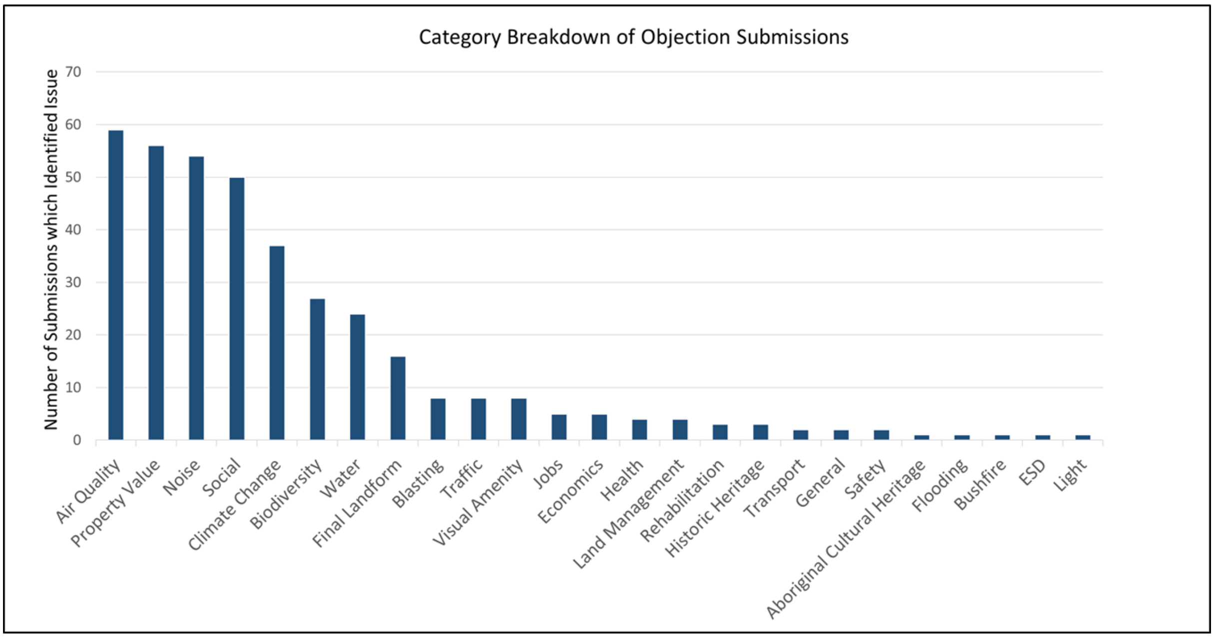
Graph 2.3 Number of Supporting Submissions from Community and Interest Group Which Identified Each Category

2.3.2 Objecting Submission Analysis

The objecting submissions raised a range of issues which have been categorised into a number of environmental, social or economic issue categories. The following categories were identified for characterising the objecting submissions from community and interest groups:

- Air Quality
- Property Value
- Noise
- Social Impacts
- Climate Change
- Biodiversity
- Water
- Final Landform
- Blasting
- Traffic
- Visual Amenity
- Safety
- Land Management
- Economics
- Health
- Rehabilitation
- Historic Heritage
- Transport
- Aboriginal Cultural Heritage
- Flooding
- Bushfire
- Ecologically Sustainable Development
- Light
- Jobs
- General Objection

Graph 2.4 shows the number of objecting submissions from community and interest groups which identified each issue category. It should be noted that multiple categories were identified in some submissions. The five categories identified most commonly in objecting submissions were air quality, property value, noise, social impacts and climate change.



Graph 2.4 Number of Objecting Submissions from Community and Interest Groups Which Identified Each Category

3.0 Agency Submissions

Government agencies make submissions relating to their areas of responsibility and typically relate to technical matters as well as matters the agency considers require consideration by the consent authority or to be addressed by conditions should development consent be granted.

The following sections respond to the specific matters raised by each agency submission. The issues raised in the agency submissions are identified in the following sections in text boxes, with a response provided following each text box.

3.1 Department of Planning, Industry and Environment – Biodiversity and Conservation Division

3.1.1 Biodiversity

Sections 3.1.1.1 to **3.1.1.3** address the BCD submission on the EIS. **Sections 3.1.1.4** and **3.1.1.5** address the further submission dated 4 December 2019.

3.1.1.1 Biodiversity Offset Strategy

'We [BCD] have not reviewed the proposed biodiversity offset package for this project. While the proponent has provided some information on possible offsetting options, they have not committed to those options.'

Mangoola is committed to delivering the proposed Biodiversity Offset Strategy (BOS) outlined in the EIS. The Biodiversity Assessment Report (BAR) prepared for the MCCO Project and which was an appendix to the EIS contained a proposed BOS which based on the analysis in the BAR provides a 100% like for like offset of the residual impacts in accordance with the NSW Biodiversity Offsets Policy for Major Projects. As also outlined in the EIS the proposed land-based biodiversity offsets will be secured under Stewardship Agreements in consultation with the NSW Biodiversity Conservation Trust (BCT).

It is noted that in Section 7 of the BAR it was discussed that the NSW Framework for Biodiversity Assessment (FBA) is a market based system and that there may be some further evolution of the proposed BOS. This statement was not intended to indicate that Mangoola was not committed to the BOS proposed but rather to indicate that there may be some adjustments during implementation (e.g. should credit calculations change following review by the BCT). The flexibility sought is consistent with that provided in recent development consent conditions for approved projects.

3.1.1.2 Biodiversity Assessment Report

BCD asked some technical questions relating to the BAR. The following responses have been prepared with the assistance of the Umwelt Ecology Team who were the accredited assessors that completed the BAR.

'1. The proponent provides the information listed in point 1 of Attachment B to complete the Biodiversity Assessment Report.'

The below highlights each of the points (a to f) as raised in *point 1 of Attachment B* of the BCD submission followed by the response:

> 1. ***Several details required for the BAR have not been provided and should be provided in the Response to Submissions Report:***
>
> **a.** ***an estimate of the percent cleared of each plant community type identified in the EIS (as per section 5.2.1.10 of the FBA)***

The requested information is provided in **Table 3.1**. We note that the percent cleared value for HU812- Forest Red Gum grassy open forest on floodplains of the lower Hunter is shown as zero (0). Review of the archived Biometric and Threatened Species Profiles datasets confirms the value as zero (0) percent.

Table 3.1 Percent Cleared of Each Relevant Biometric Vegetation Type

Plant Community Type	Percent Cleared
HU812 - Forest Red Gum grassy open forest on floodplains of the lower Hunter	0
HU816 - Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	54
HU817 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	74
HU821 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	51
HU906 - Bull Oak grassy woodland of the central Hunter Valley	53
HU945 - Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	62

> **b.** ***details of the weather conditions during surveys (as per Table 20 of the FBA)***

Table 3.2 outlines the weather conditions that occurred on the day of the floristic and vegetation integrity surveys. Data is derived from the Mangoola Coal Mine weather stations. Note, weather conditions for surveys undertaken as part of the Upper Hunter Strategic Assessment are not reproduced below as these surveys have been assessed previously and approved by BCD.

Table 3.2 Weather Conditions for Floristic and Vegetation Integrity Surveys

Date	Daily Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (%)
27 September 2010	3.8 - 26	1.2	72
28 September 2010	7 - 25.6	0	56
4 October 2011	3.2 - 18.4	0	75
5 October 2011	3 - 17.6	0	76
6 October 2011	11 - 16	1.2	89
7 October 2011	12.6 - 23.8	9	75
10 October 2011	5.8 - 23.2	0	62
17 September 2013	11 - 20.8	4.4	68.8

Date	Daily Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (%)
18 September 2013	15.2 - 24.4	0	46
19 September 2013	10.8 - 21.8	0	40
23 September 2015	3.1 - 17.2	0	50.5
24 September 2015	-0.7 - 17.2	0	57.1
25 September 2015	10.7 - 17.1	0.2	65.6
26 September 2015	7.8 - 17.7	0	69.6
27 September 2015	6.7 - 21	0	65.8
28 September 2015	2 - 22.8	0	64.2
29 September 2015	1.8 - 25.9	0	53.3
30 September 2015	5.5 - 27.8	0	56.5
1 October 2015	9.8 - 28.9	0	61.5
2 October 2015	5.9 - 26.1	0	68
3 October 2015	7.1 - 32.4	0	58.2
4 October 2015	6.7 - 34.2	0	43.2
5 October 2015	6.2 - 35.7	0	42.6
6 October 2015	7.6 - 35.6	0	41.9
7 October 2015	7.8 - 26.5	0	59.7
8 October 2015	13.6 - 20.9	0	67.1
9 October 2015	9.2 - 26.3	0	64.2
18 October 2016	7.6 - 22.5	0.2	49.9
19 October 2016	6.5 - 22.8	0	51.2
15 February 2017	17 - 31.6	0	58.9
16 February 2017	15.4 - 36.9	0.2	54.1
17 February 2017	18.1 - 38.2	1.2	63.2
18 September 2017	-0.6 - 26.7	0	50.4
19 September 2017	6.3 - 24.8	0	27.2
20 September 2017	-0.2 - 21.5	0	43
21 September 2017	0.2 - 28.2	0	39.7
22 September 2017	1.6 - 30.7	0	31
25 September 2017	13.8 - 28.6	0	18.9
26 September 2017	4 - 27.2	0	36.9
27 September 2017	9.9 - 28	0	55.3
28 September 2017	12.6 - 25.3	0	47.1
29 September 2017	5.9 - 26.2	0	37.4
3 October 2017	13.2 - 26.6	0.4	61.3

Date	Daily Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (%)
4 October 2017	8.5 - 29.2	0	62.4
5 October 2017	16.8 - 30.9	0	55
6 October 2017	11 - 26.8	0	43.4
20 September 2018	1.2 – 19.6	0	52.2
21 September 2018	1.0 – 22.2	0	52.1
24 September 2018	11.8 – 16.4	0.2	67.3
25 September 2018	8.7 – 20.0	0	61.1
26 September 2018	3.8 – 14.4	3.2	81.8

the landscape Tg value assigned to each vegetation zone, and indications of where this value may have changed due to species exclusion (as per table 20 of the FBA)

The landscape Tg value refers to the threatened species offset multiplier embedded in the BioBanking Credit Calculator (BBCC) for all Plant Community Types (PCTs). The landscape Tg value is based on the range of threatened species that are predicted to occur in each PCT, and it influences the extent of ecosystem credits for each PCT.

No ecosystem credit species predicted by the calculator were excluded and Table A2 in Appendix A of the BAR documents the multiplier for all ecosystem credit species and therefore the default settings of the BBCC were applied. For reference, the maximum multiplier for each PCT is shown in **Table 3.3**.

Table 3.3 Maximum Tg Value for Each PCT Impacted by the MCCO Additional Disturbance Area

Plant Community Type	Threatened Species with Highest Credit Requirement	Threatened Species Offset Multiplier (Tg value)
HU812 - Forest Red Gum grassy open forest on floodplains of the lower Hunter	Barking owl	3.0
HU816 - Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	Barking owl	3.0
HU817 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Barking owl	3.0
HU821 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	Barking owl	3.0
HU906 - Bull Oak grassy woodland of the central Hunter Valley	Barking owl	3.0
HU945 - Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	Barking owl	3.0

c. *identification of whether any of the threatened species considered in the assessment is a species that cannot withstand any further loss (as per section 6.1.1.1 of the FBA)*

The large-eared pied bat (*Chalinolobus dwyeri*) is listed in the archived FBA datasets as a dual species/ecosystem credit species for which the species-credit component (breeding habitat) cannot withstand further loss. Breeding habitat is documented as land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels, of which none is present within the MCCO Additional Disturbance Area. As such, a species polygon defining the area of habitat that cannot withstand further loss was not required nor was a figure shown in the BAR as per Table 20 of the FBA.

No other species-credit species impacted by the MCCO Project are listed as species that cannot withstand any further loss.

d. *a table of measures to be implemented before, during and after construction to avoid and minimise the impacts of the project, including action, outcome, timing and responsibility (as per Table 21 of the FBA); and*

The minimisation measures proposed are documented, in text, in Section 4.4.7 of the BAR and documented in detail in the existing Mangoola Coal Mine Biodiversity Offset and Management Plan and Strategy (BOMPS). To comply with the requirements of Table 21 of the FBA, Section 4.4.7 of the BAR has been summarised into **Table 3.4**, providing a summary of the minimisation measures to be implemented, as documented by the BMPS, as an outcome of the development of the MCCO Project.

Table 3.4 Measures to be Implemented Before, During and After Construction to Avoid and Minimise Impacts of the MCCO Project

Action	Outcome	Timing	Responsibility
Pre-clearance surveys	• Reduction of impacts to hollow-dependant fauna species • Minimisation of impacts to micro-bat species • Identification of habitat resources for translocation or salvage	Pre-construction	Mangoola
Tree-felling supervision	• Relocation of captured fauna individuals into nearby suitable secure habitat • Injured fauna individuals taken to a veterinary clinic or wildlife carer (where appropriate) • Translocation or salvage of habitat resources	Construction	Mangoola
Feral animal and weed control	• Minimisation of the spread of weeds within native vegetation (management of noxious weeds) • Minimise potential impacts to native fauna species from-competition and/or preying of pest or feral animal species.	Construction Operation	Mangoola

Action	Outcome	Timing	Responsibility
Fencing Control	• Minimisation of impacts to native fauna species from the use of barbed-wire fences.	Construction Operation	Mangoola
Domestic Stock	• Strategic grazing to minimise potential impacts to native vegetation caused by increased cover of weed species or increased fuel loads causing elevated bushfire risk.	Construction Operation	Mangoola
Bushfire Management	• Protect life and property, while supporting appropriate conditions for the existing ecological features.	Construction Operation	Mangoola
Water Management - Erosion and sedimentation control	• Minimisation of erosion and sediment laden runoff into adjacent watercourses	Construction Operation	Mangoola
Employee education and training	• Communication to employees on their role and responsibilities as it relates to biodiversity	Construction Operation	Mangoola

e. ***maps demonstrating indirect impact zones, or text in the BAR demonstrating how such maps are not applicable (as per Table 21 of the FBA).***

The indirect impacts from the MCCO Project are documented and assessed in the BAR and include:

- corridors and connectivity
- fugitive light emissions
- noise and blasting
- air quality
- weed and feral animal encroachment.

The MCCO Project is not expected to result in any substantial or spatially definable indirect impacts on the biodiversity values of surrounding lands during the construction or operational phases of the Project and as such, mapping of indirect impacts is not applicable for the Project.

'2. Three of the year 7 performance indicators and one of the completion criteria for post-mine rehabilitation are reworded to make them measurable and targeted, to improve the stage that the rehabilitation would be at by Year 7.'

The below provides (and highlights) the details provided by BCD in Point 2 of Attachment B followed by the response.

2. ***Table 7.5 in the EIS describes preliminary Performance Indicators and Completion Criteria for mine rehabilitation for each plant community type. These performance indicators and completion criteria are tied to the Mine Operation Plan (MOP) to be developed for the project and many are currently not-measurable. They will be refined during the MOP review stage. We (BCD) recommend that the following performance indicators and completion criteria are reworded to provide a higher measure of success:***

a. ***Site condition: the year 7 performance indicator requires that a '[n]umber of trees with hollows (i.e. natural hollows or stags salvaged from other areas and placed into rehabilitation) occur in the rehabilitation' but it does not specify a density. This performance measure could be met by placing a single salvaged stag with a hollow in the entire rehabilitated area of any of the three plant community types. The year 7 performance criteria should be set to >10% of benchmark values.***

b. ***Vegetation condition: the year 7 performance indicator requires that '[t]argeted planting of flora species characteristic or diagnostic of [a specified plant community type] is undertaken.' We recommend that this is reworded to 'rehabilitation has commenced and contains at least 25% of the species characteristic or diagnostic of [a specified plant community type] as outlined in the VIS (or equivalent) or in suitable reference sites.' This would ensure that rehabilitation has commenced by Year 7 and that it already includes a minimum of 25% of characteristic species; and***

c. ***Ecosystem function: the year 7 performance indicator states that '[h]igh threat weeds (OEH 2018bd) do not comprise more than 20% cover of any stratum' and that for the completion criteria that '[h]igh threat weeds (OEH 2018bd) do not comprise more than 10% cover of any stratum'. For ecosystem-altering species such as Acacia saligna, Olea europaea subsp. cuspidata and Chloris gayana, we recommend that their combined maximum allowed abundance for the year 7 performance criteria is not more than 5%, and that for the completion criteria they form no more than 1% of the total cover.***

The final closure criteria will be developed as part of the revised BOMPS and in consultation with DPIE and will consider the above suggestions from BCD. As discussed above, Mangoola is recognised to have industry leading rehabilitation and will apply its industry leading practice to the MCCO Project.

'3. The planted River Red Gum (*Eucalyptus camaldulensis*) and Weeping Myall (*Acacia pendula*) plants in the development footprint are shown on a map and assessed using the BioBanking Major Project credit calculator.'

As discussed in the BAR, the river red gum (*Eucalyptus camaldulensis*) and weeping myall (*Acacia pendula*) present within the MCCO Additional Project Area are clearly planted and were being used as landscaping or clearly defined block plantings and were not intended to create a native vegetation community. The river red gum samples are also clearly of non-local provenance. It was for this reason that credits were not generated for the removal of these plantings.

It is noted that relevant to this matter, BCD has recently proposed changes to the current biodiversity assessment methodology for NSW to specifically address the issue of planted vegetation. Under these proposed changes, offsets would not be required for these plantings and given this recent policy position and considering the nature of the specific plantings on the site, it is not proposed to generate credits for impacts on these planted individuals. This issue was discussed in two meetings with BCD during the preparation of this response to submissions report.

Below we have provided additional information in relation to the planted individuals of river red gum in the MCCO Additional Project Area.

<u>River Red Gum Scientific Determination</u>

BCD notes in its submission that the scientific determination for the River Red Gum endangered population is silent on planted individuals and that planted individuals should be considered part of the Endangered Population regardless of provenance. Whilst the scientific determination is silent of planted specimens, it does state that "Planting of *Eucalyptus camaldulensis* from non-local provenance introduces a potential threat to the genetic integrity of the Hunter catchment population". Whilst the onsite observation made during the field surveys suggested that the plants recorded were of non-local provenance, samples taken from the individuals within the MCCO Additional Project area have since been further examined. McDonald et al in 2009 described seven subspecies within *Eucalyptus camaldulensis* for the whole country (based on morphology, with support from genetics), and they state that the Hunter Valley population is part of subsp. *camaldulensis*. The plants within the MCCO Additional Project Area fall into subsp. *acuta* based on the very obvious acute buds, so these planted trees have been sourced from outside of the Hunter. *Eucalyptus camaldulensis* subsp. *acuta* occurs principally in Queensland, but also in north-western NSW south to about Moree, Narrabri and Baradine.

To confirm this identification, specimens were sent to the National Herbarium of NSW for identification. The advice from the herbarium confirming that the samples are subsp. *acuta* is provided as **Appendix 2**.

In summary, based on the information provided above, it is considered that the planted river red gum and weeping myall within the development footprint do not form part of their respective endangered populations in the Hunter Valley and should not generate credits.

'4. The BioBanking Major Project credit calculator is re-run, using Central Hunter Foothills as the selected Mitchell Landscape.'

The MCCO Additional Disturbance Area was revised following the avoidance of key biodiversity values, and it was noted that the dominant Mitchell Landscape applicable to the FBA assessment had changed from Lees Pinch to Central Hunter Foothills. The BAR was revised to document the change however the relevant field in the BBCC was inadvertently not updated. The BBCC field has been revised and the updated credit calculator re-submitted using the Central Hunter Foothills Mitchell Landscape. The change in landscape type has not changed the patch size score nor the landscape value score, and the remainder of the calculator assessment, including the credits generated, have not changed.

'5. That any clearing of the existing Big Flat Creek Conservation Area offset for the Mangoola Mine is replaced by a new offset that meets the Mangoola Mine consent condition requirements and that the impact for the Mangoola Continued Operations Project is also offset.'

The history of the Big Flat Creek infrastructure corridor and the Conservation Agreement that has been put in place to satisfy the conditions of the Project Approval is outlined below. We note that this issue (i.e. the excising of an area for the access corridor) was discussed in Section 2.8 (Existing Operations - Offsets) of the main text of the EIS.

The process implemented to determine the existing and potential offset liability in relation to the Big Flat Creek Conservation Area involved the following:

- The need for the access corridor was identified early in planning for the MCCO Project.
- Glencore met with personnel from DPIE on 16 February 2017 to discuss the issue and agreed the way forward. At this meeting it was discussed that:
  - the preferred approach was to excise the smallest necessary area (the design has achieved this aim)
  - Mangoola would commit to removing the infrastructure post mining and rehabilitate the area (this commitment is included in the EIS)
  - the Project Approval allowed scope to provide for the required outcome whilst still complying with the conditions relating to conservation including the requirement to establish a minimum 3,020 ha of biodiversity offsets.
- The issue was also discussed with the then OEH (now BCD) as part of establishing the Conservation Agreements over the conservation areas at Mangoola.
- It is also noted that there were a number of other minor changes made to the boundaries as part of implementing the Conservation Agreements to deal with road reserves, easements, lot boundary adjustments (i.e. inaccurate regional scale government supplied cadastre being corrected by survey) as well as the infrastructure corridor. However, to ensure compliance with the requirements of the Project Approval, where any small areas of land was excised, Mangoola added sufficient land to replace the excised areas and ensure compliance with the requirements of Condition 34 of Schedule 3.

Following the finalisation of the Mangoola offset area boundaries, Mangoola applied for Conservation Agreements for the offset sites to provide for the in-perpetuity conservation of these areas. As indicated in **Table 3.5**, four of these agreements have been finalised and are in place, with one agreement pending finalisation. As indicated in **Table 3.5**, a conservation agreement is in place over the Big Flat Creek Offset Area.

Table 3.5 Mangoola Offset Conservation Agreements

Agreement Name	Agreement Number	Status
Glencore Mangoola - Big Flat Creek Offset Area (PA 06_0014)	VC00507	Registered
Glencore Mangoola - Eastern Corridor (PA 06_0014)	VC00508	Registered
Glencore Mangoola - Northern Corridor Offset Area (PA 06_0014)	VC00519	Registered
Glencore Mangoola - Southern Offset Area (PA 06_0014)	VC00517	Registered
Glencore Mangoola - Western Corridor and Anvill Hill Offset Area (PA 06_0014)	VC00526	Lodged and Pending Finalisation

Mangoola has confirmed that the areas in conservation meet the Project Approval requirement to establish a minimum of 3,020 ha. Therefore, additional offsets related to impacts of clearing within the Big Flat Creek Conservation Area do not require any further consideration beyond what has been presented in the BAR.

3.1.1.3 Orchid Expert Report

An Expert Report was prepared to assess the suitability of the proposed offset sites as offsets for *Prasophyllum petilum* and *Diuris tricolor*, two threatened orchid species. Dr Stephen Bell was approved by BCD (then OEH) to act as an expert for these two species (approval letter dated 14/05/18). Based on the findings of the Expert Report, the proposed offsets fully satisfy the offsetting requirements for these two species. The following response addresses the points raised in the BCD submission on the EIS. Further comments relating to the proposed offsets for these threatened orchid species were made in the supplementary submission from BCD and these further comments are discussed in **Section 3.1.1.4**.

As part of its submission BCD made several comments regarding the Expert Report prepared by Dr Stephen Bell and also requested that some additional information be provided. In response to the BCD submission, two meetings were held between Dr Stephen Bell and BCD personnel to discuss the Expert Report and the matters raised by BCD. Following this process, the Expert Report has been updated by Dr Stephen Bell to address the points raised by BCD. The updated expert report:

- provides further information and justification relating to the suitability of vegetation communities assessed as orchid habitat (BCD recommendation 6)
- includes further discussion of the effect of cultivation history and other disturbance on orchid habitat (BCD recommendation 8)
- refined the mapping around water bodies and farm houses etc (BCD recommendation 8)
- provides updated information to address the points in BCD recommendation 9 and provided the requested additional data to BCD.

A copy of the revised Expert Report which addresses the comments provided in the BCD submission is provided as **Appendix 3**.

With regard to BCD recommendation 7, the updated expert report has addressed BCD's comments and as outlined below, has identified that the proposed offsets provide more than sufficient credits for the two orchid species based on using the individual count method (again, refer to **Section 3.1.1.4** which addresses the supplementary submission from BCD which focusses on an area based offset analysis). The individual credits generated by these offsets provide a significant contingency compared to the required offset credits. Therefore, monitoring in the form suggested by BCD is considered unnecessary. It is also noted that the monitoring proposed by BCD is not required by the FBA as part of the expert report process, with the policy being clear that an expert report is sufficient as the basis of generating credits for an assessed area. It is also noted that whilst rainfall is a key driver for orchid flowering there are a range of other factors that affect the flowering of these cryptic species. The expert report is considered to provide a sound basis for the determination of the suitability of the proposed offsets.

While monitoring is not proposed in the form suggested by BCD, ongoing monitoring of biodiversity offset sites would be undertaken to inform adaptive management of these sites.

Updated Offsetting Outcomes

Following the revisions made to the expert report in response to the comments made by BCD, the revised Expert Report documented a small reduction in the expected numbers of both *Diuris tricolor* and *Prasophyllum petilum* in the proposed offsets as shown in **Table 3.6**.

Table 3.6 Updated Orchid Numbers in Proposed Offsets

Species	Number of Orchids		
	Previous Expert Report	Revised Expert Report	Difference
Tarengo leek orchid (*Prasophyllum petilum*)	1,314	1,264	-50
pine donkey orchid (*Diuris tricolor*)	12,294	11,807	-487

Whilst there has been a small reduction in the numbers of orchids in the proposed offset areas, the individual based offsetting outcomes of the MCCO Project remains the same, that is, that sufficient credits are generated to offset the impacts of the MCCO Project on these two orchid species in accordance with the FBA. A revised summary of the credit outcomes is provided in **Table 3.7**.

Table 3.7 Updated Orchid Offsetting Outcomes

Species Credit	Credits Required	Previous Offset Credits Availability	Revised Offset Credit Availability	Is Credit Requirement Met?
Tarengo leek orchid (*Prasophyllum petilum*)	8,983	15,526	15,171	Yes
pine donkey orchid (*Diuris tricolor*)	17,238	146,806	143,349	Yes

Whilst the above analysis indicates that sufficient orchids are available on the proposed offsets based on individual based credit calculations, it is noted that the further submission from BCD dated 4 December 2019 proposed an area based approach to confirming offset suitability, with this submission discussed in **Section 3.1.1.4** below.

3.1.1.4 BCD Further Submission – Orchid Offsets

BCD assessed the proposed impact and offset areas, with consideration of the known and likely habitats for these threatened orchids, based on the findings of the expert report and by reviewing the records made during targeted surveys. BCD regards vegetation zones 1 to 9 as known or potential habitat within the proposed impact area, totalling 567.81 hectares. The offset area for threatened orchids is taken to be the 1,109 hectares calculated by the expert report. This assessment has found that the area of orchid habitat within the offset sites is sufficient in size to meet the offsetting requirements of the FBA for this project. Therefore, in the event of approval for the Mangoola Coal Continued Operations Project, BCD will recommend a consent condition that ensures no additional species credits for the threatened orchids can be generated from any of the 1,290 hectares of proposed offset lands for any future purpose. This condition would ensure that Principle 2 the Offsets Policy is satisfied and formalises the advice that surplus threatened orchid credits from the offset land would not be used for any other project.

In its supplementary submission BCD observes that these two threatened orchid species are cryptic and therefore, whilst surveys have been completed and previously accepted as appropriate by BCD, BCD considers that individual orchid counts may not be the most appropriate way to assess offset adequacy for these species for the MCCO Project. Mangoola is committed to providing an adequate offset for the two threatened orchid species and notes that it understands from BCD’s supplementary submission that BCD considers that the proposed offset areas are adequate to appropriately offset these species. This finding concurs with the findings of the BAR which concluded, as discussed in **Section 3.1.1.3** and based on the findings of the expert report, that the proposed offsets were adequate for these threatened orchid species.

Therefore, Mangoola accepts BCD's proposal and agrees to retire all of the credits generated for *Diuris tricolor* and *Prasophyllum petilum* on the proposed offset properties as described in the BAR as providing orchid habitat. BCD quotes 1,109 ha as the orchid habitat area in its supplementary submission, however, after the changes to the expert report requested by BCD and discussed in **Section 3.1.1.3**, this number has been revised to 1,084 ha. The total areas of the proposed offsets have not changed. To ensure clarity on this point, Mangoola proposes that the offset for these two orchid species will be 1,084 ha of orchid habitat and that no surplus threatened orchid credits from these areas will be used for any other project.

It is noted that during the process of entering into Stewardship Agreements over the proposed offset properties, experience shows that there may be some minor changes to the areas of each offset as boundaries are subject to detailed survey and other matters are addressed as part of formalising the legal conservation mechanism to the satisfaction of the BCT. Mangoola commits to ensuring that regardless of any minor changes to offset property boundaries or areas, the minimum offset areas for the two threatened orchid species across suitable offset properties will be 1,109 ha.

Based on the BCD supplementary submission, Mangoola understands that with this additional commitment, the proposed offsets are considered to be adequate to offset the impacts on these two threatened orchid species.

3.1.1.5 BCD Further Submission – Vegetation Zone 6

BCD's further submission raises questions regarding the mapping and assessment of two areas of derived native grassland as part of the BAR.

A detailed response to the questions raised in the BCD further submission is provided below, however, in summary, an appropriate and adequate assessment has been undertaken of the derived native grassland in accordance with the FBA and no changes to that assessment as outlined in the BAR are considered necessary.

> Under the Upper Hunter Strategic Assessment, BCD (formally the Office of Environment and Heritage) approved a vegetation map for the Mangoola assessment area that regarded all areas of PCT1603 Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter – Derived Native Grassland as one vegetation zone. This area has been separated into two vegetation zones (5 and 6) for the Mangoola Coal Continued Operations Project. Vegetation zone 6 covers 160.04 hectares and has been mapped as 'low condition'. The Site Value Score for vegetation zone 6 is 16.7. As the score is under 17, this 160.04 hectare area does not generate any offset credit requirement under the FBA rules. BCD analysed the vegetation quadrats that were surveyed and found that four of the six data plots for vegetation zone 6 were done in July 2017. Section 3.2.1.1 of the Biodiversity Assessment Report (BAR) states that, due to land management practices, vegetation zone 6 is in lower condition than vegetation zone 5, having a reduced diversity and cover of native ground cover species. Section 4.3 of the Orchid Expert Report notes that floristic diversity is not expected to be high for plots sampled in Winter 2017 as sampling occurred following prolonged drought conditions. Therefore, an alternative explanation for the difference between vegetation zones 5 and 6 may be the collection of the additional plot data in winter.

The Upper Hunter Strategic Assessment (UHSA) was a joint initiative of the NSW and Commonwealth governments to undertake a strategic assessment of future coal mining development in the Hunter Valley region of NSW as it related to impacts on biodiversity. Mangoola was one of the sites considered in the UHSA and it is this body of work that BCD is referring to in its supplementary submission. The Mangoola UHSA report was prepared in 2015. The UHSA process was not finalised and therefore the UHSA assessment pathway was not used for the MCCO Project.

The differences in vegetation mapping between the Mangoola UHSA and the MCCO Project relate to the scale of assessment and different assessment methodologies in accordance with the requirements of the two projects. The UHSA assessment was undertaken over a much larger area, was based on 1 biometric plot per 49 ha and relied on data from other Glencore UHSA sites (i.e. non site specific data) in accordance with the approved broader regional scale of the assessment process. The MCCO Project FBA assessment used the appropriate methodology, assessed a much smaller and targeted site and was based on a much higher sampling density of 1 biometric plot per 14 ha consistent with the requirements of the FBA. The best-practice approach for the MCCO Project resulted in necessary alterations to vegetation community typing and condition classification based on the more intensive assessment. This is a standard outcome in vegetation and condition mapping methodologies. It is therefore appropriate and expected that this more detailed assessment, based on more data, resulted in a revised assessment outcome.

The Mangoola UHSA Area comprised 2947 hectares and a total of 60 floristic plot/transects were surveyed across that area (an average of one plot approximately every 49 ha). In comparison, the Development Footprint for the MCCO Project is 623 hectares and a total of 43 plot/transects were surveyed (an average of one plot approximately every 14 ha). It is also noted that the UHSA included pooled data, as agreed with BCD (formerly OEH), from other Glencore UHSA sites within the Hunter Valley to meet the minimum plot/transect requirements for each vegetation zone identified as part of the assessment. What this means is that the Mangoola UHSA report incorporated data from other Glencore sites in the regional study area (as per the agreed survey methodology approved by BCD). For the FBA assessment for the MCCO Project all data is from the MCCO Additional Project Area.

The MCCO Project was assessed in accordance with the FBA as specified in the SEARs. In order to meet the requirements of the FBA, additional plot/transect data was required to be collected to meet the minimum survey requirements specified by the policy. This included updating the UHSA floristic plots to collect actual cover and abundance data which represented a key change in the methodology between BBAM 2008 and BBAM 2014 (used to inform the FBA). That is, whilst the existing UHSA plot data could be used in part, further data needed to be collected at these sites to fit the FBA methodology.

Survey and assessment of the proposed MCCO Project area for the FBA assessment commenced in October 2016. The process of refinement of the vegetation mapping commenced with a gap analysis of the UHSA assessment outcomes, which included the Mangoola UHSA vegetation map. As discussed above, the scale of the Mangoola UHSA assessment and the MCCO Project were vastly different. The review of the pre-existing UHSA mapping included:

- a review of historical aerial photographs
- a review of aerial photographs that were more recent than those used for the UHSA
- reconnaissance surveys of the site.

This review resulted in the identification of areas on the existing Mangoola UHSA vegetation map that warranted additional investigation in relation to PCT allocation, identification of threatened ecological communities and the extent and geographic distribution of broad condition states of the vegetation as per the requirements of Section 5.2 of the FBA. Again, it is noted that the UHSA project was conducted over a much larger area and therefore the scale of the vegetation mapping was not as refined as the mapping ultimately used in the FBA assessment. The approach documented here is vegetation mapping industry standard best-practice and in keeping with the refinement over time that occurs on BCD’s own vegetation mapping/classification programs.

This review identified that the broad condition of derived native grassland condition within the MCCO Project area was variable across the MCCO Project area, with the slopes in the western portion of the MCCO Project area identified as being in better condition than derived native grassland (DNG) communities identified on the flats in the eastern portion of the MCCO Project area. In response to this finding the two areas of PCT 817_DNG were therefore split into two condition zones. It was surmised in the BAR that the relative difference in condition between zones 5 and 6 was likely contributed to by differing historic land management practices (i.e. nature of agricultural use) across neighbouring rural properties. It is noted that these land areas are now both owned by Mangoola and are managed consistently. As such, the discussion in the BAR was referring to *historic* land management practices. The gap analysis identified the need to collect additional floristic data to meet the minimum survey requirements of the FBA, and project specific floristic surveys commenced in March 2017.

Best practice vegetation mapping involves an iterative approach. Typically this involves the review of aerial photography, site specific data collection (including a combination of floristic plot/transects, rapid vegetation assessment and meander transects), data analysis to inform the identification of vegetation community and vegetation zone boundaries, followed by further gap analysis to determine any deficiencies in the mapping or data. Refinements to vegetation or condition boundaries occur throughout this process as the data are interrogated and peer review is undertaken. Vegetation communities (and their allocated PCTs) represent areas that are relatively more homogenous in floristic assemblage than those areas not mapped as that type. Similarly, areas of the same broad condition type are more homogenous in condition than those areas not mapped as the same condition. However, in each case there is still a reasonable degree of heterogeneity, in floristics and/or condition, as vegetation types and conditions represent a repeating pattern in the landscape, rather than a bland unit with no diversity whatsoever. The task of the vegetation mapper is to represent the repeating pattern in the landscape with maps that demarcate areas of more homogenous type/condition from one another. It is an inexact science, as vegetation and condition types are artificial constructs used to classify the absolute diversity of natural systems into workable units on maps and in classification systems.

Following the iterative vegetation mapping process described above, further data collection was required to meet the requirements of the FBA and to satisfy Umwelt's own standards for vegetation mapping, and additional data was collected in April, May and July 2017.

In concert with the vegetation mapping process being undertaken by Umwelt between March and July 2017, the Glencore/Mangoola Project team was also undertaking a wide range of mine planning, environmental and other studies to inform the MCCO Project design – including the consideration of biodiversity impact avoidance options. The changes in project design resulted in changes to the MCCO Project disturbance area (and therefore the Development Footprint as assessed in the BAR), and as a result of this a range of plot/transects that had been sampled to inform a larger Project area subsequently became excess to the minimum number required by the FBA. This is common practice as changes to project boundaries means that minimum sampling requirements evolve as the project evolves and it is prudent to have additional data should it be required. All data collected have been provided to the BCD for its review.

In summary, the vegetation mapping for the FBA assessment presented in the BAR is based on much more detailed information than that collected during the UHSA and has been refined and modified based on the new information from the more detailed study. Umwelt is satisfied that the new mapping more appropriately represents the actual on-ground situation than the mapping presented in the UHSA.

The decision to split vegetation zones 5 and 6 as part of the FBA assessment was based on the clearly different vegetation condition between the two areas. The Mangoola Biodiversity Certification Assessment Report (BCAR) mapped a single low condition form of derived grassland for *PCT1603 Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter – Derived Native Grassland*. As part of the FBA assessment the better (higher quality) form of the derived grasslands (zone 5) were split from the lower quality derived grassland (zone 6) following further detailed assessment. In addition to clear differences in site value data, the distinction between these derived grassland zones is also apparent on aerial imagery and is strongly aligned to fence lines, indicating likely different historic land management practices within zone 6 (e.g. grazing pressure, stock type, pasture improvement, cultivation, weed management or a combination of these and other historical land management practices).

Four BCD assessment officers visited zone 6 on two separate site inspections, during which Umwelt ecologists provided clear identification of the mapped boundary between zone 6 and zone 5. As discussed above, no questions or concerns were raised as an outcome of these inspections nor the previous BCD assessments of the vegetation mapping of which one of these site inspections formed part.

Whilst the collection of plot data in this zone 6 predominately occurred in July 2017 (four plots sampled in July 2017 and two in March 2017), the area was not experiencing ‘prolonged drought’ at that time. Whilst we note the comments from the expert report referenced by BCD, the expert report was related to the presence of orchids and the analysis of rainfall was provided in that context. It is accepted that when targeted orchid surveys were undertaken in September 2017 there were sub-optimal conditions for these orchids, and very limited flowering occurred. However, during July 2017 there were appropriate field conditions to sample the broader vegetation types and conditions for the purpose of the FBA assessment. Furthermore it is noted that the FBA methodology does not specify or limit the seasons or months during which floristic sampling can be undertaken.

The NSW Department of Primary Industries Seasonal Conditions Information Portal (viewed 16 December 2019) identifies official drought periods (**Plate 3.1**). As outlined on the website, the Combined Drought Indicator uses the following 3 indices to determine the drought category at a given time: Rainfall Index, Plant Growth Index and Soil Water Index. The data extracted for the period relevant to this assessment is provided below indicating that non-drought conditions occurred in July 2017 and therefore the survey was completed outside of a drought period. Survey in July 2017 (noting that not all data used in the assessment was collected at this time) is appropriate as per the FBA methodology and therefore the hypothetical ‘alternative explanation’ point raised by BCD is refuted.

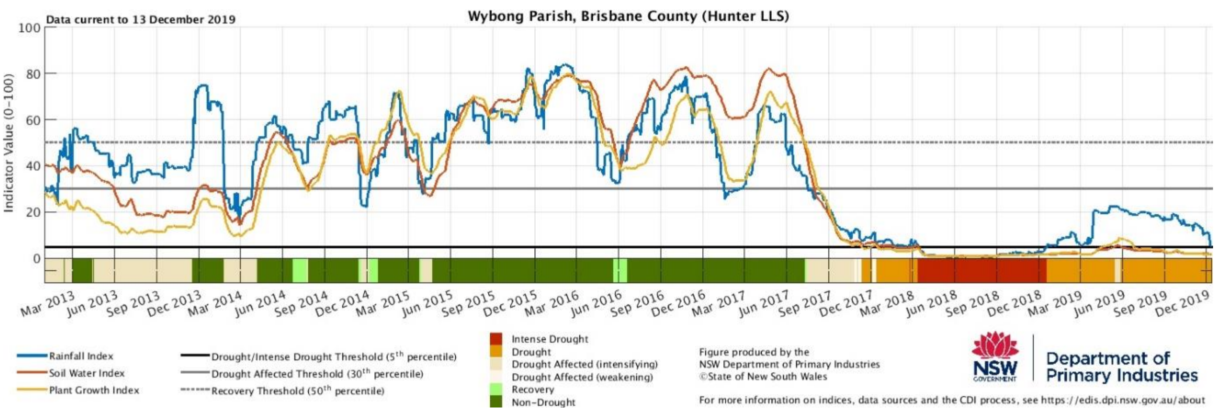


Plate 3.1 Combined Drought Indicator for Wybong Parish (Department of Primary Industries 2019)

It is also noted that surveys in July would likely have recorded a reduced cover of exotic species, especially annual species, with such species often being in lower abundance/cover in winter periods. The presence of more abundant exotic species contributes to lowering the site value score in the FBA calculator and therefore surveying at another time could have reduced the overall site value score not increased it as suggested by BCD. Regardless, any assessment is required to be undertaken at a point in time and the survey undertaken strictly met the requirements of the FBA and is appropriate for assessment purposes.

Splitting the vegetation zones and the timing of additional surveys within the new vegetation zone 6 may have had a significant impact on the potential offset liability for Glencore and raises the question of potential bias in the assessment method.

The assessment was completed following the FBA methodology and best practice professional standards. As discussed above, the data was collected in periods of appropriate climatic conditions. The data was collected and entered into the NSW Government supplied credit calculator. The offsetting outcomes are driven by the data and the calculator process. As indicated in the BAR, scientific bias exists in any field survey and mapping process given that a naturally heterogenous system is classified and mapped into repeatable patterns/units, as required by the FBA. Scientific bias exists whether the mapping/classification process is automated, semi-automated or manual. This is unavoidable in absolute terms, however Umwelt sought to minimise unintended scientific bias through internal peer review of the mapping work. Furthermore, the site inspections by BCD staff also served to test out the mapping and there was no feedback from BCD that indicated the mapping was regarded as unrepresentative. Umwelt rejects any assertion of professional assessment bias. The assessment documented in the remainder of this section demonstrates that Umwelt's approach was appropriate.

Section 2.3 of the BAR discusses the vegetation mapping methodology which has been completed in accordance with the FBA. Floristic sampling of the Development Footprint was undertaken in March and April 2017 following a gap analysis of the UHSA Data and the FBA methodology. As discussed above, during this sampling, it was identified that the derived native grasslands were not uniform across the Development Footprint and that additional sampling would be required following the finalisation of the vegetation mapping. As a result, further sampling of this area was undertaken in July 2017 to collect the number of plots required by the FBA. This stratification process is required by the FBA and our approach is consistent with best practice in the industry. Umwelt's approach is transparent and completely in accordance with the Policy. All data collected and used has been provided to BCD for its analysis. BCD officers have inspected the site including the area in which Zone 6 was mapped and did not raise any concerns from that field inspection.

The data collected from Zone 6 was entered into the BBCC by the accredited assessor and the site value score (which represents an average of the values from all the plots including those from the UHSA in this zone) is below 17, which, in accordance with the FBA, does not generate credits.

We note that the outcome of the assessment indicates a substantial difference between the site values scores of zone 5 (site value score of 28.12) and zone 6 (site value score of 16.67), providing further evidence justifying the splitting of the zones on the basis of the broad condition states identified during the vegetation mapping process.

While the intent of the FBA is to generate offset credit liability based on averaging the data collected across the zone (in order to measure the inherent natural variability with each vegetation zone), further analysis of individual plot/transect data collected during different months of 2017 has been conducted to demonstrate that the offset liability calculated by the BBCC does not change under a range of scenarios.

As part of preparing this response to the supplementary BCD submission, whilst not part of the FBA process, Umwelt has conducted additional 'sensitivity analysis' to test a hypothetical scenario and the assumptions made as part of the BAR (Umwelt 2019). We note that data collected to inform the BBCC is not intended to be used as outlined in the following analysis, however, it was considered that the sensitivity analysis may assist in providing additional clarity in relation to the broad condition state of zone 6 and the reasoning behind the splitting of the higher quality derived native grasslands that have been identified as zone 5.

As part of the MCCO Project, additional plot/transect data was collected to the east of Big Flat Creek, in an area which, due to project design refinements (an initially proposed out of pit overburden emplacement area was removed from the MCCO Project design to minimise disturbance, noise and visual impacts), no longer forms part of the MCCO Project Development Footprint. The grassland identified on the flats to the east of Big Flat Creek exist in the same broad condition state as that mapped as zone 6 (review of aerial imagery shows continuity of the vegetation zone across the creek on the lower slopes and flats, with higher quality DNGs of the upper/higher slopes to the north). In this area, two plots were sampled in March 2017, with an additional plot/transect sampled in July 2017. The plots have native species richness values of 14, 7 and 3 respectively which is comparable to what has been recorded in similar habitats in zone 6.

Further analysis of the sampling months in which data was collected has been conducted for other zones. Zone 1 is particularly illustrative as it saw data collected from five plot/transects across March 2017 (1 plot), May 2017 (1 plot), July 2017 (2 plots) and August 2017 (1 plot). The data demonstrates that the plot with the highest native species richness was sampled in July 2017, while the plot with the lowest native species richness was also sampled in July 2017. Data collected in August 2017 shows a similar native species richness as the data collected in March and May 2017. In this example, the three plots collected in winter 2017 recorded the highest, lowest and median scores in zone 1 which demonstrates that the results are driven by the inherent characteristics of the site not the date on which it was sampled.

Further analysis was also conducted on the data collected for zone 6. While Umwelt disagrees with the BCD premise that the timing of data collection for a range of plot/transects in July 2017 resulted in (potentially) biased assessment outcomes, a sensitivity analysis on native species richness for zone 6 (one of the several attributes considered in the BBCC) has been undertaken across four scenarios to determine the relative biodiversity offsetting outcomes for each scenario. None of the scenarios assessed below alter the site value score (as determined by the BBCC) and therefore there are no credits generated for zone 6 under any of the sensitivity scenarios. It is considered that this sensitivity analysis, whilst illustrative only, further demonstrates that it is the poorer condition of zone 6 not the survey period which is driving the assessment outcomes.

Sensitivity scenario 1 - Average of the native species richness across zone 6:

- All plots were assigned a native species richness score of 10 which represents the average native species recorded in all plots in zone 6.
- Site value remains at 16.67 (including conservative assessment of overstorey regeneration as 1).

Sensitivity scenario 2 - Median native species richness across zone 6:

- All plots were assigned a native species richness score of 8 which represents the median of native species recorded in all plots in zone 6.
- Site value remains at 16.67 (including conservative assessment of overstorey regeneration as 1).

Sensitivity scenario 3 - 75th percentile native species richness across zone 6:

- The 75Th percentile of native species richness scores 15.5 (rounded to 16) in all plots in zone 6. The 75th percentile has been used to determine benchmarks in the current NSW Biodiversity Assessment Method (BAM) for native species richness in ground form groups.
- Site value remains at 16.67 (including conservative assessment of overstorey regeneration as 1).

Sensitivity scenario 4 - mean native species richness across zone 6 of data not collected in July 2017:

- All plots that were sampled in July 2017 were assigned a native species richness score of 17 which represents the average native species richness recorded in plots sampled in March 2017 (that is values for the six plots of 20, 14, 17, 17, 17, 17).
- Site value remains at 16.67 (including conservative assessment of overstorey regeneration as 1).

The above sensitivity analysis indicates that artificially increasing the native species richness scores under a range of different hypothetical scenarios does not change the assessment outcomes.

In summary, the timing of the survey was completed in accordance with the FBA Policy and, notwithstanding BCD's commentary that the sampling in July 2017 potentially biased the offsetting outcomes, the additional information presented above demonstrates that zone 6 represents a lower condition derived native grassland that was identified in contrast to zone 5 which was identified as a much higher condition grassland. The splitting of the low condition grassland that was identified as part of the UHSA into two zones is considered to be an appropriate representation of the vegetation patterns and conditions identified in the MCCO Project area, based on substantial, repeated ecological survey over the five years of the MCCO Project (including constraints and pre-feasibility assessments), and the Mangoola UHSA conducted between 2013 and 2014.

The splitting of the vegetation zones may also have been inappropriate because: • the FBA states that a vegetation zone must not contain a mix of vegetation in low condition and vegetation in moderate to good condition;

It is not feasible nor standard practice to map vegetation communities in a 400m^2 grid (based on 20 x 20 m FBA biometric plots) across any sizeable project area. Plots are used to sample representative areas of a community in a similar broad condition state, including those with high and lower values for certain attributes because each zone is naturally heterogenous. Although some plots may contain slightly higher levels of native species or slightly less exotic species, which may suggest that individually they meet a "moderate to good" definition, overall Umwelt has mapped areas of broadly similar floristics and condition in accordance with standard industry best practice approaches. Vegetation communities represent areas that are relatively more homogenous in floristic assemblage than those areas not mapped as that type. Similarly, areas of the same broad condition type are more homogenous in condition than those areas not mapped as the same condition. However, in each case there is still a degree of heterogeneity, in floristics and/or condition, as vegetation types and conditions represent a repeating pattern in the landscape, rather than a bland unit with no diversity whatsoever. The task of the vegetation mapper is to represent a repeating pattern in the landscape with maps that demarcate areas of more homogenous type/condition from one another. This is done based on aerial photograph interpretation together with representative samples from the site.

Across zone 6, the ecological condition of this zone is broadly consistent and representative of an ecological pattern that has persisted in the landscape over many years and is of a lower condition than Zone 5. The BBCC averages the site value data to determine the overall site value for the zone and despite having sampled some of the better areas of this zone in individual plots, the BBCC determined that the site value score was below 17.

In addition, as noted earlier, four BCD assessment officers have visited zone 6 and the boundary with zone 5 was highlighted in the field and no issues with the delineation of these zones were raised at the time. The naming conventions of the zones as it relates to the overall condition has no bearing on the calculation of the site value scores and any subsequent impact credits generated by the BBCC. For example, Umwelt has tested changing the name of zone 6 from 'low condition' to 'moderate to good – poor' in the BBCC and there no change to the outcomes of the assessment. Umwelt is willing to change the name of zone 6 accordingly should BCD consider this necessary.

- three of the six plots of zone 6 meet the FBA's definition of moderate to good condition and the other three meet the definition of 'low condition'; and

The definitions of "moderate to good" and "low" condition in the FBA have no effect on the site value score (and therefore biodiversity offset credit liability). The only difference applicable to the assessment is that 'moderate to good' conditions requires 6 plot/transect to be sampled while 'low condition' requires only 4. The survey undertaken included 6 plots and therefore this requirement was met.

The sampling effort across zone 6 focused on areas representative of the mapped similar broad condition state (a total of 160.04 ha) and the fact that individual plots (a 0.04 hectare sample) may have higher or lower relative site values scores as determined by the BBCC does not mean that the condition of the zone requires further splitting into area of moderate to good and low condition. The sampling required by the FBA methodology seeks to measure the inherent heterogeneity of the vegetation across the zone.

Further to this, we note that the overstorey regeneration for zone 6 was conservatively entered as 1 into the BBCC, assuming all canopy species are regenerating. A further review of Umwelt's survey data indicates that only a single canopy species (*Eucalyptus crebra*) is regenerating in this zone. In the woodland form of this biometric vegetation type (BVT), *Zone 4 – HU817/1603 Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter – Moderate to Good Condition*, three canopy species were recorded on site including *Eucalyptus crebra*, *Eucalyptus moluccana* and *Angophora floribunda*. As a result, and based on previous advice from BCD, the overstorey regeneration could have been 0.33 in the BBCC. If this change was made, it would further lower the site value scores of each individual plot and all except one would individually fall well below the site value score of 17. We believe this conservative approach further indicates that there was no bias in the assessment and that Zone 6 is of lower condition.

- all plots in low condition were surveyed in July 2017 and had they been surveyed at a more suitable time, they are likely to have also been in moderate to good condition.

As discussed above, review of the vegetation mapping at the commencement of the MCCO Project identified derived native grasslands of PCT 1603 in higher (better) condition than the 'low condition' grasslands mapped across the MCCO Project area in the UHSA, resulting in the delineation of an additional zone (zone 5). Based on review of available evidence, Umwelt surmised that the difference in broad condition state between zone 5 and zone 6 was likely due to historic land management regimes (such as intensive grazing, cropping, fertiliser application, weed management and other factors such as dryland salinity).

Review of the floristic data collected in zone 6 during March and July 2017 determined that the species recorded during the March surveys are detectable during the winter months and in particular July when the sampling was undertaken. None of the species recorded during the March surveys would be absent during July and therefore it is considered unlikely that the July surveys would have overlooked species that would potentially have been detectable if the surveys were undertaken in March. The surveys in July are considered to be adequate to characterise the vegetation present in zone 6.

Four OEH/BCD assessment officers viewed the vegetation within this zone and no concerns were raised. The floristic sampling across the Development Footprint meets the requirements of the FBA and as discussed above, sampling was undertaken at a suitable time to adequately characterise the vegetation. As discussed in detail above, suitable climatic conditions occurred at the time of the surveys. There is no evidence to suggest that surveys at a different time would have led to a different outcome.

In conclusion, an appropriate assessment and analysis of Zone 6 occurred as part of the BAR.

3.1.2 Aboriginal Cultural Heritage

'Salvage of the 26 Aboriginal sites be undertaken in consultation with the Registered Aboriginal Parties and in accordance with the protocols outlined in the existing approved Aboriginal Cultural Heritage Management Plan.'

Noted. This recommendation is consistent with the commitment made by Mangoola Coal in the EIS.

The existing approved Aboriginal Cultural Heritage Management Plan (ACHMP) will be reviewed for the MCCO Project following the granting of Development Consent to outline all Aboriginal heritage management measures for the MCCO Project, responsibilities of all parties and the timeframe for required heritage works. The ACHMP may include a staged approach to the required salvage works so that areas required for earliest disturbance are completed as a priority.

Both the revision of the ACHMP and the proposed salvage works will be completed in consultation with the Registered Aboriginal Parties (RAPs).

'Test excavations are not undertaken at rock shelters that occur outside of the development footprint. References in the Aboriginal Cultural Heritage Management Plan to undertaking test excavations at rock shelters should be removed.'

The Aboriginal Archaeological Impact Assessment completed by OzArk Environmental & Heritage Management (OzArk) as part of the EIS included the inspection of 49 previously recorded sites within the MCCO Additional Project Area. All of these sites were reassessed to determine their current condition and significance. Of these, five previously recorded rock shelter sites, located to the north-west of the MCCO Additional Disturbance Area were re-inspected and their scientific significance noted as 'unknown' as the previous recordings included that a potential archaeological deposit (PAD) has been registered but there is no surface manifestation of artefacts at these locations. OzArk's assessment of these sites indicated that they may have been inaccurately recorded as rock shelter sites.

Understanding the scientific significance of these sites and whether they are, or are not a site, is important from a management and monitoring perspective for the MCCO Project going forward, particularly with regard to the potential need, or not, to monitor blast impacts from mining operations.

To accurately determine the scientific values at these sites it was proposed in the EIS that further investigation, most likely test excavation be completed at these sites to inform the assessment of significance and whether these sites require future management commitments and potential requirements for monitoring. This approach was discussed with the RAPs and included in the draft Aboriginal Archaeological Impact Assessment (AAIA) which was provided to them for review and comment with no issues raised by the RAPs in this regard.

Mangoola remain of the view that the existing approved ACHMP should be revised to include these proposed investigations to confirm if they are sites or not. Once the scientific significance (or absence thereof if they are not a site) has been determined, appropriate management and monitoring measures can be proposed and implemented. If the investigations determine that they have been incorrectly recorded and they are not sites, then it would be proposed that an application would be made for them to be delisted as a site.

'The Aboriginal cultural values identified in the Mangoola Aboriginal Cultural Values Assessment Report should be included in the Aboriginal cultural heritage management plan. They should be included in the formation of management actions to manage and mitigate harm to Aboriginal cultural values in the Mangoola Coal Continued Operations project area.'

Mangoola commits to reflect on the cultural values identified within the Aboriginal Cultural Values Assessment Report as prepared by Australian Cultural Heritage Management (ACHM) including those in the Tocomwall report in the updated ACHMP. The identified Aboriginal cultural values will be considered in the formation of management actions in the updated ACHMP which will be prepared in consultation with the RAPs.

'If approval is granted for the Mangoola Coal Continued Operations Project, provision should be made for the Aboriginal objects salvaged in the development footprint to be included in the current approved Mangoola Care Agreement C0003885.'

Mangoola agree to this provision for the Aboriginal objects salvaged in the development footprint to be included in the current approved Mangoola Care Agreement C0003885.

3.1.3 Flooding

The following summary responses have been prepared with the assistance of Hydro Engineering & Consulting Pty Ltd (HEC). A detailed response prepared by HEC to the issues raised by BCD is provided as **Appendix 4**, including the requested additional flood assessment mapping.

'1. A peer review of the flood model and mapping is undertaken'

A peer review of the flood modelling has been undertaken by Glenn Mounser, Principal Water Engineer at Umwelt. The peer review included a review of the hydraulic model, key input to the hydrologic model, flood assessment reporting and associated flood mapping. This was conducted as a staged process to allow questions and requests for further information to be addressed by HEC. Throughout the peer review process, preliminary findings were collated in a working document that also included recommendations for HEC to address various matters. Ongoing responses by HEC were added to the working document together with follow up peer review comments. The working document changed over time as the review process progressed and HEC responses were considered. Once the responses and additional information provided by HEC had been assessed, the final findings of the peer review were documented in a peer review report. A full copy of the peer review report is provided as **Appendix 5**.

After consideration of the additional assessment undertaken by HEC, including the responses to the submission from BCD (discussed below), the peer review found that while some issues had been identified and future work recommended to improve the overall accuracy of the modelling, with the additional information to be provided by HEC, the present flood modelling was sufficient for impact assessment purposes and sufficiently characterises the flooding impact of the MCCO Project for impact assessment purposes.

The peer review recommended that Mangoola consider minor updates to flood modelling to address the future detailed design phase for the MCCO Project (e.g. detailed design of haul road crossing or design of flood mitigation measures).

'Flood maps should be provided at a scale that provides for better visibility of impacts (for example, using A3 sizing).'

HEC has reproduced each of the relevant flood maps at A3 as requested. The updated mapping includes enlargements in the vicinity of Wybong Road to improve visibility of impacts and so they can be easily analysed to identify areas of impact. The updated maps are provided in **Appendix 4**.

'2. The flood impact assessment should analyse the differences in flooding for each mining stage and, at a minimum, compare pre-mining conditions with the stage that has the greatest flood impact.'

As confirmed by the Surface Water Assessment report prepared as part of the EIS, the proposed haul road crossing of Big Flat Creek (which is present at all stages of the MCCO Project) will have the greatest impact on flood hydraulics in the creek and overbank areas. The only changes from stage to stage that could affect flood levels are the development of the flood levee downstream of the proposed haul road crossing of Big Flat Creek and the progressive removal of the western upslope diversion which discharges downstream of the proposed haul road crossing. Given that both of these are downstream of the proposed haul road crossing of Big Flat Creek the effects on flood model predictions will be minor. Given the relatively short duration of the MCCO Project (eight years of mining in the Additional Mining Area), it is considered appropriate to consider a representative "worst case" stage. HEC considers that the modelled 'with project' scenario is representative of the greatest flood impact associated with the MCCO Project. It should also be noted that Mangoola are the only landholder predicted to be impacted by flooding associated with the MCCO Project.

Modelling has been undertaken to compare the flooding impacts of the MCCO Project to the existing conditions (based on the landform at 2017). HEC does not consider that a comparison to pre-mining conditions is relevant, as the existing Mangoola Coal Mine is approved and present in the existing landscape. A comparison to the pre-project conditions has therefore been provided and this approach is considered appropriate.

'3. The flood study and EIS should be updated to use the correct terms to describe flood frequency in accordance with ARR2016 requirements.'

HEC considers that terminology that is consistent with ARR2016 has been used as part of the Surface Water Assessment. HEC acknowledges that in places the report does use ratios (e.g. 1:100) rather than percentages (e.g. 1%), however, notes that this does not affect the results of the modelling or assessment outcomes. The updated terminology as recommended has been used in this RTS.

'4. The surface water assessment should consider potential flooding impacts associated with the diversion of water towards and below Wybong Post Office Road. This should include the likelihood and impact of blockage of proposed culverts under the road.'

The requested assessment has been completed as is provided in **Appendix 4**. The assessment found that the capacity of the road culverts is in excess of a 5% annual exceedance probability (AEP) peak flow rate for the case of the maximum diversion catchment and as the catchment decreases over the life of the mine, would then be able to pass peak flow rates well in excess of the 1% AEP. The assessment also considered potential impact of blockage of the culverts.

'5. The flood behaviour along Wybong Road under the proposed overpass should be reviewed to ensure that safety of the roadway is not compromised by the bund wall and overpass embankment.' '6. Further information regarding flood depth and velocity on the roadway for the with and without project scenarios should be provided so that changes in the trafficability of Wybong Road can be accurately determined.' '7. Flood mapping should be provided for the 1:10 event with the project. Values of depth and velocity should be extracted from the model so that potential impacts to the trafficability and frequency of inundation of Wybong Road can be accurately assessed.'

To address the above questions relating to flood behaviour, flood hazard and safety, a further assessment of flooding impact on Wybong Road and the associated flood hazard has been undertaken by HEC and is provided in **Appendix 4**.

The assessment noted that Wybong Road would be flood affected and unsafe for vehicles and people in several places in a 1% AEP flow in the existing situation. It also found that 6% of the length of road considered in the assessment (i.e. not 6% of the total length of Wybong Road) would be more affected by floodwaters with the MCCO Project, however, concluded that given the existing extent of flooding impacts during a 1% AEP event, this is not considered a significant increase. The assessment found that the road is predicted in the existing situation (i.e. without the MCCO Project) to have a hazard classification of H3 to H5 in some areas and therefore would currently not be trafficable in a 1% AEP event. Therefore, the assessment concluded that the existing inability of traffic to travel along Wybong Road in a 1% AEP would be unaffected by the MCCO Project.

It should also be noted that the current road has a low flow flood immunity and would be un-trafficable in a 1:20 AEP event. The MCCO Project will not change the flood immunity of the road and will increase the time of closure by 35 minutes in 1:20 AEP event.

3.2 Department of Planning, Industry and Environment – Lands, Water and Department of Primary Industries

3.2.1 Water

'The proponent should remediate and rehabilitate Big Flat Creek at the conclusion of the proposed extension. Prioritisation and development of rehabilitation options should follow the procedure set out in A Rehabilitation Manual for Australian Streams, Cooperative Centre for Catchment Hydrology, Land and Water Resources Research and Development Corporation, 2000.'

As proposed in the MCCO Project EIS, Mangoola commits to remediate and rehabilitate the parts of Big Flat Creek that are impacted or altered by the construction and operation of the proposed Haul Road Overpass. It is proposed that the Haul Road Overpass would be removed as part of closure works for the mine. The proposed works will be detailed in the Conceptual Closure Plan which will be developed as part of the implementation of the MCCO Project and will be incorporated into the Mining Operations Plan (MOP)/Rehabilitation Management Plan. When preparing the Conceptual Closure Plan, Mangoola commit to consider the procedure set out in A Rehabilitation Manual for

Australian Streams, Cooperative Centre for Catchment Hydrology, Land and Water Resources Research and Development Corporation, 2000 and will undertake consultation with BCD as part of this process.

'Works on waterfront land should be carried out in accordance with the Guidelines for Controlled Activities (2012)'

Waterfront land is defined by the *Water Management Act 2000* and includes the bed of any river, lake or estuary and any land within 40 metres of the riverbanks, lake shore or estuary mean high water mark. Works that are proposed to be completed on waterfront land as part of the MCCO Project include the following works which would be within 40m of Big Flat Creek:

- the proposed Wybong Road/Big Flat Creek Overpass
- part of the northern clean water diversion drain (where it directs clean water back into Big Flat Creek) and
- relocation of 11kV transmissions lines
- maintenance of minor access tracks for maintenance, environmental monitoring and property management.

It is also noted that there are sections of minor tributaries that will be removed by the proposed mining operations.

As discussed in Section 6.7.5 of the MCCO Project EIS, Mangoola will review and update the existing Water Management Plan (WMP) for the Project in consultation with relevant agencies and then implement this plan. Subject to the requirements of the conditions of consent, the revised WMP will include updates as necessary to the existing Erosion and Sediment Control Plan and will ensure that it is consistent with the requirements of Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries, or its latest version. This will include appropriate measures to guide the implementation of erosion and sediment controls as part of the construction phase of the MCCO Project and will detail the controls required to manage construction works in and adjacent to Big Flat Creek.

As requested by BCD the measures will also consider the published guidelines for controlled activities for works within waterfront land however section 4.41 of the EP&A Act provides that a controlled activity approval is not required for development that has been granted development consent.

'Post approval: The proponent should report any volume of water captured that exceeds the harvestable right as licensable take.'

Noted and agreed. Calculations of water licence requirements completed as part of the EIS (Section 6.7.4.2) concluded that Mangoola Coal currently holds sufficient water licence allocations to cater for the licencing needs of the MCCO Project.

'Post approval: The proponent should identify and present the peak predicted groundwater take that includes both groundwater seepage from mine spoil areas and pit inflows. The peak take should be accounted for against the licences held.'

The EIS Groundwater Impact Assessment (GWIA) completed by Australasian Groundwater and Environmental Consultants (AGE) has identified the peak predicted groundwater take for the two relevant water sharing plans in the region being the North Coast Fractured and Porous Rock WSP and the Hunter Unregulated and Alluvial WSP. The GWIA included the development of a numerical groundwater model which represents the gradual filling of the mining areas with spoils and predicted inflows from these groundwater sources including direct pit inflows via the exposed highwall and seepage through the low wall spoils.

Table 6.21 from the MCCO Project EIS is reproduced below (refer to **Table 3.8**) and provides a summary of groundwater licensing requirements and confirms that all predicted take can be readily accounted for by the existing licences held. The maximum water licencing requirement column shows the peak predicted groundwater take.

Table 3.8 Groundwater Licensing Requirements (Table 6.21 from EIS)

Water Sharing Plan	Maximum Water Licensing Requirement	Current Mangoola Entitlement
North Coast Fractured and Porous Rock WSP	280 ML/year	combined total entitlement of 700 ML/year
Hunter Unregulated and Alluvial WSP	34 ML/year for groundwater (adjusted to 5 ML/year to avoid double counting) 30 ML/year for surface water	254 ML/year

'Post approval: Revise the Water Management Plan to present descriptive detail for the monitoring, management and mitigation of potential impact risk associated with:

a. drawdown of water level to registered water users; and

b. leachate generation from out-of-pit spoil emplacement area adjacent to Big Flat Creek.'

Mangoola commits to include details in the revised WMP relating to the monitoring, management and mitigation of potential impact risk associated with drawdown of water level to registered water users and leachate generation from out-of-pit spoil emplacement area adjacent to Big Flat Creek.

It is noted from the geochemical assessment included as Appendix 21 of the MCCO Project EIS that the results of geochemical testing of Project core samples indicates that the overburden/interburden and coarse rejects materials that will be placed in-pit and ex-pit emplacements are likely to be Non-Acid Forming and non-saline.

'Post approval: Commence monthly monitoring of shallow groundwater water quality (major ions) at several sites on the eastern flank of the out-of-pit emplacement area for a minimum of 12 months prior to commencement of mining.'

Mangoola commits to complete additional baseline monitoring in the area nominated by DPIE for a minimum of 12 months prior to the commencement of mining as requested. This monitoring is proposed to be conducted at a selection of the existing bores that have been installed along Big Flat Creek in this area and may include GW01, MN 1006, GW047877, REG001 and GW07 as deemed appropriate (see Figure 8.1 in the GWIA Appendix 12 of the EIS). Mangoola commits to include this proposed monitoring within the revised water monitoring program that forms part of the WMP for the MCCO Project. The monthly monitoring frequency will be undertaken prior to the commencement of mining with the monitoring frequency and commitments made in the MCCO

Project EIS and GWIA to be followed once the baseline program has been completed and mining commences.

3.2.2 Crown Lands

> 'All Crown Land and Crown Roads within a Mining Lease must be subject to a Compensation Agreement issued under Section 265 of the Mining Act 1992, to be agreed and executed prior to any mining activity taking place and within 12 months of Project/ Modification Approval. The Compensation Agreement may include conditions requiring the Mining Lease Holder to purchase Crown land impacted on by mining activity.
>
> All Crown Land and Crown Roads located within an Exploration Licence, where subject to exploration activity, must be subject to an Access Arrangement issued under Section 141 of the Mining Act 1992, to be agreed and executed prior to any exploration activity taking place.'

Mangoola submitted a Crown road purchase application form to the NSW Department of Industry – Lands and Water, with a verbal acknowledgement from the Department of a received date of 15 July 2019. The account number 610540 was provided for this application and is listed under "Mangoola Coal". Mangoola acknowledges that all Crown land and Crown roads within a Mining Lease must be subject to a Compensation Agreement issued under Section 265 of the *Mining Act 1992*. Should the application under account number 610540 not be granted in time to allow works to commence, then a Compensation Agreement will be sought. This will be sought to be agreed and executed, prior to any mining activity taking place and within 12 months of development consent.

> 'All Crown Land and Crown Roads located within an Exploration Licence, where subject to exploration activity, must be subject to an Access Arrangement issued under Section 141 of the Mining Act 1992, to be agreed and executed prior to any exploration activity taking place.'

Mangoola acknowledges that all Crown land and Crown roads located within an Exploration Licence (EL), where subject to exploration activity, must be subject to an Access Arrangement issued under Section 141 of the *Mining Act 1992*, to be agreed and executed prior to any exploration activity taking place. Mangoola has processes in place to obtain all required approvals prior to any exploration activities in its EL areas and these controls will continue to be implemented.

3.3 Department of Planning, Industry and Environment – Division of Resources and Geoscience

3.3.1 Final Landform

> 'The Division recommends that an independent expert examination of the proposed final landform be undertaken, focusing on whether the final landform case selected by the Proponent is the best option.'

An independent expert examination of the proposed final landform has been undertaken by Andrew Hutton of Integrated Environmental Management Australia (IEMA). This examination was informed by an expert review of the mine plan and final landform from a mine planning perspective undertaken by Xenith Consulting.

The independent review and analysis of options was undertaken based on a review of documents, including the Mine Plan Options Report which was included as Appendix 2 of the EIS, as well as a site inspection of the existing Mangoola Coal Mine and overview of the MCCO Additional Project Area. The inspection was used to better understand the final landform options described in the Mine Plan Options Report including the final landform proposed for the MCCO Project and included inspecting the existing areas of rehabilitation that have been completed using the natural landform principles. A full copy of the independent expert examination of the proposed final landform along with the expert review of the mine plan is provided as **Appendix 6** and **Appendix 7**, respectively.

The independent review concluded that Case 3, as presented in the MCCO Project EIS and Mine Plan Options Report (Appendix 2 of the EIS), represents an appropriate outcome which demonstrates that Mangoola has considered the balance between delivering an economic mine plan whilst giving proper regard to leaving beneficial post mining land uses and minimising final voids. Further, the review found that Mangoola has demonstrated through the rehabilitation already completed at the existing Mangoola Coal Mine that it has been able to successfully design and construct the natural landforms along with the revegetation techniques that are proposed in the MCCO Project EIS.

As noted in the independent review, Xenith Consulting has undertaken a review of the mine planning aspects and concluded in its review that the final landform presented under Case 3 honours the constraints provided by Mangoola, achieves a volumetric balance over the life of mine and presents an appropriate balance of mine planning and economic considerations.

3.3.2 Economics

> 'The Project represents an efficient development and utilisation of coal resources which will foster significant social and economic benefits. The Division is satisfied the proposed mine design and mining method submissions adequately recover coal resources and will provide an appropriate return to the state.'

Noted.

3.3.3 Consultation – Biodiversity Offset Assessment

> '1. Continued consultation should be undertaken with:
>
> - The holders of Assessment Lease 19 (Act 1992), held by Muswellbrook Coal Company Ltd, and Exploration Licence 8064 (Act 1992), held by Ridgelands Coal Resources Pty Limited, regarding the small portion of the proposed Mangoola Offset Area that appears to encroach into the title areas.
> - The holders of Petroleum Exploration Licence 456 (Act 1991), held by Hunter Gas Pty Ltd & Santos QNT Pty Ltd, regarding the small portion of the title that overlaps the Highfields Offset Area.
> - The neighbouring mines such as Mt Pleasant and Mt Arthur regarding the potential for cumulative impacts associated with the Project.'

As part of the EIS process Mangoola engaged with representatives from both Idemitsu Australia Resources which is the holder of AL 19 and Ridgelands Coal Resources, the holders of EL 8064. Since the exhibition of the EIS Mangoola has engaged with each of these parties further regarding the small portion of the proposed Mangoola Offset Area that encroach into the respective title areas. Mangoola has also now engaged with Hunter Gas Pty Ltd & Santos QNT Pty Ltd, regarding the small portion of the title that overlaps the Highfields Offset Area.

Following this engagement, no issues have been raised by any of these neighbouring tenement holders with regard to Mangoola's proposed offsets for the MCCO Project.

Mangoola is committed to continue engaging with neighbouring tenement holders as required.

As part of the existing operations at Mangoola Coal Mine, engagement is undertaken with the existing coal mining operations of Mount Pleasant (approximately 9 km north-east), Bengalla (approximately 8.5 km east) and Mount Arthur Coal (approximately 9.5 km south-east) as required. Given the significant distance that the existing Mangoola Coal Mine and the proposed MCCO Project are located from these other mining operations no significant cumulative impacts are predicted as confirmed by the studies completed for the Project EIS.

As stated in the EIS, Mangoola is committed to continue engagement with neighbouring mines over the life of the MCCO Project as required.

'2. The Division requests that the Proponent consider potential resource sterilisation in relation to any amendments to proposed biodiversity offsets areas. The Division requests that both the Geological Survey of NSW - Land Use Assessment team and holders of existing mining and exploration authorities that could be potentially affected by planned biodiversity offsets be consulted. This will ensure there is no consequent reduction in access to prospective land for mineral exploration or potential for the sterilisation of mineral and extractive resources.'

Noted. As discussed above Mangoola has consulted with all relevant tenement holders regarding the offsets proposed for the MCCO Project and to date none have identified that the proposed offset areas are likely to result in potential resource sterilisation. With regard to the offsets proposed in its own mining title areas, Mangoola undertook an examination of potential resources within these areas prior to nominating them as offsets so that potentially economically viable resources were not sterilised.

Mangoola has also consulted with the Geological Survey of NSW - Land Use Assessment team in regards to proposed offsets for the MCCO Project which may impact upon resource tenements. No formal feedback was given on the proposed offset areas for the MCCO Project by the Geological Survey of NSW - Land Use Assessment team prior to the submission of this RTS. Mangoola is committed to continue to engage with neighbouring tenement holders and the Geological Survey of NSW - Land Use Assessment team as required.

3.4 Environment Protection Authority

3.4.1 Water

The following summary responses have been prepared with the assistance of HEC who completed the Surface Water Assessment (SWA) for the MCCO Project. A detailed response prepared by HEC to the issues raised by the EPA is provided as **Appendix 4**.

"The SWA needs to adequately assess the potential impact of discharges on the environmental values of the receiving waterways The SWA proposes a water management system that would include controlled discharges from the Pit Water Dam to the Hunter River and managed overflows from sediment retention basins to Big Flat Creek, Anvil Creek and Sandy Creek. The SWA does not include a quantitative assessment of the effect of discharges from the Pit Water Dam on pollutant concentrations in the receiving waterway and the potential impact on the environmental values. The SWA indicates that the Pit Water Dam would contain elevated pH and electrical conductivity and concentrations of aluminium and zinc would be slightly elevated" The applicant should revise the discharge impact assessment to include: • "a characterisation of the controlled discharges to waters in terms of the concentrations and loads of all pollutants expected to be present at non-trivial levels • comparison of the expected pollutant concentrations in the immediate receiving waterway during discharges to the relevant Australian and New Zealand Guidelines for Fresh and Marine Water Quality

guideline values under typical and worst-case conditions where relevant, identification of practical measures to address identified impacts"

Controlled Discharges

The existing Mangoola Coal Mine has approval for discharge from site into the Hunter River under the provisions of the Hunter River Salinity Trading Scheme (HRSTS). The MCCO Project is seeking the continued ability to enact and use this facility in accordance with the HRSTS and relevant approvals and no changes to these approved facilities or arrangements are proposed.

The assessment in **Appendix 4** also identifies that there is a low likelihood of any change to the water quality of mine water as a result of the MCCO Project and therefore no changes have been identified that would change the approved discharge arrangements and impacts.

No discharge of mine water to Big Flat Creek is approved or planned as part of the MCCO Project.

As there are no changes proposed, no further assessment of controlled discharges are considered necessary.

Managed Sediment Overflows

Three sediment dams are proposed as part of the MCCO Additional Project Area. These have been sized and will be operated in accordance with the 'Blue Book'[1], with a proposed total capacity of 180 ML. These dams will be similar to existing sediment dams which are part of the existing approved Mangoola Coal Mine. These three sediment dams will be integrated into the mine water management system, with pumped transfer of any accumulated water to the existing Pit Water Dam in order to reinstate sediment dam storage capacity within five days of a rainfall event during their operational lifetime. Once the rehabilitation has established and the area has stabilised, sediment controls are no longer necessary and the runoff can be returned to the existing catchment.

In accordance with the Blue Book, sediment dams are designed to overflow during certain higher rainfall events. The modelled data indicates that overflow from the sediment dams should occur infrequently. The data also indicates that overflow, should it occur, would be small in comparison to flow in Big Flat Creek.

Therefore, the assessment in **Appendix 4** concludes that the likelihood of any impact of sediment dam discharge on downstream water quality and hence environmental values is considered low.

'Any site-specific guideline values used in the discharge impact assessment should be derived consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality'

Tables 8 and 9 of the SWA compare monitoring data from local waterways to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality guideline values and in some cases 'site-specific trigger values'. It is unclear how these 'site specific trigger values' were derived.

If site specific guideline values are used to assess the impact of discharges, the applicant should demonstrate these have been derived consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality."

[1] Landcom (2004). "Managing Urban Stormwater: Soils & Construction Volume 1", 4th edition, March.

As discussed in **Appendix 4**, site specific trigger values (SSTVs) have been derived from the monitored data as the 80th percentile of monitored values where sufficient monitored data are available to derive this statistic (a minimum of ten records). The aim of the SSTVs is to provide a baseline against which to compare future monitored water quality in order to assess if a mining-related impact *may be* occurring. This approach has been approved as part of existing water management plans for many coal mining operations in the Hunter Valley (including Mangoola) and elsewhere in NSW (triggers are also known as impact assessment criteria). If exceeded, these lead to the gathering of additional information or further investigation to determine whether an impact has occurred and if there is a risk to the environment. SSTVs are not water quality objectives. It is also noted that water quality baseline data from monitoring locations unimpacted by existing mining activity in many cases exceed the ANZECC (2000) default guideline trigger values and therefore the approach taken in the Surface Water Assessment to derive the SSTVs is considered appropriate.

Further detail regarding the derivation of SSTVs for the MCCO Project are provided in **Appendix 4**.

3.4.2 Noise

The following responses have been prepared with the assistance of Global Acoustics who completed the Noise Impact Assessment (NIA) for the Project.

> 'Confirmation that the levels derived using the 10th percentile approach would align with the noise enhancing meteorological conditions in the NPI.
>
> The NIA has assessed noise for four operational scenarios identified as Years 1, 3, 5 and 8. The noise predictions are based on a modelling process that considers 260 individual meteorological conditions and is commonly referred to as a cumulative distribution approach. The ultimate predicted level is then established based on the upper 10th percentile of predicted levels.
>
> The Applicant should confirm that the predicted level would align with the noise enhancing meteorological conditions in the NPI. Confirmation that predicted noise levels align with noise enhancing meteorological conditions – The noise predictions made in the NIA are based on a cumulative distribution approach. The Applicant is required to confirm that the predicted noise levels using the 10th percentile approach align with noise enhancing meteorological conditions in the Noise Policy for Industry (NPfI).'

We can confirm that is correct. The 90th percentile predictions for the night period presented in the NIA align with those determined for NPfI noise enhancing meteorological conditions. However, the 90th percentile predictions for the day and evening periods are significantly higher than would be determined in accordance with the NPfI and are therefore more conservatively high predictions of noise impact.

In accordance with the NPfI, noise enhancing meteorological conditions require consideration when the frequency occurrence of gradient wind or temperature inversion conditions exceeds a significance threshold of 30 percent in any time period or season. Temperature inversion conditions do not typically require evaluation for the day or evening periods.

When assessed using the 16-direction wind compass rose approach outlined in Section D2 of the NPfI, no wind conditions at Mangoola would trigger the 30 percent significance threshold for the day or evening periods. Therefore, gradient wind conditions are not considered significant in accordance with NPfI definitions, and only 'standard' meteorological conditions require assessment during these periods, as opposed to 'noise enhancing' meteorological conditions. Despite the NPfI requirement, Mangoola has conservatively elected to present 90th percentile predictions for these periods to provide a more realistic indication of potential noise levels during times when noise enhancing meteorological conditions do occur during the day and evening periods.

In summary, 90th percentile predictions for the night period presented in the NIA align with those determined for NPfI noise enhancing meteorological conditions. Day and evening predictions conservatively include consideration of noise enhancing weather conditions, despite the NPfI only requiring consideration of relatively non-enhancing (standard) meteorological conditions.

'Further analysis of all feasible and reasonable mitigation measures in accordance with the NPI for all "marginally" and "negligibly" impacted receivers.

Nineteen receivers are identified as "marginally" impacted and 31 receivers are identified as "negligibly" impacted. The NPI requires that the starting point should be identifying mitigation measures that would achieve the Project Noise Trigger Levels and then determining those measures that are both feasible and reasonable. The later part of this process has not occurred in the NIA. Prior to the EPA considering licensing to these locations (or representative locations) should the planning approval afford mitigation rights to these locations; the NIA must be revised to include further analysis of all feasible and reasonable mitigation measures in accordance with the NPI.

The Applicant should provides a further analysis of all feasible and reasonable mitigation measures in accordance with the NPI for all locations identified as "marginally" or "negligibly" impacted. Further analysis of all feasible and reasonable mitigation measures – the NIA must be revised to include a comprehensive analysis of all feasible and reasonable mitigation measures identified for "marginally" and "negligibly" impacted receivers in accordance with the NPfI.'

The EPA has requested "*further analysis of all feasible and reasonable mitigation measures in accordance with the NPI* [sic] *for all locations identified as "marginally" or "negligibly" impacted*".

The EPA provides further information regarding its request as follows:

> *Nineteen receivers are identified as "marginally" impacted and 31 receivers are identified as "negligibly" impacted. The NPI requires that the starting point should be identifying mitigation measures that would achieve the Project Noise Trigger Levels and then determining those measures that are both feasible and reasonable. The later part of this process has not occurred in the NIA. Prior to the EPA considering licensing to these locations (or representative locations) should the planning approval afford mitigation rights to these locations; the NIA must be revised to include further analysis of all feasible and reasonable mitigation measures in accordance with the NPI.*

The NPfI states that Project Noise Trigger Levels (PNTL) are not intended to be applied as mandatory noise limits. PNTL are used as a planning tool against which to assess predicted noise impacts, and to allow determination of the significance of any predicted residual noise impacts. That is, while a project should strive to achieve PNTL, it is recognised that this is not possible in all cases, and residual noise impact may occur. Residual noise impacts occur when the best achievable noise levels predicted for a private residential receptor are greater than the PNTL, and all source and pathway feasible and reasonable noise mitigation measures have been considered.

Section 2.1, paragraph 1 of the NPfI states:

> *The project noise trigger level provides a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.*

Section 3.2 paragraph 2 of the NPfI states:

> *Where the project noise trigger level is exceeded, assess the feasible and reasonable mitigation measures that could be implemented to reduce noise down towards the relevant project noise trigger level. If it is reasonable to achieve these levels, the proponents should do so. If not, then achievable noise levels should be identified. It is not mandatory to achieve the trigger levels but the assessment should provide justification if they cannot be met. An assessment of the acceptability of residual impacts should also be provided.*

Section 4.1, paragraphs 1 and 2 of the NPfI state:

> *A residual noise impact may exist where the best-achievable noise level from a development, when assessed at a sensitive receiver location, remains above the project noise trigger levels.*
>
> *Residual noise impacts are identified **after** all source and pathway feasible **and** reasonable noise mitigation measures have been considered.*

Section 4.2 paragraph 1 of the NPfI states:

> *Planning decisions for proposed developments take into account social, economic and environmental factors. Noise impact is one factor taken into account and decisions can be made that result in residual noise impacts (that is, noise levels above the project noise trigger level). In these cases, a consent may include an obligation on proponents to undertake noise mitigation at receiver locations.*

Collectively, these extracts from the NPfI infer that predicted noise impacts may exceed the PNTL, provided they represent the best-achievable noise levels after consideration of all feasible and reasonable noise mitigation measures.

Section 4.2.4 of the NIA includes a comprehensive evaluation of noise mitigation options, including identification of which measures are feasible and reasonable, and which were incorporated into the modelling assessment. Consideration is given to various mitigation options within each of the three primary noise control strategies in accordance with Section 3.4 of the NPfI, as follows:

1. reducing noise at the source
2. reducing noise in transmission to the receiver
3. reducing noise at the receiver.

Evaluation of noise mitigation measures was an iterative process that included multiple rounds of constraints analysis to identify which measures were effective, and to identify potential production impacts associated with various options. Some of the options considered (e.g. pit orientation, equipment distributions, haul road locations, plant operating quantities, operating mode restrictions) also have major effects on mining operations and therefore the feasibility of such options needed to be considered as part of mining studies. Detail regarding some of the alternative mining options considered is included in Section 1.4.1 of the EIS.

Noise mitigation measures that were determined to be feasible and reasonable and demonstrated to provide effective control of potential noise impacts have been incorporated into the MCCO Project design and specifically assessed as part of the NIA. It is noted that the NPfI does not call for a proponent to provide a detailed explanation of control measures that where considered but not found to be feasible and reasonable.

The NIA identifies achievable noise levels after application of all feasible and reasonable noise mitigation measures. Where achievable noise levels exceed the PNTL, the significance level of resulting residual noise impact was assessed, and appropriate levels of receiver-based mitigation were recommended based on NPfI and Voluntary Land Acquisition and Mitigation Policy (VLAMP) guidelines. It is considered that the NIA has followed the requirements of the NPfI and appropriately discussed the consideration of feasible and reasonable mitigation measures to control predicted noise impacts.

As noted in the EIS and NIA as part of the existing operations Mangoola has implemented a range of mitigation and management measures to reduce noise related impacts on surrounding private residences. This has included:

- Designing mining operations with consideration of minimising noise impacts through mine design, scheduling and equipment placement.
- Replacing reversing beepers on mobile equipment with 'quackers'.
- Personnel and contractors are to be vigilant in identifying and controlling operations and activities that might result in the generation of excessive noise. Noisy operations or equipment which are identified as affecting privately owned residences are to be reported to the supervisor promptly.
- Restricting, where possible, operations on outer dump faces or elevated dumps in sensitive areas and/or during adverse weather conditions.
- Trucks operating during the night time are restricted to operational areas, where possible, below the maximum elevation of the overburden emplacement areas.
- Using predictive meteorological forecasting and real-time noise monitors that incorporate automatic alarms so that proactive control can be implemented.
- Controlling mine noise at the source through the use of equipment with appropriate sound attenuation fitted and conducting annual sound power testing for equipment to confirm compliance to commitments.
- Installing and maintaining low noise rollers on conveyor systems.
- Covering the cost of running and maintenance of air conditioners for private residences located within the noise management zone for the existing operation.

With regard to Mangoola's approach to the design and planning of the MCCO Project, noise modelling was completed on an iterative basis to enable the development of a mine plan that would minimise noise impacts as far as practicable. The detailed assessment included the consideration of a number of project alternatives. Multiple iterations of the mine plan were undertaken prior to Mangoola selecting the proposed mine plan, with the noise impacts of the MCCO Project reduced through this process. The mine plan selected is not the most optimal from an economic perspective, however, Mangoola selected this as the proposed project as it achieves an appropriately balanced outcome between mine planning, economic, environmental and social outcomes and results in reduced noise impacts when compared to some of the other project options assessed.

As part of the MCCO Project planning process the noise controls that were found to be reasonable and feasible, and which contributed to the effective control of potential impacts, were incorporated into the MCCO Project design. These controls have been included as part of the noise model for the MCCO Project.

Key measures included in the MCCO Project design that have minimised noise include:

- Mine scheduling changes to reduce the overall intensity of mining equipment operating in the MCCO Additional Project Area. This means that there is less mining equipment in the new mining area than currently operating at full production at Mangoola Coal Mine, reducing the amount of noise generated by the equipment operating in the new mining area.
- Identifying activities that could be modified during times of adverse noise propagating meteorological conditions and the management of equipment during such conditions to minimise noise impacts.
- Developing designs for emplacement areas to enable alternative emplacement locations during adverse conditions, including the provision of day and night time emplacement locations so that night time activities can be undertaken in better shielded locations.
- The inclusion of bunds in strategic locations along key haul roads, where practicable, to shield trucks and equipment on exposed sections.
- Locating key haul roads below the ground surface to maximise topographical shielding to surrounding receiver areas, where practical.
- Incorporation of reasonable and feasible noise attenuation on key plant and equipment.

As stated in the EIS, Mangoola is committed to managing noise impacts from its mining operations and has a comprehensive Noise Management Plan in place. In accordance with this plan Mangoola will continue to utilise a range of proactive and reactive noise management strategies informed by real-time noise and meteorological monitoring systems. Proactive strategies will include utilising meteorological forecasting to plan activities in advance of potentially adverse conditions and ongoing day to day planning of mining operations to reduce noise. Reactive strategies will include the modification or suspension of activities in response to a series of triggers due to noise enhancing meteorological conditions.

'Assessment of out of standard hours construction impacts

The NIA has adopted daytime construction noise criteria consistent with the Interim Construction Noise Guideline (ICNG) i.e. LAeq,15minutes 45dB(A). However, the NIA proposes to apply the existing operational noise limits in PA 06_0014 for out of standard hours construction activities. The EPA will accept assessment of daytime impacts against the ICNG, however out of standard hours construction should not occur unless the prerequisite circumstances outlined in Section 2.3 of the ICNG are met and the construction activities can be managed to satisfy the ICNG out of standard construction hours noise management levels.

The Applicant must demonstrate that the prerequisite circumstances outlined in Section 2.3 of the ICNG can be met and that the construction activities can be managed to satisfy the ICNG out of standard construction hours noise management levels.'

<u>Proposed Construction Activities</u>

Section 2.3 of the Interim Construction Noise Guideline (ICNG) provides categories of works that might be undertaken outside the standard construction hours subject to a justification as to the need.

Of the five categories provided in the ICNG, two categories are applicable to the MCCO Project including:

- the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Further justification, as to the need for construction activities outside the standard construction hours, in relation to the above, is provided below.

Delivery of oversized plant or structures

The MCCO Project will involve the construction of several infrastructure items that may require the delivery of oversized plant materials and construction equipment. While the deliveries of equipment and construction materials will be scheduled during standard construction hours it may be necessary to take delivery of items outside these hours as influenced by the following reasons:

- Location of the MCCO Project Construction – It is anticipated that many of the deliveries necessary to facilitate the Project construction would be required to come from external locations beyond the Muswellbrook Local Government Area. The MCCO Project construction areas are located approximately 150 km and 270 km from Newcastle and Sydney respectively and would require travel times of between 3 – 6 hours accounting for vehicle speeds, required routes or unforeseen traffic conditions.
- Traffic and permissibility to utilise roads during certain time periods – The New England Highway (and other RMS or local roads) maintain oversized vehicle travel restrictions depending on the scale and vehicle escort requirements. In order to comply with these requirements it may be necessary to take delivery of plant and equipment before or after standard construction hours to maintain safety and efficiency on the road network.
- Environmental conditions – Weather conditions such as wet weather or extreme heat/cold need consideration in construction activities and the timing of deliveries. As an example, for the MCCO Project the construction of the culverts through Big Flat Creek and associated temporary diversions may be directly affected by wet weather. For this reason the delivery and construction of key infrastructure elements directly linked to these components outside of standard construction hours, may be required to facilitate access needs to the creek, robust construction and build integrity, and potentially reduce environmental impacts e.g. sediment containment and surface water runoff.
- Construction efficiencies – To enable deliveries of plant and equipment outside the standard construction hours will provide for an overall more efficient and in-series construction period. This would have the effect of limiting the overall period of construction to the minimum time required necessary to facilitate the build. By maintaining an efficient construction period the impacts of the MCCO Project construction elements to stakeholders would also be reduced and in less time, whereby construction traffic would be present on the local road network.

A need to operate outside the recommended standard hours

The MCCO Project is a State Significant Development and pending approval, would provide for the ongoing employment opportunities for the current workforce of approximately 400 personnel plus additional construction and operational employment.

During the MCCO Project build, there will be activities that will be more complex or time critical than others. For example the Wybong Road/Big Flat Creek Overpass and associated haul road is a critical piece of infrastructure necessary to enable the orderly transition of mining into the MCCO Additional Project Area. Any unplanned delays associated with the construction of this infrastructure component may jeopardise the continuity with the existing operation. As a result, the construction period as proposed has been developed to minimise impacts to the local community while providing the most efficient pathway for construction. To achieve this, it is proposed that the following activities may be required to occur outside standard construction hours.

- Concrete pours – It is anticipated through the preliminary design that approximately 1,450 m^3 of concrete will be required, primarily related to the overpass and culvert construction. Depending on the construction element, this may require successive concrete deliveries to facilitate the total demand and, due to the nature of concreting, once commenced would need to be completed as a single event.

- Cranage of arch supports – Specialist personnel and equipment will be required to facilitate the construction of the arch support structures. Once commenced, this component may require the task to be completed in a single session with the aid of the specialists to ensure the integrity of the construction, the safety of the workforce and the long-term integrity of the structure.

- Structural reinforcements or engineering works to stabilise items of the infrastructure during the construction process – Items or activities may be required to ensure the structural integrity, engineering suitability or safety of infrastructure components such as foundation/temporary supports, brace beams, formwork, shoring of earthen walls, etc.

- Roadworks – It may be required that the construction and sealing of the future relocated Wybong Post Office Road; the section of Wybong Road through the arch section of the Overpass; and the Construction Access section of Wybong Post Office Road, be completed as a single event or multiple events, to minimise impacts that may relate to the integrity of the construction e.g. hot or cold weather or rain. Timing may also dictate that these activities are better completed at non-standard construction times to limit impacts on road users during peak traffic periods. Activities may include establishment of road base, formation and drainage, compaction and sealing of the roadway.

- Cranage of plant and equipment – As outlined in the justification above the location of the MCCO Project may require the acceptance of plant and equipment outside standard construction hours.

- Installation or amendments to local services – The MCCO Project will require amendments to the local power supply and fibre optics/communications network. It may be appropriate to undertake these activities at specific times to minimise disruptions to users.

- Delivery and placement of overburden material from the existing Mangoola operation – It will be required that select material from Mangoola's existing operation be placed in areas associated with the construction of the haul road overpass and approaches. Mining activities are location dependent and therefore access to certain types of overburden suitable for use in construction will likely be dependent on the mining cycle, which occurs 24 hours, 7 days per week.

As outlined above the MCCO Project intends to schedule activities during standard construction hours as far as practicable, however, for the reasons described above, may require elements related to construction to occur outside these hours. Mangoola considers that construction outside of standard construction hours is justified, as it would provide reductions to the overall time taken to complete these major tasks and, in some cases, would occur out of hours to avoid disruption to other stakeholders (e.g. road network users). This would in turn provide benefit to the local community, including through quicker restoration of normal operation of the local road network while enabling the continuity of the MCCO Project with Mangoola's existing operation.

Proposed Construction Hours and Noise Criteria

As described in the EIS, key components of construction, with the exception of the establishment of the Proposed Wybong Road/Big Flat Creek Overpass, the Wybong Post Office Road Realignment and upgrades to existing culverts under Wybong Road, may be conducted up to 24 hours per day, seven days per week. These components include:

1. establishment of construction access points, temporary office and equipment laydown areas within the MCCO Additional Project Area

2. establishment of water management infrastructure including clean water diversion drains, dams and pipelines

3. relocation of 11 kV transmission lines out of the MCCO Additional Disturbance Area.

Proposed construction hours for the Wybong Road/Big Flat Creek Overpass, Wybong Post Office Road realignment and upgrades to existing culverts under Wybong Road will generally be during the hours of 7.00 am to 6.00 pm, Monday to Friday and 8.00 am to 1.00 pm on Saturdays, Sundays and public holidays. However, as discussed above, certain components of these works may be undertaken outside of these hours. Workforce arrival at site, workforce pre-start communications, work site inspections and workforce leaving site may also occur outside of these hours.

Mangoola's reasons and justification for proposing to undertake construction works outside of standard construction hours are described in the section above. The EPA also requests that Mangoola demonstrate that construction activities can be managed to satisfy the ICNG out of standard construction hours noise management levels.

The NIA proposes to apply existing operational noise limits prescribed in PA 06_0014 for out of standard hours construction in lieu of standard ICNG out of standard construction hours criteria. These noise limits would apply to the cumulative noise emission from both mining operations in the Approved Project Area, and, out of hours construction activity.

Justification for this approach is as follows.

- It is considered that this approach places a more stringent cap on construction noise emission. If the mining operation were operating at, or close to, the approved operational limit, construction noise levels would need to be restricted to a level nearly 10 dB lower in order to maintain compliance. Such levels would be well below the ICNG out of hours construction noise criterion of $L_{Aeq,15minute}$ 35 dB. Therefore, applying existing noise limits to combined operational and construction activities is considered conservative and more restrictive than applying the ICNG approach.

- Many of the proposed construction tasks that may be audible at private residence locations exhibit similar noise characteristics to mining equipment. At a distance, it would be difficult to discern the difference between mining and construction activities, and also which area the noise is emanating from. Evaluation of compliance would be simplified if one noise limit was applicable for both activities, as opposed to attempting to differentiate noise contributions and assess against separate criteria.

- Adopting existing operational noise limits means there would be no increase in overall noise emission relative to that currently approved, and out of hours construction activities would mean no further noise impacts to the community or local residences.

Construction predictions presented in the NIA are conservatively worst-case noise levels that represent maximum impact scenarios that may occur during standard construction hours, during the peak of the construction period. A very large quantity of equipment was modelled, and the scenarios assessed consider all construction areas working at full capacity, with maximum equipment quantities and personnel, working in the most exposed work areas relative to each residence. Furthermore, construction activity predictions are logarithmically added to the operational noise criterion for each residence, causing predictions in all cases to either equal or exceed the operational noise criterion. This method of presentation may not offer a true reflection of the relatively low-level contributions from construction activities predicted, as the assumed mining noise contribution (the criterion) often dominates the combined prediction.

Table 3.9 presents construction model predictions for specific construction activities within the Wybong Road Crossing/Big Flat Creek Culvert construction area. Results are provided for both non-enhancing and enhancing weather conditions, which are based on neutral atmospheric conditions and 90th percentile construction noise predictions (for the worst-case season) respectively. Rows with grey highlight indicate residences for which the maximum envelope operational noise prediction exceeds the PNTL by more than 5 dB (i.e. are already within the acquisition zone as defined under the VLAMP).

Predictions for the Wybong Road Crossing/Big Flat Creek Culvert construction area are low in all cases. The highest prediction for non-enhancing weather conditions is $L_{Aeq,15minute}$ 16 dB, indicating works in this area would typically be inaudible in the absence of enhancing weather conditions. The highest prediction for enhancing weather conditions is $L_{Aeq,15minute}$ 35 dB, indicating some management may be required to maintain compliance with construction noise criteria. However, it should be noted that the scenarios assessed include maximum equipment quantities in each work area, which would not typically be required out of standard construction hours.

Table 3.10 presents construction model predictions for specific construction activities within the Wybong Road Realignment construction area. The highest prediction for non-enhancing weather conditions is $L_{Aeq,15minute}$ 27 dB, indicating works in this area would typically be inaudible or low level in the absence of enhancing weather conditions. The highest prediction for enhancing weather conditions is $L_{Aeq,15minute}$ 41 dB, when including residences expected to be offered acquisition due to MCCO Project operational noise. Without consideration of these receptors, the highest prediction for enhancing weather conditions is $L_{Aeq,15minute}$ 38 dB. It is again noted that the scenarios assessed include maximum equipment quantities in each work area as scheduled for standard construction hours. Out of standard construction hours, management would be implemented to maintain compliance with construction noise criteria during periods of meteorological enhancement towards nearby residences. Such periods can usually be identified ahead of time using weather forecasting tools allowing proactive management strategies to be implemented.

Table 3.9 Wybong Road Crossing Construction Noise Predictions – Laeq, 15 minute DB

Residence ID	Bridge Foundations Formwork/Steelwork/Construction		Big Flat Creek Culvert Drainage/Earthworks/Construction	
	Non-Enhancing	Enhancing	Non-Enhancing	Enhancing
66	<15	18	<15	32
148	<15	20	16	33
130	<15	20	15	35
110	<15	20	<15	35
83	<15	15	<15	29
134A	<15	19	<15	33
109D	<15	16	<15	30
170	<15	19	<15	33
139	<15	19	16	32
261	<15	15	<15	30
263	<15	17	<15	31
205	<15	18	<15	32
128	<15	<15	<15	26
144	<15	19	<15	34
154	<15	<15	15	27
156	<15	<15	<15	29
171	<15	19	<15	34
258	<15	15	<15	29
761A	<15	<15	<15	27
176	<15	<15	<15	27
175	<15	<15	<15	25
206	<15	17	<15	31
260	<15	17	<15	30
126A	<15	<15	<15	25
174A	<15	<15	<15	26
157	<15	<15	<15	25
174B	<15	<15	<15	26
134C	<15	<15	<15	20
134D	<15	<15	<15	18
172	<15	15	<15	27
165	<15	17	<15	27

Notes:

1. *Standard construction hours in accordance with the ICNG;*
2. *The assumption is, outside standard construction hours, PA 06_0014 noise impact assessment criteria would still apply;*
3. *Non-enhancing weather predictions are based on neutral atmospheric conditions;*
4. *Enhancing weather predictions are based on 90th percentile results for the worst-case season; and*
5. *Grey highlight indicates operational noise maximum envelope prediction exceeds PNTL by more than 5 dB.*

Table 3.10 Wybong Post Office Road Construction Noise Predictions – Laeq, 15 minute dB

Residence ID	Establish Base		Drains and Culverts		WPO Rd & Wybong Rd Intersection	
	Non-Enhancing	Enhancing	Non-Enhancing	Enhancing	Non-Enhancing	Enhancing
66	<15	26	<15	22	<15	24
148	26	41	22	37	25	37
130	24	39	20	35	20	38
110	21	38	18	33	17	37
83	27	39	23	35	15	31
134A	20	38	16	34	16	33
109D	23	37	19	33	17	32
170	<15	24	<15	20	<15	26
139	<15	19	<15	16	<15	21
261	<15	28	<15	24	<15	23
263	<15	23	<15	19	<15	24
205	<15	22	<15	18	<15	25
128	<15	16	<15	<15	<15	<15
144	<15	<15	<15	<15	<15	<15
154	<15	24	<15	20	<15	19
156	<15	19	<15	15	<15	<15
171	<15	22	<15	18	<15	22
258	<15	<15	<15	<15	<15	<15
761A	<15	24	<15	20	<15	19
176	<15	30	<15	26	<15	28
175	<15	22	<15	19	<15	18
206	<15	27	<15	23	<15	25
260	<15	28	<15	24	<15	24
126A	<15	21	<15	17	<15	18
174A	<15	23	<15	19	<15	18
157	16	23	<15	19	<15	21
174B	<15	23	<15	19	<15	18
134C	16	22	<15	18	<15	19
134D	<15	21	<15	17	<15	22
172	<15	15	<15	<15	<15	<15
165	<15	<15	<15	<15	<15	<15

Notes:

1. *Standard construction hours in accordance with the ICNG;*
2. *The assumption is, outside standard construction hours, PA 06_0014 noise impact assessment criteria would still apply;*
3. *Non-enhancing weather predictions are based on neutral atmospheric conditions;*
4. *Enhancing weather predictions are based on 90th percentile results for the worst-case season; and*
5. *Grey highlight indicates operational noise maximum envelope prediction exceeds PNTL by more than 5 dB.*

Table 3.11 provides a summary of proposed noise criteria applicable for various activities and construction periods.

Table 3.11 Proposed Construction Noise Limits

<table>
<tr><th>Construction Period</th><th>Time/Days</th><th>Activity</th><th>Adopted Criteria</th></tr>
<tr><td>Standard Construction Hours</td><td>7.00 am to 6.00 pm, Monday to Friday and 8.00 am to 1.00 pm on Saturdays</td><td rowspan="2">Proposed Wybong Road/Big Flat Creek Overpass, Wybong Post Office Road Realignment and upgrades to existing culverts under Wybong Road</td><td>ICNG standard construction hours criterion</td></tr>
<tr><td rowspan="3">Outside Standard Construction Hours</td><td>8.00 am to 1.00 pm on Sundays and public holidays</td><td>Existing noise limits contained in PA 06_0014 (applies to combined noise from mining and construction activities)</td></tr>
<tr><td rowspan="2">All other hours</td><td>MCCO Project construction elements not related to interactions with local road networks. For example establishment of water management infrastructure, laydown areas/access and power reticulation.</td><td rowspan="2">Existing noise limits contained in PA 06_0014 (applies to combined noise from mining and construction activities)</td></tr>
<tr><td>As outlined above to include:
• Delivery of oversized plant or structures; and
• A need to operate outside the recommended standard hours</td></tr>
</table>

__Summary and Justification__

In summary, Mangoola considers that construction outside of standard construction hours is justified, as it would provide reductions to the overall time taken to complete major tasks and in some cases would assist to minimise impacts on other stakeholders (e.g. road users). This would in turn provide benefit to the local community, including through quicker restoration of normal operation of the local road network while enabling the continuity of the MCCO Project with Mangoola's existing operation.

Existing operational noise limits contained in PA 06_0014 are proposed to apply for out of standard construction hours activities (operational and construction noise). This is considered conservative, as it affords the community a greater level of protection than having separate noise limits for operational and construction activities, and ensures no increase relative to the existing approved situation can occur.

Mangoola is committed to managing noise such that the cumulative impact from the existing Approved Project Area and construction activities do not exceed the operational noise limits prescribed in PA 06_0014 outside standard construction hours. Model predictions indicate that construction noise levels should typically be low level and would often be inaudible. Mangoola commits to implement appropriate management measures as required to maintain compliance should higher noise levels be generated due to meteorological enhancement, or through any other circumstance.

3.4.3 Air Quality

The following responses have been prepared with the assistance of Jacobs Pty Limited (Jacobs) who completed the Air Quality Impact Assessment (AQIA) for the MCCO Project.

'The EPA requires clarification of the following points prior to recommending conditions of approval: 1. Justification of background levels – Section 5.4 of the AQIA notes that background data for PM10 and PM2.5 assumes that the "minimum values from these sites reflected a location that was not being influenced by emissions from the sources/operation to be modelled". The Applicant must provide justification for the chosen methodology and detail whether the contemporaneous dataset considered wind direction in determining the upwind monitor.'

Section 5.1 of the "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (EPA 2016) notes that *"background concentrations of air pollutants are ideally obtained from ambient monitoring data collected at the proposed site"*. One of the objectives of the AQIA (Jacobs 2019) was to follow the Approved Methods as closely as possible. Background levels were therefore determined from data collected at all PM_{10} and $PM_{2.5}$ monitors in the vicinity of the proposed site and based on an approach to minimise the potential for double-counting of modelled existing mine contributions. There is no standard, prescribed methodology for developing a background dataset in this manner, therefore an estimation approach had to be adopted, as documented in the AQIA.

The derivation of contemporaneous datasets was based on the assumption that, for each day, the minimum measured non-zero 24-hour average concentration of all available monitors would have been least influenced by the source being modelled, that is, the existing Mangoola Coal Mine. This approach did not consider hourly wind directions however there were various outcomes which provided confidence that the approach was suitable for the impact assessment.

These outcomes included:

- Statistics from the derived background datasets that were similar to values expected in rural areas where mining is not present. For example, the annual average PM_{10} concentration from the derived background dataset was 11 µg/m^3. This result is comparable to measurements in rural, non-mining areas such as historical levels measured near Wybong prior to the presence of mining.

- A model performance evaluation which showed that, with the adopted approach for background levels and modelling, there was good agreement between the model predictions and measurement data. Specifically, in the key areas of interest, the model predictions were typically higher than the measured results and generally within 20% of measured results. Figure 17 of the AQIA provided information on the model performance.

‘2. Calculation and assumption of peak daily emissions – it is unclear in the AQIA whether peak daily emissions were modelled for each scenario. The Applicant must confirm if peak daily emissions were modelled and provide details and calculations for the throughput assumed for each scenario.’

The existing Mangoola Coal Mine and MCCO Project will be a continuous 24-hour per day operation with relatively constant production from month-to-month. Daily operations may fluctuate depending on many factors such as environmental conditions, production requirements, equipment availability, operating areas, and hauling/coaling locations etc. however the level of fluctuation is not able to be accurately quantified. Modelling was therefore carried out for the proposed maximum annual production for each assessment year, with daily production derived from these proposed maximum annual production data. The operations would be managed so that production would remain within approved limits.

‘3. Justification of emissions management measures including watering of haul roads – the AQIA has assumed an 85% emission control for hauling overburden and coal on unsealed roads including watering of haul roads, compaction, restricting vehicle speeds and fleet optimisation (see Table 20). The National Pollution Inventory notes that at 75% emission control is Level 2 watering, equivalent to greater than 2 L/m2/h. It is unclear whether the dispersion model assumes watering of haul routes for all hours and if the Applicant proposes to undertake this level of watering during operations. The AQIA should be revised so that controls are only applied when watering is proposed to be undertaken.’

The control efficiencies of the proposed emission management measures presented in Table 20 of the AQIA were derived from NPI (2012) and Donnelly et al (2011) unless relevant site specific data or Glencore business wide data were available to support more accurate estimates.

The control efficiency for hauling overburden and coal on unsealed roads at Mangoola Coal Mine has been subject to site-specific testing as part of a Pollution Reduction Program (PRP) under Mangoola’s Environmental Protection Licence (EPL) 12894. The Mangoola PRP “Wheel Generated Dust Control Efficiency Assessment Report” (Mangoola Coal 2014) confirmed that 85% control efficiency has been consistently achieved using the emission management measures currently employed on site. Specifically, from all testing, the dust control efficiencies for hauling overburden and coal on unsealed roads at Mangoola Coal Mine have ranged between 88% and 99%. These data supported the assumption of 85% control for the AQIA modelling. The emission management measures used during the site specific testing will continue to be employed during the life of the MCCO Project.

Mangoola is proposing to continue to have water carts available at all times however it is not possible to know precisely when watering will be required. In some situations watering will not be required to achieve desired dust mitigation; for example, in the periods after water carts have run their circuits, when there is low evaporation, in high moisture conditions, when it is raining, or when there are lower truck volumes. The modelling has therefore assumed that roads will be maintained in a state to target at least 85% control at all times.

‘4. Additional detail of proposed watering of stockpiles and unloading operations – the AQIA has assumed emission control factors for water sprays during unloading coal to ROM hopper and to minimise wind erosion from ROM and product coal stockpiles. The Applicant needs to provide detail on whether this will occur continuously during operations or if it will be triggered by particular meteorological conditions.’

Details on the proposed dust control measures for unloading coal to the ROM hopper and for minimising wind erosion emissions from the ROM and product coal stockpiles are outlined in the “Mangoola Airborne Dust Management Plan” (Mangoola Coal 2018a).

Dust control measures will continue to be implemented and maintained in all coal handling areas as they are for the existing Mangoola Coal Mine. Dust control measures include:

- enclosure of overland raw coal conveyors (already completed at existing mine)
- enclosure of coal handling and preparation plant (already completed at existing mine)
- operating water sprays on coal dump hoppers, conveyors and stockpiles
- maintaining coal handling areas in a clean condition
- maintaining all dust control equipment in serviceable condition.

The dust control measures relating to the ROM hopper include:

- operation of water sprays whenever coal is being discharged into the hopper
- operation of water sprays when the crushers are in operation
- maintaining areas around the ROM hopper in a damp condition, particularly during dry and windy weather
- clean-up of coal spillage in the vicinity of the hopper.

The dust control measures relating to the ROM and product coal stockpiles include:

- coal stockpile sprays will be activated if routine visual inspections identify that the relatively high moisture content of the coal is not sufficient to manage dust levels without additional application of water
- as an additional trigger for inspection, an alarm is generated when the wind speed reaches >8 m/s to alert Supervisors to inspect stockpiles and activate water sprays as required
- observing dust suppression effectiveness during stockpiling operations.

The modelling for the AQIA has assumed that these potential dust emission sources will be maintained in a state to achieve the control efficiencies outlined in Table 20 of the AQIA at all times.

> '5. Additional detail of proposed enclosure of conveyors to stockpiles, coal processing and coal unloading to ROM hopper – Table 20 of the AQIA notes that coal processing and conveyors to stockpiles will be enclosed. It also notes that unloading coal to the ROM hopper with be partially enclosed. It is unclear at what stage of the operation this will occur, or if it forms part of the existing operation, and to what degree these activities will be enclosed, and how. The Applicant must provide additional details including maps of the static control measures.'

Details on the dust control measures for conveyors, coal processing and coal unloading to the ROM hopper are outlined in the "Mangoola Airborne Dust Management Plan" (Mangoola Coal 2018a) and with regards to fixed infrastructure and stockpile areas reflect the measures that are currently in place at the existing approved mine. No new works are proposed in this regard with all controls and enclosures currently in place.

In this regard Mangoola commit in the EIS that all existing dust control measures will continue to be implemented and maintained in all coal handling areas. Dust control measures include:

- enclosure of overland raw coal conveyors
- enclosure of coal handling and preparation plant
- operating water sprays on coal dump hoppers, conveyors and stockpiles
- maintaining coal handling areas in a clean condition
- maintaining all dust control equipment in serviceable condition.

The dust control measures relating to the ROM hopper include:

- operation of water sprays whenever coal is being discharged into the hopper
- operation of water sprays when the crushers are in operation
- maintaining areas around the ROM hopper in a damp condition, particularly during dry and windy weather
- clean-up of coal spillage in the vicinity of the hopper.

The modelling for the AQIA has assumed that these potential dust emission sources will be maintained in a state to achieve the control efficiencies outlined in Table 20 of the AQIA at all times.

As discussed in the MCCO Project EIS and the response above these dust control measures are currently in place onsite at the existing Mangoola Coal Mine with **Plates 3.2** to **3.5** assisting to demonstrate this.

Plate 3.2 Enclosed CHPP and Conveyors at Mangoola Coal Mine

Plate 3.3 Enclosed Conveyor at Mangoola Coal Mine

Plate 3.4 Enclosed Conveyor at Mangoola Coal Mine

Plate 3.5 Existing ROM Hopper Enclosure at Mangoola Coal Mine

‘6. Additional detail on meteorological triggers to be implemented in the Trigger Action Response Plan - Section 10 of the AQIA notes that the Applicant will “implement a range of dust management measures for the key dust generating activities” and that “reactive air quality management will assess the need to modify the activities in response to the following triggers…meteorological conditions, such as dry, strong winds”. The Applicant must provide additional details on what meteorological triggers, such as wind speed, direction, temperature etc, will be used in the reactive air quality management system and how this will feed into the Trigger Action Response Plan (TARP). The Applicant has not provided detail on when the TARP process will be enacted and what management responses will be used to manage dust during operations.’

Details on the proposed meteorological triggers to be implemented are outlined in the “Dust Management Trigger Action Response Procedure” (Mangoola Coal 2018b) which is one of the procedures used to assist in dust management under the Mangoola Air Quality Management Plan. This process is currently enacted and will continue to be implemented during the operation of the MCCO Project.

In summary a Level 1 meteorological alarm is triggered when the 5-minute average wind speed exceeds 8 m/s. Specific actions taken in response to a Level 1 meteorological trigger are then be logged by the shift Mining Supervisor.

3.5 Heritage, Department of Premier and Cabinet

3.5.1 Historic Heritage

‘Historic Heritage Assessment report was prepared to meet the relevant SEAR for the MCCO Project for historical (Non-Aboriginal) heritage, and to address prior comments from the former OEH on the SEARs. Heritage, Department of Premier & Cabinet supports the note in Section 9.1 of the HAA for a standard process in managing unexpected archaeological resources and the induction training on heritage matters. Heritage, Department of Premier & Cabinet concurs with the above recommendations which are considered appropriate to manage the heritage requirements of the proposed project.’

Noted.

3.6 Department of Planning, Industry and Environment – Resources Regulator

3.6.1 Final Landform

‘The safety berm proposed along the top of each highwall may not be considered an adequate safety device to remain post closure as this device requires maintenance and possible human intervention into perpetuity.

…Additional information is required to demonstrate that sustainable rehabilitation outcomes can be achieved as a result of the project. The required additional information is as follows:

1. An adequate description of anticipated bench/highwall heights and angles.

2. A revised strategy that ensures that the area is left post closure safe, stable, non-polluting, fit for the nominated post-mining land use and sympathetic with the surrounding landforms.’

Glencore implement a series of Standards across all operations in NSW and QLD. This includes the Glencore Mine Closure Planning Protocol which provides guidance for closure planning for various stages of mine life from exploration through to post-closure management.

Associated with the objectives of the Glencore Mine Closure Planning Protocol of achieving a safe and stable landform, Mangoola commissioned a geotechnical stability assessment for the MCCO Project final landform as part of the planning process for the Project. The assessment was undertaken by Paul Lambert, Principal Engineering Geologist of Lambert Geotech Pty Ltd (Geotechnical Stability Assessment – Final Walls for Mangoola North, November 2018). Paul Lambert has been the consulting geotechnical provider to Mangoola for a number of years and is well acquainted with the existing Mangoola site conditions and methods of mining which are proposed to continue for the MCCO Project.

The report provided a preliminary assessment of the final highwall stability and determined the factor safety at multiple points around the walls of the conceptual final voids. The minimum Factor of Safety (FoS) of 1.2 was considered in the assessment completed for the final wall stability at the completion of mining. A FoS of 1.2 is the minimum safety factor used by the geotechnical engineer when assessing highwall stability at Mangoola, so that the design provides for long term stability. The report identified a number of preliminary suggestions required to achieve the FoS of 1.2 that will be included in the detailed final landform planning process as the MCCO Project progresses.

These included:

- a minimum 8 m wide bench width be adopted to protect from rock falls from slopes above
- at the Great Northern Seam floor there is no need for a bench, as it provides little benefit to overall wall stability or rock fall catch capacity
- at the Wallarah Seam floor provide a 10 m wide bench in the north/north-eastern area of the mine shell
- at the Wallarah Seam floor provide an 8 m wide bench in the southwestern area of the mine shell
- at the Wallarah Seam floor provide a 10 m wide bench in the southern area of the mine shell
- the toe of any overburden emplacement dump above a low wall should be set back a minimum of 30 m from the low wall crest.

In accordance with the principles of the Glencore Mine Closure Planning Protocol the MCCO Project mine plan and conceptual final landform, including the final highwalls and use of safety berms, will be subject to ongoing geotechnical investigation and refinement by Mangoola over the life of the operation, providing a safe and stable final landform. The potential for inclusion of a safety berm is designed to reduce the potential for access and subject to consultation with stakeholders at mine closure, another suitable alternative measure to achieve the same outcome may be preferred. It is noted that safety berms are common practice and included in mine closure plans for a number of mining operations. The safety berm, like the rest of the site post closure, will require maintenance as part of any ongoing land management process in respect of fencing, weeds, erosion etc. Final design of the highwall and completion criteria will be detailed in the MOP and subject to the review and approval from the Resources Regulator.

As stated in the EIS, a detailed Mine Closure Plan will be developed five years prior to the planned mine closure and will be aimed at achieving the post mining landform and land use as presented in the EIS. This detailed Mine Closure Plan will build on the Conceptual Closure Plan that will be in place for the rest of the mine life. The detailed Mine Closure Plan will include evaluation of re-use opportunities for facilities, infrastructure and services on the site, with the majority of demolition/decommissioning works to be planned and undertaken as soon as practicable following the cessation of mining, unless alternative post mining uses are identified at that time. Given the proposed timing for the MCCO Project this detailed mine closure planning process is anticipated to commence in approximately Year Three of the MCCO Project in the additional mining area.

As stated in the EIS, Mangoola commits to continue to investigate potential post mining beneficial land uses for the site through the development of a Post Mining Land Use Strategy as part of the detailed Mine Closure Plan. The detailed Mine Closure Plan will also investigate ways to minimise the adverse socio-economic effects of mine closure, including reduction in local employment levels. The development of the detailed Mine Closure Plan will include consultation with relevant stakeholders, which is expected to include the Resources Regulator, DPIE and MSC.

3.6.2 Safety

> 'Mine Safety Operations have not identified any risk that would require comment in relation to this matter.'

Noted.

3.7 Transport for New South Wales

> 'Transport for NSW have indicated that the exhibited documents have been reviewed and no further comment is provided at this stage of the planning process.'

Noted.

3.8 Muswellbrook Shire Council

The submission provided by MSC is presented in two parts. Part 1 provides comments directed to the planning authority that will assess and determine the application and to DPIE, whilst Part 2 provides comments specific to the MCCO Project.

With regard to Part 1, as noted by MSC in its submission these comments are for the planning authority and DPIE and accordingly this RTS does not respond to those comments. It is noted that the comments raised in Part 1 are predominately focused on the approvals process and assessment approach for mining proposals in NSW and proposes alternative assessment approaches and requirements for issues such as cumulative impacts.

In this regard Mangoola would like to reiterate that the MCCO Project EIS has been prepared in accordance with the requirements of relevant Commonwealth and NSW legislation and relevant policies and guidelines. The MCCO Project EIS provides the environmental, social and economic impact assessments required to accompany the applications for the required planning and environmental approvals for NSW and Commonwealth determining authorities. This has included detailed assessments of both site specific and cumulative impacts as required by relevant guidelines.

Further details with regard to the strategic and statutory context of the MCCO Project are presented Section 4 of the MCCO Project EIS.

Responses to the comments raised in Part 2 of the MSC submission are provided in the following sections.

3.8.1 Social

The following responses have been prepared with the assistance of the Umwelt Social Team who completed the Social Impact Assessment (SIA) for the MCCO Project.

'Table 3.3: Stakeholder Participation in SIA Program (page 15). Larger and broader mix of stakeholders would provide a more accurate and inclusive range of information informing the Social Impact Assessment.'

Engagement has been an integral component of the MCCO Project, with a comprehensive stakeholder engagement program implemented as part of the Project. Given that Mangoola Coal Mine is an established operation, and relationships with the community have been developed over time, the engagement approach adopted for the current assessment, builds on existing relationships developed and activities undertaken by Mangoola to date.

The objectives of the engagement program for the MCCO Project which commenced in 2017 were to:

- adopt a proactive approach to engagement with the community
- be open and transparent in dealings with the community
- provide meaningful and relevant information on the MCCO Project
- utilise a range of existing and new engagement methods so that all stakeholders have an opportunity to participate
- identify salient community issues and opportunities in relation to the MCCO Project to inform Project planning and assessment
- provide opportunities for stakeholder input throughout the assessment and approval process, including input on proposed management measures to reduce negative and enhance positive MCCO Project impacts.

The engagement program commenced early during the planning phases of the MCCO Project and has continued in an iterative manner throughout the Project design and assessment phases. Further details of the engagement methods utilised, and stakeholders consulted, across the assessment phases are outlined in Section 5.2 of the EIS.

The engagement program has involved three advertised Community Information Sessions held in Muswellbrook and Wybong (open to all community members), three MCCO Project focussed newsletters and individual meetings with 44 proximal landholders (including 25 landholders in Round 1 as part of the Preliminary Environmental Assessment (PEA) scoping in 2017, all of whom were engaged again in Round 2 (October 2018-February 2019) plus an additional 19 landholders (Round 2).

A number of other external meetings and briefings have also been completed during the 18-month program of stakeholder engagement for the MCCO Project, in addition to the engagement undertaken for the SIA. This has included consultation with local landholders, relevant government agencies, MSC, Indigenous stakeholders, relevant infrastructure and service providers and Non-Government Organisations, such as the Muswellbrook Chamber of Commerce and Industry.

In summary, the wider community were afforded the opportunity to participate in the engagement process either directly or through consultation completed with other groups as part of the MCCO Project.

Refer to Section 5.2 of the EIS and Section 3 of the SIA for further specific details regarding the extensive stakeholder engagement process that has been implemented for the MCCO Project.

'Section 4.2.1 Glencore Community Perception Survey. As the broad, non-specific survey results do not provide any detail with regards to the specific Mangoola Coal Mine or the MCCO Project, the survey results cannot be considered to provide a reliable view of the local community's perception of Glencore Mangoola.'

As identified in Section 3.5 and 4.2.1 of the SIA, analysis of the Glencore Community Perception is used to provide an understanding of stakeholder perceptions relating to Glencore and the existing Mangoola Coal Mine operation. While participants were not asked about the MCCO Project, results do provide outcomes of engagement with landholders residing in proximity to the Mangoola Coal Mine operations and other key stakeholders within the wider locality of the Project e.g. Muswellbrook. This survey complimented the broader consultation program which provided opportunities for stakeholders to provide specific feedback relating to the MCCO Project.

'Section 4.2.2.1 Perceptions of existing Mangoola Coal Mine. The report does not state whether or not this is the total sum of proximal landholders to Mangoola Mine.'

Section 3.4 of the SIA and Section 5.2 of the EIS outlines that Phase 1 of engagement (during the PEA Stage) involved meetings with 24 landholders.

Proximal landholders were defined as including landholders and residents residing in close proximity to the current mining operations in the state suburbs (ABS, 2016) of Mangoola, Castle Rock, Wybong and Manobalai. There were a total of 57 properties that have residual noise impacts above the PNTL for the MCCO Project and these nearby landowners were targeted for the one on one interviews. During the scoping phase those in the significant and marginal zones were prioritised and offered the opportunity to be engaged.

Two rounds of direct engagement with landholders were held as part of the SIA process. Round one occurred during the issue identification and scoping phase in July 2017 and included a total of 24 face to face and telephone interviews with landholders, 12 interviews undertaken with representatives from Mangoola and Umwelt and 12 with representatives from Mangoola only.

The second round of engagement was undertaken between October 2018 and February 2019 and included a total of 22 face to face meetings and 22 phone interviews with proximal landholders, with representatives from Umwelt only present at these interviews. Round two included all of those engaged during the first round and a further 19 additional landholders that were identified as being potentially impacted by noise as a result of the technical studies, or due to snowball sampling, whereby details of additional stakeholders to be consulted are provided by those previously engaged.

It should be noted that not all landholders that are contacted to take part in the engagement process for the SIA choose to participate. Reasons for non-participation, include: not wanting to participate in the process, relocating or no longer reside at the respective property, health reasons, too busy and/or prefer to wait for EIS finalisation to comment in the submissions phase.

'Reduction in population in proximate areas reduces the ability of these areas to attract members to emergency service organisations, such as the Rural Fire Service.'

A review of volunteering in the Muswellbrook LGA (Section 5.6.5 of the SIA) indicates that the localities of Manobalai, Denman and Mangoola had considerably higher proportions of volunteering (40%, 26% and 25% respectively), compared to the Muswellbrook LGA (18%) or NSW state average (18%). Issues relating to population decline are also assessed in response to impacts to sense of community in **Section 4.5.1**.

Whilst it is not a requirement of Mangoola's operations, there are currently several employees who volunteer their time as part of the surrounding Rural Fire Service (RFS) Brigades. Additionally, the existing Mangoola leave policy entitles employees to participate in volunteer emergency services. Mangoola also provide access to a number of fire hydrant fill points and water supply located at the Mangoola CHPP and firefighting equipment to aid in response to a bushfire. Further details in this regard are provided in **Section 4.3.1.3**. Mangoola is committed to continuing its support for the local RFS Brigades in the future.

As raised in Section 6.1.2 and 6.1.9 of the SIA, community participants also identified that the continued support for the RFS was a positive impact of the MCCO Project.

'The SIA addresses mental health concerns associated with the MCCO Project, but needs to provide a range of individualised solutions… Specific comments centre on the increased pressure on interpersonal relationships and apprehension/anxiety regarding future lifestyle and financial stability – if unable to sell their property. Noise concerns impacting sleep patterns were also noted, particularly in relation to increased irritability and a lack of ability to focus on work or study' (p. 165). This has not been adequately addressed.'

Mental health impacts are assessed in Section 7.2.8 of the SIA, stating that it is *likely* that the discussion around the MCCO Project is contributing to mental health issues for some landholders within the proximal community, with a *moderate* consequence, resulting in a '*high*' social risk.

As part of Mangoola's existing community engagement approach, personal meetings with stakeholders are offered, providing personalised opportunities for engagement and provision of detailed information regarding existing operations and the MCCO Project. This also provides the opportunity for discussion of personalised solutions to the identified issues. Mangoola will continue to implement this approach to ensure that there is a mechanism in place to respond to landholder issues and concerns.

In regard to noise, a number of studies have been undertaken that consider factors which may influence people's levels of annoyance, concern and impact as a result of noise (e.g. Cohen & Spacapan 1984, Persson et al. 2007). Such research can be used to better understand the impacts of noise on communities residing in proximity to industrial operations. Factors that have been noted in the research include:

- the degree of which the impact is attributed to industry
- predisposition of persons toward other anxious behaviours
- attitudes toward the stressor, especially when
    - noise is considered unnecessary

- there is a perception that those responsible for the noise are unconcerned about the exposed population's welfare
- the residence/those that are hearing the noise, dislike other aspects of the environment (e.g. combined noise/dust impacts)
- there is a belief that noise is harmful to health
- noise is associated with fear

- proximity to the operation
- level of trust in industry.

Noise impacts can be seen to exacerbate people's levels of annoyance and stress if a person believes they have been experiencing such impacts over an extended period of time, or with what they believe is little or no appropriate response.

Within the EIS, impacts of noise are assessed in relation to the impact on social amenity in relation to set government criteria. As noted in the SIA, it is possible that heightened levels of annoyance and concern may increase an individual's level of anxiety and stress as a result of their experience of an impact.

An assessment of noise level events which have the potential to cause sleep disturbance was completed for the MCCO Project as part of the NIA and found that there are no predicted exceedances of the criterion at any private residences and as such, no sleep disturbance impacts are predicted.

> 'Mangoola Coal must provide information to stakeholders in a form that is readily understood, and must be proactive in managing reasonable community concerns. 'Residents noted heightened stress when navigating industry reports, stating that technical jargon, data analysis and lack of industry knowledge creates confusion.
>
> It is unsatisfactory to merely respond to complaints. Some stakeholders commented that they have been encouraged by Mangoola to utilise the grievance system to allow appropriate redress of issues associated with their operations, however some landholders perceived that the continual need to complain to Mangoola was limiting their ability to cope with the MCCO Project coming closer, and they did not want to be labelled a 'whinger'.'

Engagement has been an integral component of the MCCO Project, with a comprehensive stakeholder engagement program implemented as part of the MCCO Project. The engagement program commenced early during the planning phases and has continued in an iterative manner throughout the MCCO Project design and assessment phases. A range of different engagement methods were utilised that were designed to be inclusive and tailored to suit the varying needs of those being engaged, with the provision of summary documents and more technical information. Personal opportunities for engagement were also provided, included personal meetings and community information sessions. All stakeholders were also provided with a direct line to the Project Team for any additional queries or information requests. Further details of the engagement methods utilised, and stakeholders consulted, across the assessment phases are outlined in Section 5.2 of the EIS.

With regard to the provision of non-technical information, such information was provided at the community information sessions which also provided the opportunity for stakeholders to talk to the consultants preparing the EIS and key technical studies (including noise, air quality and social assessments) and to better understand the findings. A community summary booklet of the EIS in magazine format was also prepared and distributed to the local community (over 200 residences) to provide a summary of the EIS findings in a format that was more readily accessible to stakeholders.

Members of the Mangoola team have also had numerous one on one conversations to explain study findings and are committed to providing ongoing opportunities to provide information to assist stakeholders.

In regard to complaints management, Mangoola operates a 24 hour community hotline for receipt of community complaints. As part of the complaint management process, complaints are responded to within 24 hours of receipt, investigated and the results reported to the complainant in a timely manner. This includes any measures implemented to resolve or close out the complaint.

Mangoola maintains a complaint register to record all community complaints, investigations and outcomes. Mangoola records all relevant contact with the community even if an investigation concludes that the mine's activities remain in compliance with existing project approval conditions (and other regulatory) limits; or the reported instance is not able to be attributed to the mine (e.g. a contact regarding a blast is recorded as a complaint even if the investigations finds that no blast from the mine occurred at the time reported).

While Mangoola seeks to proactively deal with all complaints, it also recognises that response and management of complaints is a last resort and therefore has a range of ongoing stakeholder engagement mechanisms to seek to effectively communicate with the local community. Mangoola is committed to continue to strive for effective communication with the local community and broader stakeholder groups.

Information provision and engagement are discussed further in Section 6.1.12 and 7.2.14 of the SIA.

'A deeper, more authentic level of understanding and engagement with the indigenous community is required. Will Mangoola Coal consider the introduction of a specific indigenous employment programme?'

Engagement with Indigenous stakeholders for the SIA is discussed in Sections 3.5 and 6.4 of the SIA. A total of 24 Indigenous stakeholders and organisations were invited to participant in the SIA, with 15 interviews conducted. In addition, 37 Aboriginal parties were engaged as part of the Aboriginal cultural heritage assessment program (refer to Section 5.4.3 of the EIS).

As noted in Section 6.12 of the EIS, employment opportunities for Aboriginal stakeholders were raised as a potential positive impact of the MCCO Project, that would benefit the Aboriginal community. Mangoola, as part of the wider Glencore community investment program, is considering the development of a trainee or work experience program, with the assistance of a third-party provider in the area of cultural heritage management, biodiversity or land management, ecology, rehabilitation or another appropriately related field.

Through the ACHAR and SIA programs undertaken for a number of operations in the Hunter Valley, Glencore has responded to community requests for the development of a work experience program for local Aboriginal youth, with the program to be rolled out across in 2020.

'Broader issues like rent rises are not addressed. For example, there was a downturn a few years ago, so people in social housing went to private rentals because the rent became cheap, then the boom came, rent went up, and people had to ask for social housing back'.

Broader issues relating to infrastructure and service provision (such as housing) are addressed in the SIA. Section 5.6.7.1 provides a comprehensive understanding of the relevant communities proximate to Mangoola's operations and evaluates their resilience and sensitivity to change. This includes access to housing and local infrastructure and services.

Mangoola Coal Mine currently has an existing workforce of approximately 400 employees. The MCCO Project will provide for continued employment opportunities for the existing workforce with up to an additional 80 workers likely required to achieve the assumed peak workforce of 480. This is below the previously assessed and approved peak workforce of 540. The majority of the existing Mangoola workforce travel to work from within the Muswellbrook LGA (51.1%), followed by the Upper Hunter (22.2%) with employees largely from the townships of Muswellbrook, Denman, Scone and Singleton. Therefore, the impact on the area of housing either through direct ownership or via rentals and the area of service access, is expected to remain similar to the current position.

Section 7.2.1 of the SIA considers the impact that any change in population resulting from the construction and operations related to the MCCO Project, which also considers impacts on community infrastructure and services in the locality. As outlined in Section 7.2.1.3 of the SIA, it is not anticipated that the MCCO Project will impact on the provision of community services and infrastructure within the Muswellbrook LGA. Therefore, whilst this issue is acknowledged, it has not been identified as an impact associated with the MCCO Project.

The project will remove the social community context of the area, particularly the Wybong Post Office Road area and its intersection with Yarraman Road. Wybong Community Hall is a strong indicator of the social prominence of this locality in Muswellbrook Shire, and that it is still regularly used by the community provides evidence of the area's continuing important social perspective.

Post mining, Mangoola Coal should consider the development of a village around Wybong Hall and intersection of Wybong PO Rd and Yarraman Rd. It is important that the sense of community is regenerated post mining. This needs to be considered as an important component of the closure plan.

The impact on sense of community is assessed within Section 7.2.3 of the SIA and largely discusses the likely population change impact that is predicted to occur as a result of the MCCO Project and the subsequent impact on sense of community in the Wybong area.

As noted in the SIA Guideline (DPE, 2017), strategies need to be developed that show a connection between the measure proposed and the significant social impact being mitigated or enhanced. Strategies to be implemented may differ in their effectiveness and/or ability to alleviate impacts, with some residual social impacts remaining, in the case of negative impacts. Certain measures may collectively address a number of different negative social impacts and potentially enhance positive impacts.

To address the issues raised by proximal landholders relating to a dwindling sense of community in the area, a number of mitigation and enhancement strategies are proposed as part of the MCCO Project including:

- implementation of a range of existing and new mitigation measures to address the environmental and social impacts of the MCCO Project
- continued implementation of a VPA with MSC (refer to **Section 3.8.2**)
- development of a Community Enhancement Program that focuses on facilitating enhancement initiatives (as a component of the VPA) for proximal landowners within the management zones for the MCCO Project

- continuation/implementation of a range of existing and new mitigation measures where applicable to address the identified impacts, based on community feedback including household cleaning and noise mitigation (as directed by a qualified structural engineer), filters for water tanks - first flush systems, cleaning of water tanks, cleaning of solar panels, landscaping/tree planting (on individual properties) and air-conditioning - provision, maintenance and electricity subsidies

- development and execution of a Social Impact Management Plan (SIMP) for the ongoing monitoring and management of social impacts.

As discussed in the EIS, Mangoola is also committed to considering all potential future land use options for land that it owns including both mining land and buffer land and properties surrounding it. As stated in the EIS, a detailed Mine Closure Plan will be developed five years prior to the planned mine closure and will be aimed at achieving the post mining landform and land use as presented in the EIS. The detailed Mine Closure Plan will include evaluation of re-use opportunities for facilities, infrastructure and services on the site, with the majority of demolition/decommissioning works to be planned and undertaken as soon as practicable following the cessation of mining, unless alternative post mining uses are identified at that time. Mangoola commits to continue to investigate potential post mining beneficial land uses for the site through the development of a Post Mining Land Use Strategy as part of the Mine Closure Plan.

'The Social Impact Assessment does not provide any consideration of the social perspective of the community post mining, and how impoverishment of the local community's social fabric may be avoided. The project will contribute to social isolation and possible perceptions of exclusion from the remaining rural community, and the impoverishment of the community's social fabric. This may create a local and wider perception of an area in social decline, with residents moving from the area and thereby perpetuating the perception of the area as one experiencing prolonged decline. This reduces optimism relating to the future sustainability of the directly or indirectly impacted rural community...The closure planning process has to commence now, not at the cessation of mining (p. 247). What will the community look like post mining?

No commentary is provided on the final social outcomes post mining and what needs to be done to ensure the resilience and heritage of the community post mining. This is of significant importance to the community.'

Sections 7.2.1 and 7.2.3 of the SIA provides details on the predicted impacts of the MCCO Project on the local population and subsequent impacts on sense of community. The EIS also identified a range of proposed mitigation measures (discussed above) to address the predicted impacts on sense of community. These mitigation measures are proposed to be implemented over the life of the MCCO Project.

In relation to opportunities post mining, Mangoola agrees that early planning for closure of the mine is required. As stated in the EIS Mangoola will update the existing conceptual closure plan for the mine to include the MCCO Project upon approval and has committed to progress to a detailed mine closure plan five years prior to closure. The detailed Mine Closure Plan will include the development of a Post Mining Land Use Strategy in consultation with MSC. The mine closure planning process is discussed in Section 6.17.4 of the EIS.

'The SIA addresses mental health concerns associate with the MCCO Project, but needs to provide a range of individualised solutions.'

Mental health impacts are assessed in Section 7.2.8 of the SIA, stating that it is *likely* that the discussion around the MCCO Project is contributing to mental health issues for some landholders within the proximal community, with a *moderate* consequence, resulting in a '*high*' social risk.

As part of Mangoola's existing community engagement approach, personal meetings with stakeholders are offered, providing opportunities for engagement and provision of detailed information regarding the operations and the MCCO Project. This also provides the opportunity for discussion of personalised concerns and potential solutions to the identified issues, including issues that impact on mental health. Mangoola will continue to implement this approach to ensure that there is a mechanism in place to respond to landholder issues and concerns.

'The Social Impact Assessment (SIA) does not consider whether the Mangoola Coal Continued Operations (MCCO) Project will impact upon the community's ability to access and enjoy the Manobalai Nature Reserve and large Crown Land holding to the south of that Reserve.'

The Manobalai Nature Reserve is located approximately 6 km to the north-west of the MCCO Proposed Additional Mining Area. At this distance no significant direct or indirect impacts are predicted that would impact this area or the community's ability to access and enjoy it.

With regard to the large Crown land holding that is situated between the Manobalai Nature Reserve and the MCCO Project Area the impact assessment completed as part of the EIS did consider the potential for impact on this Crown land. The two key issues identified as requiring specific assessment with regard to this area of Crown land were noise and blasting impacts. With regard to noise, as noted in the NIA, the Crown land located to the north-west of the MCCO Proposed Additional Mining Area has a recreational land use and impacts were therefore assessed against NPfI recreation area amenity noise levels. This assessment found that model predictions do not exceed recreation area amenity noise levels, indicating noise amenity for recreational land use should be preserved in accordance with the intentions of the NPfI.

There is a small area of Crown land that is immediately adjacent the MCCO Project Area to the north-west that for some blasts near the extremity of the mining area will fall within the 500 m blast exclusion zone. Where blasts occur within 500 m of this area, the blast exclusion zones will be managed to ensure there are no blast risks to any users of this area of Crown land.

'Key issues of noise, blast vibration, dust, lighting, traffic, fume and odour, as identified on page 36 of the SIA document, are consistent with other mining operations within Muswellbrook Shire. This result demonstrates a cumulative impact that is not readily addressed in the SIA...lack of cumulative data related to this particular location is not available and therefore it is difficult to assess the social impact of 'mining in general' that elevates the frequency and consequences of each of these key issues.'

The cumulative impacts associated with the MCCO Project were raised during consultation for the SIA and these impacts are assessed in Section 7 of the SIA. Appropriate cumulative impact assessments have also been completed for all environmental issues and the findings are discussed in the EIS.

While it is noted that there is a level of sensitivity regarding the cumulative impacts of mining in the region generally including those impacts on services such as accommodation and health services, as well as labour supply, the assessment of potential cumulative impacts as a result of the MCCO Project did not identify any significant cumulative impact issues. There are a number of operating coal mines within the Upper Hunter Valley. However, the closest mine to the MCCO Project is Mount Pleasant Mine which is located approximately 9 km to the east. Due to the distance from other mining operations, significant cumulative environmental impacts on issues such as noise, dust and blasting, as a result of the MCCO Project are not predicted.

While significant cumulative impacts are not predicted, extensive environmental and social management and mitigation measures are proposed as part of the MCCO Project and these measures will assist to further minimise any contribution of the Project to cumulative impacts in the region.

'Council requests that a condition of consent be included that requires the proponent to pursue a planning proposal for lifestyle housing blocks in the vicinity of the existing Wybong Hall as a part of the Rehabilitation Plan for the project, in order to restore the 'Village of Wybong', and to provide replacement of a housing type that has diminished in the Shire overall due to mining.'

The locality or state suburb of Wybong consists of a range of private lots ranging from small rural lifestyle properties with some medium sized farms. It is not currently and has not historically been a village. Further, it is noted that under the Muswellbrook Local Environmental Plan 2009 (Muswellbrook LEP), the Wybong locality is entirely zoned as RU1 Primary Production and E3 Environmental Management, and there are no zones that indicate it is a village or future planning strategies that indicate that developing a village is part of the current planning framework.

As discussed in the EIS, Mangoola is committed to considering all potential future land use options for land that it owns including both mining land and buffer land.

Mangoola commits to continue to investigate potential post mining beneficial land uses for the site through the development of a Post Mining Land Use Strategy as part of the Mine Closure Plan. The development of the detailed Mine Closure Plan will commence five years prior to the planned mine closure and include consultation with relevant stakeholders, which is anticipated to include the Resources Regulator, DPIE and MSC. As part of this process Mangoola would welcome the opportunity to further discuss MSC's vision for the future of the Wybong area.

'Muswellbrook Shire Council has identified that loss of population, and issues of housing availability and affordability, are linked to the acquisition and demolition of homes as part of the expansion of mine operations and development throughout the Shire. To mitigate the loss of housing, a condition of approval is requested that either: a) requires a financial contribution to a social housing provider towards the provision of affordable housing in Muswellbrook, to replace the equivalent amount of housing stock permanently or temporarily lost due to the project; or b) the construction of affordable housing in Muswellbrook, to replace the equivalent amount of housing stock permanently or temporarily lost due to the project.'

The SIA outlines that there is not predicted to be any further demand for housing by the MCCO Project operational workforce, as a result of the Project. In relation to the construction workforce, it is also unlikely that the influx of the 145 peak construction workforce, given minimal population change, will place any significant negative impact on community services and infrastructure within the Muswellbrook LGA.

The assessed worst case percentage of population change that may occur as a result of the influx of the construction workforce can be estimated using the peak workforce figure of 145 persons against the current population size for the Muswellbrook LGA (16,080). In this regard, the estimated influx of the construction workforce for the MCCO Project in the Muswellbrook LGA would constitute less than a 1% temporary increase in population for the construction period in the worst case scenario (145 peak construction workforce).

Construction will occur over a 16-month period, with some construction workers likely to seek temporary accommodation during this time in short-term rental accommodation in proximity to the MCCO Project site within the Muswellbrook LGA. Other construction workers are likely to already reside within the area or live within the region more broadly and drive in, drive out daily or as required during the construction period. Such workers may also utilise particular services while in the area, such as health, emergency, recreation services and transport/road infrastructure, during this period. As noted in Section 5.6.7 of the SIA, infrastructure and services within the Muswellbrook LGA are well developed for a regional area and it is unlikely that the construction workforce will place any significant negative impact on community services and infrastructure within the Muswellbrook LGA.

Therefore, whilst this issue raised by MSC is acknowledged, no significant impacts on housing and accommodation availability are predicted as a result of the MCCO Project and therefore specific mitigation measures are not considered necessary.

3.8.2 Economics

'Council seeks greater fidelity to predictions of labour requirements for the MCCO Project so that it can adequately assess and plan for social impacts...it is unclear if the new Full-Time Employees are entirely new positions or if they are continuing positions for the existing miners at the current mining site.'

The Mangoola Mine has previously assessed and approved to have up to 540 employees at its peak. The mine currently has an existing workforce of approximately 400 employees. The MCCO Project will provide for continued employment opportunities for the existing workforce with up to an additional 80 workers likely required to achieve the assumed peak workforce of 480. This peak will, however, remain below the currently approved 540 peak employees for the mine.

'The Proponent has approached Council with an initial offer on the terms of a VPA, however further negotiations are required before a VPA can be finalised.'

As detailed within the MCCO Project EIS Mangoola currently has a VPA in place with MSC. This includes:

- $500,000 to fund local environmental management projects – complete and paid in full
- $600,000 to fund council's education and training strategy – complete and paid in full
- $1,200,000 to contribute to the recreation assets renewal fund – complete and paid in full
- $2,200,000 to fund Denman recreation area enhancements – complete and paid in full
- $20,000/year to fund MSC environmental management and monitoring – ongoing and subject to CPI increases
- $55,000/year to contribute to road maintenance costs for part of Wybong Road – ongoing and subject to CPI increases
- $220,000/year to contribute to general mine affected road maintenance costs – ongoing and subject to CPI increases
- $235,000/year to contribute to additional environmental and community projects – ongoing and subject to CPI increases
- $100,000/year to contribute to additional environmental and community projects – ongoing and subject to CPI increases.

This existing VPA was agreed and implemented following the approval of MOD 6 in April 2014 at which time an additional $100,000 per annum was offered and accepted beyond the annual payment in place at that time. The MCCO Project as proposed represents the continuation of the existing approved operations with no changes proposed to maximum production levels and the maximum number of operational employees below the existing approved maximum (previously up to 540 approved, now seeking approval for up to 480).

As described in the EIS the MCCO Project will extend the operational life of the existing mine by approximately five years. In line with Mangoola's existing VPA, Mangoola proposes to continue its existing VPA commitments for the duration of the MCCO Project, to facilitate continued and ongoing support for a range of environmental and community projects within the Muswellbrook LGA.

Mangoola consider that it is reasonable that the existing VPA be extended for this period which would represent ongoing contributions in the order of $5M for the additional five year period of operations.

In addition to the above financial contributions Mangoola, subject to business needs and constraints, uses its best endeavours to engage six apprentices a year sourced from residents with the Muswellbrook LGA and Aberdeen.

The general terms of the VPA as offered to MSC are provided in **Table 3.12**.

Table 3.12 Summary of Voluntary Planning Agreements Offered to MSC

Approval / Mod	Contribution	Intended Use	Status (End 2019)	Forecast* (End 2026)	Forecast* (2027 to 2031)
Original	$500k - 5 equal annual instalments	Local Environmental Management	Fully paid (2013)	N/A	
	$600k - 6 equal annual instalments	Local Employment – Education & Training Strategy	Fully paid (2014)		
	$1,200k - $200k annual instalments plus interest on outstanding capital amount	Community Projects – Recreational Assets Renewal Fund	Fully paid $1.3M (2016)		
	$2,200k - paid in accordance with Council's schedule of works	Community Infrastructure – Denman Recreational Area	Fully paid $2.2M (2013)		
Mod 4	$20,000/yr plus CPI from Mod 4 until 12 months after the End of Mining Operations	Local environmental management	$173k paid	$180k	$150k
	$55,000/yr plus CPI from practical completion of Wybong Rd east until 12 months after the End of Mining Operations	Roads – Wybong Road maintenance	$660k paid	$460k	$388k

Approval / Mod	Contribution	Intended Use	Status (End 2019)	Forecast* (End 2026)	Forecast* (2027 to 2031)
	$220,000/yr plus CPI from Mod 4 until 12 months after the End of Mining Operations	Roads – General mine affected road maintenance	$1.9M paid	$1.98M	$1.67M
	$235,000/yr plus CPI from Mod 4 until 12 months after the End of Mining Operations	Additional Environmental & Community Projects (via Mangoola Coal Community Fund)	$2.03M paid	$2.11M	$1.78M
	Proponent to use its best endeavours to engage 6 apprentices a year sourced from residents within the Muswellbrook Shire and Aberdeen	Local Employment – Local Apprenticeships	Complete	Continue	Continue
Mod 6	$100,000/yr plus CPI from Mod 6 until 12 months after the End of Mining Operations	Additional Environmental & Community Projects associated with the intensification impact of Mod 6 (via Mangoola Coal Community Fund)	$630k paid	$0.86M	$726k
		Incremental Totals	$9.99M	$5.59M	**$4.72M**
Forecast total (Existing Vs Proposed)			$15.59M		$20.31M

** Forecast assumes consistent annual CPI increase of 2.8%*

As discussed in the EIS, Mangoola has made several offers to engage with MSC in order to discuss and agree the VPA requirements for the MCCO Project. Further approaches and requests for meetings have also been made to MSC by Mangoola throughout the response to submissions phase to progress these discussions.

To this end, discussions with MSC are ongoing with a preliminary meeting held with the MSC Mayor, General Manager and Chief Financial Officer in December 2019. MSC committed to providing feedback on the MCCO Project proposed VPA early in 2020. Mangoola will continue to seek to engage with MSC in order to agree to a VPA for the MCCO Project and would welcome further opportunity to meet and discuss the VPA arrangements.

'The Economic Impact study projects benefits to the local economy based on the percentage of Mangoola's current workforce that is based in the Upper Hunter. However, it is not clear how many of the current Mangoola employees migrated to and settled in the area, and how many were based in the Upper Hunter and previously worked in other regional industries before being employed at the coal mine. Council notes that one of the underpinning assumptions for the Local Effects Analysis (Appendix 7, p.45) is the expectation that 73% of the workforce for the MCCO Project will be "supplied from the SA3 region." The assumption lacks clarity on whether the potential future employees will be based in the region after migrating from elsewhere in NSW or Australia, or they will be hired from the current local residents. It is therefore difficult to make any credible impact assessment on the local economy, especially in relation to effects on industries with lower wages (e.g. local hospitality businesses) or pressure on support services (e.g. childcare and health services).'

As clarified earlier in this section in response to questions around the employment opportunities, the MCCO Project will provide for continued employment opportunities for the existing workforce of around 400 employees with up to an additional 80 workers likely required to achieve the assumed peak workforce of 480.

The analysis as outlined in the Cost Benefit Analysis (CBA) and Local Effects Analysis (LEA) completed by Cadence Economics is based on a reasonable estimation of the number of local and inter-regional workers based on existing employee data. The computable general equilibrium (CGE) modelling models the economy-wide impacts to the region and the state. The CGE modelling captures the fact that the coal mine will compete for resources from other businesses and bid up wages.

The assumption that 73% of the workforce for the MCCO Project will be supplied from the SA3 statistical region is based on the areas that the existing workforce reside within. In this regard it is considered reasonable to rely on the residential information for the existing workforce when assessing the continuation of operations at Mangoola Coal Mine.

Additionally, Mangoola uses its best endeavours to employ people from the local community as Mangoola recognises the benefits of this approach. Mangoola is committed to recruitment practices that are fair and equitable by selecting applicants who demonstrate the best fit for the particular role. The application of equal employment principles, as well as, business priorities at the time of recruitment will govern recruitment outcomes. Mangoola will prioritise the continued employment of the existing workforce for the MCCO Project but where necessary will endeavour to employ people from the local community as per the existing approach.

'The Environmental Assessment for the MCCO Project notes that "Scope 3 emissions simply acknowledge that products will continue to generate greenhouse gas emissions as they move through the value chain." That acknowledgement is not accounted for in the cost of greenhouse gas (GHG) emissions in the Economic Assessment. In Appendix 7, the assessment measures Scope 1 and Scope 2 only. Consequently, while GHG emissions for purchased goods and services and employees commuting to and from work are not considered (Scope 3), the benefits of the project to workers and suppliers are included in the calculations as net economic benefits.'

Scope 3 emissions are indirect emissions that are associated with the MCCO Project, but occur at sources owned or controlled by other entities.

The economic assessment was completed following relevant guidelines and under these guidelines the exclusion of Scope 3 emissions is reasonable.

‘The Economic impact assessment (Appendix 7) does not account for the cumulative air pollution in the entire Muswellbrook LGA. While Mangoola’s cumulative air pollution assesses total concentration of air pollutants, being background pollutants plus project-specific contribution, the area of analysis is limited to the air quality contours of the mine and not the surroundings. The surrounding region has a total of eight coal mines and two coal power stations. Greater consideration should be given to the pollution in the surroundings and the resulting cost.’

The economic assessment has relied on the findings of the AQIA when considering relevant costs associated with the MCCO Project’s impacts to air quality. The AQIA has assessed the likely air quality emissions associated with the MCCO Project and then considered these cumulatively which includes the considerations of background concentrations due to all other sources. Relevantly this assessment is focused where the MCCO Project is located (20 km west of Muswellbrook) and where its impacts are predicted to be experienced. The potential cumulative impacts on air quality associated the MCCO Project have been assessed appropriately.

Whilst it is acknowledged that the broader Muswellbrook LGA has other industrial operations including mines and power stations, the role of this assessment is not to undertake an LGA economic assessment of air quality impacts. The cumulative air quality impact assessment for the MCCO Project has appropriately identified the contribution of the MCCO Project to cumulative impacts and assessed these impacts in the cumulative context in which they occur.

As discussed in the EIS when the MCCO Project is considered cumulatively with existing background levels the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations are predicted to meet the EPA assessment criteria at all but one sensitive receiver (Residence 83). Residence 83 is subject to voluntary acquisition under the existing approved operation and is within the predicted noise voluntary acquisition zone for the MCCO Project. The AQIA modelling indicates that the MCCO Project will contribute to, but will not be the primary cause of, exceedances of the criteria.

It is not considered reasonable or necessary that the AQIA should be required to assess cumulative air pollution in the entire Muswellbrook LGA.

The economic analysis has used a reasonable approach to measure the potential economic impacts of particulate emissions. The assessment has been completed in reference to the ‘with project’ and ‘without project’ emissions and this is an acceptable and appropriate approach under relevant guidelines.

Just or equitable distribution of environmental benefits and burdens of the mine is not considered, as the cost and benefits are only calculated for the current population and not future generations. The project’s environmental impacts will affect people beyond the operational timeline of the project. The Rocky Hill Coal Mine case pointed out the importance of avoiding distributive inequity in making the impact assessments.

Just or equitable distribution of environmental impacts is considered in the sensitivity analysis and in-particular the discount rate used in the economic assessment. Sensitivity analysis completed by the economic assessment has considered a reduction in the discount rate. Reducing the discount rate from the 7% (assessed by the central case) to 4% (assessed in the sensitivity analysis) will increase the “costs” imposed on future generations, when those costs are discounted back to present values. The economic assessment therefore has considered the just or equitable distribution of environmental benefits and burdens of the mine.

The sensitivity analysis completed by the economic assessment shows that the estimated net benefits are robust in the sense that they remain (strongly) positive after testing all key assumptions underpinning the analysis.

'Council is aware of NSW Health concerns that "any increase in fine particulate pollution is statistically likely to lead to an increase in health impacts". Failure to quantify this impact and include the cost when estimating the net benefits of the MCCO Project renders the assessment incomplete.'

As described in the responses above, the economic assessment has relied on the findings of the AQIA when considering relevant costs associated with the MCCO Project's impacts to air quality. The AQIA has assessed the likely air quality emissions associated with the MCCO Project and then considered these cumulatively which includes the considerations of background concentrations due to all other sources.

As discussed in the EIS the MCCO Project will comply with the applicable annual average PM_{10}, incremental 24-hour average PM_{10}, $PM_{2.5}$, TSP and dust deposition criteria, as outlined in the VLAMP, at all privately owned residences.

The economic analysis has used a reasonable and appropriate approach to measure the potential economic impacts of particulate emissions. The assessment has been completed in reference to the 'with project' and 'without project' emissions and this is an acceptable approach under relevant guidelines.

'To investigate the full impact of the air quality impact, Council recommends that a non-market valuation study be conducted. This study will investigate the "recreational amenity of an area, sense of local community, and regional reputation associated with characteristics such as fresh produce and livestock".'

The MCCO Project represents the continuation of operations at the existing approved Mangoola Coal Mine, in an area and broader region that is already known as a coal mining region. The air quality impacts have been appropriately assessed in the context of the MCCO Project as required under NSW Government policies and guidelines and these impacts have been considered appropriately within the economic assessment. The air quality impact assessment has confirmed that there are no impacts on private residences or businesses above relevant criteria as outlined in the VLAMP and there are not considered to be any significant cumulative impacts as result of air quality on the region. In this regard the completion of a non-market valuation study is not considered warranted for the MCCO Project.

'Table 4.3: Location of Suppliers' Main Offices (p. 27). Only 8.7% of supplier expenditure is paid to companies with offices in Muswellbrook Shire. This appears to be an extremely low percentage and does not provide the level of social benefit that would be obtained from a higher percentage of local spend.'

Contributions through local supply chains

This comment relates to the outcomes of the Town Resource Cluster analysis (TRC) (Fenton, Coakes and Marshall, 2003), specifically in relation to Mangoola spend on local suppliers.

TRC analysis is a technique that allows the identification of the direct and indirect socio-economic linkages that exist between Mangoola and communities within, and outside, the Muswellbrook region by:

- considering the residential location of the workforce for the operation
- analysing workforce income and annual expenditure
- analysing locations of suppliers and their associated expenditure

- comparing the above analysis with the Mangoola MOD 6 TRC analysis and NSW Minerals Council report, for validation and triangulation purposes.

The TRC that was undertaken for Mangoola was a desktop analysis and the location of supplier offices, where Mangoola's supply spending occurs, for the purposes of that assessment was assumed to be the town in which the suppliers head office is located. Given that many of these companies are national or international companies, it is likely that this assumption has therefore conservatively underestimated the benefit of Mangoola's supplier spending on the local (Muswellbrook LGA) economy.

It is noted that major suppliers include high value aspects such as the supply of explosives for blasting or the supply/purchase of mining equipment etc. Whilst Mangoola uses its best endeavours to source local suppliers, for some of these type of contracts, Muswellbrook based suppliers may not be an option.

In order to complete a more detailed review of the data and clarify how local spend and indirect benefits are provided to the region, Mangoola sought further information from their principal suppliers operating outside of the Muswellbrook LGA. Principal suppliers were defined as those with whom Mangoola spent at least $400,000 during the 2017/2018 financial year (this being 38 suppliers, or 9% of the total number of suppliers for this financial year). These suppliers were asked to indicate whether they had:

- business facilities (inc. workshop or offices) within the Muswellbrook LGA
- employees working in the Muswellbrook LGA
- employees living in the Muswellbrook LGA
- whether they sourced services in the Muswellbrook LGA and an indication of spend.

Sixteen of Mangoola's principal suppliers, whose head office is located outside the Muswellbrook LGA, were able to participate in the additional survey and provide the above information to inform this response.

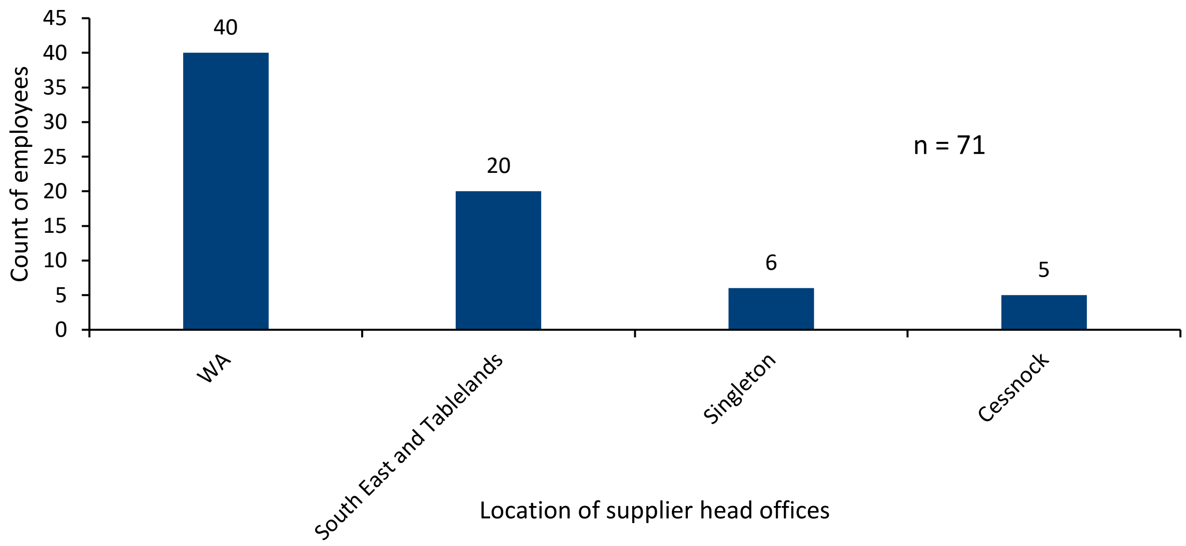
Table 3.13 shows the number of suppliers with facilities, of varying nature, in the Muswellbrook LGA. Of the 16 suppliers whose responses were analysed, four indicated that they had facilities located within the Muswellbrook LGA. This equates to 25% of surveyed suppliers. Examples of the facilities mentioned by suppliers include:

> *Reload facilities on site at Mangoola, Mt Arthur & Muswellbrook Coal*
>
> *…office located in Muswellbrook.*
>
> *Machining workshop and Fabrication workshop (separate)* [2019 supplier]

Table 3.13 Do you have any facilities/workshop/office in the Muswellbrook LGA?

	Facilities in the Muswellbrook LGA	
Location of Supplier Head Office	**No**	**Yes**
Cessnock	0	1
Lake Macquarie	1	0
Maitland	3	0
Singleton	2	1
South East and Tablelands	0	1
QLD	1	0
VIC	4	0
WA	1	1
Total	**12**	**4**

Whilst only four businesses reported having physical infrastructure in the Muswellbrook LGA, five of the 16 businesses who provided comment on their workforces' location indicated that a number of their employees were working within the LGA on a FTE basis. Together, these suppliers employ approximately 71 full time workers within the Muswellbrook LGA. The majority of these workers are employed by a single company based in WA (n=40); with a further 20 people working in the Muswellbrook LGA employed by a company based in the Wingecarribee LGA (South East and Tablelands), with businesses based in Singleton (n=6) and Cessnock (n= 5) accounting for the remainder, as shown in **Graph 3.1** below. Note that only one of these five businesses, based in Singleton, indicated that they did not have a permanent office or workshop in the LGA, meaning that workers from the remaining businesses would report to their local office/workshop and are therefore likely to live in or nearby to the Muswellbrook LGA.



Graph 3.1 Number of Employees Based and Working in the Muswellbrook LGA

In support of the assumption noted above, eight of the surveyed suppliers reported that some of their employees currently reside within the Muswellbrook LGA specifically. Mangoola vendor spend records indicate that these suppliers have head offices located in Singleton (2), WA (2), Maitland (1), Cessnock (1), QLD (1) and the South East and Tablelands region (1) (see **Table 3.14**).

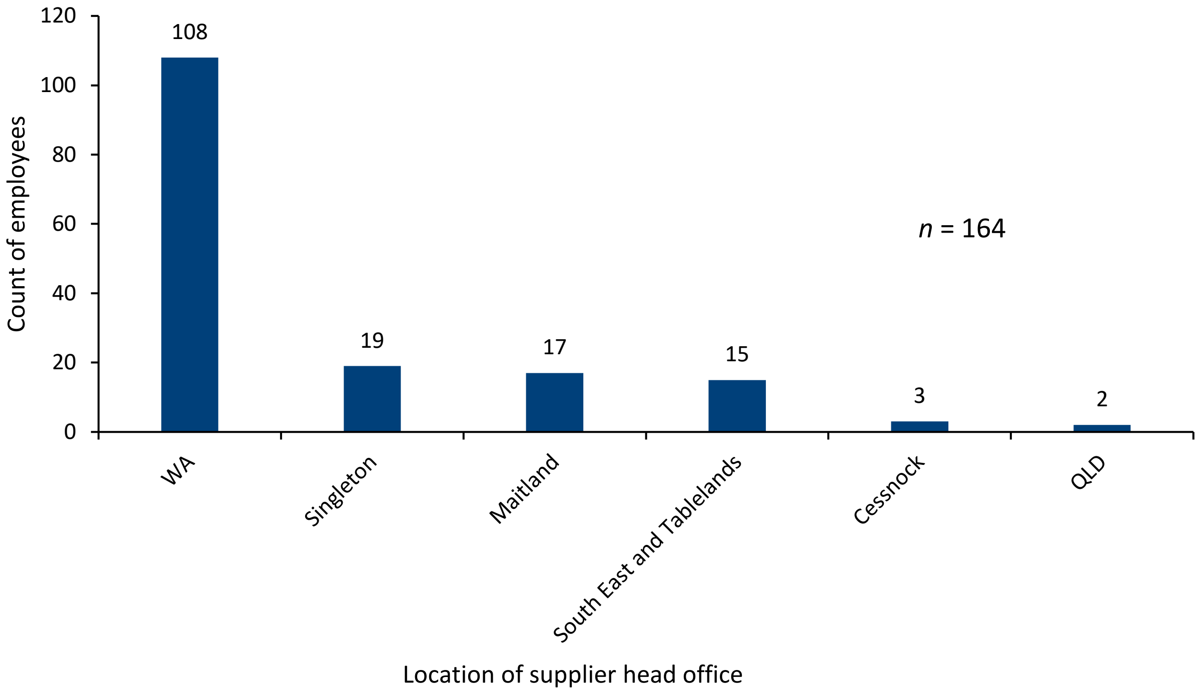
Table 3.14 Do any of your people/employees live within the Muswellbrook LGA?

Location of Supplier Head Office	Suppliers without employees living in the LGA	Suppliers with employees living in the LGA	Total Suppliers Surveyed
Singleton	1	2	3
WA	0	2	2
Maitland	2	1	3
Cessnock	0	1	1
QLD	0	1	1
South East and Tablelands	0	1	1
VIC	4	0	4
Lake Macquarie	1	0	1
Total	**8**	**8**	**16**

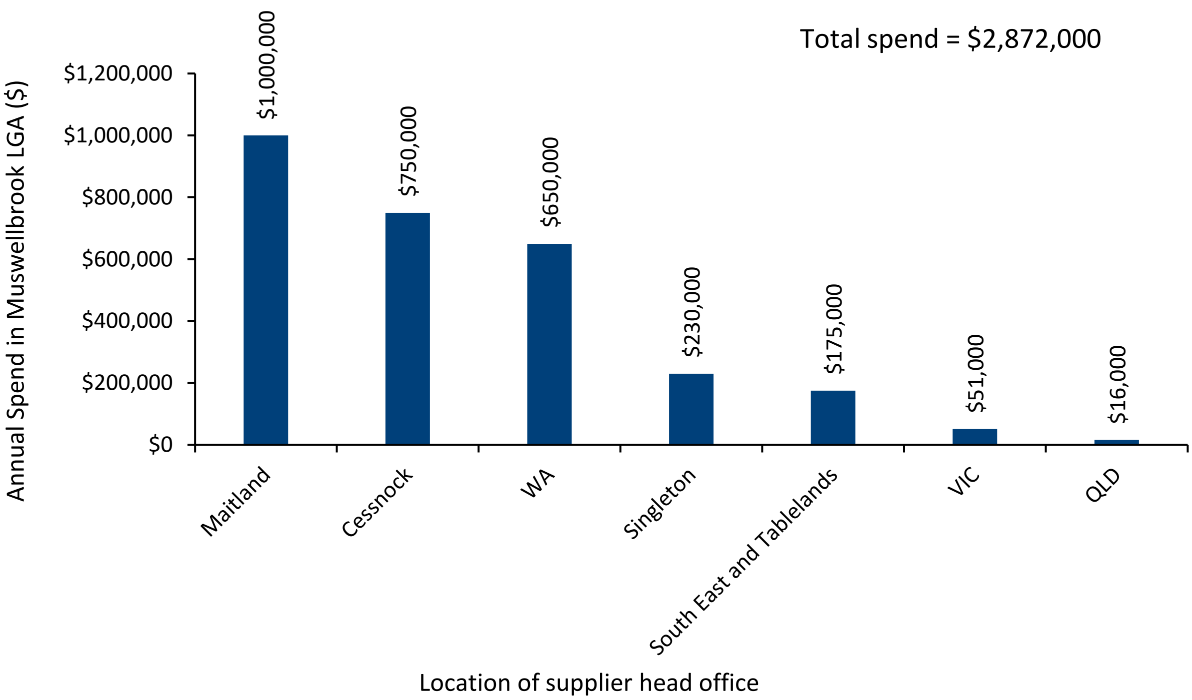
A total of approximately 164 local residents of the Muswellbrook LGA are employed by these eight suppliers, with the majority employed by companies operating from head offices in WA (108 local employees) (**Graph 3.2**). This information indicates that suppliers with head offices located outside the Muswellbrook LGA also employ people that live locally in the LGA, and supply services and people (i.e. contractors) for the benefit of other businesses within the LGA or the wider region. Note that only 71 of these workers live *and work* in the LGA (as per **Graph 3.1**), with the remaining 93 residents commuting to other LGAs for work.

Finally, surveyed businesses were asked to provide details of their use of services in the Muswellbrook LGA, particularly their annual expenditure on goods and services. As can be seen in **Graph 3.3**, while head offices were located outside the LGA, many of the businesses spend a significant amount of money on goods and services within the local area. Total spending by these companies alone approximated nearly $3M annually.

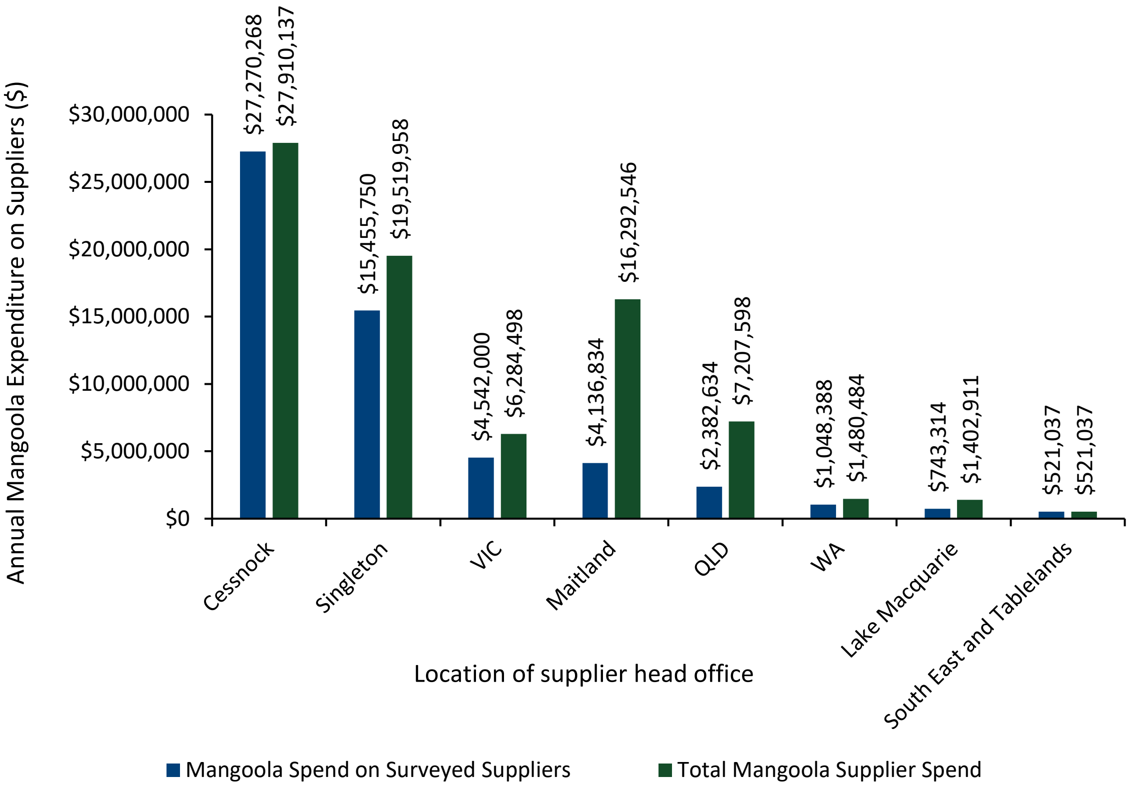
Graph 3.4 demonstrates that in terms of money spent, the recently surveyed suppliers represent some of Mangoola's largest suppliers in these locations and provides an indication of how representative the surveyed principal suppliers are, of the suppliers included in the initial desktop TRC analysis included in the SIA.



Graph 3.2 Number of Employees Living in the Muswellbrook LGA



Graph 3.3 Does your company source any services from within the Muswellbrook LGA? And if possible, provide a value of that spend per year?



Graph 3.4 Spend on suppliers with head offices located outside of Muswellbrook LGA and total Mangoola supplier spend

Summary

In summary, the responses from the supplementary survey undertaken with major suppliers of Mangoola, indicates that although a supplier's head office may be located outside of the Muswellbrook LGA, many of these suppliers still have a significant presence in the area. This presence includes:

- physical infrastructure such as facilities, workshops and/or offices
- employees that are permanent residents of the LGA
- those that work within the LGA or the wider region/other LGA's.

Approximately one third of businesses who responded to the survey had some level of local presence in terms of facilities. These surveyed businesses account for approximately 28% of the total Mangoola supplier spend in the 2017-2018 financial year ($28,847,460 of Mangoola's total $101,596,354 expenditure).

The surveyed businesses employ a combined 71 workers with roles based within the Muswellbrook LGA, and 164 of supplier employees are also reportedly living within the LGA boundaries.

Overall, approximately half of businesses who responded to the survey had some level of local presence in terms of facilities, employees or employed residents. These businesses together account for approximately 35% of the Mangoola supplier spend in the 2017-2018 financial year ($35,355,518 of Mangoola's total $101,596,354 expenditure). While some were larger businesses with a relatively small local presence, this still indicates that at least some of the expenditure from Mangoola to these businesses provides indirect benefits to the Muswellbrook LGA. Similarly, a combined goods and services spend of approximately $2.87M indicates that head office locations outside the LGA do not preclude local indirect benefits from supplier spending.

Therefore, the findings of this additional supplier analysis suggest that while a high proportion of suppliers do not base their head offices in the Muswellbrook LGA, roughly one third of the surveyed suppliers do have employees and offices or other facilities in the LGA, and approximately half employ residents of the Muswellbrook LGA. Consequently, the indirect benefits to the Muswellbrook LGA, associated with mine expenditure on suppliers, is not isolated to suppliers that are based in Muswellbrook.

Given the significant presence of mining in the Muswellbrook and Singleton area, many national suppliers with head offices in other locations employ local residents and have a local presence. Further details of the local economic impact of Mangoola spending on suppliers can be found in the LEA undertaken for the Project, which assesses employment effects of the MCCO Project with reference to the Upper Hunter. The LEA identifies the economic impacts on the communities located near the mine site.

As outlined in the EIS it is expected the MCCO Project will generate indirect benefits to local suppliers and employees of $14.1M and $76.8M respectively and result in the net incremental increase of local council rates totalling $2.7M in NPV terms over the baseline case. Indirect costs associated with the MCCO Project are minor, including transport impact costs and the loss of agricultural output of $1.0M.

Based on these assumptions, the LEA has found that the MCCO Project is estimated to provide a net benefit on the Upper Hunter region of $92.6M in NPV terms.

'Contribution required for social diversification of the economy post mining. This is due to mining locking up employment in the LGA, and inhibiting the opportunity for economic diversification, which could supply more varied employment to residents now and into the future.'

The MCCO Project is a continuation of an existing mining operation providing ongoing employment opportunities for the existing workforce for another approximately five years of mining beyond which would occur without the project. It is not considered that this ongoing employment will inhibit the opportunity of economic diversification in the region.

The benefits of economic diversity in all regions is recognised. Policies to facilitate and encourage such diversity are the primary responsibility of government and are outside the scope of the MCCO Project.

As stated in the EIS the Mangoola site will provide existing infrastructure, connectivity to road and rail transport, and a large area of buffer land, providing potential for a variety of final land uses. There are a range of strategic initiatives that are starting to plan for future employment generating land uses in the central and upper Hunter Valley region, including the Hunter Region Plan 2036 which is discussed in further detail in the EIS.

The Mangoola site has the potential to support a range of different land uses into the future. As discussed in Section 6.17.5 of the EIS, Mangoola is committed to investigating future land use options for the site post mining that have the potential to generate future employment in the region and has committed to discuss these options with MSC as part of the detailed closure planning for the MCCO Project.

'Loss of surplus to other industries. This section attempts to quantify the "surplus" rather than the value of the agricultural industry as a whole. In the case of productivity loss, it doesn't consider the loss of veterinary and farm services to the local economy due to reductions in critical mass, and of course, the flow on effects.

Table 16 (P28) estimates agricultural productivity loss over 38 years at $930,000, this is considerably lower than the calculated $3.42 million with no explanation for the $2.49 million discrepancy. However, this is only the surplus, the full loss to the local economy over this period would in fact total $11,100,000.'

The approach taken in the economic assessment is considered reasonable and appropriate with consideration of relevant guides. The assessment takes into account the loss of net benefits from the reduction in agricultural output. If the assessment was to only account for the revenue benefits it would be overstating the losses to agriculture.

Further discussion of the impact of the MCCO Project on agricultural resources is provided in **Section 3.10**.

3.8.3 Noise

'Management of noise must be made a high priority, and should be proactively monitored in a manner that is satisfactory to the proximate community. This is not a single solution problem, but should be tailored to individual stakeholders' needs.'

Noise management at Mangoola Coal Mine is undertaken as documented in the approved Noise Management Plan as required by the conditions of the Project Approval and EPL.

Mangoola recognises that noise impacts is a key issue for both the existing mine and the MCCO Project and treats this issue as a high priority and puts significant resources into this issue. The mining operations are planned around minimising noise impacts and extensive controls are in place to minimise noise. Noise mitigation is also a major focus of Mangoola's ongoing community engagement program recognising that all individuals have a different perspective on the acceptability of any noise impact.

As outlined in Section 5.5 of the EIS, noise impacts were identified by the community as one of the issues of most concern. In particular, noise was identified as a key area of concern by near neighbours to the MCCO Project. This is consistent with the community feedback that was received during the preparation of the SIAs that have been completed for the original approval and each of the major modifications that have been undertaken (namely MOD 4 and MOD 6) and during the operational phase of the existing Mangoola Coal Mine. As described in the EIS, Mangoola has continued to take community feedback on board and sought to minimise noise impacts throughout the planning and design stages of the MCCO Project.

Since operations commenced at Mangoola in 2010 the number of noise complaints received has fluctuated but generally trended downwards with a significant reduction observed since operations first commenced. In response to the concerns raised during this period, Mangoola has implemented a range of mitigation and management measures to reduce noise related impacts on surrounding private residences. This has included:

- Designing mining operations with consideration of minimising noise impacts through mine design, scheduling and equipment placement.
- Replacing reversing beepers on mobile equipment with 'quackers'.

- Personnel and contractors are to be vigilant in identifying and controlling operations and activities that might result in the generation of excessive noise. Noisy operations or equipment which are identified as affecting privately owned residences are to be reported to the supervisor promptly.
- Restricting, where possible, operations on outer dump faces or elevated dumps in sensitive areas and/or during adverse weather conditions.
- Trucks operating during the night time are restricted to operational areas, where possible, below the maximum elevation of the overburden emplacement areas.
- Using predictive meteorological forecasting and real-time noise monitors that incorporate automatic alarms so that proactive control can be implemented.
- Controlling mine noise at the source through the use of equipment with appropriate sound attenuation fitted and conducting annual sound power testing for equipment to confirm compliance to commitments.
- Installing and maintaining low noise rollers on conveyor systems.
- Covering the cost of running and maintenance of air conditioners for private residences located within the noise management zone for the existing operation.

With regard to Mangoola's approach to the design and planning of the MCCO Project, noise modelling was completed on an iterative basis to enable the development of a mine plan that would minimise noise impacts as far as practicable. The detailed assessment included the consideration of a number of project alternatives. Multiple iterations of the mine plan were undertaken prior to Mangoola selecting the proposed mine plan, with the noise impacts of the MCCO Project reduced through this process. The mine plan selected is not the most optimal from an economic perspective, however, Mangoola selected this as the proposed project as it achieves an appropriately balanced outcome between mine planning, economic, environmental and social outcomes and results in reduced noise impacts when compared to some of the other project options assessed.

As part of the project planning process the noise controls that were found to be reasonable and feasible, and which contributed to the effective control of potential impacts, were incorporated into the MCCO Project design. These controls have been included as part of the noise model for the MCCO Project.

Key measures included in the MCCO Project design that have minimised noise include:

- Mine scheduling changes to reduce the overall intensity of mining equipment operating in the MCCO Additional Project Area. This means that there is less mining equipment in the new mining area than currently operating at full production at Mangoola Coal Mine, reducing the amount of noise generated by the equipment operating in the new mining area.
- Identifying activities that could be modified during times of adverse noise propagating meteorological conditions and the management of equipment during such conditions to minimise noise impacts.
- Developing designs for emplacement areas to enable alternative emplacement locations during adverse conditions, including the provision of day and night time emplacement locations so that night time activities can be undertaken in better shielded locations
- The inclusion of bunds in strategic locations along key haul roads, where practicable, to shield trucks and equipment on exposed sections.

- Locating key haul roads below the ground surface to maximise topographical shielding to surrounding receiver areas, where practical.

- Incorporation of reasonable and feasible noise attenuation on key plant and equipment.

Mangoola is committed to managing noise impacts from its mining operations and has a comprehensive Noise Management Plan in place. This plan will be updated for the MCCO Project. In accordance with this plan Mangoola will continue to utilise a range of proactive and reactive noise management strategies informed by real-time noise and meteorological monitoring systems. Proactive strategies will include utilising meteorological forecasting to plan activities in advance of potentially adverse conditions and ongoing day to day planning of mining operations to reduce noise. Reactive strategies will include the modification or suspension of activities in response to a series of triggers due to noise enhancing meteorological conditions.

3.8.4 Blasting

> 'Table 6.18 of the EIS indicates higher levels would be acceptable criteria for heritage items and rock formations and rock shelter sites. Council requests that these criteria be amended to match the criteria for residences on privately owned land to avoid damage.'

The blast criteria adopted in the blast impact assessment for managing impacts on residences located on privately owned land are different to those for managing impacts on heritage items and rock formations as they are established to manage different things. With regard to private residences the impacts from blasting are required to be managed to minimise annoyance on residences whilst for other structures and items such as heritage sites and rock formations the impacts are managed to avoid damage.

It is noted that the criteria as adopted for the MCCO Project are consistent with the current blast limits that are in place and being managed at the existing Mangoola Coal Mine. The proposed criteria outlined in the EIS are considered appropriate and are therefore not proposed to be modified as requested by MSC.

3.8.5 Water

> 'Hydro Engineering and Consulting notes streamflow gauging station SF01 that the location of the stream depth sensor was for many years above the stream cease-to-flow level. Therefore, estimated streamflow for the period of record has limited accuracy (P19) and have attempted to build a model based on data from Dartbrook near Aberdeen. That a partially operable sensor "was for many years above the stream cease-to-flow level" raises concerns over the thoroughness of monitoring data used for other Mangoola activities'

Gauging station SF01 was installed several years ago to assist in capturing baseline data to assist in the planning and assessment of the MCCO Project. It was installed voluntarily by Mangoola and is not a compliance monitoring site. In 2017 it was identified following a review of the available data and a site inspection that the gauge was sitting above the stream cease to flow level. It is thought that following the installation of the gauge the stream bed in Big Flat Creek in this area has eroded or scoured out further and led to the stream gauge sitting above the base of the creek. Due to the highly ephemeral nature of Big Flat Creek and the very limited rainfall that has occurred in recent years, opportunities to collect stream flow information have been severely limited in any case.

It is noted that this situation has not in any way affected the validity of data or assumptions used in the Surface Water Assessment or EIS. As stated in the Surface Water Assessment in order to characterise the streamflow behaviour of streams without a reliable flow record, it is normal practice in Australia to use records of nearby gauging stations with similar catchment characteristics. In this regard data from the Dart Brook was used due to its similar catchment characteristics, however, it is likely that this is a conservative assumption and that the use of the Dart Brook would over-estimate the baseflow component of Big Flat Creek because there is no alluvium underlying Big Flat Creek and groundwater modelling indicates a baseflow flux to Big Flat Creek of 10 ML/year – which would have diminished to zero as a result of the approved Mangoola Coal Mine. Flow in Big Flat Creek is ephemeral and any baseflow is likely to be a low proportion of total flow. Therefore, the use of the flow characteristics of Dart Brook to characterise flow conditions and assess impact to flow in Big Flat Creek is considered to be conservative.

'Table 9 (P26), records water samples with Aluminium, Copper, Chromium, Lead, Manganese, Iron, Silver and Zinc exceeding ANZECC guidelines at a number of sites along Big Flat Creek. While these cannot be attributed to current mining operations they do have implications for the water quality in the final void...No modelling of concentrations of metals in the void pit water appears to be evident'

No water from Big Flat Creek will report into the final voids. In this regard the water quality in Big Flat Creek is not predicted to have any implications for water quality in the final voids. Some water from parts of the upper catchment of Big Flat Creek will flow to the final void, however, diversion drains are proposed to seek to divert water around the void where practicable and appropriate.

Final void water and salt balance modelling was undertaken as part of the Surface Water Assessment to simulate the behaviour of the pit lake that would form in each of the final voids. Based on the Geochemical Assessment for the MCCO Project runoff and seepage from overburden is not expected to be acidic and is not expected to contain significant metals concentrations. Therefore, long term salinity is the likely main issue for pit lake water quality. Further details with regard to the assessment of void water quality is provided below in response to MSC's questions regarding water assessment for the final voids.

'Based on a geochemical assessment by EGi (2019), runoff and seepage from overburden is not expected to be acidic and should not contain significant metals concentrations. However, this relates to runoff and leaching from overburden provided the overburden is capped with "a minimum 3m cover of clean overburden" (Appendix 21: Geochemical Assessment. P37). This report appears to only refer to leachate and runoff from overburden and water quality in the tailings dams and doesn't take into account inputs of groundwater.'

The scope of the Geochemical Assessment was to assess the mine materials (overburden, rejects and tailings) in order to identify any geochemical issues and provide recommendations for materials management. Groundwater quality is considered and assessed in the GWIA. The findings from the Geochemical Assessment are an input to the GWIA and Surface Water Assessment (as relevant to spoil seepage water quality). Further details as to how this is addressed in the EIS is provided in the following response to MSC's questions regarding water assessment for the final voids.

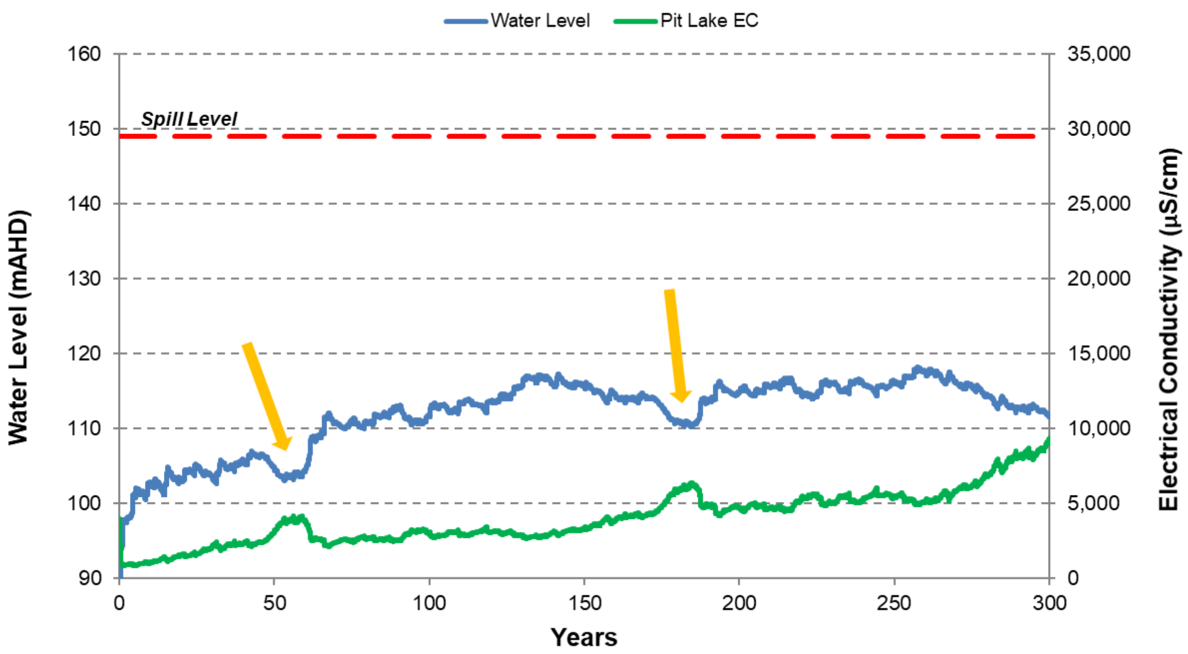
With regard to the references made to capping in the submission, to clarify, the Geochemical Assessment discusses that in order to manage potential acid and salinity effects on the rehabilitation of the tailings dam areas that appropriate controls will be required and in this regard notes that the current conceptual cover for the tailings dam areas involves placement of a minimum 3m cover of clean overburden. There is no requirement or need to cap overburden areas.

The Geochemical Assessment found that following testing of materials from the current operations and the MCCO Additional Project Area that overburden and coarse rejects materials are likely to be non-acid forming and non-saline. They are also expected to be alkalinity producing, providing an additional factor of safety. The MCCO Project is mining within the same seams and geology as the existing Mangoola Coal Mine, where experience has found this to be the case, with pit water monitored to be neutral to slightly alkaline (pH 8 to 8.5) and of relatively low salinity (EC of 3,500 to 5000us/cm).

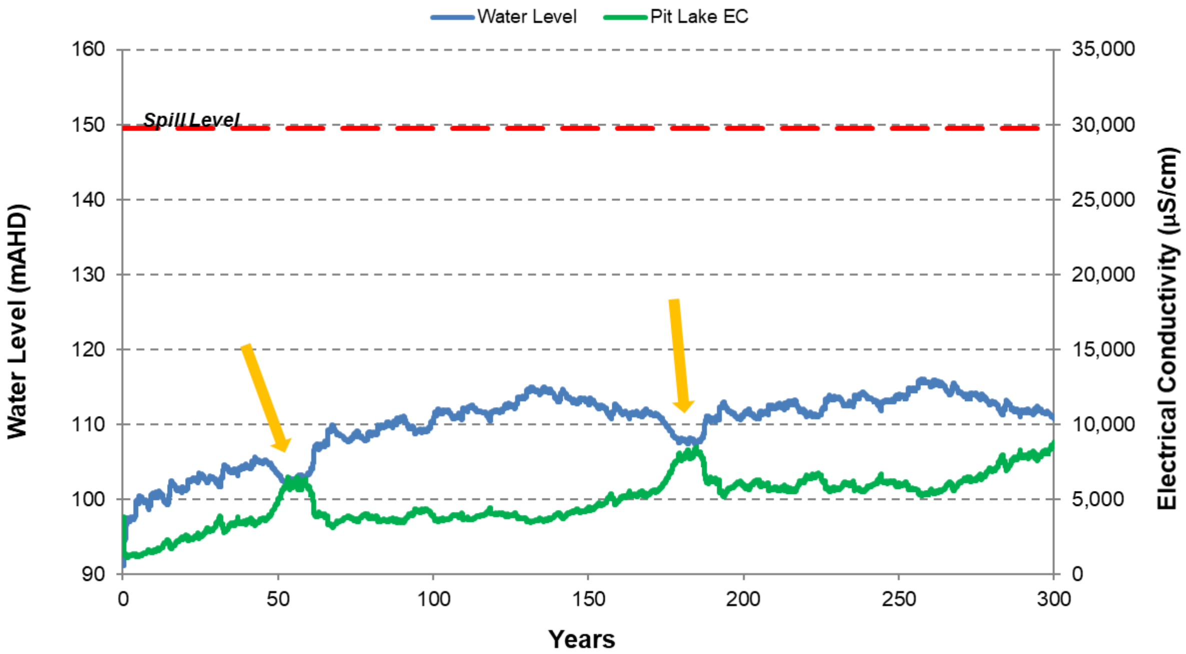
'Voids are to be designed as long term groundwater sinks:
- Has water balance modelling been undertaken for all final voids?
- What were the findings and assumptions
- How have groundwater flows been maximised?'

As outlined in the EIS (refer to Section 6.7.3), two final voids are proposed as part of the MCCO Project; the existing approved void in the approved mining area and a second void in the MCCO Additional Mining Area. Final void water and salt balance modelling was undertaken as part of the Surface Water Assessment to simulate the behaviour of the pit lake that would form in each of the final voids. Based on the Geochemical Assessment for the MCCO Project runoff and seepage from overburden is not expected to be acidic and is not expected to contain significant metals concentrations. Therefore, long term salinity is the likely main issue for pit lake water quality.

The final void models simulate inflow from remnant final void catchment rainfall runoff (including direct rainfall), groundwater inflow from bedrock and seepage from emplaced overburden areas as well as outflow due to evaporation and groundwater outflow on a daily basis. The predicted final void water levels and forecast salinity are provided in **Graph 3.5** and **Graph 3.6**. The occasional rises in modelled salinity and concurrent falls in water level as indicated on the abovementioned figures with orange arrows, represent historical drought periods in the modelled climatic record.



Graph 3.5 Predicted Final Pit Lake Water and Salinity Levels – Approved Mining Area



Graph 3.6 Predicted Final Pit Lake Water and Salinity Levels – MCCO Additional Mining Area

The final void modelling results indicate that both the final pit lakes would reach an equilibrium level more than 30 m below their respective spill levels (i.e. the lakes are contained). Equilibrium levels would be reached slowly over a period of more than two hundred years. Final pit lake salinity levels would increase slowly as a result of evapo-concentration.

3.8.6 Biodiversity

The following responses have been prepared with the assistance of the Umwelt Ecology Team who completed the BAR for the Project. Reference to the relevant numbered paragraphs in MSC submission is provided where relevant to assist cross referencing to the issues raised.

'(Paragraph 44) The MCCO project will disrupt surface water flows to Big Flat Creek, resulting in reduction in flow for that creek on a permanent basis. This will impact on the biology of the creek and the plant and animal species dependent on current flow rates and water levels in the alluvium.'

As described in Section 6.9.4.1 of the EIS Big Flat Creek is ephemeral and only flows after rainfall. As discussed in Appendix 11 (Surface Water Assessment) of the EIS the creek also has generally poor water quality (naturally occurring, not related to the existing mining operations). Further, as described in Section 6.8.2 of the EIS the groundwater impact assessment has confirmed that there is no alluvium associated with Big Flat Creek but there is a thin layer of colluvial sediment adjacent to the creek. The colluvium associated with Big Flat Creek thins and transitions to regolith overlying highly weathered bedrock as it extends away from the creek. The regolith typically lies above the groundwater table and any water present will occur after notable rainfall events rather than an interception of the regional groundwater table.

With regard to potential impacts on the biology of Big Flat Creek, an Aquatic Ecology Assessment was completed for the MCCO Project. This assessment did not predict any significant impacts on aquatic ecology in Big Flat Creek. As stated in the aquatic ecology assessment and the BAR the impact of the MCCO Project on riparian communities has been addressed through the generation of ecosystem credits, in accordance with the FBA and these impacts will be offset.

'(Paragraphs 53 & 54) Reconsideration on the status of the presence of Central Hunter Valley Eucalypt Forest and Woodland [the CEEC] should be undertaken in light of this apparent conflict.'

Umwelt has undertaken detailed assessment of the potential for this community to be present in the areas impacted by the MCCO Project and has found it to be absent.

As part of the assessment, consultation was undertaken with BCD and the Commonwealth Department of Energy and Environment (DoEE) in relation to the Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered Ecological Community (CEEC). Both the NSW and Commonwealth agencies have reviewed the assessment that underpinned the conclusion that the CEEC is not present within the MCCO Additional Disturbance Area. The Project was referred to DoEE in August 2018 which included a detailed review of the CEEC listing and vegetation occurring within the MCCO Additional Project Area and the Umwelt findings that the CEEC was not present on the site. The controlled action decision for the MCCO Project did not list this CEEC as being impacted by the MCCO Project. DoEE's controlled action decision supports Umwelt's assessment that the CEEC does not occur in the MCCO Additional Disturbance Area. A summary of the outcomes of the analysis which determined that the CEEC does not occur in the MCCO Additional Disturbance Area is provided in **Table 3.15** below.

The Approved Conservation Advice for the CEEC contains a list of key diagnostic characteristics which a vegetation community must meet to conform to the listed community. **Table 3.15** below identifies the two key diagnostic characteristics from the Approved Conservation Advice which conclusively rule out the occurrence of the CEEC within the impact area.

Table 3.15 Analysis of Key Diagnostic Characteristics for the Central Hunter Valley Eucalypt Forest and Woodland

Key Diagnostic Characteristic	Results of Targeted Survey and Assessment in MCCO Project Area
It typically occurs on lower hillslopes and low ridges, or valley floors in undulating country; on soils derived from Permian sedimentary rock	The MCCO Additional Project Area occurs on lower hillslopes and low ridges and broad valley floors associated with Big Flat Creek; however the soils mapped within the portion of the MCCO Additional Project Area with floristics that required further consideration to determine the presence or absence of the CEEC have been identified as Triassic and not Permian in origin. Therefore, the MCCO Project Area cannot support the Central Hunter Valley Eucalypt Forest and Woodland (CHVEFW) CEEC. It is noted that there are is some Permian geology underlying the MCCO Additional Project Area, however, there are no Permian derived soils in the area that has vegetation which could potentially be the CEEC.
AND	
It does not occur on alluvial flats, river terraces, aeolian sands, Triassic sediments, or escarpments	The sediments of the portion of the MCCO Additional Project Area with floristics that required further consideration to determine the presence or absence of the CEEC are derived from Triassic sediments. Therefore, the MCCO Additional Project Area cannot support the CHVEFW CEEC.

A detailed soil assessment (including survey) was undertaken for the MCCO Project by EMM Consulting Pty Limited (EMM,2019). MSC has identified a perceived conflict between the conclusion drawn from the detailed soils assessment and the geology presented on Figure 3.4 of Appendix 19 (EMM 2018). Figure 3.4 of the EMM report presents the geology based on the Singleton 1:250,000 Geological Sheet (1969) and does not depict soils. The detailed soil assessment for the MCCO Project, presented in Section 4, concludes that "*The MCCO Additional Project Area is situated on the edge of* *the Permian Singleton Coal Measures mapping with much of the surface geology being formed by the Triassic Narrabeen group (as determined both from regional geological mapping and from detailed geological investigations undertaken with the MCCO Additional Project Area).The detailed soil survey undertaken within the MCCO Additional Project Area found that the soils have mostly been derived from the Triassic Narrabeen group. The Sodosol and Tenosol soils found in the MCCO Additional Project Area generally support the soil landscape mapping done by Kovac and Lawrie (1991) Soil Landscapes of the Singleton 1:250,000 sheet (with some localised boundary readjustments). There are no clearly Permian derived soils within the MCCO Additional Project Area. Permian derived soils may be located further to the east of the MCCO Additional Project Area, where the Castle Rock, Roxburgh and Brays Hill soil landscapes are located."*

'(Paragraph 55) Page 50 (of the BAR) notes the presence of planted vegetation...Vegetation planted with the assistance of government funding formerly came under the classification of "Protected Regrowth" (Native Vegetation Conservation Act) and is now defined as Category 2 Regulated Land under the Local Land Services Act, 2013 (Part 5A, Division 2, Section 60I, 2 (a)). There appears to have been no attempt to determine if these plantings are Category 2 Regulated Land.'

The biodiversity assessment for the MCCO Project was undertaken in accordance with the Framework for Biodiversity Assessment, in accordance with the SEARs. Therefore, an analysis of Category 2 Regulated Land was not required.

'(Paragraph 56 and 57) Appendix D Page 11 records the presence of Cymbidium canaliculatum, which is an endangered population in the Hunter Catchment 7, however there is no mention of this species in Section 3.3 or discussion of efforts to determine the size of the population or of management strategies.'

Appendix D of the BAR documents the flora species recorded during the floristic sampling across the wider MCCO Project Area. The *Cymbidium canaliculatum* documented in the species list was at Plot MQ10, which is situated to the north-west of the MCCO Additional Project Area and will not be impacted by the MCCO Project.

'(Paragraph 58) Avoidance and Minimisation Measures (Page 65) ...adding together the total areas of the alternatives then claiming it as a large avoidance of impacts is spurious at best. Considered separately, as they should be, the impacts of even the largest of the alternatives are far smaller than the preferred option.'

As described in Section 1.4 of the EIS, detailed concept and pre-feasibility studies have been completed for the MCCO Project considering mining options, layouts, overburden emplacements and infrastructure arrangements to determine the proposed MCCO Project design. The key alternative mine design options that were considered but not selected during this process are outlined in the EIS and included additional mining areas, additional out of pit overburden emplacement areas and a number of alternative infrastructure alternatives. These options were not ultimately selected as part of the preferred project case and hence any impacts associated with them have been avoided. These options were not considered instead of the proposed MCCO Project but in addition to or a variation to it. That is, each of these options included the finally proposed MCCO Project plus the additional impact of the alternative considered. Therefore not proceeding with these alternatives has avoided impact.

In summary, the alternative options documented in the BAR as avoidance outcomes do not represent the sum of options but rather reductions in the total footprint through considered design. Each of the options considered were in addition to the MCCO Additional Disturbance Footprint as proposed in the EIS and therefore not proceeding with these options has resulted in avoidance of impacts.

‘(Paragraph 59) Access Corridor. Page 69: " The location where this access corridor is required includes approximately 12 ha of the originally proposed biodiversity and cultural heritage offset areas. This portion of the former offset area has been excised from the Conservation Agreements that are currently being formalised with the NSW Government". Has this “offset” been offset? Has it been accounted for in the area to be cleared?’

As documented in **Section 3.1.1**, Condition 34 of Schedule 3 of the current Mangoola Project Approval provides flexibility on the exact boundaries of the Conservation Areas but is specific about the area of conservation required (i.e. 3,020 ha). The necessary offsets are in place to meet the requirements of the current Project Approval. Therefore, the impacts of clearing within this area do not require any further consideration beyond what has been presented in the BAR.

‘(Paragraph 60) Page 69 : Importantly, the main function of the corridor, which is to maintain gene flow across the landscape (not just species movement) is unlikely to be affected in the short or medium term while the overpass exists or in the long-term after the mining has ceased and the vegetated connection along Big Flat Creek is re-established. Gene flow across the landscape requires movement of species across the landscape, given that a portion of this corridor is to be cleared for vehicle movement then it stands to reason that gene flow, and species movement, across this section will be affected.’

The temporary obstruction of the vegetated corridor along Big Flat Creek created by the access corridor is unlikely to obstruct gene flow across the landscape. Whilst the access corridor proposed will create a temporary obstruction for ground dwelling or arboreal species with dispersive biology (macropods for example), this obstruction is temporary and at a very localised scale and unlikely to impact on their ability to disperse through the landscape. The access corridor will not impede mobile fauna species such as birds and bat or pollinators such as bees or wasps. At a landscape scale, the temporary obstruction is not likely to affect the geneflow for the species that are temporarily obstructed from moving along the creek.

‘(Paragraph 61, 62 and 63) Indirect impacts from fugitive light emissions, noise impacts and air quality – MSC submission raises concerns that the indirect impacts associated with the MCCO Additional Project Area have not been adequately assessed.’

Behavioural changes in animals can occur in response to the physical presence of a development and include changes in foraging locations and mating behaviour (Gleeson and Gleeson 2012). This may lead to changes in species composition in the landscape, with these impacts resulting from impacts such as fugitive lighting, noise and air impacts. Noise impacts can affect fauna physiology and behaviour, particularly by causing disruption to communication including mating calls, territorial calls and alarm calls (OEH 2016). Research into the impacts of altered lighting indicates that it can trigger behavioural and physiological responses including changes in foraging behaviour, disruptions of seasonal day length trigger cues for critical behaviour, disorientation and temporary blindness and interference with predator prey relationships (OEH 2016). Blasting overpressure and vibration has the potential to disturb routine activities of fauna, particularly birds and bats, including disrupting breeding cycles and behaviour patterns (OEH 2016).

Appropriate controls to minimise impacts will be implemented as part of the MCCO Project including minimisation of fugitive lighting emissions, noise levels and air quality. There will be no substantial change to fugitive light emission impacts, noise impacts or air quality impacts on the surrounding fauna habitat given that the proposed mine operation is already part of, and adjacent to, existing mining operations with existing impacts. While it is acknowledged that the impacts will move further north as the operation progresses, the change in the nature of impacts is not considered to be substantial and will occur progressively over the life of the Project. Specifically with regard to lighting, during operations only mobile lighting will occur in the MCCO Additional Mining Area as the existing mine infrastructure will be used for the MCCO Project.

Conversely as operations move north some of the previously experienced indirect impacts on areas of existing and adjoining habitat in the south where mining has occurred will be reduced as mining operations move away. The areas that have been mined will also be progressively rehabilitated and returned to habitat for fauna species to utilise.

'(Paragraph 66) Proposed offset areas to the north of the project site are subject to exploration licence EL8064 (Ridgelands Resources). This raises questions over the long term security of some of the offset sites.'

The Biodiversity Offset Areas identified in the BAR are proposed to be secured through Biodiversity Stewardship Agreements. Biodiversity Stewardship Agreements are in-perpetuity agreements and can be established in an area which has an EL with the consent of the licence holder. Consultation has been undertaken with relevant tenement holders regarding the offsets proposed for the MCCO Project and to date none have identified that they have any concerns with the proposed areas.

'(Paragraph 67 and 68) The methodology [relating to the expert report for orchid offsets] does not appear to have been used on either the proposed project area nor to the existing Mangoola site to estimate total numbers lost.'

The FBA allows an Expert Report to be prepared as an alternative to conducting field surveys and was commissioned as part of the development of the BOS because weather conditions were not favourable for orchid survey in 2017, 2018 or indeed 2019. The MCCO Project area and the development footprint were surveyed between 2013 and 2016 during years of favourable flowering conditions.

The Expert Report did not need to consider the extent of threatened orchid habitat within the MCCO Project area as detailed, seasonal surveys were undertaken during favourable climatic conditions. The extent of orchid habitat in the MCCO Project area is therefore considered to be well known and adequately surveyed.

In determining the extent and likely population size of *Diuris tricolor* and *Prasophyllum petilum* in the MCCO Additional Project area, all known records were considered, including those areas that have been cleared as a result of approved developments.

The methodology described in the Expert Report is considered appropriate to accurately determine the extent of habitat for the species' in the proposed biodiversity offset areas, in accordance with the requirements of the FBA.

'The proposed MCCO project does not appear to be planning any further translocations from the affected area'

The MCCO Project has proposed a 100% like-for-like offset to compensate for residual impacts on *Diuris tricolor* and *Prasophyllum petilum.* Translocation of individuals is therefore not currently proposed as part of the biodiversity offset strategy.

3.8.7 Historic Heritage

The following responses have been prepared with the assistance of the Umwelt Historic Heritage Team who completed the Historical Heritage Assessment for the Project.

'While there may be few built items of heritage significance in the area, the village and surrounding properties that constitute Wybong have existed for more than 150 years. The Shire of Wybong was constituted in 1906. There are memories associated with this location and the decline in population living in this locality, due to mining, disrupts the ongoing cultural links for this community and place.'

The history of the Wybong locality is acknowledged and is considered in the Historical Heritage Assessment (Section 4.0 of Appendix 15 of the EIS). The importance of the local history of the area is also acknowledged in the significance assessment presented in Section 7.2 of Appendix 15, where the contributory value of the study area and its component elements in relation to this wider history is assessed.

As discussed in the Historic Heritage Assessment, it was assessed that direct impacts associated with the MCCO Project would not result in an adverse impact to the heritage significance of the wider study area or the local area more broadly. Similarly, the assessment found that no direct impacts would occur to any listed or potential heritage items located outside of the MCCO Additional Disturbance Area but within the wider study area.

'The EIS states that based on the findings of the Heritage Assessment, there are no recommendations for assessment, investigation or recording with regards to Historic Heritage. Yet the description of the Millville homestead indicates it is very representative of the evolution of homesteads in these early pioneer locations...At minimum there should be a demolition plan prepared, and followed, for the Millville residence, that allows detailed photographic evidence to be taken to document the phases of construction, and a report prepared that captures the important values and themes this residence represents for Wybong and the early settlers of the Valley.'

The significance assessment of 'Millville' provided in the Historical Heritage Assessment states that it does not meet any of the seven criteria for heritage listing, including representativeness.

However, in acknowledgement of 'Millville's' historical value to the local area (irrespective of its ability to meet any of the seven criteria for heritage listing), and in response to MSC's submission, Mangoola commits to undertaking an archival recording of the property prior to any demolition works. Archival recording during demolition works will be undertaken if deemed to be warranted as a result of information obtained during the recording prior to demolition.

Copies of the archival recording will be provided to Heritage, Department of Premier and Cabinet, and MSC, for inclusion in their respective libraries. A copy will also be provided to the Muswellbrook Shire Local Family and History Society for their records.

3.8.8 Traffic and Transport

The following responses have been prepared with the assistance of GHD who completed the Traffic and Transport Impact Assessment (TTIA) for the Project.

'The assessment contained in the GHD Report for Umwelt – Mangoola Coal Mine Continued Operations 2219171 is an inadequate assessment because it fails to satisfy the requirements of the SEARs. No proper assessment of the likely transport impacts, such as volume of operational traffic, capacity, road condition, safety and efficiency on the road network from the operating phase of the development has been undertaken. The reason given in the assessment is that operational traffic volumes are not expected to increase following construction of the project. However this seems contradictory to the facts contained in the Economic Impact Assessment, page 24 section 2.5.1, which states that an additional 199 FTE workers will be employed.'

The TTIA as prepared by GHD for the EIS is considered to adequately address the SEARs for the EIS as issued by DPIE on 15 February 2019. Section 1.3 of the TTIA (Appendix 17 of the EIS) outlines where in the report the SEARs have been addressed, including each of the comments received from RMS and MSC in their submissions to DPIE for input to the SEARs.

The traffic operations for Mangoola Coal Mine have previously been assessed and is currently approved for up to 540 operational employees. With regard to the assessment of operational traffic impacts associated with the MCCO Project, no increases above those previously assessed and the approved limits are proposed, with the project actually seeking approval for a lower maximum operational employee level of up to 480 employees. It is noted that the current operational workforce is approximately 400 employees and thus while still below the previously assessed peak employment approved for the mine, there will be additional employment, associated with peak production levels, as part of the MCCO Project. The TTIA also included an assessment of the 2022 horizon year, when peak construction activity for the MCCO Project is expected to occur.

The TTIA is therefore considered to represent a conservative assessment of the traffic impacts, based on information provided by the Mangoola to account for:

- the expected peak construction activity, including the peak workforce of up to 145 workers
- construction heavy vehicle traffic generation of up to 12 inbound and 12 outbound trucks (internal and external) per hour.

The analysis undertaken in the TTIA indicates that intersections in the vicinity of the MCCO Project are expected to operate with a good level of service (LoS A, refer to Table 4.1 of the TTIA report) in the 2022 horizon year, with the forecast increase in vehicle activity associated with the construction of the MCCO Project.

The TTIA report identified that the intersections in the vicinity of the MCCO Project are expected to operate with ample spare capacity with the expected construction traffic generation and the traffic and transport impacts of the MCCO Project construction vehicle activity is expected to be negligible.

The Economics Assessment considers employment numbers differently as required by the Economic Guidelines. In this regard the numbers stated in the Economics Assessment as referenced above (i.e. additional 199 FTE) has been considered in the Economics Assessment as the incremental increase of the MCCO Project over the existing Approved Mangoola Coal Mine operation specific to the Additional Mining Area and excludes contractors.

'Council asks for clarification on the traffic volumes predicted and specifically if these include both operational and construction traffic during the construction phase. The data indicates that during construction the project will generate up to 169 trips per hour. Does the predicted traffic volume include operational traffic? As this data has been provided by the client, has it been independently verified to be a correct estimation?'

As stated in Section 3.2.1 of the TTIA (Appendix 17 of the EIS), the Mangoola Coal Mine currently has approval for up to approximately 540 total full-time equivalent operational personnel. This number of employees would not be surpassed for the proposed MCCO Project. As the approved maximum operational traffic volumes are not expected to increase above those previously assessed and approved, the TTIA has only assessed the peak construction phase of the MCCO Project.

The current vehicle activity associated with the operation of the Mangoola Coal Mine has been captured in the traffic surveys undertaken for the study and the current network intersection performance which form the baseline for the TTIA (refer to Table 2.2 in the TTIA). The predicted construction traffic is then added to this for the analysis of the 2022 horizon year (assumed peak construction period), with a conservative background traffic growth rate applied to the surveyed volumes.

As discussed in Section 3.2.2 of the TTIA:

- The highest peak hour traffic generation scenario has been adopted for the assessment of the mine under the peak construction scenario. The forecast traffic generation for the project has been assumed to be 169 vehicle trips in total for both the AM and PM peak hours, consisting of 24 heavy vehicle movements and 145 construction worker movements (light vehicles).

- There is expected to be opportunities for construction workers to car share. However, to provide a conservative assessment of the MCCO Project, a car occupancy of one person per car has been assumed for worker trips.

Whilst MSC's question regarding if the proposed traffic data has been independently verified, this is not a requirement for the TTIA or EIS. As the proponent, Mangoola is responsible for defining the Project and Project Description for which it is seeking approval and is responsible for providing the relevant assumptions and information associated with this such as production schedules, timing, employee numbers, materials and delivery requirements etc. However, the information that has been used to inform the TTIA and EIS as provided by Mangoola is considered to be reliable and has been documented as assumptions upon which the traffic modelling was undertaken (refer to Section 1.4 of the TTIA).

'Section 2 of the Traffic and Transport Impact Assessment (TTIA) - Existing Conditions - provides commentary on the existing road network characteristics including how the roads are classified and the function that they perform according to the Roads and Maritime classification system. This information omits any consideration or reference to Muswellbrook Shire Council's 'Road Asset Management Plan' which identifies mine affected roads such as Wybong Road as having specifically identified functions and hierarchy. Therefore, the information given in the report is not specific to Council's roads and does not align which the class descriptions and required functions of the roads according to Council's Road Asset management plan.'

As detailed in Section 2.1.1 in the TTIA, the key roads included were defined as local roads (under the control of MSC) in accordance with the RMS functional hierarchy and the *Roads Act 1993*. This classification indicates that local roads are under MSC control. This is consistent with standard practice for traffic assessments.

Section 2.1.2 of the TTIA provides a detailed description of each of the key roads with supporting photographs.

The hierarchy in the Road Asset Management Plan 2013-2017 (Appendix E) whilst acknowledged, does not supersede the criteria provided in the TTIA.

Additionally, the criteria in the plan have no bearing on the analysis and conclusions of the TTIA, namely, all the intersections of interest are expected to operate with an acceptable LoS A both with and without the expected MCCO Project traffic volumes.

> 'The TTIA indicates that the proposal will have impacts to Wybong Road, Wybong PO Road and Yarraman Road, with changes to the road network proposed. Any changes to the road network, including road closures, will be subject to the approval of Muswellbrook Shire Council. Council's current policy is that it will not approve any closures to public roads and or changes to the Shire's road network until the 'Mine Affected Roads Network Plan (2015)' has been reviewed and updated.'

MSC's comment about the requirement for approval from MSC for road network changes are noted and understood.

To clarify, the TTIA does not indicate that the MCCO Project will have any significant impacts to traffic using Wybong Road, Wybong Post Office Road and Yarraman Road. As part of the TTIA tube counts were undertaken to support and inform the assessment and these indicate that each of these roads currently accommodates relatively small traffic volumes, as follows:

- Wybong Road: up to 130 – 150 vehicles per hour
- Wybong Post Office Road: up to six vehicles per hour
- Yarraman Road: up to six vehicles per hour.

The analysis completed in the TTIA indicates that the MCCO Project trips will have a negligible impact on the surrounding road network.

With specific regard to Wybong Post Office Road, and the proposed realignment of a portion of it by the MCCO Project, the TTIA identified that the project may lead to minor increases in travel times (less than a minute) and that it will significantly improve the current road condition, which is currently of a poor standard.

In addition, Wybong Post Office Road currently intersects Wybong Road at an angle of less than 70 degrees, which does not comply with Austroads Design Guidelines. The proposed realignment will provide a new priority controlled T-intersection of Wybong Post Office road and Wybong Road, which will be designed and constructed in accordance with Austroads Guidelines.

The proposed realignment of the impacted portion of Wybong Post Office Road is therefore not expected to have any detrimental impacts on either Wybong Road or Yarraman Road.

Other than minor increases in travel times, the realignment of a portion of Wybong Post Office Road is expected to improve the quality of the road network in the vicinity of Mangoola Coal Mine.

With respect to the Muswellbrook Mine Affected Roads – Stage 1 Road Network Plan (Network Plan) (Cardno 2015) it is noted that Wybong Post Office Road is listed in this as a minor local road and is not included in any of the proposed road network scenarios presented in the strategy. As confirmed by traffic survey completed for the EIS it currently has a very low utilisation. Therefore, as the Network Plan does not include Wybong Post Office Road in any of the proposed road network scenarios and due to the very minor nature of this road, the Network Plan or subsequent updates to this Network Plan should not place limitations on the progression of this matter.

Mangoola is aware that MSC have initiated an update to the Network Plan and, as outlined in **Section 3.8.8**, has consulted with MSC to enable the consideration of MCCO Project traffic related matters. Mangoola will continue to engage with MSC with regard to the requirement for the closure of a portion of Wybong Post Office Road. However, Mangoola respectfully request that approval of the road closure associated with the realignment not be dependent upon the update of the Network Plan as it is considered that given the benefits of the proposed relocation and upgrade and the minor usage of this road, it can be considered as a specific case on its merits. Mangoola will continue to seek to engage with MSC in regards closures to public roads and changes to the Shire's Network Plan for the MCCO Project and would welcome further opportunity to meet and discuss the proposed Network Plan.

'Section 3.2.2 of the TTIA -The proposal includes the construction of an overpass over Wybong Road. This structure has the potential to restrict vehicular movement at this location specifically for Over Size Over Mass vehicles (OSOM). Council at the meeting 30 July 2019, noted the preliminary design of the overpass on Wybong road, that is proposed to have a clearance of 5.4m vertical and 7m seal width (10m width clearance) across Wybong road. The proposed clearance is of concern to Council as this route is used on a regular basis as an alternative route to the Golden Highway by OSOM vehicles which cannot cross the Hunter River Bridge on the Denman Road, or when emergency detours and road works are in place.
Council records indicate that of the 95 + OSOM approvals for the use of Wybong Road from January 2019 to June 2019, 62 truck movements were in excess of 5.4m height, with the average being 5.8m high. The largest vehicle that has recently travelled on this part of Wybong Road measured 9.5m wide and 5.8m high. Therefore based on the historic use of the road for OSOM vehicles Council would reject this design of the Wybong Road Overpass due to the height and width restriction that it would impose, if submitted as part of the S138 application to construct.'

As discussed in the EIS, Mangoola require the establishment of operational access to the MCCO Additional Project Area. It is proposed to construct a dual haul road and light vehicle road overpass over Wybong Road and Big Flat Creek to provide access from the existing Mangoola Coal Mine (refer to Figure 3.10 in the EIS). The overpass will enable the efficient haulage of material and equipment between the two operational areas and once constructed will ensure that there are no disruptions to traffic flows on Wybong Road.

The overpass will be designed and constructed to meet Austroads and RMS design standards in consultation with MSC. The overpass construction will have an overall width of approximately 150 m including the haul road and light vehicle road, underpass, culvert structures as well as temporary erosion and sediment control works. The overpass is proposed to be a precast concrete arch structure, complete with median bund and perimeter bunds for both vehicle containment and visual amenity. The structure will be rated to carry ultra-class haul trucks and excavators up to 800 tonnes nominal operating mass (larger than the current excavators onsite for engineering purposes).

It was proposed in the EIS that Wybong Road will continue to have two 3 m traffic lanes and a minimum height clearance of 5.4 m to pass through the overpass. The overall width within the arch structure had a clearance of 10m. Mangoola has been consulting with MSC since February 2018 on the details of the proposed crossing. In the MSC submission dated the 16 September 2019, MSC make comment that "*based on the historic use of the road (Wybong Road) for Over Sized Over Mass (OSOM) vehicles Council would reject this design of the Wybong Road Overpass due to the height and width restriction that it would impose, if submitted as part of the S138 application to construct*."

In its submission MSC provided some indication of the use requirements and stated *'Council records indicate that of the 95 + OSOM approvals for the use of Wybong Road from January 2019 to June 2019, 62 truck movements were in excess of 5.4m height, with the average being 5.8m high. The largest vehicle that has recently travelled on this part of Wybong Road measured 9.5m wide and 5.8m high.'*

Considering the MSC comment and no firm recommendation as to the height and width requirements, Mangoola has sought further advice through a number of avenues to determine a revised height and width dimension suitable for the Wybong Road traffic lanes width and the minimum height clearance through the overpass.

Attempts have been made through RMS to seek a recommendation on the Wybong Road traffic lanes width and the minimum height clearance through the overpass. The RMS Regional and Outer Metropolitan Division for Road Access (OSOM) Operations was approached to provide advice. The division was unable to provide dimensions for the traffic lanes width and the minimum height clearance through the overpass. The RMS Regional and Outer Metropolitan – Hunter Region, Infrastructure Services was approached to provide advice. The division was unable to provide dimensions for the traffic lanes width and the minimum height clearance through the overpass.

Advice was also sought through one of the key local heavy vehicle transport providers Bowers Heavy Transport based in Singleton NSW that utilises Wybong Road, particularly for dump truck body transport. Advice from Bowers Heavy Transport was that the largest load is typically 5.8 m high and 9.5 m in width. It should be noted that these dimensions are commensurate with the MSC comments regarding OSOM use of Wybong Road noting that the average and the largest vehicle height dimension, was at the same dimension of 5.8 m high.

In the absence of any written advice, Mangoola has also taken nominal height readings of various fixed regional overhead structures located on the Hunter Valley road network that would be expected to have OSOM loads/vehicles travel under these structures. The height readings were taken using a measuring device described as “Bosch Professional GLM 500”, with a measurement range 0.05 m – 50.00 m and a typical measurement accuracy +/- 1.5 mm. The device has a laser included, enabling clear definition of the location of the measurement to the structure. The measurements were taken from safe locations (standing on the non-road side of the Armco and placing the hand/measuring device on the road side of the Armco) and observations then made of the road surface to determine whether there was a likely reduction in clearance from the measurement taken. The results of the readings are summarised in **Table 3.16**.

Table 3.16 Height Readings of Various Regional Overhead Structures Located on the Hunter Valley Road Network

Date	Location	Structure Description	Measurement Location	Observed Road Shape	Observed Likely Minimum Clearance
24/09/2019	Hunter Expressway "Bridge Street" Overpass near Branxton	Concrete overhead bridge	Measured on the far left side of the verge (looking west) near the side bridge wall, adjacent the "jersey barrier". Measured nominal value 6.5m	Dual lane carriageway sloping up from measurement location	6.2 m – 6.3 m
24/09/2019	New England Highway Truck average speed monitoring at Belford	Steel overhead structure	Measured on the far left side of the verge (looking west) on the traffic side of the Armco railing. Measured nominal value 7.3m	Dual lane carriageway and it appears the road dips from the RHS of the west bound lanes to the left verge, with a likely reduction in clearance on the RHS	7.0 m – 7.1 m
26/09/2019	New England Highway Truck average speed monitoring northwest of Singleton (near Rixs Creek mine)	Steel overhead structure	Measured on the far RHS side (looking northwest) on the non-traffic side of the Armco railing/top of the concrete footing of the monitoring structure, to the underside of the overhead structure. Measured nominal value 6.6m	The concrete footing is lower than the tar surface of the road and the road dips (road crowned in center) from the center line to the RHS, with a likely reduction in clearance in the center of the roadway	6.2 m – 6.3 m
26/09/2019	Golden Highway Truck average speed monitoring northwest of Sandy Hollow (Giants Creek area)	Steel overhead structure	Measured on the far RHS side of the verge (looking east) on the traffic side of the Armco railing. Measured nominal value 6.5 m	The road dips (road crowned in center) from the center line to the RHS verge, with a likely reduction in clearance in the center of the roadway	6.2 m – 6.3 m

Of key interest in the assessed overhead structures described in the table, is the truck average speed monitoring station with the overhead steel structure north-west of Sandy Hollow at a height of 6.2-6.3 m. OSOM vehicles using Wybong Road when negotiating the Golden Highway in either a westwards direction or travelling east when coming from the west, have to negotiate the fixed overhead structure at Sandy Hollow.

Power lines currently transverse Wybong Road in a number of locations along its length. Ausgrid Standard NS220 Overhead Design Manual, Table 13.1.2a Minimum Clearance from Roads, Ground or Boundaries states that for low voltage lines (less than 11kV) the minimum clearance dimension over the carriageway of roads is 6.0m. The “Notes for Tables” accompanying the table do comment that greater clearances may be required where regular high loads are likely such as the New England Highway and Golden Highway.

Based on the advice gained verbally and the measured values of the regional overhead structures Mangoola has revised the clearances within the concrete arch structure of Wybong Road to account for loads up to 10 m in width and 6.2 m high.

It is noted that the disturbance footprint of the revised haul road overpass design remains within the MCCO Additional Disturbance Boundary as assessed in the EIS and the changes as proposed would not change the results of flood assessment or visual amenity assessment and accordingly no additional environmental assessments are required.

> ‘Section 2.1.8 Freight Routes, makes no comment of the importance of Wybong Road to the freight industry in terms of a transportation route for OSOM vehicles used for transportation of equipment and goods within the state.’

Mangoola acknowledges the importance of Wybong Road to the freight industry in terms of a transportation route for OSOM vehicles as confirmed by the above response and commitment to a revised design for the Wybong Road overpass that has a larger clearance.

> ‘During the construction phase for the proposed Wybong overpass it is proposed to construct a bypass of Wybong Road. Construction of a side track would be subject to Council approval and would need to be guided by the requirements of RMS Traffic Control at Worksites manual which requires a full design to be submitted to Council for approval. Any proposed side-track would need to be suitable for use by OSOM vehicles and would be subject to conditions for the maintenance during the construction period or period that it is in use.’

The NSW Government Roads and Maritime Services Technical Manual, Traffic control at work sites, dated 27 July 2018 (Document No. RMS.18.898 Version 5.0) through the manual’s policy statement, states that this manual must be used on all Roads and Maritime road and bridge work sites.

The manual is for personnel responsible for Roads and Maritime road and bridge work sites and contains:

- example traffic control plans (TCPs) for a range of work activities
- information on how to develop a Traffic Management Plan (TMP) and risk assessment prior to development of a TCP
- instructions on how to select an example TCP for a specific work activity
- instructions on how to design new TCPs
- guidance for traffic control in a number of specific situations.

The purpose of the manual is to maximise safety by ensuring that traffic control at Roads and Maritime work sites consistently complies with best practise. For work associated with the MCCO Project the manual also compliments the Roads and Maritime specification, G22 WHS Construction and Maintenance Works. The manual states that a documented risk assessment shall be undertaken for all types of works to identify and analyse all hazards when developing a TMP and TCP for work zones.

The MCCO Project is committed to being guided by the requirements of the NSW Government Roads and Maritime Services Technical Manual, Traffic control at work sites, for works associated with road works.

The proposed side-track would be suitable for use by OSOM vehicles to at least the same standard as the existing Wybong Road and as per Section 9.5 of the manual consideration has been given to OSOM vehicles in the design of the side track. Local topography and vegetation conditions are such that there are significant clear zones on each side of the road that extend beyond the shoulder areas. Where appropriate, fixed signage and/or variable message signboards will be used and will provide contact details for the Construction Site Manager for the coordination of movements of OSOM vehicles along the diversion. The MCCO Project would be subject to the maintenance of the side track, during the construction period or the period that the side track is in use.

'Section 3.2.3 – Although the existing conditions of consent allow employees to use Wybong Road east and Kayuga Road, Council would not permit traffic to use these roads, to maintain consistency with the conditions of consent for other mines. Therefore the assumptions used in section 3.2.3 are not correct. Council also requests that this existing condition be amended.'

As stated in the EIS there are no changes proposed to the operational traffic impacts above what has previously been assessed and approved and the assessment of construction traffic has confirmed that all relevant intersections will continue to operate at appropriate levels of service. Accordingly, Mangoola sees no reason why Mangoola employees should now be restricted from using these roads. Conditions imposed on another project to address an impact associated with that project should not be applied to Mangoola where no impacts requiring management have been identified.

'Section 2.1.9 Active Transport and Public Transport makes no mention of the impacts, if any, to the 'National Trail' which includes part of Wybong Road'

The Bicentennial National Trail is a multi-use recreational trekking route that traverses 5,330 km from Cooktown in far north Queensland to Healesville in Victoria. Mapping details and guidebooks associated with the trail are available on the Bicentennial National Trail website (www.bicentennialnationaltrail.com.au).

The trail is broken up into 12 sections with guidebooks available with mapping details for each section.

With respect to the location of the MCCO Project Section 9 Ebor to Aberdeen is located to the north of the MCCO Additional Project Area and makes its way through the parcels of Crown land located to the north west. At its closest the trail comes within approximately 1 km of the MCCO Additional Mining Area. At this distance no impacts on the trail or its users are predicted consistent with the findings of the assessment of impacts on Crown land adjoining the MCCO Additional Project Area. Further west in the vicinity of Sandy Hollow the trail does cross Wybong Road. No works or impacts on Wybong Road in this area are proposed that would impede the use of the trail.

‘Section 2.3 - Crash Data - Although the crash history is acknowledged, the report suggests that there is no significant safety deficiencies in the road network near the intersections of interest. What is this assumption based on and is it based on safety audits conducted on the roads? The report fails to mention the existing conditions imposed by the State Coroner following a fatality which occurred on the road. Therefore Council considers that an inadequate assessment of the impacts to road safety from the development has been undertaken.’

As described in Section 2.3 of the TTIA the assessment of road safety in the road network near the intersections of interest was undertaken based upon a review of crash data provided by RMS for the previous five available years (2013 to 2017). Upon review of this data, GHD identified (as noted in the TTIA) that ten crashes had been recorded during this period along approximately a 35 km length of road, which suggests that there are no significant safety deficiencies in the road network near the intersections of interest.

It is now understood that there was a fatal accident on Wybong Road in August 2018, which was not included in the 2013 to 2017 RMS crash data. Information on the fatal accident was therefore not available when the TTIA was being prepared, as it would have only become available through the Centre for Road Safety in 2019. The publicly available data regarding this accident sourced by GHD does not indicate the cause of the accident. As part of the response to submission process a copy of the State Coroners report referred to in MSC’s submission was requested but not provided and therefore could not be further considered.

It is also noted that more recently in September 2019, there has been another fatal accident on Wybong Road and investigations into the accident are ongoing.

It is considered that the TTIA has completed an adequate assessment of the impacts to road safety from the MCCO Project, based on the information available when the report was prepared.

It is noted that the State Coroner has previously recommended that improved escort arrangements should be provided for oversize vehicles on narrow rural roads. As stated in Section 4.4 of the TTIA report, the movement of oversize vehicles will be undertaken in accordance with Roads and Maritime and the National Heavy Vehicle Regulator Guidelines.

Any other recommendations made by the Coroner about the recent fatalities, that are relevant to the MCCO Project will be adhered to.

It is noted that a Road Safety Audit is not a requirement for a traffic and transport impact assessment.

3.8.9 Visual Amenity

‘Appendix 18 – Visual Amenity Assessment Materials is very brief – has there been an error in production of the EIS that has meant a lot of the material has been inadvertently deleted?’

To clarify Appendix 18 – Visual Amenity Assessment Materials includes 12 figures which provides all of the radial analysis and photomontages that have been prepared as part of the visual amenity assessment. This appendix of supporting materials should be reviewed along with the detailed assessment in the main text of the EIS. No materials have been deleted or omitted.

It is noted that as outlined in the EIS, the MCCO Additional Project Area is well shielded and the proposed additional mining area is not predicted to be visible from any surrounding residences. Some views of the additional mining area will be available from local roads.

‘The installation of landscaped bund for the full frontage of the project area to Wybong Road is proposed to lessen visibility. The EIS does not provide detail on heights of the bund, the proposed density/type of plantings or assess the impact this amelioration measure will have. Council requests that conditions be included that require:
- That screen plantings be installed at sufficient density to assist with screening mine components from sensitive viewpoints, including Ridgelands Road and Wybong Road.
- A minimum screen planting canopy density, measured from ground level to a height of 8m above ground level, of 60% (alternatively expressed as a leaf to air gap ratio of 2:1) is to be achieved adjacent to Ridgelands Road;
- A minimum screen planting canopy density, measured from ground level to a height of 6m above ground level, of 60% (alternatively expressed as a leaf to air gap ratio of 2:1) is to be achieved adjacent to Wybong Road; and
- The visual bunding adjacent to Wybong Road is to be removed as part of the closure plan for the site.’

The visual amenity assessment included in the MCCO Project EIS has identified that no views are predicted from any private residences due to the effects of intervening topography. Views will be available to active mining areas including overburden emplacement areas from some sections of the surrounding road network, including along parts of Wybong Road and Ridgelands Road. Views from public roads will be intermittent and generally short term in nature depending on the location due to the speeds being travelled, changing orientations and the effects of intervening vegetation along the road verges. The progressive rehabilitation of overburden emplacement areas, starting with the outer faces from the early stages of the MCCO Project and shaping of the final landform to conform to the surrounding natural environment is expected to reduce the visual impact from all areas where views are possible. As described in the EIS Mangoola proposes to plant tree screens along parts of Wybong Road, the realigned section of Wybong Post Office Road, and Ridgelands Road and incorporate a visual bund along Wybong Road which will assist in minimising the visual impacts of the MCCO Project.

To provide a more representative impression of the views that would likely be available to the MCCO Project a revised set of photomontages from the key locations along Wybong Road and Ridgelands Road are provided in **Appendix 8**. These show a rendered photomontage (with realistic colouring) of what is likely to be visible during the operational and post closure phases of the Project. This supports the finding in the EIS that views will be intermittent and generally short term in nature with initial impacts reduced as progressive rehabilitation is completed.

To clarify, visual bunds are not proposed for the full frontage of the MCCO Additional Project Area to Wybong Road. The proposed areas where visual bunds and tree screens are proposed are shown on the staged mine plans (see Figures 3.3 to Figure 3.6 in the EIS).

For the areas where visual bunds are proposed to minimise views to the MCCO Project, these are planned to be approximately 3.5 m high and located approximately 40 m from the road. It is noted that in the areas along Wybong Road the visual bund also forms the required flood levee which is required to protect the proposed mining area from inundation during flood events associated with Big Flat Creek.

The proposed bunds would be vegetated using similar methods as undertaken in the Mangoola post mining rehabilitation areas. The shaped areas would be covered with stripped topsoil to a nominal depth of 100mm. This topsoil would then be ripped along the contours to key into the bund material and provide erosion scour protection. Directly after ripping the bunds will be seeded using an endemic seed mix consisting of native grasses, ground covers, shrubs and canopy species. The shrub layer will consist primarily of *Acacia salicina, A. decora, A. falcata, A. deanei, A. implexa, Dodonaea viscosa, Cassinia arcuata* and *Notelaea microcarpa*. The canopy species will comprise a mix of *Eucalyptus dawsonii* and *E. crebra*. These species have been selected due to their natural local distribution and good performance in revegetation and rehabilitation areas, both in terms of rapid growth and resilience. The bund areas will be seeded at high densities to ensure adequate screening effects are achieved.

Given the relatively low level of visual impacts predicted, the fact that some parts of the existing operation are already visible from public roads and the relatively short nature of the operations in the MCCO Additional Project Area (approximately 8 years) and the benefit that progressive rehabilitation will have to reduce visual impacts as shown on the revised photomontages, Mangoola does not consider that it is warranted to include a condition that stipulates screening densities for the tree screening proposed along sections of public roads. It is also noted that unlike landscape plantings for screening individual buildings, the plantings along the bund of native species are over a disperse area and therefore the wording of the proposed condition by MSC requiring specific canopy densities is not considered appropriate in this context and considering the nature of the impact.

As proposed by the conceptual final landform in the EIS the visual bunds and flood levees are proposed to be removed/incorporated into the final landform as proposed for the MCCO Project (see Figure 6.41 in the EIS).

3.8.10 Rehabilitation

'Impacts will be ongoing for a long time, for example base flow to Big Flat Creek is predicted to remain impacted for a 500-year recovery period. What mechanisms will Mangoola put in place to take responsibility for ongoing issues after Mine closure?'

It is noted that some impacts, particularly those associated with changes to groundwater and surface water environments can remain for a long period following mine closure. In this regard, the water studies completed for the MCCO Project identified the potential volumes of water that might be removed from the existing environment following closure (including from catchment area reductions and reductions in baseflow). As described in Section 6.7.4 of the EIS the long term predicted reductions in surface flow and baseflow following closure represents a small and likely indiscernible impact to flow in Wybong Creek (including Big Flat Creek which flows into it). Mitigation proposed would involve the permanent retirement of the required volume of water associated with the water access licence (WAL) from the Wybong Creek Water Source within the Hunter Unregulated and Alluvial Water Sources WSP. Mangoola holds sufficient water under WALs to achieve this.

With regard to other impacts post closure, in accordance with NSW legislation and policy, Mangoola is required to put a bond in place to ensure funding is available for rehabilitation and closure of the mine. This bond would only be released once the completion criteria agreed with relevant government agencies have been met, ensuring that appropriate arrangements are in place to provide for effective rehabilitation outcomes.

'The mine rehabilitation aims to "Establish similar native vegetation communities to those that will be impacted by the MCCO Project." Rehabilitation after seven years is expected to be "trending towards benchmark", without an actual expected and measurable value this term is meaningless.'

As described within Section 6.17.3 of the EIS the rehabilitation strategy for the MCCO Project is consistent with Mangoola's currently approved rehabilitation practices which have been recognised as industry leading. Rehabilitation will be undertaken in accordance with a revised MOP incorporating the Rehabilitation Management Plan that will be reviewed and updated as part of the implementation of the MCCO Project. The MOP will detail performance measures and criteria for specific rehabilitation areas, to be used as benchmarks against which performance of the rehabilitation practices can be measured. The monitoring of rehabilitation performance will be regularly reported to DPIE and DRG as it is currently for the existing approved operations.

The rehabilitation will look to establish vegetation communities that represent particular PCTs. The PCT classification is the current standard NSW classification and vegetation in NSW is required to be assigned to a PCT for assessment under the Biodiversity Assessment Method (BAM). Each PCT has been assigned benchmarks which describe the reference state to which sites are compared to score their site-scale biodiversity values. The three primary attributes of biodiversity; composition, structure and function can be described by benchmarks. Benchmark condition, under the BAM, represents the best attainable values of composition, structure and function of the PCT and can be obtained through the OEH Bionet Vegetation Classification system. As mentioned above, the MOP will detail specific performance measures and criteria for specific rehabilitation areas and will include the specific benchmark values seeking to be achieved by the proposed rehabilitation.

A working party with participants from Muswellbrook Shire Council, DPIE, Premiers and Cabinet, Mangoola Coal Operations P/L, Muswellbrook Chamber of Commerce, traditional owners and local land council members and the Hunter JO Economic Transitions Committee should be established by the year 2025 to commence planning for the transition to a post-mining suite of uses for the site.

As stated in the EIS a detailed Mine Closure Plan will be developed with this process to commence 5 years prior to the planned mine closure and will be aimed at achieving the post mining landform and land use as presented in the EIS. The Mine Closure Plan will include evaluation of re-use opportunities for facilities, infrastructure and services on the site, with the majority of demolition/decommissioning works to be planned and undertaken as soon as practicable following the cessation of mining, unless alternative post mining uses are identified or proposed at the time. Given the proposed timing for the MCCO Project this process is anticipated to commence in approximately Year Three of the MCCO Project in the additional mining area.

As stated in the EIS, Mangoola commits to continue to investigate potential post mining beneficial land uses for the site through the development of a Post Mining Land Use Strategy as part of the Mine Closure Plan. The Mine Closure Plan will also investigate ways to minimise the adverse socio-economic effects of mine closure, including reduction in local employment levels. The development of this detailed Mine Closure Plan will include consultation with relevant stakeholders, which may include the Resources Regulator, DPIE and MSC.

Mangoola is pleased to note MSC's interest in working with Mangoola regarding the transition of the site to other land uses post mining and welcomes the opportunity to work through this process with MSC.

There needs to be a high level of indigenous engagement with rehabilitation, final landforms and land uses, how the land will be cultivated. For example, is there a need for consideration of bush tucker? The indigenous community needs genuine participation in end use planning (p. 184).

Mangoola will continue to engage with the RAPs for the MCCO Project as part of the development and implementation of the updated ACHMP. This consultation process will provide opportunities for the parties to provide input on a wide range of issues. Mangoola also expects the local Aboriginal community to be a stakeholder in future discussions regarding closure of the site and transition to a future land use.

As described in the EIS, the final landform and rehabilitation of the MCCO Additional Project Area is proposed to be returned native woodland vegetation and be used to meet part of the biodiversity offset requirement for the MCCO Project.

At the close of mining operations every effort should be made to maintain the quantum of employment opportunities, in turn avoiding economic and social disruption to the local community through loss of job opportunities. Post-mining land use opportunities for rehabilitated mine land could include:

- Recreational uses
- Hydropower and other renewable energy generation activities
- Tourism and Theme parks
- Wildlife habitat and conservation
- Water storage and irrigation
- Intensive Agriculture/Aquaculture
- Industrial Development
- Replacement lifestyle lots and creation of a new Wybong village community focused on land in the vicinity of the Wybong Community Hall.

As discussed in Section 6.17.5 of the MCCO Project EIS Mangoola is committed to continue to investigate complementary and alternative land use options over the life of the MCCO Project and closure process through the development of a Post Mining Land Use Strategy for its land holdings. Mangoola acknowledges the range of potential future land uses identified by MSC in its submission and agrees that the site has significant potential for future non-mining land uses. Mangoola will consider the opportunities identified by MSC along with other identified potential land uses (including those identified in the EIS) as part of developing the Post Mining Land Use Strategy.

The Mangoola site will provide existing infrastructure, connectivity to road and rail transport, and a large area of buffer of land, providing potential for a variety of final land uses. There are a range of strategic initiatives that are starting to plan for future employment generating land uses in the central and upper Hunter Valley region, including the Muswellbrook LEP, the Synoptic Plan and the Strategic Regional Land Use Plan for the Upper Hunter (Department of Planning and Infrastructure 2012) and the Hunter Region Plan 2036. The strategic land use objectives for the area surrounding the MCCO Project as identified within these plans have been considered as part of the concept closure planning process for the MCCO Project and will continue to be considered as part of the detailed closure planning for the mine.

Expected credit points (excluding individual species credits) generated at the time of "Preliminary Completion" are expected to be 2,187, this is in contrast to the 17,718 credit points the site is currently assessed at. There is no expected timeline for this and given that rehabilitation aims to *"Reduce the need for long term monitoring and maintenance by achieving effective rehabilitation"* it would appear there is an expectation to write rehabilitation of the site off well before it has become "similar". Given that the criteria for preliminary completion is >50% benchmark richness and canopy class coverages ranging from 25 to 200 percent of benchmark values the completed rehabilitation could look nothing like that upon which it is based.

The credits created through the establishment of rehabilitation should not be compared to the credits created by the impact assessment to predict quality of rehabilitation as impact credits and rehabilitation credits are calculated using different techniques and are not comparable. The fact that the rehabilitation only generates 12% of the credits created by the impact reflects the inherent offset ratio factor used by the BioBankling Calculator to ensure no net loss and the perceived risk associated with establishing ecological rehabilitation in a post-mining landscape. That is, the same area of vegetation in a rehabilitation area generates significantly lower credits when compared to an impact area. This is by design to ensure that the total area of vegetation provided as an offset is substantially larger than the area impacts, thus providing a net gain.

The MOP will detail performance measures and criteria for specific rehabilitation areas and will include the specific benchmark values seeking to be achieved by the proposed rehabilitation and a proposed timeline.

In order for the ecological rehabilitation that is proposed as part of the project to be relinquished, it will need to meet relevant completion criteria that will consider the floristic, structural and functional components of the specific PCTS that it is seeking to replicate, in accordance with industry standards and the MOP.

3.8.11 Final Landform

> 'Each alternative mine and final landform scenario is considerably smaller than the preferred option for impacts on vegetation and final water catchment capture from Big Flat Creek. Considered separately, as they should be, the impacts of even the largest of the alternatives are far smaller than the preferred option. Council prefers Final Void option 4 (One void in the North) to option 3'

As described in Section 1.4 of the EIS, detailed concept and pre-feasibility studies have been completed for the MCCO Project considering mining options, layouts, overburden emplacements and infrastructure arrangements to determine the proposed MCCO Project design. The key alternative mine design options that were considered but not selected during this process are outlined in the EIS and included additional mining areas, additional out of pit overburden emplacement areas and a number of alternative infrastructure alternatives. These options were not ultimately selected as part of the preferred project case and hence any impacts associated with them have been avoided. These options were not considered instead of the proposed MCCO Project but as an addition to or a variation to it. That is, each of these options included the finally proposed MCCO Project plus the additional impact of the alternative considered. Therefore, not proceeding with these alternatives has avoided impact.

As such each of the options considered are in addition to the MCCO Additional Disturbance Footprint as proposed in the EIS and are not standalone or separate options.

Further as detailed in **Section 3.3.1** an independent expert examination of the proposed final landform has been undertaken by Andrew Hutton of IEMA. The independent review concluded that Case 3, as presented in the MCCO Project EIS, represents an appropriate outcome which demonstrates that Mangoola has considered the balance between delivering an economic mine plan whilst giving proper regard to leaving beneficial post mining land uses and minimising final voids. Further, the review found that Mangoola has demonstrated through the rehabilitation already completed at the existing Mangoola Coal Mine that it has been able to successfully design and construct the natural landforms along with the revegetation techniques that are proposed in the MCCO Project EIS.

Mangoola accepts this finding and endorsement of the final landform that has been developed and selected for the Project.

> Transition to post-mining activities should commence before mining ceases. This may require adjustments to Mining Lease conditions and the LEP to facilitate

Mangoola agrees that planning for the transition to post-mining activities should commence well before mining ceases and has committed to do so. MSC's interest in this area is acknowledged and Mangoola would welcome the opportunity to work with MSC on future land use options for the site, including matters such as potential changes to the Muswellbrook LEP to facilitate outcomes. As outlined in the EIS, Mangoola has committed to prepare a Post Mining Land Use Strategy as part of the detailed Mine Closure Plan and will consult with MSC as part of this process.

With regard to the mine closure planning process, as described in Section 6.17.4 of the EIS, the Mangoola approach to the mine closure planning process considers each phase of the mining operation, with closure planning commencing at the exploration and project phase, continuing through the operational phase and eventually to sign-off of rehabilitation and successful mining lease relinquishment. The level of detail required in a closure plan increases as the operation proceeds towards the planned closure date.

The existing Annual Rehabilitation and Mine Closure Plan for Mangoola Coal Mine will be updated to include the MCCO Project Additional Project Area. It will include details regarding final land use objectives and completion criteria, rehabilitation and final void management strategies as well as the process for engaging relevant stakeholders in the closure planning process to be adopted throughout the mine life. When the mine is within five years of the planned closure date the detailed closure planning process will be initiated. The detailed Mine Closure Plan will consider relevant policies and guidelines including MSC's Land Use Development Strategy.

The detailed Mine Closure Plan, will be developed in consultation with government, including MSC and other stakeholders, and will include details covering the evaluation of re-use opportunities for facilities, infrastructure and services on the site. The majority of demolition/decommissioning works will be planned and undertaken as soon as practicable following the cessation of mining, unless alternative post-mining uses are identified or proposed for these assets at the time. Given that the MCCO Project involves eight years of mining, this detailed closure planning process will commence within a few years of the commencement of mining activities under the new development consent. The Post Mining Land Use Strategy will be prepared as part of the detailed Mine Closure Plan.

Open Cut Voids - What are the rehabilitation "treatments" and revegetation plans for voids? How have these been determined? And what is their purpose (to what objectives and criteria)? Water management is an oblique activity and not an end use. What is the end use of the proposed pit lakes?

The rehabilitation treatments and revegetation plans for the MCCO Project final landform are described in Section 6.17.2 of the EIS and shown on Figure 6.41 of the EIS.

With regard to the final voids, the landform within the final voids is defined as all land that is not able to be rehabilitated to a subsequent use and will include highwalls, benches, ramps and the area where water will accumulate to form a pit lake. The highwall is a rock face which represents the edge of the mining area and extends down to the pit floor. It consists of a series of steep slopes and benches. The low wall, which is the face of emplaced overburden within the pit is planned to be shaped and rehabilitated and available for other land uses (i.e. either conservation or agricultural land uses) and so is not considered part of the final void.

A range of different final landform and final void configurations were investigated for the MCCO Project as discussed in Section 1.4.3 of the EIS. As an outcome from this process, the proposed mine design for the MCCO Project involves the movement of overburden from the MCCO Additional Project Area to the Approved Project Area. The proposed final landform has two final voids remaining at the completion of mining. The existing final landform and void for the approved mining area will be established generally as currently approved, however, as part of the MCCO Project it will be improved due to the application of a revised natural landform design, shallower slopes on the low wall and a reduced void area.

At the completion of mining, it is proposed that a second void will remain on the north-west boundary of the MCCO Additional Project Area.

The key design features and processes associated with the proposed final voids and surrounding landform are outlined below:

- The highwalls may incorporate a series of benches. The stability of the highwalls will be assessed by a suitably qualified geotechnical engineer and appropriate stabilisation measures such as battering down weathered material will be undertaken progressively (where required) to ensure long term stability of the highwalls post-mining.

- A safety berm will be established along the top of each highwall, designed to restrict inadvertent access to the highwalls.

- The highwall benches will be revegetated with a suitable native vegetative mix using local species, where appropriate, above the predicted final void water level. Highwall treatment will likely be undertaken to facilitate a safe and stable final landform and to soften the visual appearance of the highwalls.

- The low walls will be reshaped and revegetated above the predicted final void water level to a safe and stable slope.

As outlined in Section 6.7 of the EIS, a groundwater assessment of the final landform (at closure) indicates that the proposed final voids (non-back filled mine areas) will form long-term hydraulic sinks and will be comprised of two open water pit lakes. The final void water balance modelling found that these pit lakes will not spill as the predicted water level will reach equilibrium well below the spill point of the voids. Equilibrium levels would be reached slowly over a period of more than two hundred years. Final pit lake salinity levels would increase slowly as a result of evapo-concentration. After approximately 300 years the salinity of the final voids will have an EC of less than 10,000 µS/cm (or less than approximately 6400 mg/L assuming a factor of 0.64 to convert from µS/cm to mg/L). At this water quality the voids would be available for a range of uses including recreational uses and potentially aquaculture (if desired in the post mining landscape) as is discussed further in Section 6.17.5 of the EIS.

At this salinity, the final void pit lakes could support a range of fish species. Certain fish and other aquatic species can tolerate a broad range of water quality including the salinity values predicted for the final voids, including Silver Perch and Australian bass. The ANZECC Guidelines for Silver Perch identify a salinity of less than 3000 mg/L for freshwater and between 3000 and 35,000 mg/L for saltwater (Australian and New Zealand Environment and Conservation Council). Australian bass can tolerate 12,000 to 15,000 mg/L (Victorian Fisheries Authority). The proposed voids are therefore predicted to have salinity levels after 300 years that would cater for both of these species.

Refinement of the design of the final voids will continue throughout the life of the MCCO Project as the mining operations progress. A Final Void Management Plan incorporating the outcomes of specific final void groundwater assessments and identifying the use options for the final voids will be developed and included in the detailed Mine Closure Plan.

As discussed in Section 6.17.5 of the EIS, with regard to the proposed final voids, they are proposed to be water bodies in a conservation landscape. While alternative uses are not proposed as part of the EIS, the availability of waterbodies in the post mining landscape combined with the predicted water quality within the final voids provides the opportunity for a range of uses. Should such uses be proposed, they would require further detailed consideration at that time subject to the individual water quality needs of each land use, with the following discussion based on the outcomes of the final void salinity assessment completed as part of the Surface Water Assessment.

Table 6.34 in the EIS provides further analysis of potential alternative post mining land uses for the Mangoola Coal Mine, including the final voids.

Landforms are to be independently assessed as safe and stable compatible with surrounding natural landscape.
- By whom?
- What discipline and qualifications?
- How compatible?
- What if they are not? what redress is expected?

Final voids will be assessed by a qualified geotechnical engineer for stability to ensure they do not represent a safety risk:
- How is "safety risk" defined?
- What detail as to safety will be incorporated e.g., safety factors?
- What management will be undertaken to manage all void safety risks falls; and
- drowning

A similar issue was raised in the submission provided by the Resource Regulator and in this regard the detailed response to that issue as presented in **Section 3.6.1** is considered to adequately address the questions raised by MSC. Ultimately the relevant NSW government agencies will need to determine if the final landform meets the agreed completion criteria which will include a requirement to be safe, stable and non-polluting. Relinquishment of the mining lease and associated rehabilitation bonds will not occur until the relevant government agencies are satisfied with the rehabilitation of the site.

3.8.12 Greenhouse Gas

"The impact of GHG emissions are global in nature, as a result, apportioning the whole costs of CO2e associated with the MCCO Project overstates the cost to NSW. To estimate the impacts on NSW, it is appropriate to apportion a component of the total global costs to NSW. The approach adopted is to apportion the global GHG costs estimated to NSW using the ratio of NSW population to global population. On a global basis, the total estimated GHG cost is $29.1 million in NPV terms, see Table 18. Attributing the GHG costs based on the NSW population, consistent with the Guidelines, results in an attributed GHG cost of $0.03 million to NSW in NPV terms."

'Using this reasoning Greenhouse gasses released when coal from Mangoola is burnt should be similarly apportioned, CO2e of coal produced by the MCCO project would total around 100 million tonnes, or roughly 25 times that released during production, using Cadence Economics methodology this would equate to around $0.75 million, however on the polluter pays principle it should be paid at the source which would be a cost of $29 million dollars to the residents of NSW.'

Consistent with Australia's international obligations under the United Nations Framework Convention on Climate Change the level of greenhouse gas emissions attributable to the MCCO Project are measured by the Scope 1 and Scope 2 emissions. It is not a requirement nor appropriate as part of the economic assessment to measure or apply a cost to greenhouse gas emissions released from the use or burning of the coal produced by Mangoola (i.e. Scope 3 emissions).

The assessment of impacts and apportioning of costs associated with GHG emissions within the economic assessment for the MCCO Project is consistent with the *Guidelines for the economic assessment of mining and coal seam gas proposals* released by the NSW Government in December 2015.

‘The applicant should be required to prepare an Export Management Plan that ensures that any coal extracted from the development that is exported from Australia; is only exported to countries that are: a) parties to the Paris Agreement within the UN Framework Convention on Climate Change; or b) countries that have established policies to reduce greenhouse gas emissions to a level similar to the Paris Agreement. ‘

Mangoola has incorporated a range of measures into the MCCO Project design, with the aim of minimising GHG emissions and improving energy efficiency from the mining operation. Energy efficiency was a key driver for the design of the mine plan as one obvious consequence of reduced energy usage is a reduction in operating costs. Reduced energy usage also means reduced GHG emissions. Key measures included in the MCCO Project design to minimise emissions include:

- limiting the length of material haulage routes (where feasible), thus minimising transport distances and associated fuel consumption
- designing haul roads and haulage routes to minimise energy usage and therefore GHG emissions
- considering energy and fuel efficiency when selecting new equipment (it is noted that the MCCO Project primarily uses the existing equipment and infrastructure and limited additional equipment is required)
- scheduling activities so that equipment and vehicle operation is optimised.

Mangoola has also demonstrated a track record of managing GHG emissions from its mining operations and has an Energy Saving Action Plan in place. Mangoola has met its greenhouse gas reporting obligations under the *National Greenhouse and Energy Reporting Act 2007* (Cth.) and has also managed its greenhouse gas emissions in accordance with the Safeguard Mechanism.

Glencore, the owner of Mangoola, is committed to transitioning to a low-carbon economy, and has announced publicly that it will limit coal production broadly to current levels. The MCCO Project fits within Glencore’s production cap commitment as it is focused on sustaining current coal production, and is not proposing an increase in annual production or output.

Glencore recognises that over the next 20 years the percentage of the global primary energy mix supplied by coal is predicted to decline. As the MCCO Project will meet a continuing demand for thermal coal, and fits within Glencore’s committed production cap, Glencore considers that the MCCO Project is aligned with the global energy market.

As stated in the EIS (Appendix 25) report titled *Mangoola Coal Continued Operations Project, Observations from Glencore Coal Assets Australia regarding the Rocky Hill and Wallarah2 Cases on Climate Change and Greenhouse Gas Emission* (May 2019) Glencore and its respective shareholders are already taking action to reduce GHG emissions and promote the development and deployment of low-carbon technologies. Glencore supports and invests in progressing advanced coal technologies (including high-efficiency, low-emissions (HELE) and carbon capture, use and storage (CCUS) technologies) in Australian and other countries around the world, aimed at achieving significant and material reduction of emissions from coal consumption.

Glencore notes in MSC's submission that the MCCO Project should be required to prepare an Export Management Plan to manage greenhouse gas emissions which stated:

> *The applicant should be required to prepare an Export Management Plan that ensures that any coal extracted from the development that is exported from Australia; is only exported to countries that are:*
>
> *a) parties to the Paris Agreement within the UN Framework Convention on Climate Change; or*
>
> *b) countries that have established policies to reduce greenhouse gas emissions to a level similar to the Paris Agreement.*

A response to the above suggested condition from Mangoola and Glencore is provided below. For convenience it refers to the above condition as the Suggested Condition.

It is considered that there are important policy reasons as to why the Suggested Condition relating to the preparation of an Export Management Plan should not be imposed on the MCCO Project.

The condition requiring the preparation of an Export Management Plan, in the context of mining and GHG emissions, was raised by the Independent Planning Commission (IPC) in respect to United Collieries Pty Ltd (a majority owned subsidiary of Glencore, on behalf of the United Wambo joint venture partners) United Wambo Open Cut Coal Mining Project (SSD 7142) (United Wambo Project). On 2 August 2019 the IPC published on its website a statement which included a proposed draft condition of consent relating to the preparation of an Export Management Plan (Proposed Condition) (should the United Wambo Project be approved).

In a response to the IPC regarding the Proposed Condition the United Wambo Joint Venture submitted a statement outlining the reasoning as to why the Proposed Condition should not be imposed. On 29 August 2019 the IPC approved the United Wambo Project subject to Development Consent conditions which included the requirement for the preparation of an Export Management Plan (with some minor amendments to the draft Proposed Condition as exhibited). Despite the imposition of the Proposed Condition for the United Wambo Project, and consistent with this previous position provided to the IPC in relation to the United Wambo Project, Glencore would like to again highlight the reasons why the inclusion of, in this case, the Suggested Condition should not be applied to the MCCO Project (SSD 8642).

Aside from the direct impact that this will have on Mangoola, Glencore considers that the Suggested Condition would likely be perceived by other investors as creating a sovereign risk in investing in mining in NSW which may undermine achieving the aims of the Mining SEPP to 'promote the development of significant mineral resources' (see clause 2(b1) of Mining SEPP).

The requirement for a Suggested Condition, in effect, creates new public policy. The apparent objective of the Suggested Condition is to ensure that the Project's coal is only transported to countries which have committed, through being signatories to the Paris Agreement or some other equivalent policy measures, to take action to reduce GHG emissions. Any policy decision that seeks to regulate or constrain the trade and export of goods from Australia rests with the Commonwealth Government.

Glencore and Mangoola consider that the Suggested Condition discriminates unfairly against one particular project in one particular industry and is not an appropriate mechanism by which to achieve the objective of reducing GHG emissions on a global level. Such a regime is inequitable because a condition of this kind would only be imposed on the MCCO Project, which would result in inconsistent regulation between the MCCO Project and the other estimated 50 coal mines in NSW, not to mention other industrial developments that may produce Scope 3 emissions. If countries leave the Paris Agreement or otherwise adjust their policy settings in a manner that may be considered inconsistent with the objectives of the Paris Agreement, this may mean that the market for the Project's coal will diminish.

The Suggested Condition would apply to the MCCO Project despite the fact that Mangoola has no control over:

a) the policy actions of countries to which the Project's coal is exported; or

b) the manner in which the coal is ultimately consumed by the end customer, or the Scope 3 emissions that result from that consumption.

The Suggested Condition is inappropriate and represents a shift in public policy for NSW, Mangoola considers that the following impracticalities and problems exist with the Suggested Condition:

a) The Suggested Condition does not recognise the fact that coal sales are not just made directly to end user customers, but also to traders and other producers and third parties. Even with direct sales to end user customers, the destination country of the coal is not always known as some customers operate in multiple jurisdictions and desire the flexibility to determine the end location for the coal they have purchased. In addition, sales are often effected via brokers or online trading platforms where the identity of the buyer (and the end destination) is not always known at the time of sale. In the event of a sale to a coal trader, the ownership of the coal passes to the trader at the point the coal is loaded onto a vessel. From that point, an individual cargo of coal might be on-sold, and also blended, multiple times before it reaches the ultimate destination. Mangoola does not have control over what happens to coal from the MCCO Project that is on-sold, making compliance with the condition impossible to achieve.

b) In addition, coal from the MCCO Project may be blended with coal from other mines, at various points in the delivery chain, after which point Mangoola often has no control over the coal and is unclear how the Suggested Condition would apply in respect of MCCO Project coal that is blended with coal from other mines.

c) Coal sales are often forward sold (including coal sales that would occur as part of the MCCO Project). With this in mind, in a scenario where a country to which the Project's coal is exported leaves the Paris Agreement but a customer that is resident in that country has forward sold contracts still in place, the continued existence of such contractual arrangements may either render the Project non-compliant with the development consent or cause Mangoola to be in a position where it is unable to perform its obligations under those contracts.

On 12 October 2019 the Rix's Creek South Continuation of Mining Project (SSD 6300) was granted Development Consent by the IPC to expand and continue open cut mining operations at up to 3.6 Mtpa for an additional 21 years. Relevant to this discussion, the development consent conditions granted in respect to SSD 6300 <u>did not</u> include the requirement for an Export Management Plan or other similar condition. In their *Statement of Reasons for Decision* (IPC, 12 October 2019), after consideration of the information provided the IPC stated:

'353 The Commission finds the Department's recommended conditions of consent are adequate to require the application to reduce and report on how the Application is minimising Scope 1 and (relevant) Scope 2 emissions that are reasonably controlled by the Applicant, to the greatest extent practicable. The Commission finds that these conditions are adequate and responsible for a project of this size and nature given the current national and state policies.' Mangoola notes that DPIE will complete an Assessment Report for the MCCO Project which, after consideration of the information provided (ongoing), may also be accompanied by recommended conditions of development consent that they consider appropriate to the MCCO Project to assist the IPC when determining the

Application and to ensure any residual impacts are effectively mitigated. In consideration of the above, Mangoola respectively suggests that the imposition of the Suggested Condition should not be applied to the MCCO Project.

It should be noted that the NSW Government has recently introduced the *Environmental Planning and Assessment Amendment (Territorial Limits) Bill 2019* that will provide greater policy direction and will preclude consent authorities imposing export management plan type conditions. In the Second Reading Speech for the Bill, the Minister for Planning and Public Spaces outlined that a new section 4.17A would be inserted into the EP&A Act and stated the effect of this new section would be as follows:

> *'The bill principally clarifies that development consent conditions can only be imposed if they relate to impacts occurring within Australia or its external territories. It does so by inserting a new section 4.17A of the Environmental Planning and Assessment Act 1979 that identifies prohibited conditions which have no effect if they are part of a development consent granted under part 4 of the Act. This includes consent for State significant development. The prohibited conditions will include those imposed for the purpose of achieving outcomes or objectives relating to the impacts occurring outside Australia or an external territory as a result of the development, as well as the impacts occurring in the State as a result of any development carried out outside Australia or one of its external territories. This will prevent consent authorities from imposing conditions seeking to control, for example, downstream greenhouse gas emissions or other climate change impacts occurring outside Australia as a consequence of development that is carried out outside Australia.'*

The effect of the amendment if successfully passed means that it will not be appropriate to impose the Suggested Condition.

3.9 Roads and Maritime Services

3.9.1 Traffic and Transport

'Roads and Maritime have reviewed the Environmental Impact Statement prepared by Umwelt and dated July 2019, and the Traffic and Transport Report prepared by GHD and dated April 2019, and request the following additional information: 1. Details on the location of the car parking area for workers during the construction stage of the project.'

As described in the MCCO Project EIS construction laydown areas and construction workforce offices and facilities will be located within the MCCO Additional Project Area. The exact location of these facilities will be dependent on final designs and on the timing of construction, however, these facilities will be located within the MCCO Additional Disturbance Area generally within the areas as shown on Figure 3.11 in the MCCO Project EIS. Adequate access to and construction phase parking will be provided to cater for the peak construction workforce.

As discussed in Section 3.10 of the MCCO Project EIS the existing Mangoola Coal Mine site access will be used for the operation of the MCCO Project. However, during the construction phase, it will also be necessary to establish direct access to the MCCO Additional Project Area from Wybong Road, Wybong Post Office Road and Ridgelands Road. The management of construction access points will occur via a construction traffic management plan. The construction traffic management plan will be developed in consultation with MSC prior to the commencement of construction activities. The plan will identify the measures to be implemented to manage potential construction related traffic impacts; including construction access points and parking requirements.

Mangoola commits that there will be no car parking for construction workforce vehicles within the road easements of the existing public roads surrounding the site.

Access gates to construction points and car-parking areas will be set back a distance to at least, allow a full B-double sized truck to turn off the public road network without remaining encroached on the road easement.

'2. Consideration of any cumulative impacts from any other approved development in the area.'

The TTIA for the MCCO Project EIS included an assessment of the 2022 horizon year to account for the expected construction activity. As stated in the EIS there are no proposed changes to the existing maximum production rate or increases to the existing approved operational employee numbers above those that have previously been assessed and approved.

The traffic surveys undertaken for this study have captured vehicle activity associated with existing approved development in the area including Mangoola Coal Mine, Bengalla Coal Mine and the Mount Pleasant Mine.

An annual growth rate of 1.5% was applied to the current (based on 2017) traffic volumes to account for traffic growth in the area.

Therefore, the TTIA has appropriately considered cumulative impacts from other approved development in the area.

The analysis undertaken in the TTIA indicated that the intersections of interest are expected to operate with a good level of service through to the 2022 horizon year accounting for the vehicle activity associated with the construction of the MCCO Project.

'3. It is proposed that a temporary bypass road will be built during the construction of the Wybong Road/Big Flat Creek Overpass. Details of the design of this bypass are requested to assess its suitability for large vehicle access.'

The temporary bypass road to allow for the construction of the Wybong Road Overpass has been designed for the following:

- Guide to Road Design Part 3: Geometric Design Austroads 2010
- Design speed 60 km per hour
- Design traffic loading 3 x 105 Equivalent Standard Axles
- Two-way with two traffic lanes 3.0 m wide with 0.5 m shoulders for a total formation width of 7 m
- 3% cross fall
- Subgrade Californian Bearing Ratio of 4%
- 400mm structural pavement, comprising 250 subbase, 150 base
- 2 coat spray seal (14/10), 6.5 m wide
- Line marking and signage to AS1742.

The proposed temporary bypass would be suitable for use by OSOM vehicles to at least the same standard as the existing Wybong Road and as per Section 9.5 of the NSW Government Roads and Maritime Services Technical Manual, Traffic control at work sites, dated 27 July 2018 (Document No. RMS.18.898 Version 5.0). Local topography and vegetation conditions are such that there are significant clear zones on each side of the road that extend beyond the shoulder areas. Where appropriate, fixed signage and/or variable message signboards will be used and will provide contact details for the Construction Site Manager for the coordination of movements of OSOM vehicles along the diversion.

'4. The intersection of New England Highway/Denman Road (Sydney Street) has not been included in this assessment. The assessment states that workers travelling to the site from Muswellbrook would access the site via Bengalla Road or Kyuga Road, and workers from Singleton would use Thomas Mitchell Drive. No traffic, including heavy vehicles, have been distributed through the intersection of New England Highway/Denman Road (Sydney Street). Justification for omitting this intersection from the assessment is requested'

The requested additional intersection analysis has been undertaken and is provided as **Appendix 9**. The additional assessment concludes that the intersection of New England Highway and Sydney Street will continue to operate with an acceptable level of service, accounting for the construction vehicles and ongoing operation vehicles, associated with the MCCO Project.

3.10 Department of Primary Industries – Agriculture

3.10.1 Agriculture

'Biophysical Strategic Agricultural Land is the most productive land in NSW and is an extremely limited resource. DPI Agriculture does not support the use of this resource for biodiversity offset purposes. The project should be amended such that the proposed biodiversity offset areas avoid BSAL.'

As described in the MCCO Project Agricultural Impact Statement (AIS) and EIS the proposed Wybong Heights offset area has a total of 148 ha of BSAL mapped across it (based on regional government mapping). This includes a small area (<1 ha) associated with the Wybong Creek floodplain and a larger area of mapped BSAL on a basalt plateau. As described in the AIS, the larger area located on the basalt plateau area has not been used for cropping in the last 15 years, based on aerial imagery from 2004 to 2018. This indicates the presence of a limitation to cropping or other higher identity agricultural land uses.

At the time that the AIS was completed and included within the MCCO Project EIS no formal assessment or site verification had been undertaken for the areas of mapped BSAL on this property. As part of the response to submission phase this work has now been completed and is provided in **Appendix 10**.

Clayton Richards (Certified Professional Soil Scientist) of Minesoils has undertaken the BSAL Assessment in accordance with the Interim protocol for site verification of BSAL (OEH 2013) and concluded that all area of regionally mapped BSAL associated with the basalt plateau in the proposed Wybong Heights offset property is verified non-BSAL. These areas have been verified non-BSAL based on the assessment of the first 4 criteria in the Interim Protocol including slope, rock outcrop, unattached rock fragments and gilgai.

The area of mapped BSAL associated with the banks of Wybong Creek (<1ha) was not included as part of the work completed by this site verification assessment due to its small size and this small area has not be assessed. The inclusion of this small area of regionally mapped BSAL in the offsets proposed by the Project is not considered to have any significant impact on agricultural productivity of the property or region.

'The Mangoola Agricultural Impact Statement has been assessed and is not considered acceptable. Many of the requirements of the AIS are spread through the 25 Appendices and the main document or are not addressed.'

The AIS was based on the requirements of the Agricultural Impact Statement technical notes, 'A companion to the Agricultural Impact Statement guideline' (NSW Department of Primary Industries, April 2013). **Table 3.17** below (adapted from Table 2.1 of the AIS) identifies the sections where the AIS technical notes requirements are addressed.

Many of the aspects of the AIS draw on technical studies such as the surface water assessment, groundwater impact assessment, noise impact assessment, etc. Each of these studies are discussed in the EIS and are included as appendices to the EIS. To reduce replication of the same information the AIS provides a summary of factors relevant to agriculture for the purpose of completing the AIS and does not repeat the information contained elsewhere in the EIS.

Table 3.17 Overview of AIS Technical Notes and Where Addressed in AIS

Section of AIS Technical Notes	AIS Technical Notes Assessment Requirements	Relevant Section of the AIS
1.0	Project overview • Overview of the project and project description	**1.1, 1.2**
2.1, 2.2	Assessment of agricultural resources in the project area • Detailed soil assessment and description • Slope and land characteristics identifying agricultural land suitability and land capability classes of the pre-mining landscape	**4.2, 4.3, 4.4,**
3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.1.7	Agricultural resources within locality • Soil characteristics including soil types and depths • Topography • Water resources and extraction location • Vegetation • Climate and climate variability	**3.0**
2.3, 3.1.3, 3.1.5,3.2	Agricultural land use and production • History of agriculture in the project area for a minimum of 10 years and correlation between history and climatic background. • Management practices of agricultural enterprises in the project area • Agriculture support infrastructure in the locality. • Location and type of agricultural industry in the locality. • Agricultural enterprises in locality.	**5.0**

Section of AIS Technical Notes	AIS Technical Notes Assessment Requirements	Relevant Section of the AIS
2.4, 2.5, 2.6, 2.7, 4.1, 4.2, 4.3, 5.6, 5.7	Impact assessment • Land to be temporarily removed from agriculture, including the agricultural usage of the land, agricultural suitability and LSC. • Land to be returned to agriculture post mining, including LCS, evidence of feasibility, management requirements and land use type. • Land that will be permanently removed from agriculture (including offset sites), including expected decrease in LSC. • Agriculture undertaken on buffer or offset zones during life of project • Impacts on agricultural resources • Assessment of impacts on water availability and water movement • Assessment of socio-economic impacts • Discussion of capacity of rehabilitated land for the intended final land use • Planning for progressive rehabilitation	**6.0**
5.1-5.5	Mitigation and management • Project alternatives • Monitoring programs to assess predicted versus actual impacts • Trigger response plans and actions taken if required • Appropriateness of remedial actions to address and respond to impacts	**7.0**
6.0	Consultation	**2.5.2**

'There is no demonstration that the project attempts to avoid or remediate Agricultural Impacts. Mitigation measures in the projects documentation refer to Environmental Management Systems, which focus on soil, water, noise, air and biodiversity and not agriculture.'

A key finding of the AIS was that impacts to agriculture are considered low (see further discussion of cattle numbers, impact to sale yards and employment below).

The main impacts of the MCCO Project are impacts to the agricultural resources (e.g. soil, water, biodiversity and associated impacts such as noise and air) in the MCCO Additional Project Area. Therefore, the implementation of the EMS which will assist to mitigate these impacts is considered appropriate.

Another key mitigation measure is the progressive rehabilitation of the proposed additional mining area and is discussed in in Sections 3.3 and 6.17 of the EIS.

A discussion of the post mining land capability is included in Section 6.2 of the AIS. The proposed post mining land use for the mining area is native vegetation, final void and infrastructure. No agricultural land uses are proposed for the post mining landscape, as discussed in the AIS. Post mining land with Land and Soil Capability (LSC) Classes between 3 and 6 will be capable for native vegetation.

It is noted that as with current land management use practices at Mangoola Coal Mine, Mangoola will seek to continue to use adjoining land that they own, including areas of properties that might be purchased as part of this Project for ongoing agricultural land uses, such as grazing.

> 'Stocking rates (DSE/ha) or yields of fodder or grain crops (tonnes/ha) have not been supplied to inform gross margins used to determine the loss of agricultural production to the locality. The lack of data to give justifiable estimates of agricultural production weakens the rigour of the cost benefit analysis for the proposal.'

The AIS used the actual stocking rate of the mining area based on data collected from the current property manager to determine the impact to agriculture by the MCCO Project.

Fodder grains are not present in the areas affected by the MCCO Project and therefore no impacts will occur. The stocking rates presented as DSE per hectare are discussed below.

To further address this comment from DPI Agriculture, we have completed a further assessment using the NSW Department of Primary Industry Guidelines 'Beef stocking rates and farm size – Hunter Region' (DPI, 2006) (DPI Stocking Guidelines) to assess the impacts on stock numbers and production for the MCCO Additional Project Area as well as the proposed offset sites at Wybong Heights and Mangoola. This analysis is included in **Table 3.18**. It should be noted that the MCCO Additional Project Area and the proposed Mangoola offset site have some overlaps. To avoid double accounting of areas for the purposes of this analysis, the proposed Mangoola offset site areas contained in the MCCO Additional Project Area are included in the latter and excluded from the proposed offset site.

For assessment purposes it was assumed that LSC Classes 2, 3 and 4 areas are improved pastures which have a higher production capacity and would be used for vealer production. LSC Classes 5 and 6 are assumed to be native pasture and only suitable for weaner production. LSC Classes 7 and 8 are considered unsuitable for grazing. A production unit is a cow and calf with the calf being sold as either a vealer or weaner depending on land capability.

Table 3.18 Assessment of Impacts on Cattle Production

Area	Production System	Production Units
MCCO Additional Project Area	Vealer production on improved pastures (Units)	204
	Weaner production on unimproved pastures (Unit)	70
	Total	**274**
Proposed Mangoola offset site	Vealer production on improved pastures (Units)	0
	Weaner production on unimproved pastures (Unit)	95
	Vealer production on improved pastures (Units)	83

Area	Production System	Production Units
Proposed Wybong Heights offset site	Weaner production on unimproved pastures (Unit)	9
Total area proposed offset	**Total**	**188**

Based on the above analysis, in the MCCO Additional Project Area, land for potential 274 production units will be removed. The combined proposed offset areas will remove land for approximately 188 production units. In total using the DPI Stocking Guidelines assessment method T462 production units are calculated to be removed. In comparison the analysis undertaken in the AIS used actual stocking rates and found that approximately 560 head would be removed as a result of the MCCO Project (350 within the MCCO Additional Area and 210 from the proposed offsets). Further analysis of the assessment undertaken in the AIS is provided below.

Due to the current drought, the MCCO Additional Project Area has been destocked. As provided in the AIS, the average cattle number in the MCCO Additional Project Area is 350 breeders. According to the land manager, the calving rate is approximately 70%, resulting in an average of 245 production units.

In average years, approximately 150 head are run on the proposed Mangoola offset area, excluding the MCCO Additional Project Area. For the proposed Wybong Heights offset site, circa 140 breeders are present in average climate years. Assuming a 70% calving rate, on average 105 production units are present at the proposed Mangoola offset area and 98 production units at the proposed Wybong Height offset area.

The proposed Mangoola offset area was also been destocked between June and August 2018 because of the severe drought conditions, while the proposed Wybong Heights offset site herd has been reduced to 75 breeder as the dams and well on the plateau have run dry.

As calving rates can be variable, the production units calculated with the DPI Stocking Guidelines as presented in the table above and production units based on breeders on the land and a 70% calving rate are considered comparable.

As discussed in the AIS, a herd of on average 1,200 head are run across the Mangoola owned mine land. The MCCO Project would reduce that herd by 350 of these grazed within the MCCO Additional Project Area and 150 head within the proposed Mangoola offset site. Colinta Pastoral Company (Colinta) as a subsidiary company of Glencore utilises and manages grazing land owned by Mangoola and Glencore. This reduction will require Colinta to vary the way it operates on Mangoola owned land, however, it will not affect the ongoing productive use of the other Mangoola owned land. Due to the good quality of the southern grazing areas, outside of the MCCO Additional Project Area and proposed offsets, the Colinta operation will be continued but at a reduced scale or with a change to operations. Such a change could include purchasing calves from other operations for fattening on Mangoola owned land.

At the proposed Wybong Heights offset site, 40% of the herd will be lost, but grazing will be continued to be carried out in the floodplain areas adjacent to Wybong Creek. Colinta manages two additional properties in the Wybong Heights area. Both of these properties have extensive grazing land and in average years, on average 750 head of cattle are run across the all three properties.

For the larger Colinta cattle operation, the loss of breeders run on the MCCO Additional Project Area, proposed Mangoola and Wybong Heights offset sites make up 11% of the Colinta NSW cattle numbers and just over 1% of the Colinta Australian herd. Therefore, the MCCO Project is not predicted to result in a significant impact on Colinta's operations nor result in a significant loss of agricultural productivity from the region.

> 'There is no investigation into the cumulative effects of mining in general, and this project specifically, on the loss of agriculture in the locality and region as required by the Strategic Regional Land Use Policy — Guideline for Agricultural Impact Statements, October 2012.'

As required by the Guideline for Agricultural Impact Statements the AIS assesses potential impacts of the MCCO Project to agriculture in a site specific and regional context. This included an assessment of impacts on agriculture within the MCCO Additional Project Area, the proposed offset sites, the surrounding locality (10km diameter from centre of project area) and the region (Muswellbrook LGA).

In this regard the AIS assessed impacts to agricultural resources and enterprises from the MCCO Project as low. This is mainly due to the limited capability of the impacted land to sustain high impact agriculture (such as cropping), the relatively low cattle number going to saleyards from the areas of interest and the absence of impact to agricultural employment. For example, the AIS found that the impact to the local saleyards through the MCCO Project is considered negligible as for the worst case scenario, the reduction of cattle being sold at a saleyard is 1%. Consistent with the findings of the EIS no discernible impacts (i.e. as a result of air, noise, blasting emissions) are predicted for any agricultural enterprises located in the locality or region.

> The impact on Agricultural Employment in the region is not assessed beyond a statement that impacts are 'not anticipated'

The MCCO Project proposes to continue operations with the operational employee numbers staying within the maximum previously assessed and approved for the mine. Therefore, there is not predicted to be any additional strain on the existing agricultural workforce in the area due to the MCCO Project.

The agricultural work force employed through the grazing operation in the impacted area is low. Currently, 2.5 Full Time Equivalent (FTE) workers are employed to manage the cattle operation at the Mangoola owned land, in an average climate year this number increases to 3 to 4 FTE employees. In addition, a veterinarian is engaged for approximately three work days per year. A contract hay bailer may be engaged for a maximum total of two work days a year.

The proposed Wybong Heights offset site is part of a 4,451 ha large property. Management of this property employs 1.5 FTE workers. A veterinarian will, on average, be engaged for seven days a year and a spraying contractor for approximately five days a year. Spraying advice and general soil test advice is paid through purchase of product, such as feed and fertiliser, at the advice provider.

While there will be a reduction in total cattle numbers on the Mangoola owned land, there will continue to be agricultural production across much of the Mangoola owned land and ongoing agricultural employment will occur. A change in employment numbers, if required at all, will have a negligible impact on the agricultural workforce in the region.

The AIS demonstrated, that a reduction of cattle numbers sold due to the MCCO Project has a small impact to local saleyards (worst case scenario 1% decrease in cattle at the Singleton saleyard). Therefore, a loss of agricultural employment at the saleyards due to the MCCO Project is not anticipated.

3.11 NSW Health

3.11.1 Health

'We await the EPAs overall review of the AQIA to confirm the validity of the air quality assessment and the predicted impacts. We note that there is no evidence of a threshold below which PM is not associated with health effects and so HNELHD [Hunter New England Local Health District] supports best practice interventions to minimise PM emissions. The Noise Impact Assessment in the EIS predicts that the Project will increase noise levels such that voluntary acquisition rights will apply to seven residences and acoustic treatments will be required at nineteen residences to reduce noise levels inside the homes. It is advised that the proponent engage in clear and open consultation with the owners/occupiers of these residences to ensure they are aware of additional impacts and their options.'

Noted. Consultation with any potentially impacted residences was undertaken as part of a comprehensive stakeholder engagement program for the MCCO Project EIS. Mangoola will continue to engage with impacted residents as the project progresses though the assessment and determination process and will ensure they are aware of the predicted impacts on their residence and the available mitigation options.

3.12 Dams Safety Committee

'It is noted that MCCO have acknowledged that any dams required to be constructed for water management will be subject to assessment in accordance with Dam Safety NSW requirements, to determine if any will be Declared Dams. The DSC has no recommendations for the Mangoola Coal Continued Operations Project.'

Noted.

4.0 Community and Interest Group Submissions

As outlined in **Section 2.0**, 321 submissions were received from community and interest groups with 72% of these provided in support of the MCCO Project. In total 304 individual community submissions and 17 interest group submission were received. A response to the issues raised in these submissions is included in the following sections grouped by theme.

A number of the community and interest group submissions received were similar or had consistent or common themes. Where this is the case, a combined response has been provided to each theme under the heading Common Community and Interest Group Issues. For each common issue some examples of specific quotes from the submissions are provided to assist the reader to understand the nature of the issue raised. Specific issues, that is, where an issue was raised only once or is specific to a particular residence or property, have also been addressed and are provided in a separate section for each issue.

4.1 Air Quality

Issues relating to air quality were raised in 55 community submissions and three interest group submissions.

A detailed Air Quality Impact Assessment (AQIA) was undertaken as part of the EIS and was included in Section 6.5 and Appendix 9 of the EIS. The AQIA was prepared in accordance with the SEARs for the MCCO Project which required a detailed assessment of potential impacts in accordance with the Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW and VLAMP. Where relevant the findings from the AQIA have been used to inform the below response.

4.1.1 Common Community and Interest Group Issues

4.1.1.1 Cumulative Air Quality Impacts

Issues relating to air quality impacts especially cumulative impacts in the local area were raised in 49 community submissions. An example of the submissions relating to cumulative air quality impacts in the local area is provided below.

Community Submissions

'The Upper Hunter already has multiple mining operations which currently impact negatively on air quality – evidenced by repeated air quality exceedances. Any additional operations such as this project will only serve to exacerbate this issue.'

'This project will only add to the already very concerning and dangerous levels of air pollution, due to the cumulative impacts of the many existing mines in the area.'

The MCCO Project will result in emissions to air from a variety of activities including activities such as material handling, material transport, processing, wind erosion and blasting. These emissions will mainly comprise particulate matter (dust) from general mining activities, and to a lesser extent, diesel exhaust emissions and fume from blasting.

Mangoola understands that air quality is an important issue for the community and has designed the Project to minimise air quality impacts with a range of mitigation and management measures incorporated into the MCCO Project design.

These measures include:

- Reductions to the overall MCCO Additional Disturbance Area through optimisation of the Proposed Additional Mining Area and design of emplacement activities to reduce the area of out of pit emplacement required. This reduced the overall disturbance footprint for the MCCO Project and therefore the area of mining operations that could generate dust.
- Mine scheduling changes to reduce the overall intensity of mining equipment operating in the MCCO Additional Project Area. This means that there is less mining equipment in the Proposed Additional Mining Area than currently operating at full production at Mangoola Coal Mine, reducing the amount of dust generated by the equipment operating in the MCCO Additional Project Area.
- Limiting the length of material haulage routes (where feasible), thus minimising transport distances and associated dust generation and diesel emissions.
- Design of emplacement activities so that different emplacement locations can be used in different meteorological conditions to avoid operating in exposed areas in windy conditions that could increase dust generation, where practicable.
- Inclusion of temporary rehabilitation areas as part of the emplacement area design to reduce wind generated dust.
- Continued implementation of the air quality management practices of the approved Mangoola Coal Mine (e.g. through a high level of active dust control).

The closest mining development to the existing Mangoola Coal Mine is the Mount Pleasant Mine located approximately 9 km north-east. Local weather conditions means there is almost no transport of air emissions from the Mount Pleasant Mine towards the Mangoola Coal Mine area and vice versa. This is due to the prevailing winds which are typically from the northwest in winter and from the southeast in summer. Under these winds, the cumulative impacts of the Mangoola Coal Mine when combined with the other mines located closer to Muswellbrook are predicted to be minimal. The AQIA also determined that potential future changes to nearby developments such as Mount Pleasant Mine, Bengalla Mine and Mt Arthur Mine would not be significant enough to result in cumulative air quality impacts, due to the relative location of Mangoola. The assessment concluded that other mining operations in proximity to the MCCO Project have little influence on air quality in the area of interest around the Mangoola Coal Mine.

The AQIA also concluded that with the MCCO Project, cumulative dust levels and other air quality parameters are predicted to comply with the relevant criteria at all surrounding private residences.

4.1.1.2 Health Impacts from Poor Air Quality

Issues relating to health impacts from poor air quality and dust were raised in 33 community submissions and three interest group submissions. Examples of the submissions for health impacts are provided below.

Community Submissions
'I have concerns regarding the direct impact of coal operations on air quality and thereby the health of residents in the Upper Hunter.'
'Our airshed is already overburdened by existing mining operations with cumulative impacts including increased incidence of respiratory disease (especially asthma) and low birthweights for babies. We do not need or want to be increasing the footprint of existing mining operations. This will only lead to greater air quality issues and exceedances, putting our communities and their health at even greater risk'

Denman Aberdeen Muswellbrook Scone Healthy Environment Group

'Exacerbating air pollution, daily health alerts are already being issued and Summer is months away.

Wybong Concerned Landowners Group

'Our air quality compromised so that we worry about the long term effects this will have to our health and that of our children and grandchildren. We have air quality in this area that is some of the worst in NSW. The Department of Planning should not consider that this project could be approved and add to this problem.

As discussed in Section 6.22.1 of the EIS, the World Health Organisation identifies air pollution as a major environmental risk to health. The measurement and monitoring of air pollution in Australia is governed by the National Environment Protection Measure for Ambient Air Quality (Ambient Air NEPM) (NEPC 1998). The Ambient Air NEPM provides goals for carbon monoxide, lead, nitrogen dioxide, ozone, sulphur dioxide and particulate matter.

A key focus of the community, academia, industry and government agencies in Australia over the last several years, including a particular focus in the Upper Hunter Valley, is particulate matter. Particulate matter in air can include dust, smoke, plant spores, bacteria and salt. Human activities resulting in particulate matter include activities such as mining, burning of fossil fuels, transportation, agriculture, hazard reduction burning, incinerators, and the use of solid fuel for cooking and heating.

The size of particulate matter determines its potential impact on human health. Larger particles are usually trapped in the nose and throat and swallowed, whereas smaller particles ($PM_{2.5}$) may reach the lungs. Exposure to particle pollution is known to have an impact on human health, particularly for people with pre-existing health conditions. There is no known safe level of exposure, where there is not a potential for an impact on human health (WHO 2005).

The air quality guidelines adopted in NSW are those recommended by the EPA and are specified in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (EPA 2016). These criteria were set to be consistent with the Ambient Air NEPM (NEPC 1998). The Ambient Air NEPM stated that its desired environmental outcome was 'ambient air quality that allows for the adequate protection of human health and well-being'.

The VLAMP includes the NSW Government's policy for voluntary mitigation and land acquisition to address dust (particulate matter) impacts from state significant mining, petroleum and extractive industry developments. The VLAMP has air quality criteria in line with the NEPM standards and EPA criteria. These criteria set by the NSW Government have been used as the basis of the assessment of the potential impacts of health associated with particulate matter.

PM_{10} and $PM_{2.5}$ are the components of air borne particulate matter which are relevant to human health impacts. The NSW Government has set criteria for PM_{10} and $PM_{2.5}$ that are intended to protect human health. The AQIA concluded the following for the MCCO Project in relation to PM_{10} and $PM_{2.5}$ emissions:

- There are no private sensitive locations which are predicted to experience exceedances of the annual average PM_{10} and $PM_{2.5}$ criteria at any stage of the MCCO Project.
- Maximum 24-hour average PM_{10} concentrations are predicted to meet the 50 µg/m^3 criterion at all but one sensitive receptor location in all assessment years. This property is subject to voluntary acquisition under the existing approved Mangoola Coal Mine operations and is within the predicted noise voluntary acquisition zone for the MCCO Project.

- Concentrations of 24-hour $PM_{2.5}$ will continue to be variable from day-to-day. There are typically a few days each year when $PM_{2.5}$ concentrations exceed the EPA assessment criterion of 25 µg/m^3 which is largely influenced by wood smoke in the Muswellbrook region. The predicted 24-hour $PM_{2.5}$ impacts do not trigger the VLAMP air quality related voluntary mitigation or acquisition criteria.

- The MCCO Project is predicted to comply with the PM_{10} and $PM_{2.5}$ criteria specified in the VLAMP at all private sensitive receptor locations. Additionally, post blast fume emissions and diesel exhausts emissions from the MCCO Project are not expected to result in any adverse air quality impacts.

In regard to minimising air quality impacts, as discussed in the EIS, Mangoola is committed to effectively managing the air quality impacts associated with the MCCO Project and will implement a range of dust management measures for the key dust generating activities. These measures are currently implemented as part of the existing Air Quality Management Plan for the Mangoola Coal Mine and will continue to be implemented as part of the MCCO Project.

4.1.1.3 Amenity Impacts from Dust

Issues relating to dust from mining operations causing amenity impacts on residents were raised in 20 community submissions. Examples of the submissions for amenity impacts are provided below.

Community Submissions
'An example of this concern is that after bathing my young children at our property in Wybong there is a black film in the bath tub that has only appeared in recent years from the coal dust collected on the roofs of the house (this also goes into the drinking water to the property). The level of dust is unacceptable with the kind of rural amenity that people choose to live in this area for. I personally notice black dust on every exposed surface on the property at Wybong we visit and am concerned about my young children being exposed to coal dust in this volume'
'The Property is already impacted by excessive dust. The house (inside and out), veranda, pool and outdoor table and chairs are constantly filthy. The children's toys are not left on the back veranda as they are constantly covered in coal dust'

Amenity impacts from dust emissions are commonly associated with particulate matter (TSP) and deposited dust emissions. Mangoola conducts ongoing air quality monitoring for the existing Mangoola Coal Mine operations. The monitoring data was reviewed as part of the AQIA for the MCCO Project to determine background air quality levels. The following conclusions were made in regards to the background levels for TSP and deposited dust:

- TSP concentrations have remained below the EPA's assessment criterion (90 µg/m^3). An annual average of 50 µg/ m^3 was assumed for modelling purposes.

- Dust deposition has remained below the EPA's assessment criterion (4 g/m^2/month). An annual average of 2.3 g/m^2/month was assumed for modelling purposes.

The monitoring data shows that TSP and dust deposition concentrations have remained below the EPA's amenity assessment criterion during operations of the existing Mangoola Coal Mine.

The AQIA for the MCCO Project concluded that no private residences are predicted to experience exceedances of the annual average TSP criterion (90 µg/m^3) or the annual average dust deposition criteria (4 g/m^2/month) at any stage of the MCCO Project. Therefore, amenity dust levels are predicted to meet relevant criteria at all surrounding sensitive receivers.

As described in the EIS as part of Mangoola's existing operations, Mangoola go beyond the requirements of the Project Approval and offer surrounding residences a range of management measures to further reduce impacts of the operations. Such strategies include:

- filters for water tanks - first flush systems
- cleaning of water tanks
- cleaning of solar panels
- air-conditioning - provision, maintenance and electricity subsidies.

Despite the AQIA confirming that the MCCO Project will comply with all applicable air quality criteria as outlined in the VLAMP, Mangoola has committed in the EIS to continue to offer mitigation to private landholders. This includes the commitment to private landholders living within a 4 km radius of the active mining area will be offered an inspection and if deemed required cleaning of residential rainwater tanks once per year. Private landholders living within a 4 – 6 km radius of active mining operations will be offered an inspection and if deemed required, cleaning of residential rainwater tanks will occur every two years, upon written request by the landholder.

4.1.1.4 Emissions from Mining Equipment

Issues relating to air quality impacts due to emissions from mining equipment was raised in one community submission.

> **Community Submissions**
> 'The pollution from large mining equipment has to be accounted in the overall air quality that has been degraded since the start of mining in the area. With large excavators using 8000lt of diesel, mine trucks using 3000lt, dozers 800lt per day plus other ancillary machines it quickly adds up, but unlike modern road going diesel vehicles mining equipment don't have pollution mitigating devices.'

Emissions from diesel exhausts associated with off-road vehicles and mining plant and equipment have been assessed as part of the AQIA. As discussed in Section 3.3.2 of the EIS the MCCO Project proposes to largely use the existing equipment fleet that is already in place at Mangoola Coal Mine. The most significant emissions from diesel exhausts are products of combustion including carbon monoxide (CO), NO_2 and particulate matter (PM_{10} including $PM_{2.5}$). The NO_2 and PM_{10} (including $PM_{2.5}$) have been considered as part of the AQIA.

Modelling of the potential NO_2 concentrations associated with diesel use as part of the MCCO Project indicates a maximum 1-hour average concentration at the nearest private residence location of approximately 50 $\mu g/m^3$. With the addition of maximum background levels of 80 $\mu g/m^3$, the predicted levels readily comply with the criteria of 246 $\mu g/m^3$. Predicted annual average NO_2 concentrations at the nearest private residence are approximately 10 $\mu g/m^3$ or less. With the addition of conservative background levels of 21 $\mu g/m^3$, the predicted levels comply with the criteria of 62 $\mu g/m^3$. All other surrounding private residences are more distant and are predicted to have lower levels than those predicted at the nearest residence.

Additionally, as discussed in the EIS, fuel use efficiency will be a key criteria when allocating the existing trucks to the MCCO Project operations. New fuel use and emissions technology will be considered should any new trucks be purchased over the life of the MCCO Project.

4.1.2 Specific Air Quality Issues

A number of community submitters queried the air quality impacts predicted for their private residence. Tailored responses have been provided for these submitters below.

Air dispersion modelling was completed using various inputs including emissions sources based upon representative mine plan stages for the MCCO Project, meteorological data and background air quality data. The results were then compared to relevant EPA assessment criterion and the criteria contained within the VLAMP. The EPA and VLAMP assessment criteria are provided in **Table 4.1**. Air quality impacts occur when the best achievable air quality levels predicted for a private residence, are greater than the EPA and VLAMP criteria.

As stated in the EIS and responses in the sections above, the AQIA has concluded that all relevant air quality parameters for the MCCO Project are predicted to comply with the applicable criteria at all surrounding private residences.

Table 4.1 EPA and VLAMP Air Quality Assessment Criteria

Substance	Averaging Time	EPA Criterion	VLAMP Mitigation Criterion
PM_{10}	24-hour	50 µg/m³*	50 µg/m³**
	Annual	25 µg/m³*	25 µg/m³*
$PM_{2.5}$	24-hour	25 µg/m³*	25 µg/m³**
	Annual	8 µg/m³*	8 µg/m³*
TSP	Annual	90 µg/m³*	90 µg/m³*
Deposited Dust	Annual (maximum increase)	2 g/m²/month	2 g/m²/month**
	Annual (maximum total)	4 g/m²/month*	4 g/m²/month*

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).

** Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.

Residence 206 (Submission ID SE-92556)

Dust at 20 Yarraman Rd:

'We are already severely impacted by dust and Mangoola is proposing to come twice as close. Yet the dust modelling seems nowhere near criteria limits. This does not seem credible. On our sheet from Mangoola:

1. PM_{10} Annual average is 12ug/m³;
2. $PM_{2.5}$ is 5ug/m³.

How can this be right if according to the EA (main text p.190) the background level for $PM_{2.5}$ (annual average) is already 5.2 ug/m³?

Monitoring of $PM_{2.5}$ is carried out approximately three kilometres to the south of Residence 206 at a site referred to as D01. The data from D01 show that the annual average $PM_{2.5}$ concentrations were 5.7 µg/m³ in the representative meteorological year (that is, 2014).

Air quality modelling was carried out to predict existing and future $PM_{2.5}$ concentrations at all locations around Mangoola mine including at property 206. The modelling showed that existing annual average $PM_{2.5}$ concentrations at property 206 were 5.342 µg/m^3. This result compares well to the measured result of 5.7 µg/m^3 at D01. The slightly lower prediction at Residence 206 is expected given that this property is located further from Mangoola mine than D01 and that Mangoola mine is identified as a source of $PM_{2.5}$.

Annual average $PM_{2.5}$ concentrations at Residence 206 are expected to increase by 0.154 µg/m^3 with the Mangoola Continued Operations Project (see Appendix G of the AQIA). This predicted small level of increase is not apparent in the AQIA due to the presentation of rounded whole numbers. This increase would be a result of the progression of mining closer to property 206 however the concentration of 5 µg/m^3 is still below the EPA's air quality impact assessment criteria of 8 µg/m^3.

The predicted air quality levels at Residence 206 do not exceed the EPA or VLAMP criteria for health or amenity at any stage during the MCCO Project.

Residence 157 (Submission ID SE-69325)
'Dust levels which would be way above the Australian standards'

The air dispersion model identified the following predicted air quality impacts for Residence 157:

- Maximum 24-hour average PM_{10} of 46 µg/m^3 with a maximum incremental impact of 19 µg/m^3 from the MCCO Project in isolation
- Annual average PM_{10} of 14 µg/m^3 with a maximum incremental impact of 3.7 µg/m^3 from the MCCO Project in isolation
- Maximum 24-hour average $PM_{2.5}$ of 26 µg/m^3 with a maximum incremental impact of 3 µg/m^3 from the MCCO Project in isolation
- Annual average $PM_{2.5}$ of 6 µg/m^3
- Annual average TSP of 54 µg/m^3
- Annual average total dust deposition of 2.9 g/m^2/month.

The predicted air quality levels at Residence 157 do not exceed the VLAMP criteria. All results for air quality are also below the EPA criteria with the exception of 24-hour average $PM_{2.5}$. The EPA criteria for 24-hour average $PM_{2.5}$ was noted to be already exceeded by background levels prior to the AQIA for the MCCO Project.

Residence 144 (Submission ID SE-93451)
'The Air Quality Impact Assessment (AQIA) only considers the impact that the emissions have on a typical member of the community. Given my disability the impact of the dust emissions on me is greater. The threshold level at which an impact is assessed as being severe should therefore be lower'

The AQIA has assessed the potential of the MCCO Project to cause adverse air quality impacts by considering the impact assessment criteria noted by the EPA. These criteria are published in the EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2016).

Most of the EPA criteria are drawn from National Standards for air quality set by the National Environmental Protection Council of Australia (NEPC) as part of the National Environment Protection Measures (NEPM). For particulate matter, the EPA has developed assessment criteria from the NEPM for PM_{10} and $PM_{2.5}$.

The main aim of setting air quality standards is to prevent adverse health impacts from air pollution and to provide adequate protection for all Australians (NEPC 1998). Air quality standards and criteria (including those for PM_{10} and $PM_{2.5}$) are informed by scientific and technical data on public health and are regularly reviewed and revised as new scientific evidence on the effects on public health emerges.

The EPA does not specify different criteria for different sensitivities of population groups, such as those with a disability. Rather, the EPA criteria have set its criteria to provide protection for the whole of the population including consideration of sensitive population groups. This is done by setting criteria that include margins of safety to ensure protection of sensitive groups.

Residence 144 (Submission ID SE-93451)

'For 2011/2012 through to 2017/2018 in the National Pollutions Register, Mangoola mining operations reported annual PM10 emissions between 2,500,000 kg and 5,900,000 kg.

The AQIA estimated the PM10 emissions from the MCCO Project would range from 656,339 kg (Year 8) to 1,209,436 kg (Year 3)'

The estimated emissions in the AQIA will differ to the data reported to the National Pollutant Inventory (NPI) primarily because of different emission factors. The data reported to the NPI are based solely on the emission factors prescribed in the "Emission Estimation Technique Manual for Mining" (NPI, 2012). The data presented in the AQIA are based on emission factors from all relevant and contemporary sources available at the time of assessment including:

- NPI "Emission Estimation Technique Manual for Mining" (NPI, 2012)
- AP42 "Compilation of Air Pollutant Emission Factors" (US EPA, 1985 and updates).

The AP42 emission factors are more regularly reviewed and updated than the NPI factors and are informed by more recent scientific data relating to coal mine emissions. The AP42 emission factors are therefore more appropriate to be used for impact assessments where emissions are to be estimated as accurately as possible. It is acknowledged that ideally the best available emissions factors would be used for all reporting, however, particular government reporting processes (such as the NPI) require use of a specific methodology and this is required to be followed.

With regard to the MCCO Project AQIA, there were various outcomes which provided confidence in the estimated emissions for the impact assessment. In particular, the model performance evaluation showed that there was good agreement between the model predictions and measured data.

The potential change in air quality at property 144 has also been assessed. Monitoring of PM_{10} is carried out approximately three kilometres to the south of property 144 at a site referred to as D01. The data from D01 show that the annual average PM_{10} concentrations were 14 µg/m^3 in the representative meteorological year (that is, 2014). This is below the EPA criteria of 25 µg/m^3.

Air quality modelling was carried out to predict existing and future $PM_{2.5}$ concentrations at all locations around Mangoola mine including at property 144. The modelling showed that existing annual average PM_{10} concentrations at property 144 were in the order of 12 µg/ m^3. This result compares well to the measured result of 14 µg/ m^3 at D01. The slightly lower prediction at property 144 is expected given that this property is located further from Mangoola mine than D01 and that Mangoola mine is identified as a source of PM_{10}.

Annual average PM_{10} concentrations at property 144 are expected to increase from 12 µg/m^3 to 14 µg/m^3 with the Mangoola Continued Operations Project (see Appendix G of Jacobs 2019). This increase would be a result of the progression of mining closer to property 144 however the concentration of 14 µg/m^3 is still well below the EPA's impact assessment criteria of 25 µg/m^3.

Residence 144 (Submission ID SE-93451)

'The MCCO Project Air Quality Impact Assessment (AQIA) only considered a single year of meteorological data (i.e. 2014) which is poor baseline understanding the impact on my home.

It is my opinion that the choice of a single year, 2014, as 'typical' was subjective.

Consideration of a minimum 3 consecutive years of varying meteorology would have captured a more appropriate range of meteorological conditions of the local terrain and provided a truer reflection of dust emissions.'

The AQIA has followed the EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2006) for identifying the meteorological data to be used. Specifically, the EPA requires that impact assessments are "conducted using at least one year of site-specific meteorological data". In addition, the "Approved Methods" states that the data should be "correlated against a longer-duration site-representative meteorological database of at least five years (preferably five consecutive years) to be deemed acceptable". The meteorological data used for the assessment were selected from a review of five consecutive years of data. The process followed the EPA requirements and the 2014 data were subsequently selected based on:

- high data capture rate, meeting the EPA's requirement for a 90% complete dataset
- similar wind patterns to other years
- rainfall being slightly below the long-term average, and the preference was for a slightly drier than average year (for a more conservative approach)
- air quality conditions which showed similarities to other years and not adversely influenced by bushfire activity
- consistency with other recent air quality impact assessments.

In response to the submitters request, the potential effects of using additional meteorological data has been considered as part of this response to submissions. Meteorological data from three consecutive years (2014, 2015 and 2016) were subsequently used to simulate the potential contributions of the MCCO Project to local air quality. **Figure 4.1** shows the predicted annual average PM_{10} concentrations due to the Project using 2014, 2015, and 2016 meteorological data. It can be seen from these results that the contribution of the Project to local air quality (that is, PM_{10}) is expected to be similar from year-to-year. These results indicate that the conclusions of the AQIA will not change due to consideration of three consecutive years of meteorological data.

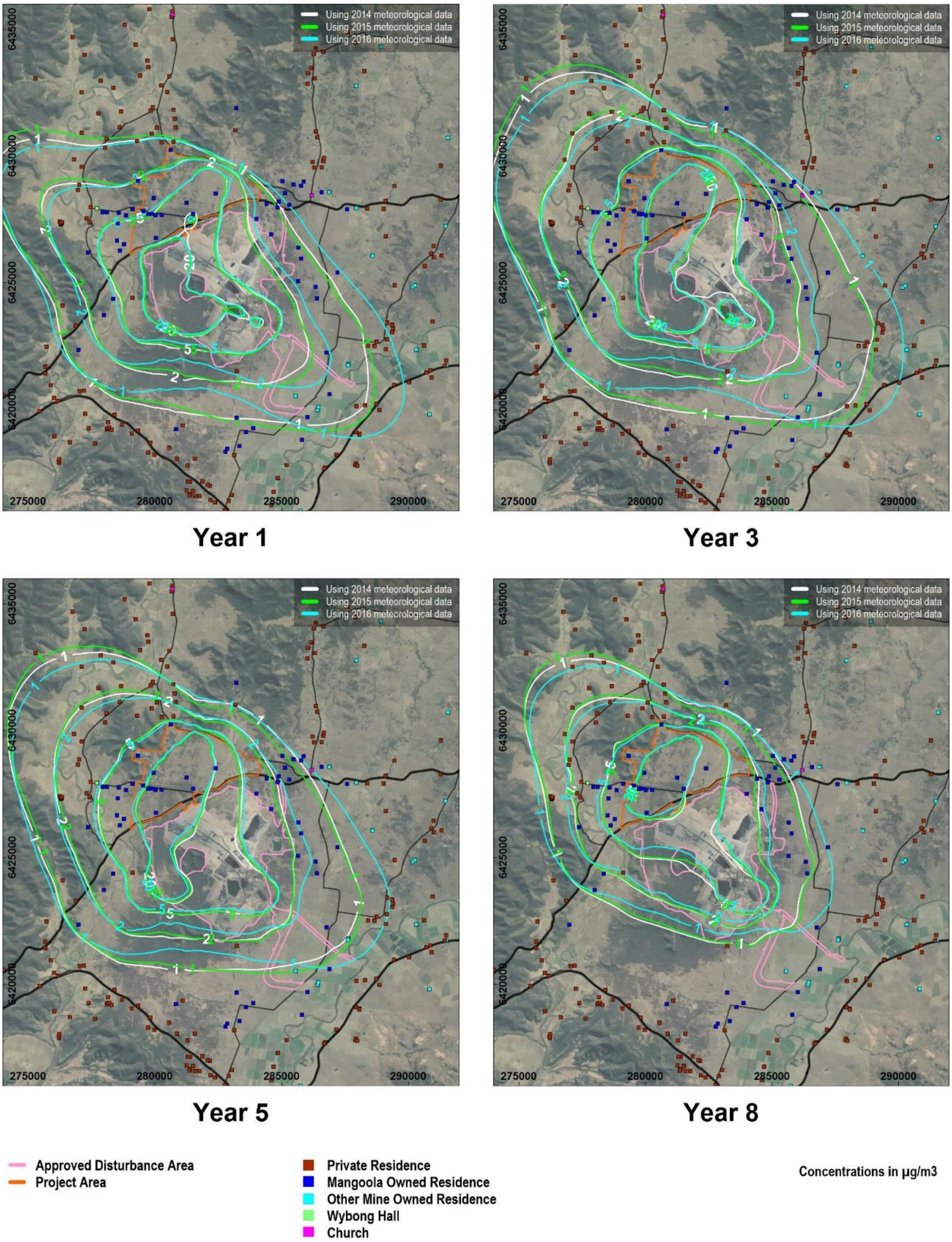


Figure 4.1 Predicted Annual Average PM_{10} Concentrations Due to the MCCO Project Only

Residence 130 (Submission ID SE-93723)

'We currently receive all of the mitigation options Mangoola Coal offer —Water & Air Conditioning Filters changed, Tank Cleaning etc however we are currently still being negatively impacted. If the extension was to be approved Jason Martin has confirmed that the dust, will be significantly worse however no further mitigation can or will be offered to us!'

The air dispersion model identified the following predicted cumulative air quality impacts for Residence 130:

- Maximum 24-hour average PM_{10} of 47 µg/m^3 with a maximum incremental impact of 21 µg/m^3 from the MCCO Project in isolation
- Annual average PM_{10} of 15 µg/m^3 with a maximum incremental impact of 4.1 µg/m^3 from the MCCO Project in isolation
- Maximum 24-hour average $PM_{2.5}$ of 26 µg/m^3 with a maximum incremental impact of 4 µg/m^3 from the MCCO Project in isolation
- Annual average $PM_{2.5}$ of 6 µg/m^3
- Annual average TSP of 54 µg/m^3
- Annual average total dust deposition of 2.8 g/m^2/month.

The predicted air quality levels for Residence 130 do not exceed the VLAMP criteria. All results for air quality are also below the EPA criteria with the exception of 24-hour average $PM_{2.5}$. The EPA criteria for 24-hour average $PM_{2.5}$ was noted to be already exceeded by background levels prior to the AQIA for the MCCO Project.

Further, it is noted that Residence 130 would be afforded voluntary acquisition rights due to predicted noise impacts from the MCCO Project. Mangoola has held discussions with the owners regarding their rights and options as part of the voluntary acquisition rights process. To this end, it was explained by representatives of the MCCO Project Team to the property owner that based on predicted impacts, and should the MCCO Project be approved, it would be anticipated that Residence 130 would be placed in the new development consent as a property subject to voluntary acquisition and mitigation upon request.

Regarding the statement that 'no further mitigation can or will be offered to us', the property owner may be referring to impacts based on the current approved operations. Residence 130 currently receives available mitigation or has been provided one off treatments in the past (installation of split system air conditioner), including regular contributions towards electricity and maintenance, annual tank cleaning (4 tanks) and installation and quarterly maintenance of first flush filters.

4.2 Noise

Issues relating to noise were raised in 51 community submissions and three interest group submissions.

A detailed Noise Impact Assessment (NIA) was undertaken as part of the EIS and is included in Section 6.4 and Appendix 8 of the EIS. The NIA was prepared in accordance with the SEARs for the MCCO Project which required a detailed assessment of the likely impacts of the MCCO Project in accordance with the Noise Policy for Industry (NPfI) (EPA, 2017) and VLAMP.

4.2.1 Common Community and Interest Group Issues

4.2.1.1 Noise Impacts on Local Area

Issues relating to noise impacts on the local area were raised in 38 community submissions and one interest group submission. Examples of the submissions relating to noise impacts on the local area are provided below.

Community Submissions

'The project will result in increased unacceptable noise impacts on the community and residents in proximity to the mine.'

'We are concerned about the unacceptable levels of noise near our property and in the once peaceful valley that our property resides in, the enjoyment of this quiet area is being diminished.'

Lock the Gate Alliance (ORG03)

'Mangoola mine has had a devastating impact on the rural community in Wybong. The noise from the mine has depopulated the district and those people that remain are stranded with intrusive and disruptive noise, but unable to leave.'

As discussed in Section 6.4 of the EIS, the NIA found that after the application of reasonable and feasible noise controls, the MCCO Project would have residual noise impacts on a number of private residences. Residual noise impacts occur when the best achievable noise levels predicted for a private residence are greater than the Project Noise Trigger Levels (PNTL). The PNTL for the MCCO Project are provided in **Table 4.2**.

Table 4.2 Project Noise Trigger Levels

Time Period	Project Noise Trigger Level $L_{Aeq,15minute}$ dB
Day	40
Evening	35
Night	35

The following residual noise impacts are predicted for the MCCO Project:

- Seven private residences exceeded the PNTL by more than 5 dB and were deemed under the VLAMP to fall within the significant impact category. Under the VLAMP these seven private residences would be afforded voluntary acquisition rights.

- 18 private residences (updated following the purchase of Residence 170 by Mangoola since EIS exhibition) exceeded the PNTL by more than 2 dB but less than 5 dB and were deemed under the VLAMP to fall within the marginal impact category. Under the VLAMP these 18 private residences would be afforded receiver mitigation rights.

- 31 private residences exceeded the PNTL by more than 1 dB but less than 3 dB and were deemed under the VLAMP to fall within the negligible impact category. Under the VLAMP these low-level exceedances do not warrant receiver based treatments or controls.

As part of the existing operations Mangoola has implemented a range of mitigation and management measures to reduce noise related impacts on surrounding private residences. This has included:

- Designing mining operations with consideration of minimising noise impacts through mine design, scheduling and equipment placement.

- Replacing reversing beepers on mobile equipment with 'quackers'.

- Personnel and contractors are to be vigilant in identifying and controlling operations and activities that might result in the generation of excessive noise. Noisy operations or equipment which are identified as affecting privately owned residences are to be reported to the supervisor promptly.

- Restricting, where possible, operations on outer dump faces or elevated dumps in sensitive areas and/or during adverse weather conditions.

- Trucks operating during the night time are restricted to operational areas, where possible, below the maximum elevation of the overburden emplacement areas.

- Using predictive meteorological forecasting and real-time noise monitors that incorporate automatic alarms so that proactive control can be implemented.

- Controlling mine noise at the source through the use of equipment with appropriate sound attenuation fitted and conducting annual sound power testing for equipment to confirm compliance to commitments.

- Installing and maintaining low noise rollers on conveyor systems.

- Covering the cost of running and maintenance of air conditioners for private residences located within the noise management zone for the existing operation.

With regard to Mangoola’s approach to the design and planning of the MCCO Project, noise modelling was completed on an iterative basis to enable the development of a mine plan that would minimise noise impacts as far as practicable. The detailed assessment included the consideration of a number of project alternatives. Multiple iterations of the mine plan were undertaken prior to Mangoola selecting the proposed mine plan, with the noise impacts of the MCCO Project reduced through this process. The mine plan selected is not the most optimal from an economic perspective, however, Mangoola selected this as the proposed project as it achieves an appropriately balanced outcome between mine planning, economic, environmental and social outcomes and results in reduced noise impacts when compared to some of the other project options assessed.

As part of the project planning process the noise controls that were found to be reasonable and feasible, and which contributed to the effective control of potential impacts, were incorporated into the MCCO Project design. These controls have been included as part of the noise model for the MCCO Project.

Key measures included in the MCCO Project design that have minimised noise include:

- Mine scheduling changes to reduce the overall intensity of mining equipment operating in the MCCO Additional Project Area. This means that there is less mining equipment in the new mining area than currently operating at full production at Mangoola Coal Mine, reducing the amount of noise generated by the equipment operating in the new mining area.
- Identifying activities that could be modified during times of adverse noise propagating meteorological conditions and the management of equipment during such conditions to minimise noise impacts.
- Developing designs for emplacement areas to enable alternative emplacement locations during adverse conditions, including the provision of day and night time emplacement locations so that night time activities can be undertaken in better shielded locations.
- The inclusion of bunds in strategic locations along key haul roads, where practicable, to shield trucks and equipment on exposed sections.
- Locating key haul roads below the ground surface to maximise topographical shielding to surrounding receiver areas, where practical.
- Incorporation of reasonable and feasible noise attenuation on key plant and equipment.

Mangoola is committed to managing noise impacts from its mining operations and has a comprehensive Noise Management Plan in place. In accordance with this plan Mangoola will continue to utilise a range of proactive and reactive noise management strategies informed by real-time noise and meteorological monitoring systems. Proactive strategies will include utilising meteorological forecasting to plan activities in advance of potentially adverse conditions and ongoing day to day planning of mining operations to reduce noise. Reactive strategies will include the modification or suspension of activities in response to a series of triggers due to noise enhancing meteorological conditions.

In summary, Mangoola acknowledge that the existing and proposed mining operations will result in noise impacts on the local community. To mitigate this impact Mangoola has changed the design of the project and has implemented a number of noise controls to minimise impacts. Where impacts over VLAMP criteria are predicted affected residences will have acquisition and/or management rights.

4.2.1.2 Sleep Disturbance

Issues relating to sleep disturbance were raised in eight community submissions and one interest group submission. Examples of the submissions relating to sleep disturbance from noise impacts is provided below.

Community Submissions
'Family members have experienced disturbed sleep because of mining activities from Mangoola Mine in the past and the possibility of this being an unbearable issue will increase.'
Wybong Concerned Landowners Group (ORG02)
'Many of us are subjected to noise at a level that awakens us, especially during the winter months.'

An assessment of noise level events which have the potential to cause sleep disturbance was completed as part of the NIA for the MCCO Project. Sleep disturbance is assessed by predicting noise levels from plant items known to generate noise that can stand out above the general mining or background noise continuum. Examples of these short-term noise sources which could cause sleep disturbance include excavator bucket noise, dozer track noise, rear dump truck exhaust and first pass loads into empty truck bodies. The assessment in the NIA modelled each of the potential short-term noise sources along with operational scenarios to identify the maximum possible short-term noise emission. The maximum short-term noise emission predicted was LAF,max criterion of 47 dB. The NIA found that there are no predicted exceedances of the LAF,max criterion of 52 dB at any private residences for the MCCO Project and as such, no sleep disturbance impacts are predicted.

4.2.1.3 Complaints Process

Comments relating to Mangoola having an inadequate complaints process for noise impacts were raised in eight community submissions. An example of the submissions relating to noise complaint management is provided below.

Community Submissions

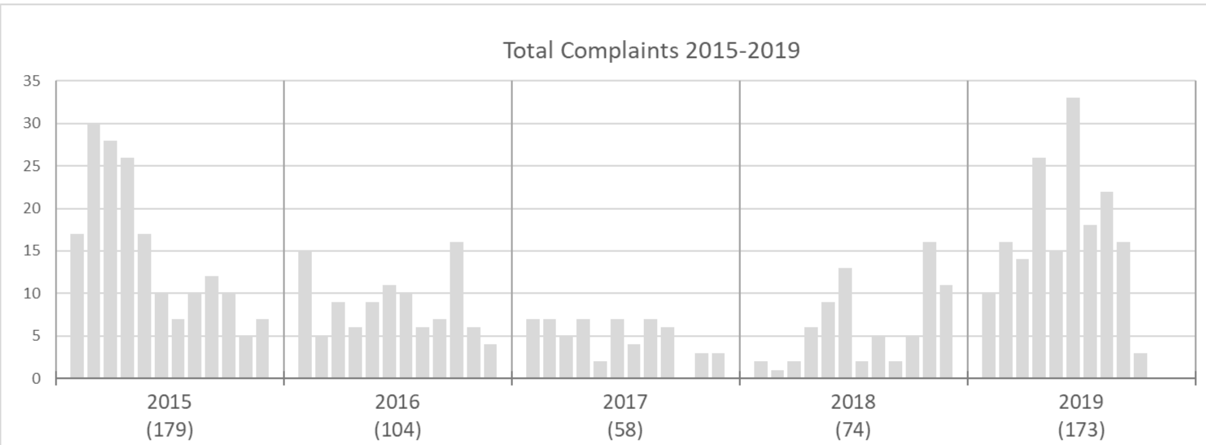
'When we complain we are usually told that the mine is compliant, and nothing is ever done.'

'we rang the Mangoola Community Hotline several times and there were no measures put in place to make the noise better until the EPA was called and within 10 minutes the operation was shut down'

'In 2018/2019 I lodged a total of 44 noise related complaints as a result of the current operations. At no time have my complaints, or my requests for more comprehensive noise monitoring been addressed to my satisfaction.'

Mangoola investigates all complaints and seeks to minimise its impacts, however, as noted in the comments, compliance with noise conditions does not mean that all community members will be comfortable with the level of noise. Where complaints are made about noise levels that are below the relevant criteria, Mangoola still look for opportunities to minimise noise and will change operations to achieve this where practicable.

Mangoola has a detailed management procedure in place to ensure that any community complaints for existing operations are recorded, investigated and communicated appropriately. This includes complaints received for noise, air quality and blasting activities, as well as, any other issues the community may identify. The Mangoola Complaints Database indicates that there were 588 complaints received in the five year period from 1 January 2015 to 6 October 2019 (see **Graph 4.1**). Of the complaints received in this period 90% (528) indicated that noise was the nature of the complaint. Other categories of complaints received during this time related to air quality (2%), blasting (5%), lighting (2%), traffic (1%) and other miscellaneous categories.



Graph 4.1 Total Complaints 2015 – 2019 (1 January 2015 to 6 October 2019)

As stated in the EIS, during the past eight years there have been a total of nine exceedances of the applicable noise criteria (two in 2017, four in 2016 and three in 2015). There have been no exceedances of noise limits in 2018 and 2019.

Mangoola's existing Project Approval (PA 06_0014) and EPL 12894 require an approved method for receiving, handling, responding and recording complaints. The Complaints Management Procedure for the existing Mangoola operations was prepared to satisfy approval conditions.

The following is a summary of the complaints handling process within the Complaints Management Procedure:

Mangoola maintains a 24 hour, 7 day a week Community Response Line (1-800-014-339) in accordance with EPL 12894

- the Environment and Community (E&C) team, Mining Supervisor (OCE) and other key Mining and CHPP management, including the Operations Manager, are immediately notified via text and/or email of any complaints received through the Community Response Line (CRL)
- OCE, CHPP Supervisor or member of the E&C team, will contact the complainant (if the complaint is not anonymous) to acknowledge receipt of the complaint within the timeframe requested by the complainant as per notification (text/email), or as close as possible to that timeframe, to discuss details of the complaint
- an investigation of the complaint is undertaken as soon as practicable once the complaint is received and the complainant advised of the findings generally within 48 hours of a complaint (or as soon as practicable)
- if necessary, a review of operations will be undertaken and operations may be modified to address any further potential noise impacts. The review of operations includes:
  - confirmation of location of operations including dumpling levels (RL), equipment type and CHPP status
  - review of real-time noise monitoring data from the nearest monitor to the complainant's location
  - review of weather conditions at the time of the complaint
  - listening to audio file recordings at the time of the complaint to identify any obvious noise impacts.

Complaints are investigated regardless of whether the noise monitoring alarm system has been triggered. Where necessary, operational changes are made to address the issues raised in complaints. Follow up communication with the complainant is undertaken to explain the outcome of complaint investigations. A monthly summary of complaints received is published on the Mangoola website.

4.2.1.4 Noise Monitoring

Comments relating to inadequate noise monitoring were made in two community submission.

Community Submissions
'We have received conflicting information over the years from Mangoola about how the mine is measuring the noise levels- at times we have been told they use mobile devices and at other times they listen with their ears!' 'monitoring apparatus and systems do not seem to alert them to any increase in impacts to our community. Mangoola has many systems to best understand their impact on us as a community but seem to rely on us informing them before, any change in their operation can begin.'

The existing noise monitoring network at the Mangoola Coal Mine includes five permanent real-time noise monitoring locations and three mobile units that are relocated on an as needs basis for noise management. Monitors are situated to consider topography, proximity to private residences and prevailing wind direction (NW and SE). Monitors provide 24-hr continuous information on the ambient noise environment around the monitoring site and generate quantitative data and audio recordings that can be used to determine the likely source of the noise and for comparison against noise impact assessment criteria. Each monitor is programmed to send an SMS to the E&C team, shift supervisors and other key operational personnel if a trigger noise level is reached. These trigger levels (Level 1 Alarm and Level 2 Alarm) are based on modelled noise levels and relevant noise impact assessment criteria.

In addition to real-time noise monitoring, an attended noise monitoring program is used to determine compliance against the noise criteria for the existing Mangoola Coal Mine. Monthly attended monitoring is conducted at relevant sensitive receptors to check compliance with the conditions of approval. The need for attended noise monitoring outside monthly compliance monitoring routine, can be triggered when three consecutive, valid, Level 2 alarms from the same monitoring location are received. When this occurs, monitoring is to be conducted within seven days by appropriately accredited and qualified acoustic consultants.

Ongoing noise monitoring for the MCCO Project will be undertaken in order to validate EIS predictions and monitor compliance with relevant criteria. The real-time and attended noise compliance monitoring locations for existing operations will be revised as necessary prior to the commencement of the MCCO Project to provide adequate coverage of the MCCO Project Area. The revised noise monitoring program will be included in the updated Noise Management Plan.

With reference to the comment about 'listening with their ears' when complaints are made or higher levels of noise are flagged by real-time monitoring alerts, the monitoring equipment used allows Mangoola personnel to listen to the noise being recorded at certain noise monitors. This can assist in determining if the noise is coming from the mine and assist in responses to address the impact. On occasion, mine personnel may visit locations surrounding the mine to listen to noise levels as well. Mangoola considers that a range of different monitoring techniques provides the most effective guidance in managing noise impacts.

4.2.1.5 Independent Noise Assessment

Issues relating to noise assessment were raised in one community submission.

Community Submissions
'I would like to see comprehensive independent noise assessments made to evaluate the impact of noise on local residents.'

The NIA undertaken as part of the MCCO Project EIS was prepared by Global Acoustics. The NIA was subject to an independent peer review by EMM which was included as an Appendix to the NIA (refer to Appendix 8 of the MCCO Project EIS). This process was voluntarily undertaken by Mangoola to ensure that the assessment was prepared in accordance with appropriate policies and guidelines, used appropriate methodologies, and provided accurate modelled predictions of the likely noise impacts associated with the MCCO Project. The peer review was undertaken in a staged manner so that peer reviewer input could be obtained at each key phase of the assessment (e.g. at model setup stage, reporting phase etc.). The peer review found that the completed NIA was of a high quality and was prepared in accordance with relevant professional standards.

The NIA as completed for and included in the EIS is considered to provide an appropriate assessment of the Projects predicted noise impacts on local residents and the surrounding area.

4.2.2 Specific Noise Issues

4.2.2.1 Construction Noise Impact

Residence 124 (Submission ID SE-93460)
'I also fail to see how there will not be any increase in noise during the construction phase when both construction and existing mining operations will be operating concurrently for approximately 18 months. How will the noise that will be generated from the construction phase be dealt with? i.e. will it be treated and/or dealt with under the new Project conditions or will Mangoola Coal be required to ensure that noise levels pursuant to the existing conditions are met for both the existing operation and construction?'

As discussed in Section 6.4.2.3 of the EIS, noise impacts during construction would largely result from noise generated during earthworks and other activities associated with the establishment of the Wybong Post Office Road realignment, construction of the haul road overpass over Big Flat Creek and Wybong Road and construction of water management infrastructure. Construction activities are anticipated to be completed over an approximate 16-month period prior to and during Project Year One. Construction noise modelling was undertaken to identify any potential noise impacts. A worst-case scenario was considered for construction noise modelling based on the predicted peak construction period and the maximum total machine operating hours. To account for noise that may be generated concurrently by the existing Mangoola Coal Mine, it was conservatively assumed that the existing site would be operating at approval limits.

The Interim Construction Noise Guideline (ICNG) (DECC, 2009) provides noise management criteria for construction activities. The ICNG noise criteria for construction activities are summarised in **Table 4.3**.

Table 4.3 ICNG Construction Noise Assessment Criteria Levels

Construction Hours	Noise Affected Criteria (dB)	Highly Noise Affected (dB)
Standard Construction Hours	45	75
Outside Standard Construction Hours	37*	NA

*Construction outside standard hours for the MCCO project is proposed to comply with the noise impact assessment criteria listed in PA 06_0014 for existing operations.

The construction noise assessment found that three private residences have 90th percentile predictions which exceed the standard noise affected construction criteria i.e. 45 dB. No private residences exceeded the highly noise affected criteria i.e. 75 dB. The three private residences which exceed the noise affected construction criteria are within the VLAMP voluntary acquisition zone for operational noise associated with the MCCO Project. No additional impacts were predicted on private residences due to construction noise associated with the MCCO Project. During non-enhancing weather conditions, and outside the peak construction period, the NIA found that construction noise is expected to be well below the noise affected construction criterion at all residence locations.

4.2.2.2 Private Residence Noise Results

Some community submitters queried the residual noise impacts predicted for their residence. Tailored responses have been provided for these submitters below.

There may be an expectation by some individuals that operations at Mangoola Coal Mine should not be able to be heard at all, at all times. NSW Government Policy and subsequent approvals of State Significant Development projects enable noise impacts up to criteria set by the NSW Government. This criteria may result in Mangoola being audible at certain times but still be operating well within the allowable impact criteria set by the Conditions of Consent.

Residual noise impacts occur when the best achievable noise levels predicted for a private residential receiver are greater than the PNTL. The PNTLs for the MCCO Project are provided in **Table 4.2**. The significance of the residual noise impact is then assessed as per the NPfI and VLAMP to determine the need for receptor-based treatment options. It is noted that different significance categories (negligible to significant) are specified in the NPfI and VLAMP. The VLAMP method is more conservative as it affords voluntary acquisition rights to private residences with predictions exceeding PNTL by more than 5 dB.

The results provided below for residual noise impacts on private residences are 90th percentile LAeq values; that is, the noise level that is likely to be exceeded 10 per cent of the time in the worst-case scenario.

Residence 157 (Submission ID SE-69325)

'The noise levels that will impact our property situated only 1km from the most western end of the proposed pit.'

The noise model identified the following predicted noise impacts for Residence 157:

- maximum residual noise impact of LAeq,15minute 37 dB
- maximum exceedance of PNTL of 2 dB.

Residence 157 has been assessed to have a negligible residual noise level under VLAMP. In accordance with VLAMP, this low level exceedance does not warrant receiver-based treatments or controls.

It is noted that whilst this residence is relatively close to the MCCO Project, it is well shielded by topography.

Residence 261 (Submission ID SE-80791 and SE-80790)

'When confronted about the 38dB (A) noise line shown on figure 3 in the combined noise contours all year all time period map in the summary booklet the contour line follows our whole property boundary fence, even as far as following the dips and corners which seem unlikely that noise will follow a boundary line, but seems convenient that Mangoola Coal Operations owns the property next to us and both properties are completely flat with no hills or rises within the contour of the land.'

The noise model identified the following predicted noise impacts for Residence 261:

- maximum residual noise impact of LAeq,15minute 38 dB
- maximum exceedance of PNTL of 3 dB.

Residence 261 has been assessed to have a marginal residual noise level under VLAMP. In accordance with VLAMP, this marginal exceedance warrants receiver-based mitigation rights. As described in the EIS, Mangoola will implement reasonable and feasible receiver based noise mitigation measures which may include measures such as double glazing, insulation or air conditioning to residences located within the active noise management zone upon written request.

With regard to the shape of the contour, it is in no way affected by property boundaries which were not considered in the noise modelling process. The shape is a reflection of the effect of topography between the MCCO Project and this residence. This effect occurs due to topography closer to the mine and not immediately adjacent to the property.

Residence 206 (Submission ID SE-92556)

'Our background noise levels are 22dB or lower (measured at a near neighbours by Mangoola mine consultant EMGA/Mitchell Mclennan in 2011). Our maximum noise level (Night) is 37dB and this will be mining noise. An increase in noise of 15dB means it will be almost 3 times as loud (2.8 times) and it will be mining noise not rural bushland noise. At 37dB under VLAMP this does not even qualify for mitigation. And even if it did what would you do in a house like this?'

Residence 206 (Submission ID SE-92557)

'We are told the worst case noise will be 37dB and the mine does not need to do anything to relieve the lived experience. Our background noise levels are 22dB or lower (measured at a near neighbour's property by Mangoola mine consultant EMGA/Mitchell McLennan in 2011). I have concerns that the noise modelling does not take into consideration the local topography of the area to the North of the mine. The noise comes across the low points in the range between us and the mine, travels across the creek flats hits Manobalai Hill and bounces back. While it is already too loud at our home, on the southern boundary of our property it is actually louder over the rest of our property further away from the mine. I worry that any increase in noise will be intolerable.'

The issues raised in this submission are quite technical in nature and therefore require a technical response. This technical response is provided below, however, in summary, noise can be measured in a range of different ways and period. For example you can measure the lowest noise over a long period of time (e.g. 9 hours) or the highest noise over a short period of time (e.g. 15 min) or the average noise level. Therefore, it is important when comparing noise levels that a like for like comparison is made. A more technical response follows.

It is acknowledged that background noise levels in this area are low. However, the referenced background noise level of 22 dB should be viewed with context regarding what the value represents. It is likely the background level reported is a Rating Background Level (RBL), which is a single-figure background level used to establish applicable assessment noise levels for use in noise impact assessments. The RBL is the median of a set of Assessment Background Levels (ABL). ABL are the lowest 10th percentile values of measured LA90 values for each assessment period (day, evening and night). LA90 values are the lowest 10th percentile of measured levels in each 15-minute interval. Therefore, RBL and ABL values represent the lowest of the low, or in other words, represent the lowest background levels measured in an assessment period. They do not represent typical background levels, and do not provide an indication of ambient noise level experienced the majority of the time (i.e. the ambient LAeq).

As stated above, RBLs are used to establish assessment noise levels, in this case the PNTL, which are used to evaluate the significance of predicted noise emissions. Where RBLs are found to be less than 30 dB(A) for the evening and night periods, as per the NPfI the RBL is set to 30 dB(A); and where it is found to be less than 35 dB(A) for the daytime period, it is set to 35 dB(A). For this residence, PNTLs of LAeq,15minute 40/35/35 dB are applicable for the day/evening/night periods. The highest prediction for residence 206 is LAeq,15minute 37 dB, which is 2 dB higher that the lowest PNTL. In accordance with the NPfI and VLAMP, this level of impact is considered negligible.

Manobalai Hill is located approximately 1.2 km to the north from Residence 206. While this hill contains a number of rocky outcrops, it has an average angle of less than 45 degrees. This average angle of the southern faces means the majority of acoustic energy arriving will be reflected up and away rather than back toward the source and, additionally, would be subject to scattering in multiple directions due to the complex surface shape. Further, due to the distance from Residence 206 to Manobalai Hill (approximately 2.4 km there and back), any reflected noise, which Global Acoustics consider most unlikely to occur, should not cause a significant increase in received noise levels at the residence.

Residence 172 (Submission ID SE-93407)

'The mine noise is keeping us both away at night...We have requested from Mangoola several times special noise testing at our property due to the unique formation on the hills behind us however our requests have been ignored'

The noise model identified the following predicted noise impacts for Residence 172:

- maximum residual noise impact of LAeq,15minute 35 dB.

There was no predicted exceedance of the PNTL for Residence 172. As such, there are no predicted residual noise impacts on this residence as a result of the MCCO Project. This is not to say that the MCCO Project may not be audible at this location, however, it is predicted to comply with acceptable levels set by relevant guidelines.

Residence 130 (Submission ID SE-93723)

'If the extension was to be approved Jason Martin has confirmed that the noise will be significantly worse (41 decibels in the day time and 42 decibels at night) however no further mitigation can or will be offered to us'.

The noise model identified the following predicted noise impacts for Residence 130:

- maximum residual noise impact of $L_{Aeq,15minute}$ 42 dB

- maximum exceedance of PNTL of 7 dB.

Residence 130 has been assessed to have a significant residual noise level under VLAMP. In accordance with VLAMP, this significant noise exceedance warrants voluntary acquisition rights. The owners of the property have been advised of this assessment outcome and of their rights and options with regard to voluntary acquisition.

Mangoola has held discussions with the owners regarding their rights and options as part of the voluntary acquisition rights process. To this end, it was explained by representatives of the MCCO Project Team to the property owner that based on predicted impacts, and should the MCCO Project be approved, it would be anticipated that Residence 130 would be placed in the new development consent as a property subject to voluntary acquisition and mitigation upon request.

Regarding the statement that *'no further mitigation can or will be offered to us',* the property owner may be referring to impacts based on current approved operations. Residence 130 currently receives available mitigation or has been provided one off treatments in the past (installation of a split system air conditioner), including regular contributions towards electricity and maintenance, annual tank cleaning (4 tanks) and installation and quarterly maintenance of first flush filters.

Residence 299 (Submission ID SE-90521)

'We are also very concerned about further noise impacts...We do not qualify for any mitigation even though we are impacted'

The noise model identified the following predicted noise impacts for Residence 299 residence:

- maximum residual noise impact of LAeq,15minute 35 dB.

There was no predicted exceedance of the PNTL at this residence. As such, there are no predicted residual noise impacts on this residence as a result of the MCCO Project. This is not to say that the MCCO Project may not be audible at this location, however, it is predicted to comply with acceptable levels set by relevant guidelines.

Residence 110 (Submission ID SE-93718)

'Models are not correct. Area should be treated as a rural not heavy industrial.'

As stated in Section 2.6 of the NIA a rural land environment was assessed. There is no reference to heavy industrial in the NIA or EIS and the rural nature of the surrounding land was considered in the NIA.

Residence 144 (Submission ID SE-93451)

'A more rigorous analysis of the location and movement of equipment over the life of the project to determine the true worst case (as compared to the report's 'typical worst-case scenario') is required for my home… This comprehensive review of the MCCO Project would have resulted in my home (ID144) triggering the Voluntary Land Acquisition and Mitigation Policy (VLAMP).'

Residence 144 provided a detailed submission that raised a number of matters relating to noise. These matters are addressed separately below and collectively contribute to the above question about the validity of the noise model and assessment outcomes for Residence 144. A response to each issue is provided in the following pages beneath each point raised in the submission.

Residence 144 (Submission ID SE-93451)

'In Year 1, on commencement of MCCO Project operations the two largest and loudest 996 Excavators (according to the equipment table and sound power data levels) are positioned within 3 kilometres of my home. As these Excavators and the established truck fleets establish initial surface operations they are encroaching towards my home. In Year 1 my home's noise prediction for night is 40dB(A). A noise prediction above 40dB(A) is considered significant and triggers the Voluntary Land Acquisition and Mitigation Policy (VLAMP).

I consider that the model is inadequate as it pertains to my home, as it relies on a fixed average location of the excavator/fleet sound points. These fixed positions do not reflect the worst-case scenario for mining operation in the more northern area nor the intensity of activity in these early years (Year 1 to Year 3) – the locations are too centralised and too far to the south.

The model location and depth of the sound modelling source locations is critical to the efficacy of the model and therefore the assessment of the impact on my home.

The results of a data model are reliant on the variable inputs of that data model. Given the limitations I have identified with the variable inputs, it is not appropriate for the MCCO Project to assess my home as being only marginally impacted by their proposed operations.

A true worst-case modelling scenario would include circumstances where the mining fleet is in the most northern locations on the upper mining benches and a second or third mining fleet is in close proximity (reflecting the mining intensity in that area). These noise source locations should then be modelled with worst case wind speed and direction and worst case temperature inversion occurrences. This is probable to increase the dB(A) reading for my home to between 42-45 dB(A). The current fleet modelling locations assumption are too simplistic and do not accurately reflect the true variability.'

Noise source positions in the models are intended to represent a typical worst case operating configuration with consideration of all residences that may be impacted by noise from the mining operation. While mining is a dynamic process, and equipment locations will vary over time, the scenarios assessed are considered appropriate to provide a good indication of the upper limit of noise emission levels.

The modelled depth of mining equipment is indicative of the actual operating depth of equipment during each mining stage in accordance with the MCCO Project production schedule.

The modelled intensity of mining assessed for each stage is consistent with the MCCO Project production schedule, and the quantity of equipment proposed to operate in the MCCO Additional Project. There are a range of factors that drive equipment distribution at a mine, including the need to give each piece of equipment and its associated truck fleet (where relevant) sufficient working space. Therefore to be realistic, the models must reflect how mining operations are actually run.

Model predictions presented in the NIA are 90th percentile levels determined using the cumulative distribution of results methodology. This method determines a noise level that is likely to be exceeded 10% of the time in each of the four seasons. A range of results is calculated for a comprehensive set of meteorological conditions, and frequency of occurrence of each of these meteorological conditions is calculated from historical meteorological data. The cumulative distribution of these results is analysed to establish a single value for comparison with criterion. As such, the methodology includes consideration of worst case wind speed and direction, and temperature inversion conditions.

Whilst the model layouts used in the EIS were considered appropriate, in response to the submitters request further modelling has been completed to evaluate whether concentrating noise sources in the north end of the pit results in a higher level of noise impact than assessed in the NIA.

Figure 4.2 shows the modelled NIA excavator positions in the MCCO Additional Project Area for Year 1 as blue circles. Additional excavator positions concentrated in the northern end of the pit are shown as red circles. These positions have a spacing of 250 metres.

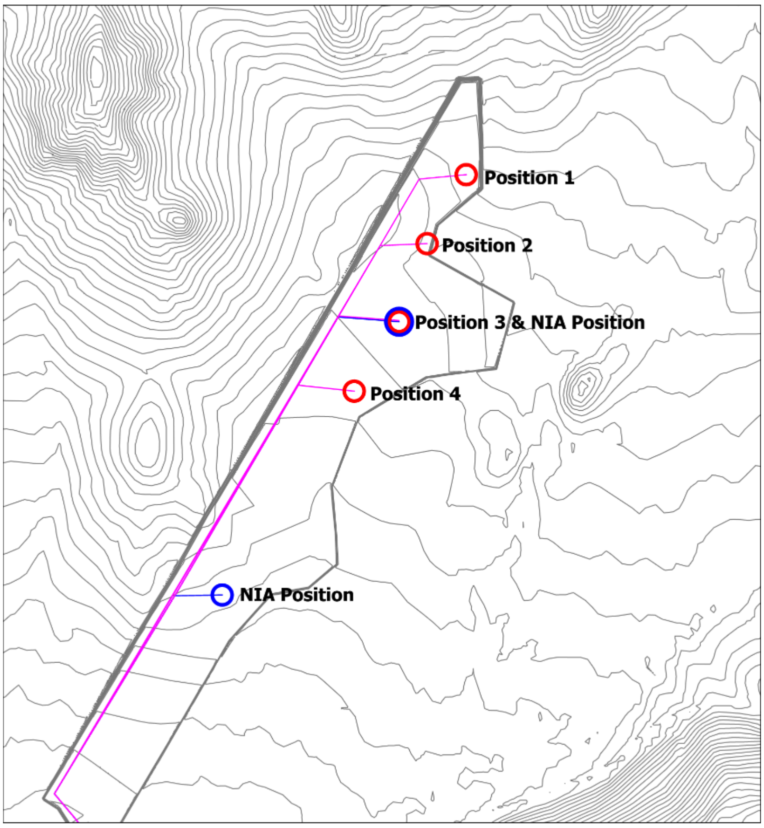


Figure 4.2 Year 1 Modelled Source Positions

Table 4.4 indicates which operating positions were included in four separate operating scenarios (Scenario 1 is the NIA base case (that is, the case for which results were presented in the EIS)).

Table 4.4 Year 1 Assessed Operating Positions

Excavator/Fleet	Position 1	Position 2	Position 3	Position 4
Scenario 2				
IB1 (996)	X	-	-	-
IB2 (996)	-	X	-	-
Scenario 3				
IB1 (996)	X	-	-	-
IB2 (996)	-	-	-	X
Scenario 4				
IB1 (996)	-	X	-	-
IB2 (996)	-	-	X	-
Scenario 5				
IB1 (996)	-	-	X	-
IB2 (996)	-	-	-	X

Notes: 'X' denotes excavator and fleet modelled at that position.

Table 4.5 presents Year 1 90th percentile model predictions for each of the assessed scenarios, and, the difference relative to the base case (NIA predictions). A minor increase of 1 dB relative to the NIA results was predicted for the evening period for one scenario in Year 1. This result does not cause an increase to the maximum prediction envelope for residence 144 of LAeq,15minute 40 dB, which is governed by the night period where no change was predicted. All other results in **Table 4.5** show no change or an improvement in noise results for the additional scenarios modelled.

Table 4.5 Year 1 90th Percentile Model Predictions LAeq,15minute dB

Scenario	90th Percentile Prediction			Comparison to Base Case		
	Day	Evening	Night	Day	Evening	Night
Base Case	38	38	40	NA	NA	NA
2	35	35	36	-3	-3	-4
3	37	37	39	-1	-1	-1
4	36	37	39	-2	-1	-1
5	38	39	40	0	1	0

Figure 4.3 shows the modelled NIA excavator positions in the MCCO Additional Project Area for Year 3 as blue circles. Additional excavator positions concentrated in the northern end of the pit are shown as red circles. These positions have a spacing of 250 metres.

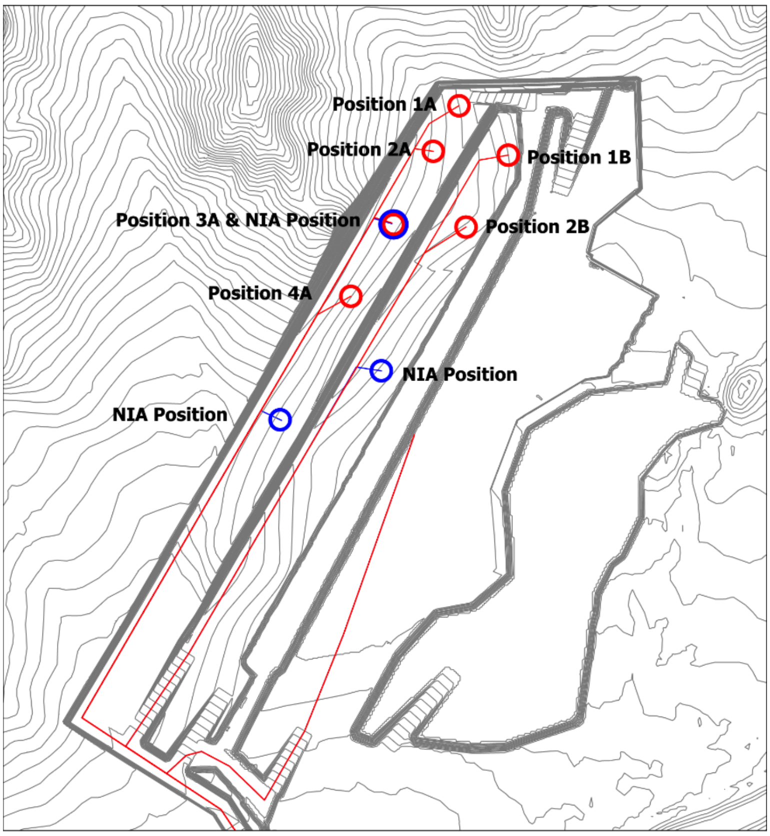


Figure 4.3 Year 3 Modelled Source Positions

Table 4.6 indicates which operating positions were included in five separate operating scenarios (Scenario 1 is the NIA base case).

Table 4.6 Year 3 Assessed Operating Positions

Excavator/ Fleet	Position 1A	Position 2A	Position 3A	Position 4A	Position 1B	Position 2B
Scenario 2						
IB1 (996)	X	-	-	-	-	-
IB2 (996)	-	X	-	-	-	-
94C (9400)	-	-	-	-	X	-
Scenario 3						
IB1 (996)	X	-	-	-	-	-
IB2 (996)	-	-	-	X	-	-
94C (9400)	-	-	-	-	X	-
Scenario 4						
IB1 (996)	-	-	X	-	-	-
IB2 (996)	-	X	-	-	-	-
94C (9400)	-	-	-	-	X	-
Scenario 5						
IB1 (996)	-	-	-	X	-	-
IB2 (996)	-	-	X	-	-	-
94C (9400)	-	-	-	-	X	-
Scenario 6						
IB1 (996)	-	-	X	-	-	-
IB2 (996)	-	X	-	-	-	-
94C (9400)	-	-	-	-	-	X

Notes: 'X' denotes excavator and fleet modelled at that position.

Table 4.7 presents Year 3 90th percentile model predictions for each of the assessed scenarios and the difference relative to the base case (NIA predictions). A minor decrease of 1 dB relative to the NIA results is reported for the evening period for all scenarios. Day and night predictions remain unchanged relative to the base case for all scenarios.

Table 4.7 Year 3 90th Percentile Model Predictions LAeq,15minute dB

Scenario	90th Percentile Prediction			Comparison to Base Case		
	Day	Evening	Night	Day	Evening	Night
Base Case	36	38	39	NA	NA	NA
2	36	37	39	0	-1	0
3	36	37	39	0	-1	0
4	36	37	39	0	-1	0
5	36	37	39	0	-1	0

The results of this additional modelling show the scenarios assessed in the NIA are generally representative of worst case operating configurations, and concentrating equipment in the northern end of the pit does not increase overall predicted noise impact for Residence 144 relative to that predicted in the NIA. The additional modelling shows the scenarios assessed in the NIA are generally representative of worst case operating configurations, and concentrating equipment in the northern end of the pit does not increase overall predicted noise impact for Residence 144 relative to that predicted in the NIA.

A two year resolution for the interval between assessed mining stages is shorter than is typically assessed for mining NIA's. The mining configurations assessed for Year 1 and Year 3 of the MCCO Project are considered adequate for the purpose of predicting maximum likely noise emission. Mangoola is committed to implementing mitigation controls in order to meet noise criteria at all stages of the mining operation.

Residence 144 (Submission ID SE-93451)

'In Year 3 (through to Year 5) there is a significant increase in mining equipment allocated to the new pit areas of the MCCO Project. Over 60% of the mining equipment fleet, largely constituted by the loudest equipment, is now located in the new pit areas of the MCCO Project. Given this concentration of equipment, the location of the sound modelling source locations at average positions in the central part of the MCCO Pit is inadequate.

In Year 3 to Year 5 my home's noise prediction for night is 39dB(A). The very minor drop in the noise prediction (from Year 1 40dB(A)) appears to rely on the noise source points being located on the lowest benches and therefore the noise being shielded by the (only) ridgeline which separates MCCO from my home. The model is inadequate as it relies heavily on assumptions as to shielding effect of the ridgeline. There is no baseline data to support this hypothesis. The coupled assumption of noise shielding by the ridgeline and failing to account for likely variances in the mining operation fleet locations is inadequate for making the determination of 39dB(A) for Year 1 to Year 5.

As this is the time frame of most concern to me, the model is too simplistic and inadequate as it pertains to my home.'

The increase in mining equipment in the MCCO Additional Project Area in Year 3 increases the combined total sound power of equipment in that area by 5% relative to Year 1, which is considered minor. Total sound power is the logarithmic sum of the individual sound powers of all items of equipment on site at a given point in time. It provides a measure of the total potential acoustic energy that may be emitted by a site. Further increases in Years 5 and 8 are also minor, and equate to an additional increase in combined sound power of just 1%.

Model predictions in Years 3 and 5 are 1 dB lower than predicted for Year 1. A minor decrease is to be expected, as increased shielding is provided by the pit walls as mining progresses and becomes deeper in the pit, and the shielding effect of the intervening ridge of land also increases as mining moves closer to the barrier. The predicted decrease in Year 8 relative to Year 1 is 3 dB, which is a result of increased barrier attenuation being provided by the highwall and the intervening ridge of land.

EMM conducted an attended noise monitoring survey at various locations to the north-west of Mangoola Mine on a weekly basis between 7 June and 26 September 2019. A key objective of this monitoring was to test the effect of the ridge line on noise impacts from Mangoola Coal Mine. The key assessment outcomes include the following:

- Measurement locations were established on the south side and north side of the intervening ridge adjacent property 144. The northern location was located as close to property 144 as possible. The southern location was located as close to the ridge as possible in the same direction from Mangoola Mine at property 144. Simultaneous measurements were taken at each location on a weekly basis, during the night period, on 11 occasions during the survey, primarily during winter months. During periods when noise from Mangoola Mine was enhanced to the north due to atmospheric conditions, the difference in measured LAeq between the two positions was typically in the range 9 to 12 dB. Predicted differences in LAeq between those locations ranges from 7 to 11 dB, which is considered quite a good correlation between measured and modelled results. This exercise serves to validate the shielding effect of the ridgeline, and demonstrates that attenuation corrections applied by the model are of the correct order of magnitude.

- Attended monitoring results demonstrated compliance with current approved noise limits at Residence 144.
- Mangoola Mine noise contributions complied with current approved noise limits at all monitoring locations during the 15-week monitoring period.

As noted above, the monitoring program completed by EMM serves to validate the shielding effect of the ridgeline and demonstrates that the shielding effects reported by the model are measured in the environment.

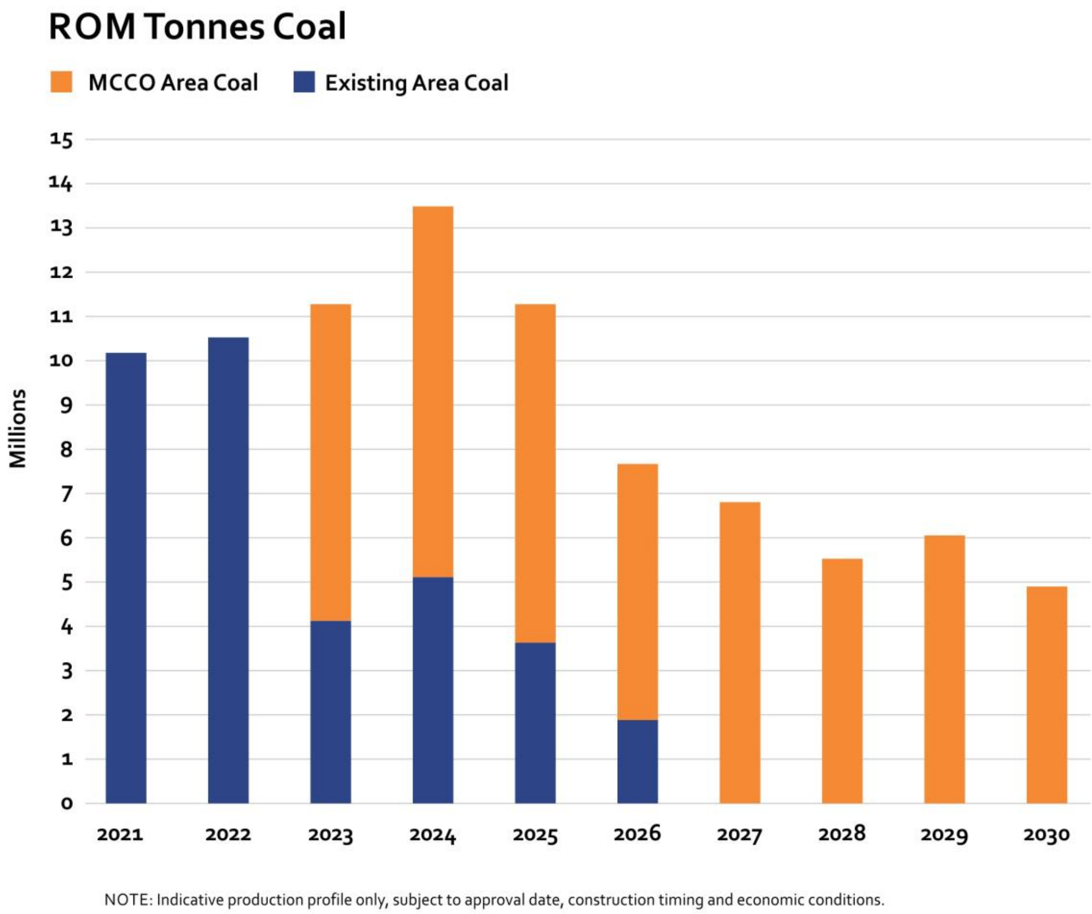
Residence 144 (Submission ID SE-93451)

'In Year 5, when my home is assessed at 39dB(A) all mining activity for Mangoola Coal is now located in the MCCO Project area and operating at levels of 13.5Mtpa ROM Coal Production. This is the equivalent of all the current Mangoola Coal annual production. Adding to this in Year 5, the MCCO Pit spoil dumps are at full height and are encroaching from the west in the direction of my home. No allowance appears to have been made in the NIA for the increased activity of the trucks in and around the dumps, and particularly with regard to the now predominate dumping by trucks at height and in a progressively easterly direction (the direction of my home). The NIA does not appear to give appropriate weight to the height of the spoil dump. Given proposed production rates, it is likely that the spoil dump height at this time will be significant and will be close in height to the ridgeline and even exceed the ridgeline height. The modelling and the analysis appear to be silent on this consideration.'

In accordance with the production schedule for the MCCO Project, significantly less than 13.5 Mtpa ROM coal will be extracted from the MCCO Additional Project area in Year 5. The 13.5 Mtpa is the peak production rate for which approval is being sought and does not represent an annual production rate. An indicative production profile for the MCCO Project was included in Section 3.3.1 of the EIS and is reproduced below as **Graph 4.2**.

The Year 5 model does account for activities on the overburden emplacement areas, and trucks are modelled hauling to and dumping on the highest emplacement areas. The assertion that the emplacement heights will be close to or even exceed the ridge height is incorrect. Dump height remains 40 vertical metres lower than the absolute lowest point on the ridge line, and approximately 120 metres lower than the lowest portion of the ridge located between the MCCO Additional Project Area and Residence 144.

Modelling takes full account of the operating elevations of equipment, surrounding topography and meteorological effects.



Graph 4.2 Indicative Production Profile

> **Residence 144 (Submission ID SE-93451)**
>
> 'Despite assertions that ROM Coal Production will decrease to 6.0Mtpa, the NIA for Year 8 is unlikely to be accurate for a 13.5Mtpa ROM Coal production rate (for which this approval is being sought). According to the NIA, any increase in production or change in production timelines is proposed only to be dealt with by 'reasonable and feasible' mitigation measures. This places me in a position where I am solely reliant on Mangoola Coal's mine management practices during the years of operation of the MCCO Project. I am particularly vulnerable in the years of the project when mining operations intensely concentrated at the base of the ridgeline less than 2km in distance from my home.'

The maximum ROM coal extraction rate sought for approval over the life of the MCCO Project is 13.5 Mtpa. However, in accordance with the proposed production schedule provided in Section 3.3.1 of the EIS and reproduced above as **Graph 4.2**, ROM coal extraction rates vary year to year and will decrease over the life of the project, particularly once all operations move across to within the MCCO Additional Project Area. The maximum production achievable from the proposed additional mining area is affected by the physical constraints dictated by MCCO Additional Project Area and the conscious decision to reduce the mining intensity following iterative constraints analysis during the mine planning phase, with a reduction in noise impacts to proximate receivers a key consideration in the mine plan and schedule proposed.

Residence 144 (Submission ID SE-93451)

'No allowance has been made in the NIA for the combined operating sound power of multiple mining loader, dozer, drill and truck units. The aggregate of the mining units can have a combined operating sound power of 125dB(A) – 127dB(A), which is far in excess of the stated values for individual mining units. This is further intensified when one to three fleets are concentrated as outlined in all of the MCCO operating assumptions.

The sound power data in the NIA fail to consider this effect which I consider is to be of critical importance in modelling the impact on my home.'

The assertion that the combined operating power of multiple pieces of mining equipment was not considered in the NIA is incorrect. While the NIA lists individual sound powers for each equipment type, which is standard practice, each model scenario conservatively considers all equipment to be operating concurrently, at full power. Therefore, the effect of the combined sound power of all equipment is included in model predictions.

Residence 144 (Submission ID SE-93451)

'The NIA only refers to a 'typical' worst case scenario. This appears to be an attempt to limit the worst-case scenario that may affect adjacent properties such as my home. Given that the noise levels that impact my home are consistently on the VLAMP limits, limiting the model to a 'typical' scenario appears to be an arbitrary construct that is designed to advantage the MCCO Project at my expense.'

The 'typical' worst case scenarios assessed represent exposed operations that could occur for reasonable periods of time. Model predictions presented in the NIA represent the upper range of noise levels that may occur during periods of strong meteorological enhancement, in combination with equipment operating in exposed locations. During periods of lesser meteorological enhancement, when weather effects mitigate noise propagation, noise emission levels should be less than those presented in the NIA. As described above, results of additional modelling show the scenarios assessed in the NIA are representative of worst case operating configurations, and the scenarios assessed in the NIA are generally consistent with the highest predicted levels for a range of operating configurations.

Residence 144 (Submission ID SE-93451)

'My retained mining - noise expert has advised me that a more comprehensive analysis of the fleet mix, fleet positioning and fleet mining depth assumptions is required. These assumptions need to be matched to the revised combined power estimates. This is particularly critical for Year 1 to Year 3 of the MCCO Project. This comprehensive analysis should also reflect a robust approach to the equipment positioning in locations of 500m – 1,000m further to the north than the positions assumed in Figures B-1, B-2 (and even B-3) Modelling Source Locations Year 1, 3, 5 respectively.'

As described above, additional modelling has been completed as requested by the submitter. A range of operating positions at 250 metre intervals were assessed in the northern end of the MCCO Additional Project Area, approximately 500 to 1,000 metres further north than modelled for the NIA. The models include an appropriate fleet mix that is consistent with the proposed mining fleet, suitably representative equipment positions, and includes combined sound powers for all equipment operating concurrently at full power. This has confirmed that there is no change to assessment outcomes for Residence 144 as a result of this additional evaluation.

Residence 144 (Submission ID SE-93451)

'I am certain that when this comprehensive analysis is matched with the worst case weather conditions that it will demonstrate the sensitivity of mining fleet positioning in the MCCO Project to the increased noise impact on my home.'

As described previously, consideration of worst case weather conditions is included in the cumulative distribution of results approach applied to the NIA. The NIA is comprehensive and has been prepared in accordance with NSW noise policy and guidelines. Additional modelling as requested by the submission shows that mining fleet positioning does not change the maximum predicted noise impact for Residence 144 and in many scenarios resulted in minor reductions.

Residence 144 (Submission ID SE-93451)

'Given the emphasis that the NIA places on the ridgeline as a "natural barrier that will mitigate noise propagation to the north and north west of the proposed Additional Mining Area" I would consider that as a minimum Mangoola Coal should have been undertaken extensive unattended noise monitoring in these locations to validate the assumption and methodology of the noise model. Noise monitoring locations NC02 and NC10 which are used to obtain the baseline data for the noise model are NOT located to the north of the ridgeline.

As no unattended monitoring data is available to the north of the ridgeline, I do not consider that Mangoola Coal should be able to rely on the assumption that the ridgeline mitigates noise propagation in their NIA.'

A list of perceived issues follows the primary assertion above, each of which is reproduced below in italics. A response to each issue is provided beneath each point.

Residence 144 (Submission ID SE-93451)

'The NIA states that the unattended monitoring data used to qualify the existing background levels is sourced from monitoring locations NC02 and NC10.'

In accordance with the NPfI, background noise is defined as:

> *The underlying level of noise present in ambient noise, generally excluding the noise source under investigation, when extraneous noise is removed. This is described using the LAF90 descriptor.*

NC02 and NC10 monitoring data were used to evaluate background noise levels for the purpose of setting assessment noise levels in accordance with the NPfI. As expected for a rural area, background noise levels are low and the minimum default background noise levels nominated in the NPfI were used to determine assessment noise levels. Evaluation of the shielding effect provided by the ridge is not an NPfI requirement, and does not form part of a background noise assessment. As the minimum default background noise levels nominated in the NPfI were adopted for the assessment, no form of further analysis would result in a lower background noise level.

Residence 144 (Submission ID SE-93451)

'According the NIA, NC02 and NC10 are considered "representative of all areas east, west, and north of the proposed Additional Project Area that may be impacted by noise the proposed mining operations'

This is correct. All areas east, west and north of the MCCO Additional Project Area are of a rural nature, and background noise levels in all areas would be similarly low. As noted above, the minimum default background noise level nominated in the NPfI were adopted.

Residence 144 (Submission ID SE-93451) 'We do not consider that NC02 and NC10 are representative of the existing noise levels for areas north of the ridgeline and in the direction of the advancing MCCO Project's mining operations.'

As per the previous point, NPfI default minimum background noise levels are applicable on both sides of the ridge, and were used to determine assessment noise levels.

Residence 144 (Submission ID SE-93451) 'The Sleep Disturbance Assessment clearly shows that the predicted noise level at my home will often be over 40 dB(A), with LAmax dB 44db(A) levels recorded in Year 1. This clearly demonstrates the intrusiveness of the noise from the operations during Year 1.'

As noted earlier, different noise descriptors relate to different types of noise and measures over different time periods. In general terms, an LAMax is a maximum noise level measured over a short period of time whereas the reference to 40 dB(A) relates to a LAeq,15minute noise level which can be described as the average noise level over a 15 minute period.

In accordance with NPfI definitions, noise intrusiveness is evaluated using the LAeq,15minute descriptor. The LAmax descriptor is used to measure and quantify maximum noise level events, and is used to evaluate potential sleep disturbance and therefore the two are not directly comparable. Global Acoustics advises that an LAmax of 44 dB is actually quite low in regard to sleep disturbance and does not demonstrate an intrusive noise issue.

Residence 144 (Submission ID SE-93451) 'The Sleep Disturbance Assessment for my home shows that my home is affected, and often to a greater extent than the homes that have triggered the VLAMP acquisition process.'

The maximum noise event prediction for Residence 144 is LAmax 44 dB, which is well below the NPfI maximum noise assessment level of LAmax 52 dB. Therefore, no sleep disturbance impact is predicted.

Residence 144 (Submission ID SE-93451) 'Mangoola Coal has had ample time to locate noise monitoring stations to the north of the ridgeline over the course of current operations. The fact that Mangoola Coal has chosen not to do so and now seeks to rely on that lack of data to its advantage is cause for concern.'

Permanent real-time noise monitoring equipment is used for mine management. The current monitoring network is adequate for that purpose, and the use of monitoring locations north of the mine, but south of the ridge, allows for conservative management of noise for residences located on the northern side of the ridge. That is, noise levels on the north side of the ridge will be lower than on the south side due to distance and the effect of the ridge (referred to as barrier attenuation). Therefore, managing noise to maintain compliance on the south side of the ridge also maintains compliance north of the ridge.

As noted above, Mangoola has recently commissioned EMM to undertake noise monitoring to assess the effect of the ridge in regard to noise, finding that the effect monitored demonstrates that the shielding effects reported by the model are measured in the environment.

Residence 144 (Submission ID SE-93451)

'The NIA states that the model takes into account barrier and ground attenuation and that the ENM Terrain Category 2 for rural land has been adopted. However, it is not possible to ascertain from the EIS whether Terrain Category 2 is the correct category as no justification for this choice is provided. Given the complexity of the topography surrounding my home there may be a more appropriate category than Terrain Category 2.'

ENM terrain category 2 representing a rural environment is the most suitable category for this project. Other categories that represent urban and city environments are not appropriate.

Residence 144 (Submission ID SE-93451)

'My lived experience of the current Mangoola Mine is that the worst noise levels experienced at my home occur in association with reflected noise i.e. the echoing and funnelling of mine noise as a result of interaction with local complex terrain. The ridgeline is not a continuous barrier and the assumption that it is erroneous. While a computer model with poor input variables may show it as a continuous barrier, I can attest as someone who has walked and ridden around that ridgeline my entire life, that it is not a continuous barrier.'

The ridgeline was included in the models with a 2 metre contour interval, which adequately captures the height and direction variances along the length of the ridge. Knolls and saddles along the length of the ridge, and spurs on either side are included in model topography.

Residence 144 (Submission ID SE-93451)

'The ridgeline dips towards the low point (AHD 220m) and incorporates many lower saddles. This, when coupled with the mining in the shallow areas particularly in Years 1 - 3, wind direction and temperature inversions significantly increase the potential for higher noise impact for my home than is described in the NIA.'

As described previously, variances within the ridge landform, depth of mining and weather effects are accounted for in the modelling assessment.

Residence 144 (Submission ID SE-93451)

'Noise levels will increase under inversion conditions as the sound waves are refracted downwards (over and around the ridgeline that is supposed in the NIA to act as a shield to my home which is less than 2km away).'

Temperature inversion effects, including downward refraction, are accounted for in the modelling assessment. It is noted that proximity to the ridgeline increases the barrier attenuation provided by the ridge, as the amount of downward refracted energy that can arrive at any given location reduces closer to the ridge. It is a well-established acoustic fact that the closer a source or receiver is to a barrier, the better the barrier performs at mitigating noise propagation.

Residence 144 (Submission ID SE-93451)

'The NIA relies on the data from the weather station. Best practice would require that this weather station would also include an Inversion Tower. This does not appear to be the case for the MCCO Project and therefore the NIA is not best practice. It is unclear how the temperature inversion occurrences were modelled – one can only assume using averaged data from another location?'

The NPfI allows for either direct measurement or indirect calculation methods to estimate frequency occurrence of inversions. For this NIA, Pasquill–Gifford stability categories and associated inversion strengths were calculated using the sigma theta method in accordance with Section D1.4 of the NPfI. It should be noted that both methods would trigger the frequency occurrence significance threshold, and temperature inversion effects would require assessment regardless of whether the direct or indirect method was applied.

Residence 144 (Submission ID SE-93451)

'we regularly experience noise and sleep disturbance. When I measure the noise, I routinely register noise levels of greater than 40 dB(A) and sometime in excess of 50dB(A). I have sent such evidence to MC as part of recent noise complaints. I have yet to receive an appropriate response to my complaints.'

It is likely that mining noise is audible at Residence 144 from the current operations during periods of meteorological enhancement in that direction. It should be noted that annoyance and disturbance due to noise are subjective, and do not necessarily indicate non-compliance.

With regard to the measured levels mentioned, there is insufficient detail to make informed comment. Unless measurements were taken with a suitable calibrated sound level meter, over a 15 minute period using the LAeq metric, and by a suitably trained operator capable of determining the noise that is contributing to the level being monitored, no evaluation of actual mining noise emission can be made and the levels indicated can be meaningless.

It is noted that as discussed above, monitoring undertaken by acousticians in the vicinity of Residence 144 has reported compliance with noise limits. As also discussed above, this is not to infer that noise from the mining operations is not audible at this location as audibility and compliance can occur concurrently.

Ridgelands Residents Inc (ORG 03)*

'In relation to Noise Mitigation our family home at 740 Ridgelands Road, Manobalai, home to myself, my sister and brother-in-law and two disabled adult family members was listed in the Environmental Assessment, EPA Pollution licence and the Ministers Consent Conditions 3 and 8 as requiring Noise Mitigation of air-conditioning, insulation, double glazing, sealing, regular solar panel cleaning, regular tank water supply cleaning and reimbursement of electrical costs for operation of the necessary mitigation measures. We complied with the Conditions of Consent and requested in 2009 and again 2012 that the Noise Mitigation be applied. Our request was met with refusal from Glencore Mangoola and we remain the only pre-Mangoola residence (mine owned or privately owned) that has not received Noise Mitigation. The refusals to Noise Mitigate follow on my Presidency of the Wybong Action Group which opposed the Anvil Hill Open-cut Coal Mine (Mangoola) from its tender, my teaching and In-Perpetuity Conservation Agreement under the National Parks and Wildlife Act 1974 (NSW) with the NSW Minister for the Environment.'

*Two community submissions ID SE-93809 and SE-69813-, also identified the failure of Mangoola to comply with obligations for noise mitigation as required in the approvals for Anvil Hill Project (Mangoola Coal) Conditions 3 and 8. The response below is considered adequate to address SE-93809 and SE-69813.

On 7 June 2007 Project Approval PA 06_0014 was granted based on predicted impacts arising from the original *Anvil Hill Environmental Assessment* (Umwelt 2006). Residence ID 205 (address 740 Ridgeland's Road, Muswellbrook (Lot 5, DP 252956)) was listed in Schedule 3, Condition 3 Table 1 - Noise impact assessment criteria.

Prior to subsequent modification to PA 06_0014 Schedule 3, Condition 8 provided that, if upon the receipt of written request from the landowner listed in Table 1, Mangoola shall implement additional reasonable and feasible noise mitigation measures on the land in consultation with the landowner.

Following commencement of operations in 2010, PA 06_0014 was later modified (Mod 4) to reflect the changes sought as described and assessed in the *Modification to Mangoola Coal Mine Plans and Relocation of the 500kV Electricity Transmissions Line Environmental Assessment* (Umwelt 2010) and the Response to Submissions (Umwelt 2011).

On 22 June 2012 PA 06_0014 (Mod 4) was approved resulting in changes to the conditions of the Project Approval. Relevant to this discussion, Residence ID 205 was not contained in the listed properties in Schedule 3, Condition 3 Table 1 Noise impact assessment criteria (Mod 4). However, the *Response to Submissions* (Umwelt 2011) and revised Statement of Commitments stated, '6.4.10 Xstrata Mangoola confirms that those residences identified as having rights for noise mitigation and management in accordance with the original Project Approval No 06-0014, will still have those rights available to them, irrespective of whether the modification (Mod 4) results in their property no longer being predicted to receive the level of noise impacts above the relevant trigger level specified in the current Project Approval' (Umwelt 2011).

In parallel to the above, during the period July 2010 to 2013, ongoing consultation with the property owner (and tenant acting on behalf of the property owner) occurred in relation to implementing the conditions of PA 06_0014 (as modified). This included the completion of a property inspection report of ID 205 to provide a guide to suitable measures that may be implemented to minimise noise at the residence. In April 2013, Mangoola made an offer to install noise mitigation (initial offer) specific to the landowners residence and property attributes. The property owner disputed the mitigation measures outlined in the initial offer and the matter was subsequently referred to the then Director-General of the Department of Planning and Environment for resolution. In August 2013, the Director-General's delegate determined that the measures proposed by Mangoola (as per the offer provided in April 2013) were reasonable, generally commensurate with the expected level of impact, and would provide an adequate level of noise mitigation for the interior of the residence.

In the period from September 2013 to April 2015 Mangoola used its best endeavours to work cooperatively with the property tenant to install the proposed mitigation measures as soon as practicable. To date, the noise mitigation measures as outlined in the initial offer have been unable to be installed.

Associated with the MCCO Project, Residence ID 205 is predicted to experience noise from the MCCO Project at levels where it is expected that voluntary acquisition rights will apply as outlined in the VLAMP. Should the MCCO Project be approved, and in accordance with conditions of development consent, Mangoola will make reasonable endeavours to arrive at an outcome agreeable to both parties.

4.3 Social

A detailed SIA was undertaken as part of the EIS and is included in Section 6.3 and Appendix 5 of the EIS.

Following the public exhibition of the EIS, a number of submissions were received from members of the community relating to the social impacts of the MCCO Project, primarily the social impacts on sense of community, social amenity (dust, noise and visual impacts), property value and health. Responses to these submissions are provided in the following sections, however, it should be noted that many of the submissions identify the linkages that exist between the social impacts identified, given that social impacts are often highly interrelated and not mutually exclusive.

Selected comments obtained through the submissions process are also used to highlight the issue sentiment and do not reflect all the comments received in relation to each social impact theme.

4.3.1 Community Issues

4.3.1.1 Sense of Community

Impacts on sense of community including its composition, cohesion, character, function and sense of place were raised in 35 community submissions.

Community Submissions

'the project will contribute to the ongoing degradation of the local community - in both number and spirit. Many residents will leave the area due to the negative environmental, air quality and noise impacts'.

'A sense of Community is an important part of rural life. Already many members of the Wybong community have been displaced and an expansion would further impact on the disintegration of our community feel. The Hall, once a hub of social life holds a small percentage of activities compared to years gone by. Many of the community members mourn this loss'.

'This project has already very negatively impacted community to the North of the existing mine are greatly threatened by this proposed project. The Wybong community will be decimated'.

'The local community has suffered greatly, the local hall events see dwindling numbers and reduced enthusiasm to hold events due to this which is impacted by the mine, the local fire brigade is unable to recruit new numbers due to the dwindling numbers of home owners living in the area and the people they are putting in the mining houses around are less than interested in the local community and more interested in the cheap rent'.

'I am concerned that if approved the project will further fragment the community. Once we knew our neighbours, we knew their cars, we knew their kids and their dogs, we looked out for each other but now properties are rented. Renters come and go and don't get involved in the community'.

'Having lived in Wybong for the past 30 years (before Mangoola) we have seen a once vibrant community with lots of families, children and successful farming operations dwindle down to a small handful of people. We used to have wonderful family dances/Christmas Parties at the Wybong Hall which were always full however ever since Mangoola Coal came to the area the Community has been decimated, and now we are lucky to see 20−30 people turn up to these events. I understand that Mangoola have proposed a "Community Enhancement program" however you actually need a community to benefit from these programs. How will this program solve the "Community" problem when no one lives in Wybong anymore!'

During consultation for the SIA, community members raised a number of concerns relating to the Project's impact on sense of community. As noted in the SIA (refer to Table 8.6 in Appendix 5 of the EIS), the impact of continued mining activities as a result of the MCCO Project on sense of community was ranked as a 'high perceived stakeholder issue'.

Section 3.0 of the SIA (Appendix 5 of the EIS) articulates the definition and purpose of undertaking a Social Impact Assessment and outlines the range of social impacts that may directly or indirectly affect individuals or communities as a result of a project change. One of these social impact categories refers to impacts to people's way of life - that is how they live, work, play and interact with each other; as well as impacts on their communities, that is their cohesion, stability, character, services and facilities; and culture – shared beliefs, customs and values.

A factor that has influenced sense of community in the locality surrounding the MCCO Project is a declining population, primarily seen by community stakeholders to be due to acquisition of properties by mining companies. Population trend data and analysis is provided in Section 5.6.4 of the SIA; and while data is difficult to interpret, due to changes in ABS population boundaries from 2006 to 2016; the data for the Sandy Hollow locality (which includes the localities of Wybong and Hollydeen) decreased by 10% from 2011 to 2016. The Muswellbrook LGA has in contrast seen a 2%

increase in population over the same time period, and is expected to increase by 19% by 2036 (refer to Section 5.6.4.3 of the SIA for further discussion).

The impact on sense of community in the area is further assessed and described within Section 7.2.3 of the SIA. Seven property acquisitions are anticipated in accordance with the VLAMP as a result of predicted noise impacts, resulting in a potential 13% decline in the existing population in the Wybong SSC and 3.9% in the Manobalai SSC (assuming that these properties are not rented which they are proposed to be, so the actual result may be less or nil, but with different people). Given the possible loss of community members in the Wybong area as a result of the Project, the SIA has ranked this as a 'high' predicted impact on the proximal community, particularly Wybong.

As noted in the SIA Guideline (DPE, 2017), as part of the SIA, strategies need to be developed to demonstrate how significant social impacts are to be mitigated or enhanced as part of the project. Strategies to be implemented may differ in their effectiveness and/or ability to alleviate impacts, with some residual social impacts remaining, in the case of negative impacts. Certain measures may also collectively address a number of different negative social impacts and potentially enhance positive impacts.

In consideration of this, to address the issues raised by the proximal landholders relating to the dwindling sense of community, a number of mitigation and enhancement strategies have been proposed as part of the MCCO Project including:

- continued implementation of a VPA with MSC (refer to **Section 3.8.2**)
- development of a Community Enhancement Program that focuses on facilitating enhancement initiatives (as a component of the VPA) for proximal landowners within the management zones for the MCCO Project
- continuation/implementation of a range of existing and new mitigation measures to address the identified impacts, based on community feedback including household cleaning and noise mitigation (as directed by a qualified structural engineer), filters for water tanks - first flush systems, cleaning of water tanks, cleaning of solar panels, landscaping/tree planting (on individual properties) and air-conditioning - provision, maintenance and electricity subsidies.
- development and execution of a Social Impact Management Plan (SIMP) for the ongoing monitoring and management of social impacts.

Some submissions also note that the proposed Community Enhancement Program will not be beneficial if there is a reduced community remaining in the surrounding area. A key objective of the Community Enhancement Program is to enhance the value of the area by providing resources and support for projects identified by the community members through the program. As noted in the SIA (refer to Section 8.1.1 in Appendix 5 of the EIS) such projects may include: support for local events to bring the community together, implementing waste and recycling services for local residents, facilitation of field days and pest/weed programs (prickly pear, pig/fox/deer/wild dog baiting programs) and/or further development and maintenance of local infrastructure (e.g. Wybong Hall, Cemetery, Church, Playground etc).

Given the above, the SIA has demonstrated an understanding of the nature of the communities in which the MCCO Project is located and has identified the potential impacts of the MCCO Project on sense of community as a result of population change over time. The proposed Community Enhancement Program proposes to work with local community members to identify projects which may assist in facilitating sense of community during the life of the Project.

As discussed in the EIS, Mangoola are also committed to considering all potential future land use options for land that it owns including both mining land and buffer land and properties surrounding it.

4.3.1.2 Social Amenity

Impacts on social amenity including the impact on surroundings and its aesthetic value and/or amenity, were raised in eight community submissions received.

> **Community Submissions**
>
> 'The Wybong area was an escape for us, being able to drive out of town where you are surrounded by mines, we would drive down Ridgeland Road where there are trees and a rural outlook, this will now just be another mine that we have to drive past only minutes from our home'
>
> 'The project will directly impact the health, wellbeing and spirit of the local community due to air quality, noise, visual, and financial impacts'

During consultation for the SIA, social amenity concerns raised by proximal landholders, primarily related to the impacts on way of life and rural lifestyle. The impacts identified included those expected to be experienced as a result of further change in dust/air quality, operational noise, blasting and visual impacts.

Through review of past and current mining proposals, it is evident that the social impacts of mining are a key area of interest at a community level. While mining projects can result in significant positive economic benefits, they also have the potential to impact the social amenity of proximal landholders and communities as a result of environmental impacts such as dust, noise and blasting. While strategies like the Upper Hunter Air Quality Monitoring Network, developed by OEH, have provided a platform to share air quality monitoring data; dust impacts on social amenity remain a consistent issue in relation to mining projects. It is also evident that given the current drought being experienced in NSW and within the Hunter Valley, the issue of air quality, is particularly heightened in the current project assessment as referenced in some submissions.

Impacts on social amenity are discussed in Section 7 of the SIA (see specifically Sections 7.2.4, 7.2.5, and 7.2.10 in Appendix 5 of the EIS). In relation to noise, the analysis in the SIA found that noise was likely to have an impact on proximal landholders, with a major social consequence predicted for those residences in the acquisition zone, a moderate consequence to those resident in the management zone, with social impact rankings predicted as 'high'.

In regards to the social impact of dust, it was determined that with adequate controls, such as those outlined in the current site Air Quality Management Plan, further impacts of dust, as a result of the MCCO Project would be possible with a moderate impact on nearby landholders, resulting in a 'moderate' social impact. This assessment utilises the outputs of the air quality study, which indicates that air quality in relation to the MCCO Project can be adequately managed within the required criteria limits. However, this issue was identified as a 'high' perceived social impact from the perspectives of proximal landholders (refer to Section 7.2.4 of the SIA). Visual amenity was predicted to be a 'low' social impact (refer to Section 7.2.9 of the SIA) with the visual assessment confirming that there would be no direct view of the MCCO Project from private residences with some views available from sections of surrounding public roads.

The noise, dust and visual amenity impacts of the MCCO Project were assessed in detail and the findings presented in Section 6.4, 6.5 and 6.14 of the EIS. It should be noted that existing noise, dust and visual amenity impacts have been approved as part of the existing Mangoola Coal Mine operations. The MCCO Project is a brownfield project and represents an extension of an existing mining operation, as such, nearby residences to the existing Mangoola Coal Mine may already experience some noise, dust and visual amenity impacts which have been approved under PA

06_0014. To date a number of existing measures have been applied to surrounding residences to mitigate noise and dust impacts, and further reduce impacts on social amenity of the Mangoola Coal Mine operations.

To address community concerns around social amenity impacts for proximal landholders, a number of mitigation and enhancement strategies have been proposed as part of the MCCO Project as discussed in **Section 3.8.2** and **Section 4.3.1.1**. These are additional to the technical mitigation measures included for residential receptors (e.g. air quality, noise etc) in the MCCO Project EIS.

In accordance with NSW Government policy, it is expected that voluntary acquisition rights will be provided to owners of the most affected properties (a total of seven properties). Mangoola has also committed to instigate a range of management mechanisms for other impacted properties to mitigate any impacts experienced as a result of the MCCO Project.

4.3.1.3 Impact on Community Services

Community Submissions

'Money received by NSW and the Commonwealth in some small way supposedly flows to Wybong. We have no mobile reception, limited free to air TV, only satellite internet, no garbage collection, no sewerage and no town water. We did have a beautiful quiet rural environment before Mangoola started operations. Muswellbrook medical services are already under pressure. Schools in the LGA consistently perform below the state average. We do not want another mine in our community'.

'The community and local fire brigade have been decimated by the mine. With an extension this will further community loss. For the miner can throw money at a local hall or fire brigade unit. But if there isn't anyone left to hang onto the fire hose it doesn't benefit the community at all. The miner doesn't release equipment/ staff to man the local bush fires brigades. Therefore, it must be a condition of consent that they do supply staff and equipment to fight bush fires in the local areas when needed. They got rid of the community, so they take over the job'.

Concerns relating to lack of services in the assessment area were noted during consultation. A range of mitigation measures to enhance local community infrastructure and services and address community needs are outlined in Section 8.0 of the EIS.

While the MCCO Project is not expected to have a direct impact on access to the services identified, as part of the Project a VPA will be established with MSC with a view to provide funding to assist it to deliver community benefits. Monetary contributions often addressed in such agreements, include the provision of, or the recoupment of, the cost of providing public amenities or public services. Therefore, such contributions could include the provision of services to the Wybong area subject to the discretion of MSC as the elected representatives of the people that reside in the Wybong locality. Mangoola is keen to see a local benefit to the Wybong area as part of the VPA.

The perception recorded from local landholders during consultation suggested that community participation in the Wybong area has diminished over time. A review of volunteering in the Muswellbrook LGA (Section 5.6.5 of the SIA) indicates that the localities of Manobalai, Denman and Mangoola had considerably higher proportions of volunteering (40%, 26% and 25% respectively), compared to the Muswellbrook LGA (18%) or NSW state average (18%). Issues relating to population decline are also assessed in response to impacts to sense of community in **Section 4.3.1.1** above.

To date Mangoola has provided, through its community SMARTY Grants program, funding at the Wybong RFS for the lining of tanks along with the purchase of a new firefighting pump. Most recently, Mangoola provided funds for the purchase and installation of a 3G electronic fire hazard rating board which was unveiled in October 2019 at its position near the intersection of Wybong Road and Bengalla Link Road. The electronic fire sign is the only one of its kind in the district and enables volunteer members to log in and update the sign remotely and avoid having to physically change the sign in line with daily conditions.

Whilst it is not a requirement of Mangoola's operations, there are currently several employees who volunteer their time as part of the surrounding RFS Brigades. Additionally, the existing Mangoola leave policy entitles employees to participate in volunteer emergency services. Mangoola also provide access to a number of fire hydrant fill points and water supply located at the Mangoola CHPP and firefighting equipment to aid in response to a bushfire. Mangoola is committed to continuing its support for the local RFS Brigades in the future.

As raised in Sections 6.1.2 and 6.1.9 of the SIA, community participants identified that the continued support for the RFS was a positive impact of the MCCO Project.

4.3.1.4 Property Values

Issues relating to property value were raised in 53 community submissions and three interest group submissions and identified as a key perceived social impact in the SIA, with many proximal landholders consulted identifying this as a high perceived social impact of the MCCO Project. Examples of the submissions relating to concerns regarding impacts on property values are provided below.

Community Submissions

'the project will directly negatively impact land values within the area. Values will decrease and lead to an inability for some residents to sell their properties due to the negative impacts (air quality/noise/light) from the project encroaching on their properties.'

'Land values in the local area especially will decrease; and some residents will be unable to sell their properties at all due to the proximity of the project, and because potential buyers will not be willing to suffer the negative impacts. Other residents will move away due to the negative impacts of the project which will further diminish the community.'

'There is no sharing of benefits. Glencore will receive enormous wealth while the landholders in the local community will be economically disadvantaged through their properties being completely devalued.'

'The Social Impact Assessment clearly identifies loss of property values as the top issue for residents local to the mine extension however the mine's submission fails to address this in the Community Enhancement Programme.'

Wybong Concerned Landowners Group (ORG02)

'Our properties have become stranded assets. Landholders are currently unable to discharge their natural property rights of being able to sell when and if they want at a fair unimpacted market price.'

As discussed in the SIA and Section 6.3.4.1 of the MCCO Project EIS, the most frequently identified social impacts related to property value (70), with concerns centred on the potential decrease in property value due to proximity to the mining operation; a sense of entrapment as a result of perceiving to be unable to sell property in the area; and concerns pertaining to acquisition zoning in relation to the MCCO Project. As part of the MCCO Project EIS, a property assessment (Tew, 2018) was undertaken and included as Appendix 4 of the SIA to identify any changes in property values and sales data from 2005 to 2018, for properties in proximity to mining operations.

As discussed in **Section 2.3.2**, impacts to property value and lack of sale-ability from the MCCO Project was identified as a key issue in objecting submissions from the community and interest groups. In response to this key issue, Tew Property Consultants undertook an additional property value analysis of specific property sales in proximity to the MCCO Project which built on the previous assessment undertaken for the EIS. The additional property value analysis (Tew Report) by Tew Property Consultants (Tew, 2019) was also peer reviewed by Knight Frank Newcastle (Knight Frank, 2019). This process of peer review was voluntarily undertaken by Mangoola to ensure that the Tew Report utilised an appropriate method for analysis with justified outcomes. The peer review by

Knight Frank supported the method and key findings of the additional property value analysis. The Tew Report (Tew, 2019) and the associated peer review are provided in **Appendix 11**.

In regards to the potential decrease in property values due to the presence of mining, the Tew Report noted that following analysis of the prevailing market in the Muswellbrook LGA, there is no evidence to support the proposition there is a reduction in the market value of rural lifestyle land as a consequence of proximity to the MCCO Project. This conclusion is based upon analysis and comparison of the available sales evidence, statutory valuations applied for rating and taxing purposes as well as other statistical data specific to the movement of residential property values in the locality. The Tew Report identified the following key findings:

- The sales data for properties in proximity to the MCCO Project appears to be at comparable values to similar assets situated in similar localities but which are further removed from mining operations.

- Sales transactions achieved in proximity to the MCCO Project indicate that there is a fluid market for rural lifestyle assets in the west Muswellbrook and Wybong localities where vendors are prepared to meet the market value.

- Detrimental impact upon property values becomes indiscernible at a point where the scientific testing verifies environmental factors including noise and particulate matter (air quality) do not exceed the relevant criteria determined by the regulators to the extent they have acquisition rights under the VLAMP.

- Analysis of available sales evidence, indicates a perception of stigma due to proximity to mining operations does not always translate to a reduction in market value.

- Properties which are situated in proximity to a proposed mine but which are not predicted to be impacted by environmental factors or reduced amenity (to the extent they have acquisition rights under the VLAMP) do not appear to evidence a detrimental impact upon value as a consequence of that proximity.

- The residential sales data analysed for Muswellbrook over the previous 14 years indicates there is a relationship between operational activities in the mining sector and fluctuations in local Real Estate markets. When the local economy is buoyant and employment prospects are strong, residential Real Estate sales volumes are also strong and values generally increase.

The above findings were supported by the peer review carried out by Knight Frank which noted that as part of its own investigations it was unable to identify a discernible detrimental value trend in locations whereby scientific testing verifies that factors such as noise and air quality do not exceed regulatory criteria.

It is noted that the perceived uncertainty relating to property sales, currently or in the future, for proximal landholders located nearby to the MCCO Project presents a difficult issue to manage. The Tew Report identifies this community concern, but found that it is not shown in property sales data. The VLAMP provides voluntary acquisition rights for those properties identified as significantly impacted by noise or dust. Those properties that are still impacted, but to a lesser degree fall within the marginal zone, are afforded mitigation, which is directed at mitigating the impacts of the development. This may include measures such as air conditioning and electricity subsidies; double-glazing of windows and other noise mitigation measures; and dust mitigation measures such as water tank cleaning and provision of water filters on drinking water tanks.

A number of submissions also referred to the proposed Community Enhancement Program as not being a sufficient mitigation measure to address the risk of property devaluation. It is noted that the technical assessment of property value impacts have not identified it as an issue requiring management outside of those properties significantly impacted by noise impact, with these properties addressed via voluntary acquisition under the VLAMP. Despite the technical assessment finding, Mangoola acknowledge the community concern regarding this matter and has proposed the Community Enhancement Program as a mechanism to assist in addressing this concern.

As noted in the SIA Guideline (DPE, 2017), impact strategies need to be developed that indicate a clear connection between the measure proposed and the significant social impact being mitigated or enhanced. Strategies to be implemented, however, may differ in their effectiveness and/or ability to alleviate impacts, with some residual social impact, or in this case, residual community concern remaining. Furthermore, certain measures may collectively address a number of different negative social impacts and potentially enhance a number of positive impacts.

To address community concerns around impacts on property values, a number of additional mitigation and enhancement strategies have been proposed as part of the MCCO Project as discussed in **Section 3.8.2** and **Section 4.3.1.1**.

The specific measures and strategies relevant to mitigate impacts on property value include:

- Development of a Community Enhancement Program (as a component of the VPA) that focuses on facilitating enhancement initiatives for proximal landowners within the management zones for the MCCO Project.
- Continuation/implementation of a range of existing and new mitigation measures to address the identified impacts, based on community feedback.
- Development of a post mining land use strategy as part of the Mine Closure Plan.
- Implementation of property specific measures with local affected landholders to the north of the MCCO Project for a number of proximal landholders who are outside the VLAMP voluntary acquisition area.
- Development and execution of a SIMP for the ongoing monitoring and management of social impacts.

4.3.1.5 Health Impacts

Impacts on health (both mental and physical) were raised in community submissions and primarily related to impacts on health as a result of the changes to surroundings and psychosocial factors (e.g. stress and anxiety). Frustrations and uncertainties with the decision-making and project assessment process were also noted as factors that may exacerbate psychosocial impacts.

Community Submissions

'For those who are unable to sell their properties (due to decreased land values or lack of buyers due to the impact of a mine being in close proximity), as well as those that feel they have no choice but to move away, this will lead to solastalgia (a form of mental or existential distress caused by the negative transformation of one's environment)'.

'Only those who have lived with this dreadful situation can really understand the stress and powerlessness felt due to Government Policy. The community has already been damaged. How is this co-existence? All the benefits go to the proponent and none to the Wybong community...Where will it end? Mangoola state themselves in their EIS that if market conditions and the resource are satisfactory, they may wish to apply for further mining approvals. The outcome of this uncertainty is that landholders stop spending money on improvements to their properties, which in turn has a negative impact on businesses in the area. It also has a very detrimental impact on landholder's health and enjoyment of their homes...The espoused benefits from this project do not go to those closest to the mine.'

'The mental health concerns around this mine's extension in the Manobalai community are tremendous, as landowners are already facing great challenges under the idea that their properties are now unwanted by prospective buyers.'

'We have heard gossip from mine employees about the local residents that complain about mine operations to Mangoola. This is downright bullying and scaremongering so that people are too ashamed or scared to complain. I fear the impact of a boycott on our successful local business from mine employees if they were to learn we opposed the mine. We have a right to work and operate a business without this stress and fear. The worry and concern that this issue has had on us is immeasurable. We are very decent, hardworking local people who do not deserve to be caught up in this projects evaluation...The time taken and stress caused by having to evaluate and oppose this mine continuation has had a huge impact on my family's day to day lives. We receive no compensation or apology even for the disruption this proposal has had on our lives'.

This project and approval process places unreasonable mental stress on residents due to the EIS not adequately addressing the concerns raised during the stakeholder interviews.

Concerns in relation to the stress and anxiety caused by the MCCO Project were raised during consultation, with some community members raising concerns that they didn't feel comfortable raising a formal complaint with the company for fear of backlash from other community members. In addition, community concerns related to a distrust in the Government's assessment and approvals process, with some community residents feeling powerless to impact decision making processes. These community concerns are discussed in Sections 6.1.6 and 6.1.12 of the SIA, with further assessment of these impacts provided in Sections 7.2.7 and 7.2.14 of the SIA (see Appendix 5 of the EIS).

'Solastalgia' is a term coined by environmental philosopher Glenn Albrecht to describe the impact of environmental change on human health (see Albrecht et al, 2009). Taken from a combination of the words, '*desolation*', '*solace*' and '*algia*' (anguish or pain), it is broadly defined as "…*the distress that is produced by environmental change impacting on people while they are directly connected to their home environment*."

The concept of 'Solastalgia' was raised in the NSW Environment Court proceedings relating to the Mt Thorley/Warkworth Project and appears closely linked to the notion of sense of community; with an additional focus on the health impacts that may result from a breakdown in a community's composition, character, cohesion and sense of place. Such impacts have been described in the response to sense of community impacts provided in **Section 4.3.1.1**. The breakdown in a community's sense of place is therefore seen to result in heightened levels of uncertainty and insecurity, ultimately impacting an individual's mental health. The degree to which such impacts may be experienced depends upon the individuals psychological and physical circumstance.

The concern about perceived issues such as property values in a mental health context is recognised as being separate to the technical assessment outcomes for this issue. As outlined in earlier sections, however, a range of mitigation measures are proposed to address these issues.

Impacts to physical health were also raised during consultation and are assessed in Section 7.2.7 of the SIA. The air quality assessment, as outlined in Section 6.5 of the EIS, concludes that air quality modelling undertaken as part of the MCCO Project, does not suggest that human health will be adversely impacted by the MCCO Project for proximal neighbours or the wider Muswellbrook community, utilising the air quality criteria set by the NSW EPA. The noise assessment as outlined in Section 6.4 of the EIS, also concludes that no sleep disturbance impacts are expected as a result of the MCCO Project with other identified noise impacts being managed in accordance with the VLAMP.

Within the SIA, impacts of the MCCO Project on health have been acknowledged with the assessment predicting that it is possible that heightened levels of stress and anxiety have and may be experienced by those residing in proximity to the MCCO Project.

It is acknowledged that a number of submissions raise that the EIS/SIA do not adequately address concerns raised during the interviews process. As noted in the SIA Guideline (DPE, 2017), impact strategies need to be developed that indicate a clear connection between the measure proposed and the significant social impact being mitigated or enhanced. Strategies to be implemented, however, may differ in their effectiveness and/or ability to alleviate impacts, with some residual social impacts remaining. Furthermore, certain measures may collectively address a number of different negative social impacts and potentially enhance a number of positive impacts. There were a wide range of suggested mitigation measures suggested by community stakeholders as part of the engagement process. All of these measures were considered by Mangoola with a number adopted. Some measures that were not achievable or which did not tangibly improve outcomes were not adopted.

4.3.1.6 Economic Impact - Lack of direct economic benefit to the local community

Community Submissions

'We received minimal benefits from the funds that Mangoola has, the Muswellbrook shire council make an excessive amount of money from the mine however the Wybong community miss out again, we have limited if no services in the area, no mobile phone reception, expensive limited satellite internet, no garbage collection, no town water or sewerage.'

'The proposed economic benefits increase the further away from the mine you go. The only mitigation measures for local residences are to reduce the effects of the noise and dust produced by the mine.'

'… I don't feel that the expansion will benefit the town of Muswellbrook any more than it already is. The workers who don't live in the area (and from what I can fathom there are a lot) do not help the community in any way except for a bit of food for the days they are here and some rent, rent which could be utilised by the many other residents in the town looking for accommodation who actually live in the town full time.'

Township Resource Cluster (TRC) analysis (Fenton, Coakes and Marshall, 2003), utilising current employee and supplier data provided by Glencore (2018) for the current assessment, reveals that Mangoola's current operations specifically make a significant economic contribution to local communities in the region through:

- employment (direct impact)
- employee annual household expenditure (indirect impact)
- employee use of local community services
- business supplier expenditure (direct impact).

These economic contributions are summarised in **Table 4.8** for key towns that are significantly benefited based on their associations with the existing Mangoola Coal Mine operations.

Table 4.8 Summary of TRC Results for Key Locations of Interest

	Muswellbrook (SSC)	Denman (SSC)	Scone (SSC)	Cessnock (LGA)	Singleton (LGA)	Maitland (LGA)	Newcastle (LGA)
Number of Mangoola employees by residence location	141	44	41	5	57	7	5
Employees' annual household expenditure (estimated)	\$11.3M	\$3.5M	\$3.3M	\$0.39M	\$4.6M	\$0.58M	\$0.39M
Mangoola total spend on supplier contracts	\$8.83M	\$0.03M	\$0.25M	\$27.99M	\$19.55M	\$16.33M	\$4.3M

In addition, the Economic Impact Assessment completed for the EIS (refer to Section 6.2 of the EIS) provides an assessment of the economic contribution of the MCCO Project to the local region and state.

While it is evident that the existence of the current Mangoola Coal Mine operations, and the continuation of the MCCO Project, does and will continue to make a significant contribution to local communities in the region; commonly those that live in closest proximity to mining operations and projects perceive little benefit to the rural localities in which they reside. There is also a lack of general service or business providers located in the Wybong area which limits the opportunity for direct spend by Mangoola in this area, however, it is recognised that the dominant employment area for people living in Wybong, is the mining industry.

In line with Mangoola's existing VPA, Mangoola proposes to continue its existing commitments for the duration of the MCCO Project, to facilitate continued and ongoing support for a range of environmental and community projects within the Muswellbrook LGA. Mangoola propose that part of this funding be allocated to relevant projects in the Wybong locality to address locality needs and aspirations e.g. access to relevant services and/or enhance the local area, through the implementation of the Community Enhancement Program.

4.3.1.7 Impacts on Sustainable Industries

The impact of the MCCO Project, and ongoing mining in the region, was raised in five community submissions received; with concerns relating to a dependency on mining/lack of economic diversity and impacts on other industry sectors e.g. agriculture, viticulture and equine.

Community Submissions

'The issues of air quality, land degradation and community impacts as outlined above all contribute to negatively impact on other sustainable industries within the Upper Hunter. Agriculture, thoroughbreds and wine industries may not employ the numbers in the short term the mines do, but our jobs are ongoing for generations. Our young skilled workforce is constantly being taken by the mining industry. We need an industry balance in this region. The Department of Planning needs to be aware of our other existing sustainable industries and support them by way of ceasing further mining projects in the area'

'The potential loss of more community members displaced by mining and the opportunity cost of seeing more land and water devoted to mining rather than more sustainable industries are all significant issues for the health and wellbeing of our community.'

'The Muswellbrook local government area, and the Hunter region generally, is at risk of losing any diversity of industry that remains as a result of continued expansion of large scale open cut mining projects. There is total lack of diversified industry in the Muswellbrook LGA.'

Section 5.6 of the SIA uses the sustainable livelihoods approach (DfID, 1999) to provide a comprehensive understanding of the relevant communities proximate to Mangoola's operations and to evaluate their resilience and sensitivity to change. Preparation of the study involved collection, collation and analysis of secondary data, with relevant primary data collected through personal stakeholder interviews, used to supplement secondary data where relevant. This approach includes an analysis of the economic capital of the locality and region.

Mining was the top industry of employment in Mangoola, Castle Rock, Wybong, Denman, Muswellbrook and the Upper Hunter State Electoral District. Agriculture, forestry and fishing was the top industry of employment in Sandy Hollow and Manobalai, with mining still the second largest employer in Manobalai (refer to Section 5.6.6.1 of the SIA).

In comparison to NSW, it is evident that the mining industry is a dominant economic force across all of the study communities and the Upper Hunter as a whole. Wybong has the largest proportion of employment in mining (28%), followed by Mangoola (26%) and Castle Rock (25%) (refer to Section 5.6.6 of the SIA).

Increasing economic diversity in the Upper Hunter and the Muswellbrook LGA is a key challenge faced by the NSW Government and the MSC. The Strategic Regional Land Use Plan Upper Hunter (2012) suggests that the dominance of the mining industry (including related industries) places pressure on other industries including the equine and viticulture industries which have to compete for land, labour and wages. MSC's strategic plan also identifies economic and industry diversification as a key need and strategy for MSC (refer to Section 5.7 of the SIA), with forums previously developed by MSC, with participation of relevant industry sector representatives, to address such issues.

The MCCO Project seeks approval for the continuation of operations at the existing Mangoola Coal Mine and would provide ongoing opportunities for the existing workforce. Further it is located on land largely owned by Mangoola and immediately adjacent to the existing approved operations.

A comprehensive AIS was prepared to assess the potential agricultural impacts associated with the MCCO Project and is provided in Appendix 20 of the EIS. The AIS has taken into account the existing land capability and current and historical agricultural uses of the MCCO Additional Project Area. In this regard it has found the land within the MCCO Additional Disturbance Area has historically been and is currently used as low intensity grazing land. No other agricultural enterprises are located within the MCCO Project Area. The land predominantly has moderate to severe (LSC Class 4), severe (LSC Class 5) and extremely severe (LSC Class 7) limitations to agriculture.

The AIS also considered impacts of the MCCO Project on agricultural resources and uses/enterprises in the locality as well as agricultural support services and infrastructure. The assessment found that the impacts associated with the MCCO Project are considered to be small in the regional agricultural context and they are not expected to impact on any of the surrounding agricultural enterprises.

Accordingly, it is not considered that the MCCO Project poses any significant threats or impacts to other industries including sustainable agricultural industries as a result of competition for land, human or other resources or as a result of direct or indirect impacts from the Project.

As noted above, the need for economic diversification in the Upper Hunter Valley is recognised and is a key challenge for government. Mangoola can and will contribute to this topic through consideration of post mining land use options for the site and will do so in consultation with MSC.

4.3.1.8 Post Mining Land Use and Community Sustainability

Community Submissions

'The environmental impacts of the proposed mine also cause a great deal of stress and worry because I wonder what will happen when all the coal is gone? What's going to happen to the land and the community when the mine closes? While this is in the distant future, I wonder what will happen to the beautiful place that I call my home? Will they expand further and further? Living in a mining area I can see how a coal mine can drastically change the landscape the coal mines and fear that the limited non mined area where I live will turn out like the other mines which are depressing to look at.'

Concerns regarding future land use post mining were raised during consultation with proximal landholders and have also been raised in one community submission received in relation to the MCCO Project. Considerations for future land use are discussed in Section 6.17.5 of the EIS. As stated in the EIS the existing approach to final landform establishment and rehabilitation at Mangoola Coal Mine, which includes the use of natural landform design principles and rehabilitation of native woodland communities are recognised as industry leading practice. These practices will be applied to the MCCO Project.

As stated in the EIS, a detailed Mine Closure Plan will be developed five years prior to the planned mine closure and will be aimed at achieving the post mining landform and land use as presented in the EIS. Mangoola has committed to continue to investigate potential post mining beneficial land uses for the site through the development of a Post Mining Land Use Strategy as part of the Mine Closure Plan. The Mine Closure Plan will also investigate ways to minimise the adverse socio-economic effects of mine closure, including reduction in local employment levels. The development of the detailed Mine Closure Plan will include consultation with relevant stakeholders, which is expected to include the Resources Regulator, DPIE and MSC.

4.3.2 Interest Group Issues

One interest group raised concerns in relation to the social impact assessment.

Lock the Gate Alliance (ORG03)

The social impact assessment (SIA) foregrounds the economic contribution of the mine and downplays the negative of the mine by qualifying all these as "perceptions" of the landholders affected, and "perceived mining-related health concerns" This is compounded by the SIA giving only a "low" social impact ranking for the impact of mine dust and "moderate" for mental distress despite the known health impacts of particulate pollution and clear feedback from nearby landholders that air pollution is affecting their health'

A key component of the SIA is the process of understanding, from a community perspective, community issues, values and uses associated with the assessment area, and specifically the perceived impacts and opportunities associated with the Project. These impacts are then further assessed to predict any significant social impacts in relation to the Project, that may require mitigation or enhancement (refer to Sections 7.0 and 8.0 of the SIA).

In the context of this assessment, the word perceived has been interpreted as "*noticing or becoming aware of something" or "to understand or think of somebody/something in a particular way*" (Oxford Dictionary). As such, Section 6 of the SIA discusses how the community notice, understand and interpret social impacts based on their understanding of the MCCO Project and their experience in living with the impacts of the existing Mangoola Coal Mine operations.

Impacts to mental and physical health were raised by the community during consultation, as assessed in the SIA (refer to Section 7.2.7 of the SIA).

While landholders may experience impacts of the existing operations and express fears regarding continued impacts, the air quality study has assessed the impact of changes in air quality on health, in relation to the MCCO Project, according to criteria developed by the NSW EPA. This technical assessment outlines that while air quality impacts will occur as a result of the MCCO Project, these impacts are not anticipated to exceed the relevant government criteria.

Within the SIA, impacts of the MCCO Project on health have been acknowledged with the assessment predicting that it is possible that heightened levels of stress and anxiety have, and may be experienced, by those landholders residing in proximity to the MCCO Project.

4.4 Climate Change

Issues relating to climate change were raised in 32 individual submissions and four interest group submissions. All submissions from individuals and interest groups identified common issues which applied to multiple submitters.

A detailed Greenhouse Gas and Energy Assessment (GHGEA) was undertaken as part of the EIS and is included in Section 6.18 and Appendix 22 of the MCCO Project EIS. The GHGEA includes an assessment of potential impacts on climate change, and Section 9.4 of the EIS reviews the proposed project against the principles of ecologically sustainable development (ESD) including intergenerational equity.

4.4.1 Common Community and Interest Group Issues

4.4.1.1 Climate Change and Intergenerational Equity

Issues relating to climate change impacts and intergenerational equity were raised in 31 community submissions and one interest group submission. Examples of the submissions relating to climate change are provided below.

Community Submissions

'The continuation of this mine should be rejected on the basis of its climate change impacts and intergenerational equity.'

'Beyond Muswellbrook and the Hunter region, intergenerational equity issues, such as climate change and irreversible global warming, must also be seriously considered in the evaluation of a proposal to continue coal mining on such an immense scale.'

Denman Aberdeen Muswellbrook Scone Healthy Environment Group (ORG04)

'The negative contribution to Green House Gas Emissions and accelerating Climate Change.'

Hunter Environment Lobby Inc (ORG05)

'We want to preserve our environment for future generations. '

Section 9.4.2 of the EIS discusses intergenerational equity and outlines the objectives of the MCCO Project that relate to intergenerational equity. This section also notes that the environmental management measures as committed to by Mangoola in the EIS have been developed and evaluated to minimise the impact on the environment to the greatest extent reasonably practicable.

Mangoola acknowledges the accumulation of GHG in the atmosphere is an important driver of climate change. Further, Mangoola recognises that climate change has the potential to drive intergenerational issues such as climate risk, loss of biodiversity, loss of natural resources, loss of industry, loss of infrastructure and loss of amenity. Mangoola also believes the MCCO Project has the potential to assist to drive intergenerational issues such as economic growth, infrastructure investment and regional development.

Section 6.18 of the EIS considers the impact the MCCO Project may have on climate change. The MCCO Project, in isolation, is unlikely to influence global emission trajectories. The MCCO Project will operate as part of globally interconnected industries and economies, which will generate greenhouse gas emissions many orders of magnitude higher than the MCCO Project. The MCCO Project is forecast to generate a relatively insignificant proportion of global emissions, and future global emission trajectories will largely be influenced by global scale issues such as technology, population growth and greenhouse gas policy.

It is not considered likely that the MCCO Project will hasten the impacts of global climate change, as the Project is unlikely to accelerate the accumulation of greenhouse gases in the atmosphere. Planned mine sequencing will see mining (including mining equipment) progressively transfer from the existing mine to the MCCO Additional Project Area and the planned peak coal recovery rate does not exceed the currently approved coal recovery rate (i.e. 13.5 Mtpa). The MCCO Project is planned to prolong operations at Mangoola and supplement retiring coal production at Glencore facilities. The MCCO Project will prolong the release of greenhouse gas emissions from the Mangoola site, however, the magnitude and timing of the emissions are unlikely to accelerate climate change.

Mangoola recognises that over the next 20 years the percentage of the energy generation market supplied by coal is likely to decline. As the MCCO Project meets an existing and projected demand and fits within Glencore's committed production cap, Mangoola considers that the MCCO Project is aligned with the global energy market.

4.4.1.2 Greenhouse Gases and Scope 3 Emissions

Issues relating to increase in greenhouse gas emissions and Scope 3 emissions from the MCCO Project were raised in 15 submissions. Examples of the submissions relating to greenhouse gas impacts are provided below.

Community Submissions

'The project will increase the release of greenhouse gases into the atmosphere.'

'On rough numbers the Scope 3 emissions from this extension would be more than Australia's entire Paris commitment'

Ridgelands Residents Inc (NFP NGO) (ORG01)

'This volume of carbon emissions is untenable when the carbon budget requires no new coal extraction if we are to meet the global target of 1.5 degree increase in temperature, as Australia supported in the Paris Agreement.

The figures for this particular increase in size of the MCCO amount to 407,000 CO_2 Eq tonnes/pa for Scope 1; 51,000 CO_2 Eq tonnes /pa for Scope 2 and 13,036,000 CO_2 Eq tonnes/pa for Scope 3 emissions for each year of production.

The overall total increase in emissions has been forecast as 407,940,000 tonnes of CO_2 Equivalent emissions over the life of this mine. Without any adequate figures for cumulative impacts on the Hunter and the world Carbon load, we reiterate our concerns and posit that the Department will be negligent to sign off on this extension.'

Lock the Gate Alliance (ORG03)

'The proponent's assessment of greenhouse and climate change impacts is inadequate. It asserts that the more than 100 million tonnes of greenhouse pollution that will be created by this project "is unlikely to influence global emission trajectories" but offers no supporting information that could substantiate this claim by contextualising the greenhouse emissions of the project within global carbon budgets consistent with the temperature goals of the Paris climate agreement and within coal demand and emissions trajectories of the countries where the coal will be burnt.'

The GHGEA prepared for the EIS found that over its operational life the MCCO Project has the potential to generate approximately 3.25Mt CO_2-e of greenhouse gases (Scope 1 emissions) and approximately 0.4Mt CO2-e of Scope 2 emissions from consuming electricity. The GHGEA also found that end use consumption of coal products produced by the MCCO Project, have the potential to generate approximately 100Mt CO_2-e of greenhouse gases (reported as Scope 3 emissions). The GHGEA did not find that the MCCO Project would generate more than 100Mt CO_2-e of greenhouse gas emissions. Under relevant assessment guidelines, the MCCO Project has very clearly defined operational boundaries from a greenhouse gas assessment perspective, and the MCCO Project does not include coal consumption. The GHGEA is required to assess potential greenhouse gas emissions generated by coal consumers (i.e. Scope 3 emissions), however, the actual emissions generated by coal consumers will be heavily dependent on their management and adoption of technology.

To put the MCCO Project's emissions into perspective the Project is expected to contribute approximately 0.00073% to global emissions per annum, based on current policy settings, and the Project's forecast Scope 1 emissions.

The Australian Government has ratified the Paris Agreement. As a first step the Australian Government has committed to reducing GHG emissions by 26-28%, on 2005 levels, by 2030. The Australian Government has also developed its Nationally Determined Contribution (NDC), which is a high level plan to achieve national mitigation targets. Australia's NDC does not preclude the ongoing development of the mining industry nor support the notion of "no new coal extraction". Most of the MCCO Project's coal will be exported to countries who are parties to the Paris Agreement, and these countries have, or are in the process of developing measures to mitigate greenhouse gas emissions from sectors that consume coal.

Australia's national climate change policy has a number of components, this includes the Emissions Reduction Fund (ERF) and the Safeguard Mechanism. The ERF provides financial incentive for the deployment of low cost abatement projects in Australia. Under the safeguard mechanism, the MCCO Project will be assigned an emissions baseline that it will need to maintain emission levels to. It is only when the mine exceeds this emission baseline that there is any carbon cost incurred and then it is only for the portion of total emissions which exceed the assigned baseline. It should be noted that baselines under the safeguard mechanism are calibrated to align with Australia's national emission reduction target and commitments under the Paris Agreement.

Mangoola has a demonstrated track record in managing GHG emissions from its current operations and has an Energy Saving Action Plan in place. A range of design measures have been incorporated by Mangoola into the MCCO Project specifically to minimise GHG emissions and improve energy efficiencies from the mining operation (refer to Section 6.18 of the EIS).

4.4.1.3 Consideration of Rocky Hill Decision

Issues relating to the precedence of the Rocky Hill Mine decision were raised in 11 community submissions. Two examples of the community submissions relating to the Rocky Hill Mine decision are provided below.

Community Submissions

'Justice Preston has made a landmark decision in the Gloucester Rocky Hill Mine decision and this must be taken into account when considering this project.'

'The project will increase the release of greenhouse gases into the atmosphere. In the decision against Gloucester Coal the Land and Environment Court found merit in that Groundswell argued that the Project should be refused because the GHG emissions from the Project, both direct and indirect, would be inconsistent with Australia's commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement'

On 8 February 2019, Chief Judge Preston of the NSW Land and Environment Court delivered judgment in the case of *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7 (Rocky Hill case).

In that case, the Court found that the development application for the Rocky Hill Coal Project should be refused on numerous grounds. In particular, the Court found that the "significant and unacceptable planning, visual and social impacts" of that project warranted refusal on those grounds alone. The greenhouse gas emissions of the Rocky Hill Project and their contribution to climate change was said by the Court to be "a further reason for refusal". The judgment did not cite climate change as a key reason for refusal and did note that there is a role for fossil fuel projects in the short term.

The Rocky Hill case was concerned with the specific facts and circumstances of that proposed mining project. The consent authority is obliged to consider and determine the development application for the MCCO Project on its own, individual merits, having regard to the environmental assessment material and information that is before it.

In addition to the response provided above Glencore has provided the following statement:

> *Coal is a widely distributed natural resource that is produced in more than 40 countries worldwide. The largest resources are found in China, USA, Australia and Indonesia. Most coal (estimated at 82% of global production) is used in the country in which it is mined. China and the USA in particular – the world's two largest coal producers – consume the majority of their coal domestically. Approximately 17% of global coal production is traded on the seaborne market. The remaining percentage (1%) represents landborne trade, including trade within Europe, into China from its neighbours, and between Canada and the USA. Despite being a relatively small proportion of global coal production, the seaborne coal market is important for the Australian, Indonesian, Colombian and Russian coal industries, which are strongly dependent on exports.*
>
> *Pacific basin trade currently accounts for approximately 81% of the seaborne market, with Indonesia and Australia being the largest suppliers. The developed Asian economies of Japan, South Korea and Taiwan have traditionally been the principal Pacific basin importers, however growth in these markets has been limited in recent years. Growth has instead been concentrated in the developing economies of China, India and to a lesser extent, Southeast Asia (SEA). The total volume of coal (both thermal and metallurgical) traded on the seaborne market is forecast to increase.*
>
> *In Australia's main export markets, thermal coal will remain the dominant fuel for power generation through the mid and long term, and systemic factors limit the diffusion of renewable energy including cost, intermittency, requirements for storage, and geographic limitations. In Japan, China, South Korea, and India coal dominates the overall power mix. Coal's dominance is expected to persist through to 2035 and beyond, and a key reason is that coal continues to be the most economical fuel source in most Asian power markets.*

In India, coal use is on the rise, due to economic growth and increasing requirements for low cost electricity. Furthermore, India has shown a growing preference towards higher energy coals from Australia, Mozambique, and the US.

Increased focus on CO2 emissions and increased usage of high efficiency, low emissions (HELE) power plants has the potential to increase demand for high rank Australian thermal coal (being higher quality with lower CO2 emissions) in the seaborne market at the expense of low rank Indonesian coal.

Any imposed restriction (by Australia) in the supply of thermal and metallurgical coal, both increases the global cost of coal supply, and drastically reduces revenue from coal production to Australia.

For seaborne thermal coal, there would be an aggregate increase in global emissions from power stations if Australian coal was replaced by lower quality coal which produces more carbon emission per energy unit of coal burned.

The difference in emissions, and difference in value creation in Australia, whereby coal trade from Australia is restricted, shows that Australia would see significant value loss, should new coal supply not be approved. It also shows that the overall emission profile of the coal industry would increase as a result of substitution of high quality Australian coal with lower quality alternative sources from Indonesia, Russia and China which produce more CO2 per unit of energy created when burned.

4.4.1.4 Transitioning to Alternative Energy and Sustainable Industries

Issues relating to the need to transition to alternative energy and economies were raised in three community submissions. An example of the submissions in relation to alternative energy and sustainable industries is provided below.

Community Submissions
'I feel there should be consideration of the climate change issue and that no further mining operations should be developed in this area. Instead there should be priority and focus placed on development of sustainable industries and renewable energy alternatives to mining.'

As discussed in Section 4.4.1 of the EIS, the NSW Government has developed a strategic long-term plan for guiding land use planning decisions for the Hunter Region until 2036 (*Hunter Regional Plan 2036*, DPE 2016). The plan acknowledges that coal mining will remain significant in the Hunter Region, as it is one of the mainstays of the economy. Coal has contributed to driving investment in transport and energy infrastructure in the Upper Hunter, and it will "continue to underpin the growth and diversification of the Hunter's economy and employment base" (DPE, 2016).

As noted in the previous response, Mangoola recognises that over the next 20 years the percentage of the global primary energy mix supplied by coal is likely to decline. Subject to timing of granting development consent, mining associated with the MCCO Project will cease in 2030. As the MCCO Project meets an existing and future demand and fits within Glencore's committed production cap and the NSW Government's plan for the Hunter region, Mangoola considers that the development of the MCCO Project is currently aligned with the global energy market.

Glencore is committed to sustainably sourcing commodities that are used in processes and products every day. Glencore supports and produces the minerals that go into renewable energy as well as providing coal which is the foundation for baseload energy in many developed and developing economies.

4.5 Biodiversity

Issues relating to biodiversity were raised in 23 community submissions and four interest group submissions.

A detailed Biodiversity Assessment Report (BAR) was prepared as part of the EIS and is included in Section 6.9 and Appendix 13 of the MCCO Project EIS. The BAR was prepared in accordance with the SEARs for the MCCO Project which required an assessment of potential ecological impacts of the MCCO Project as per the NSW Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects (FBA).

4.5.1 Common Community & Interest Group Submissions

4.5.1.1 Impacts to Flora and Fauna

Issues relating to impacts on flora and fauna were raised in nine community submissions and one interest group submission. Examples of the submissions relating to flora and fauna impacts are provided below.

Community Submissions

'There is also the very obvious environmental concerns. The beautiful landscape with its unique flora and fauna will be replaced by massive destruction.'

Wybong Concerned Landowners Group (ORG02)

'The many hectares cleared for the current open cut mine have damaged habitat for fauna and flora.'

As discussed in Section 6.9 of the EIS, the construction and operation of the MCCO Project will result in direct impacts to biodiversity values within the MCCO Additional Disturbance Area. A total of 570 ha of native vegetation will be impacted by the MCCO Project consisting of 356 ha of woodland or open forest and 214 ha of derived native grassland. The direct impacts of clearing vegetation include loss of native vegetation and fauna habitats. The MCCO Project is not expected to result in any substantial indirect impacts on the biodiversity values. Minor indirect impacts associated with habitat connectivity, fugitive light emissions, dust, noise, groundwater changes, weeds and feral animals may occur during the construction and operational phases, however, once the proposed mine rehabilitation has become established, the long-term connectivity of the area will be improved. These indirect impacts will be similar to those currently experienced with the existing mine in operation and will therefore not substantially change with the MCCO Project.

Mangoola has, where possible, altered the MCCO Project to avoid and minimise ecological impacts in the MCCO Project planning stage. Additionally, a range of mitigation strategies have been proposed to address impacts on biodiversity values prior to the consideration of offsetting requirements. Mangoola has an existing approved Biodiversity and Offset Management Plan and Strategy which provides guidance for minimising the impacts of its operations on biodiversity. This existing plan will be updated as part of the implementation of the MCCO Project and be implemented to mitigate adverse biodiversity impacts during construction and operation. This will include specific measures to manage potential impacts on native fauna species in the MCCO Additional Disturbance Area during vegetation clearing and ongoing vegetation management. Mitigation measures will include but are not limited to:

- vegetation and habitat clearing protocols
- feral animal and weed control
- fencing and access control

- bushfire management
- sediment and erosion control
- dust, noise and lighting impact
- pathogen management.

The proposed management measures are described in the existing approved management plans. The management measures will mitigate impacts to native fauna species and will contribute to the maintenance of habitat quality in adjacent remnant habitats. Prior to disturbance in the MCCO Additional Project Area, any applicable management plans will be updated to include the MCCO Project. In addition to management measures, Mangoola is also committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the MCCO Project.

4.5.1.2 Threatened Species

Issues relating to impacts on threatened species were raised in nine community submissions and one interest group submission. Examples of the submissions relating to endangered species are provided below.

Community Submissions

'Loss of threatened ecological communities and have a detrimental effect on a number of endemic species.'

Denman Aberdeen Muswellbrook Scone Healthy Environment Group (ORG04)

'Exacerbating destruction native species and habitat including the orchids Prasophyllum petilum and Diuris tricolor. These orchids were not acknowledged in the initial Anvil Hill EIS and so Mangoola proceeded on a false premise…'

As discussed in Section 6.9.2 of the EIS, listed Threatened Ecological Communities (TECs) and listed threatened species were recorded within the MCCO Additional Disturbance Area during field surveys. Four TECs listed under the *Biodiversity Conservation Act 2016* (BC Act) and one TEC listed under the EPBC Act were recorded including:

- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (EEC) (BC Act)
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)
- Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC (BC Act)
- White Box Yellow Box Blakely's Red Gum Woodland EEC (BC Act)
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community (CEEC) (BC Act and EPBC Act).

In addition to listed TECs, the MCCO Additional Disturbance Area was predicted to contain suitable habitat for listed threatened species under the BC Act and EPBC Act. The FBA methodology categorises threatened species as either ecosystem-credit species or species-credit species which are defined as:

- ecosystem-credit species – species that can be reliably predicted to occur in PCTs and have a high likelihood of occurring on the site. Therefore, targeted surveys for ecosystem credit species are not required
- species-credit species – species that cannot be reliably predicted based on a PCT, distribution or habitat criteria. These species require targeted survey effort to determine their presence or otherwise on the site.

Seven ecosystem-credit species were recorded in the MCCO Additional Disturbance Area during targeted surveys including:

- Glossy Black-cockatoo (*Calyptorhynchus lathami*) (Vulnerable under the BC Act)
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) (Vulnerable under the BC Act)
- Little Lorikeet (*Glossopsitta pusilla*) (Vulnerable under the BC Act)
- Speckled Warbler (*Chthonicola sagittata*) (Vulnerable under the BC Act)
- Varied Sittella (*Daphoenositta chrysoptera*) (Vulnerable under the BC Act)
- Squirrel Glider (*Petaurus norfolcensis*) (Vulnerable under the BC Act)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) (Vulnerable under the BC Act)
- Southern Myotis (*Myotis macropus*) (Vulnerable under the BC Act).

Four species-credit species were recorded in the MCCO Additional Disturbance Area during surveys undertaken for this assessment including:

- Pine Donkey Orchid (*Diuris tricolor*) (Vulnerable under the BC Act)
- Tarengo leek orchid (*Prasophyllum petilum*) (Endangered under the BC Act and EPBC Act)
- southern myotis (*Myotis macropus*) (vulnerable under the BC Act)
- Large-eared Pied Bat (*Chalinolobus dwyeri*) (Vulnerable under the BC Act and the EPBC Act).

The proposed biodiversity offset strategy has been developed in accordance with the FBA and completely satisfies the credit requirements of the MCCO Project. This includes suitable credits for listed TECs and listed threatened species which will be directly impacted by the MCCO Project.

4.5.1.3 Adequacy of Offsets

Issues relating to the adequacy of proposed offsets were raised in three community submissions and one interest group submission. Examples of the submissions relating to the adequacy of offsets are provided below.

Community Submissions

''The proposed biodiversity offsets don't meet current NSW policy, which requires that when endangered habitat is destroyed, it's offset must be "like for like". That is, the same area of the same remnant ecosystem must be protected somewhere else. The proponent has not attempted to do this. So-called "supplementary measures" (such as paying into a fund) must only be a last resort, according to the policy. The four NSW listed threatened ecological communities, one of which is also listed as threatened at the Commonwealth level; White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community have not been adequately protected and offset under the current proposal.'

Hunter Environment Lobby Inc (ORG05)

'HEL is concerned that the system of purchasing Eco System Credits to offset for the eleven threatened species found here in the latest EIS is not an adequate way to deal with the issue of Biodiversity demise...At a time when species are becoming extinct at an alarming and rapid rate, we believe to remove another 570 hectares of valuable irreplaceable forest habitat and threatened species is irreconcilable with an ecologically sustainable outcome..'

Mangoola and its parent company Glencore have strong records in preparing and implementing biodiversity offset strategies that address significant biodiversity matters and adequately counterbalance impacts on them.

As discussed in Section 6.9.6 of the EIS, the proposed biodiversity offset strategy has been developed in accordance with the FBA and completely satisfies the credit requirements of the MCCO Project. The FBA process is a credit driven system where calculators provided by the NSW government are populated with ecological data about the site to generate 'impact credits'. The project is then required to offset these credits through a biodiversity offset strategy with the system designed to ensure a net gain in biodiversity is achieved by requiring much larger area to be conserved than is impacted. The proposed biodiversity offset strategy for the MCCO Project consists of the following:

- In-perpetuity conservation using the retirement of biodiversity credits through the establishment of the following Offset Sites:
  - Mangoola Offset Site (located on land adjacent to the impact area for the MCCO Project)
  - Wybong Heights Offset Site.
- in addition to this, available credits from proposed offset sites currently being finalised by Glencore will be used. These include:
  - 790 credits for HU817 from the proposed Highfields Offset Site
  - *Prasophyllum petilum* credits and *Diuris tricolor* credits from the proposed Mangrove Offset Sites
- 2187 credits generated from the restoration of up to 456 ha of native vegetation communities as part of ecological mine rehabilitation.
- payment into the Biodiversity Conservation Fund for the small number of remaining credits.

The proposed biodiversity offset strategy prioritises "like for like" offsets in accordance with the NSW Biodiversity Offset Policy for Major Projects. Payment to the Biodiversity Conservation Fund has only been utilised when appropriate land based offsets cannot be secured. The proposed biodiversity offset strategy has been developed in accordance with the FBA and completely satisfies the credit requirements of the MCCO Project.

4.5.1.4 Chosen Offset Sites

Issues relating to the location of chosen offset sites were raised in two community submissions. An example of the submissions relating to chosen offset sites are provided below.

Community Submissions
'Within the biodiversity offset areas the proposed offset areas that are outlined, seems strange to want to purchase properties that will not even slightly be affected by the operations of the mine and purchase more farming land from the community rather than purchasing properties that are closely impacted and suffer from the coal mine every day which could be used as the same thing.'

As discussed in Section 7.8 of the BAR, all offset methods proposed are in accordance with the FBA and are considered 'like for like' in accordance with the NSW Biodiversity Offset Policy for Major Projects.

Mangoola is also committed to establishing connectivity pathways between proposed offsets, the existing established offset areas of Mangoola Coal Mine and existing established offsets areas for other Glencore projects. Additionally, some of the proposed MCCO Project offset areas fall within the Great Eastern Ranges Conservation Corridor Initiative area which has been identified as a priority conservation area for NSW. Mangoola has considered "like for like" requirements and connectivity pathways in terms of identifying suitable offset properties.

4.5.1.5 Impacts to Manobalai Nature Reserve & Great Eastern Ranges

Issues relating to impacts on the Manobalai Nature Reserve and associated wildlife corridors were raised in seven individual submissions and one organisation submission. Examples of the submissions relating to the nature reserve and associated wildlife corridors are provided below.

Community Submissions
'It will also threaten the wildlife corridor from the Great Eastern Ranges to the Manobalai Nature Reserve.'
Denman Aberdeen Muswellbrook Scone Healthy Environment Group (ORG04)
'The further destruction of 623Ha reduces the opportunities of plant and animal migration (as a response to climate change) offered by the Great Eastern Ranges (GER) The GER is already narrowed in this area.'

The Manobalai Nature Reserve is located approximately 6 km north west of the MCCO Proposed Additional Mining Area. The Manobalai Nature Reserve has extensive native vegetation and represents a link between remnant patches of vegetation in the central Hunter Valley to the Wollemi National Park. No impacts are predicted on the Manobalai Nature Reserve from the MCCO Project.

It should be noted that the proposed biodiversity offset strategy for the MCCO Project includes the Wybong Heights Offset Site. A significant biodiversity asset of the proposed Wybong Heights Offset Site comes from its position in the regional landscape, particularly its proximity to Manobalai Nature Reserve. The proposed offset site is also located within the wildlife corridor proposed as part of the Great Eastern Ranges Initiative. As such, the establishment of the proposed Wybong Heights Offset Site will result in a substantial increase in the area of land conserved in perpetuity within the wildlife corridor of the Great Eastern Ranges Initiative.

4.5.1.6 Loss of Upper Hunter Biodiversity

Issues relating to cumulative loss of biodiversity in the locality were raised in one individual submission.

Community Submissions

'I regularly visit this region and am already concerned about the environment in this area, an expansion of this mine will only increase the destruction of the environment in the Wybong region specifically, and the Upper Hunter generally.'

As discussed in Section 4.4.6 of the BAR, the MCCO Additional Disturbance Footprint is situated in a landscape that is characterised by agricultural and mining land uses. The MCCO Additional Disturbance Area and surrounding land has previously been cleared for agricultural and mining developments including the existing Mangoola Coal Mine. The MCCO Project will result in the loss of approximately 570 ha of native vegetation due to the MCCO Project, consisting of 356 ha of woodland or open forest and 214 ha of derived native grassland. It is recognised that the clearing of vegetation for the MCCO Project will remove native vegetation and thus contribute to cumulative habitat loss and vegetation clearance in the locality. This loss is considered incremental in relation to the historic clearing practices which have previously occurred in the upper Hunter Valley.

The indirect impacts of the MCCO Project including cumulative vegetation loss will be similar to those currently experienced by the existing Mangoola Coal Mine. To address these indirect impacts, mitigation and offset strategies are proposed including:

- the delineation of clearance areas to avoid unnecessary impacts and clearance of surrounding vegetation
- rehabilitation of the area post mining as described in the EIS
- habitat enhancement measures such as the installation of nest boxes, salvaged hollows, fallen timber, hollow logs and rocks to supplement mine rehabilitation areas
- the implementation of a biodiversity offset strategy in accordance with the FBA, including local biodiversity offsets which include habitat regeneration areas.

It should be noted, that once the proposed mine rehabilitation of the MCCO Project has become established, the long-term connectivity of the area will be improved, relative to the current conditions and status.

Ridgelands Residents Inc (NFP NGO) (ORG01)

'The negative contribution to Climate Change and Negative actual Impact on the Kindilan Conservation Agreement, the habitat of the two undescribed un-recorded species of brown, and green, Wybong burrowing froglets (OEH 2015). Negative actual Impact on the Banded Kangaroo species known to utilise habitat in the MCCOP disturbance area.'

As discussed in Section 2.2 of the BAR, a detailed literature review including searches of NSW and Commonwealth threatened species databases was undertaken for the MCCO Additional Disturbance Area. All potentially occurring threatened species (known or proposed for listing) identified in database searches have been considered within the BAR. The species mentioned in this submission do not match the common names of any currently described species nor any threatened species listed or proposed for listing under the BC Act or the EPBC Act, however, under the FBA process impacts on all relevant species have been considered.

Habitat for all native fauna species occupying the habitats of the MCCO Project area will be offset as part of the ecosystem-credit component of the biodiversity offset strategy, which will ensure that the habitat of all locally occurring species will be conserved in the local area in perpetuity.

4.6 Water

Issues relating to water impacts were raised in 21 community submissions and two interest group submissions.

A detailed Surface Water Assessment (SWA) and a detailed Groundwater Impact Assessment (GWIA) were undertaken as part of the EIS and are included in Section 6.7 and Appendix 11, and Section 6.8 and Appendix 12 of the EIS, respectively.

4.6.1 Common Community and Interest Group Issues

4.6.1.1 Surface Water Resources

Issues relating to impacts on surface water resources were raised in 12 community submissions. Examples of the submissions relating to impacts on surface water resources is provided below.

Community Submissions
'The mine will also draw more water than is reliably available in the region. This water is needed for communities and agriculture and the environment. The huge amount used by this mine cannot be balanced against those more important uses.'
'The security of our water resources is threatened by mining operations. I understand Mangoola has previously exceeded their own forecasts for water usage.'

A detailed SWA was prepared for the EIS by HEC in accordance with the SEARs for the MCCO Project. The assessment determined the likely impacts of the MCCO Project on existing surface water resources and water users. The EIS found that the Project is not predicted to result in significant impacts on downstream water quality, flooding or water users.

Surface water usage in the vicinity of the MCCO Project Area occurs within the Wybong Creek Water Source of the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009. The creeks within the greater Wybong Creek catchment have 132 licensed private surface water users, extracting water for domestic and irrigation purposes. The MCCO Project is also located in an area subject to the Water Sharing Plan for the Hunter Regulated River Water Source 2003. As per Schedule 3, Condition 25 of the Mangoola Coal Mine Project Approval, Mangoola does not use any licensable water from the Wybong Creek Water Source for mining purposes, other than that incidentally collected by approved mining operations.

Mangoola currently holds a total of 861 ML share components of Wybong Creek unregulated WALs, which is sufficient to account for interception of undisturbed area runoff from both the existing Mangoola Coal Mine and the MCCO Additional Project Area in excess of harvestable rights. Mangoola also holds 17 ML total share components of Hunter River regulated high security WALs and 2,758 ML total share components of Hunter River regulated general security WALs. The water take licensing system in NSW has been designed to provide for sustainable environmental flows and thereby minimises the cumulative impacts of water take by all water users.

The SWA has confirmed that the externally sourced water requirements of the MCCO Project can be met entirely through the existing licences that Mangoola hold.

The majority of mine water supply is obtained from runoff captured from disturbed mine landforms and water reclaimed from the tailings storage. Operational (makeup) water supply is obtained by pumping from the Hunter River via general and high security WALs where necessary, however, mine water supply is intended to be primarily met through water generated/reused on site.

4.6.1.2 Water Quality Impacts

Issues relating to impacts on water quality were raised in four community submissions. Examples of the submissions relating to water quality impacts are provided below.

Community Submissions
'Reduction of water flows and increased salt levels in Wybong Creek and Hunter River'
'[…] the loss of the Big Flat tributaries and Anvil Creek […] while only being small assisted the Wybong Creek flush outs during flood events by removing salt and other contaminants.'

The MCCO Additional Project Area primarily lies within the catchment of Big Flat Creek with a small section extending into the Wybong Creek catchment. As discussed in the MCCO Project EIS, the key potential impacts of the MCCO Project on surface water relate primarily to the ephemeral Big Flat Creek, with water capture associated with the mine water management system resulting in reduced catchment flowing to Big Flat Creek (and to a smaller degree to Wybong Creek) and resulting in minor reductions in flow to the creeks.

The EIS SWA concluded that the MCCO Project is not anticipated to impact downstream water quality in Big Flat Creek and Wybong Creek, and therefore it is unlikely that the MCCO Project will contribute to any cumulative impacts on downstream water quality. All discharges to the Hunter River via the existing approved discharge point will be managed in accordance with the HRSTS which has been designed to manage the salt load of the Hunter River to within sustainable levels. Discharges will be monitored prior to release to achieve compliance with water quality conditions, and therefore no significant impacts to downstream waters are likely.

The risk of sediment laden water affecting downstream waters is mitigated by the MCCO Project's water management system, which is designed in accordance with design criteria established by the NSW Government specifically for sediment control at mining and quarrying operations. The current operation has successfully implemented sediment and erosion control measures to manage water quality and these measures will be extended to the MCCO Project.

The SWA has not predicted adverse impacts on downstream water quality as a result of the MCCO Project and therefore there is minimal risk of contamination of surface waters.

Mangoola currently operates Mangoola Coal Mine in accordance with a Water Management Plan which was prepared in consultation with NSW Government agencies and subsequently approved. The Water Management Plan describes the management of environmental and community aspects, impacts and performance relevant to the site's water management system, and includes a surface water monitoring plan. Mangoola will review and update the Water Management Plan (including the surface water monitoring plan) for the MCCO Project in consultation with DPI Water and DPIE and then implement this plan. The updated Water Management Plan will be prepared in accordance with the MCCO Project's conditions of consent.

4.6.1.3 Groundwater Impacts

Issues relating to groundwater impacts were raised in five community submissions. Examples of the submissions relating to groundwater impacts are provided below.

Community Submissions
'The mine will not commit to compensation if their void in the ground takes away our ground water supply.'
'We are concerned about the loss of underground water and water balance which would directly affect our farming activities and our ability to sustain vegetation.'

‘I worry that the mining operations will affect Wybong Creek which has underground flows close to the proposed mining area.’

A detailed GWIA was prepared for the EIS by AGE in accordance with the NSW Aquifer Interference Policy (AIP) and SEARs for the MCCO Project. The assessment determined the likely impacts of the MCCO Project on existing groundwater resources and water users.

The assessment found that the MCCO Proposed Additional Mining Area will intercept groundwater in the bedrock including in the coal seams. The assessment found that there will be no direct take of any alluvial groundwater as a result of the mining within the MCCO Proposed Additional Mining Area. Mining will continue to reduce flux (flows) between the bedrock and the Wybong Creek alluvium with the majority of the total change in flux during active mining (maximum 33 Megalitres (ML)/year) attributed to the continued operations within the approved Mangoola Coal Mine (maximum 30 ML/year). The incremental predicted change due to mining within the MCCO Proposed Additional Mining Area is a maximum of 3 ML/year.

Mangoola’s current groundwater licences will readily account for the groundwater take predicted for the MCCO Project.

The GWIA has not predicted any impacts to groundwater quality as a result of the MCCO Project and therefore found that there is negligible risk of contamination of groundwater such that human health impacts could occur, or that the Project would impact on agriculture.

With regard to the potential for impacts to private bores the numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the Aquifer Interference Policy. As outlined in the EIS, one private bore is already predicted to be impacted by mining at the approved Mangoola Coal Mine.

A more detailed response to the potential for impacts on specific private bores as requested by some submitters is provided in the following section.

4.6.1.4 Impacts to Private Groundwater Bores

Four community submissions raised issues in regards to impacts on their private groundwater bores. Tailored responses have been compiled for these submissions.

During the response to submissions phase AGE undertook further field investigations and modelling to complete a more detailed assessment on the submitters private groundwater bores. The AGE report for field assessment of private groundwater bores is provided in **Appendix 12**. The scope of work included:

1. Inspecting each private bore to confirm the exact location, depth and usage
2. Collecting water samples from each private bore for laboratory analysis of water quality
3. Using the MCCO Project numerical groundwater model to estimate drawdown at each private groundwater bore.

Property owners were contacted prior to fieldwork and inspection of the groundwater bores to ensure that that appropriate land access arrangements were in place. Fieldwork was undertaken by an AGE hydrogeologist on 23 October 2019.

The results of the fieldwork including the location, depth and water quality of the relevant private groundwater bores is provided in **Table 4.9** for the three properties that agreed to have inspections completed. A suitable arrangement to inspect the fourth property (Residence 144) was not able to be made.

Table 4.9 Results of Private Bore Assessment in Proximity to the MCCO Project

Bore Information	Residence 261 Bore	Residence 157 Bore	Residence 130 Bore
Easting#	0280609	0280751	0277511
Northing#	6432443	6430608	6427358
Drill Date	2018	2011	Unknown*
Purpose	Stock and domestic	Stock and domestic	Stock and domestic
Total Depth (m)	94	85	30
Pump Depth	84	80	25
Water Level (mbgl)	Unable to measure**	Unable to measure**	14.58
Yield during development (L/s)	1.4	6-7	Unknown^^
Yield (currently)(L/s)	2^	1.5	Unknown
Pump	Electric submersible	Electric submersible	Windmill
Sampled for laboratory analysis	Yes	Yes	Grab only+
Electrical conductivity (µS/cm)	12,720	4,112	3,753
pH	6.86	7.27	7.15
Temperature (Celsius)	20.6	21.1	21.9

GDA94, MGA Zone 56
* Present on property at time of acquisition (1999)
** Unable to measure due to sealed headworks
^ Pumps bore dry (requiring 30 minute recovery – landholder information)
^^ Not enough wind to pump and estimate
+ No purging undertaken, a singular sample taken of the bore at a specific depth and time

Residence 261 (Submission SE-80791) & (Submission ID SE-80790)*

'Our underground water source will be effected by the proposed mine extension, as a young farming family struggling to make ends meet within the worst drought in Australia we have continued to establish a profitable farming business that will now be effected by Mangoola and we will potentially loose our water source we have paid many thousands of dollars for as you could imagine this is hard to come to terms with as this will then be dramatically effecting our business and our income. Mangoola do offer bore monitoring for private landholders but with the figures of the noise testing being so suss I find it hard to believe the figures will not be made to accommodate the mine not us. They have told us they will affect ground water but seem unless I can prove it was them affecting it; it's just bad luck- another case of guilty until you can prove yourself innocent. Not to mention Mangoola hold most of the water licences within the area which makes it extremely hard for people to expand their enterprises when there are no water allocations available and they are not willing to give them up...I feel being 1 of the 2 privately owned bore holders within this operation I will be dramatically impacted by this and be substantially left out of pocket. I then in turn will not be able to make my farm a sustainable or have a profitable business and my crops, cattle and family will be sadly impacted. Water NSW has informed me that my bore quality and flow rate will be affected if this operation is approved.'

*Note, both submissions received from Residence 261 were identical in regards to groundwater issues.

Findings for Residence 261 Bore

The updated details for the Residence 261 bore (refer to **Table 4.9**) was entered into the MCCO Project numerical groundwater model. The updated predicted maximum drawdown in the groundwater bore pump layer is 0.182 m. Accordingly, the numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the AIP. This means there is no trigger for make good provisions with the landholders. However, Mangoola is committed to undertaking regular water level monitoring of this groundwater bore to confirm the groundwater model predictions subject to agreement from the landholder.

Residence 157 (Submission ID SE-69325)
'The likely impact on our ground water bore situated North West of the mine in the Sydney City aquifer and 88 meters from ground level and flowing at approx. 400 litres per minute'

Findings for Residence 157 Bore

The updated details for the Residence 157 bore (refer to **Table 4.9**) was entered into the MCCO Project numerical groundwater model. The updated predicted maximum drawdown in the groundwater bore pump layer is 1.296 m. Accordingly, the numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the AIP. This means there is no trigger for make good provisions with the landholders. Mangoola is committed to undertaking regular water level monitoring of this groundwater bore to confirm the groundwater model predictions.

Findings for Residence 130 Bore

It is noted that Residence 130 did not put a submission in regarding impacts to private groundwater bores. However, fieldwork and updated numerical groundwater modelling was offered for all private groundwater bores in close proximity to the MCCO Project Additional Mining Area to ensure the accuracy of model predictions.

The updated predicted maximum drawdown in the groundwater bore pump layer for this bore is 0.008 m. Accordingly, the numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the AIP. This means there is no trigger for make good provisions with the landholders. However, Mangoola is committed to undertaking regular water level monitoring of this groundwater bore to confirm the groundwater model predictions.

Residence 144 (Submission ID SE-93451)
'My 2 private bores, GW201 589 and GW080 507 provide my house with domestic water. The EIS does not effectively consider the impact that the drop in the water table will have on my bores and the consequence of the loss of water access for me and for the value of my property.'

Residence 144 was contacted prior to the additional AGE fieldwork to determine if inspection of their bores could be undertaken. However, a suitable access arrangement was not able to be made and no additional work could be undertaken for the private groundwater bores (GW201 589 and GW080 507) identified in the Residence 144 submission.

The GWIA undertaken as part of the MCCO Project EIS included an assessment of potential drawdown impacts on private groundwater users. A search of publicly available information including the NSW state government groundwater bore database was undertaken for registered bores in proximity to the MCCO Project. The results of the searches for Residence 144 bores (GW201 589 and GW080 507) are provided below in **Table 4.10.**

Table 4.10 Publicly Available Information for Registered Bores Residence 144

Bore Information	GW201 589	GW080 507
Drill Date	2011	2003
Purpose	Stock, domestic	Stock, domestic
Depth (m)	84.0	Not recorded
SWL (mbgl)	10.0	Not recorded
Yield	0.5	Not recorded

The GWIA included an assessment of the registered bores located on the property of Residence 144 with the numerical model predicting that maximum drawdown in the groundwater bore pump layer is approximately 0.3 m for GW201 589 and 0 m for GW080 507.

Accordingly, the numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the AIP for both bores. Mangoola is committed to undertaking groundwater level monitoring of private groundwater bores in proximity to the MCCO Project to ensure the accuracy of model predictions. However, this would require land access from the relevant landholder and approval to install a data logger for ongoing monitoring. As outlined in the EIS, should any private bores be affected by the MCCO Project, Mangoola will repair the bore, provide an alternative water supply or implement other measures agreed with the landowner.

4.6.2 Specific Water Issues

4.6.2.1 Predicted Water Usage of the MCCO Project

One community submitter raised a specific issue in regards to the predicted water usage of the MCCO Project in the EIS.

Residence 206 (Submission ID SE-92556)

'The Mangoola 2018 Annual Review, Table 33, page 67 shows comparison of actual 2018 Water Usage 3,142ML vs. the 2014 MOD 6 high water demand scenario prediction of 889 ML. This is an increase of 353% above mine worst case predictions.'

Experience gained from the existing mining operations at Mangoola Coal Mine has identified that the previous groundwater assessment over-predicted groundwater inputs. In this regard, in certain periods, in particular during dry periods, inputs from the Hunter River have changed due to reduced groundwater inflows to account for the deficit and meet operational requirements, however overall water usage across the site has not substantially differed from what was assumed. All water extracted from the Hunter River in this regard has remained within the allowable limits of the licences held by Mangoola.

As identified in the submission and reported in the 2018 Annual Review water usage at Mangoola Coal Mine including at the CHPP and for haul road dust suppression and extraction of water from the Hunter River were greater than predictions made in the 2013 Surface Water Assessment (as part of the MOD 6). This increase in required extraction from the Hunter River was due to the lower than predicted inputs from groundwater and due to low rainfall received on-site during 2018 due to the drought conditions. Conversely, the Hunter River offsite release was less than the predictions in the 2013 Surface Water Assessment with no discharge required to date.

The predictions made in the MOD 6 assessment are not approval limits and it is noted that all water extracted from the Hunter River was within the allowable licence limits held by Mangoola.

A site water balance was completed as part of the EIS and confirmed that Mangoola has an adequate water supply within the existing water management system at Mangoola Coal Mine to meet the predicted water requirements for the MCCO Project. The predicted water requirements of the MCCO Project can be met entirely through the existing licences that Mangoola hold.

Calculations of water licence requirements completed as part of the EIS concluded that Mangoola currently holds sufficient water licence allocations to cater for the licencing needs of the MCCO Project.

4.6.2.2 Water Extraction

Hunter Environment Lobby Inc (ORG05)

'HEL has concluded that until such time as there is a comprehensive and representative monitoring program across the Hunter catchment, there is no conclusive measure of the trends for salinity in the river system, and hence there should be no increase in mining activity, or, as in this case no increase in rate of extraction or increase in mine water discharges into the Hunter River system.

HEL considers that the proposal to increase the extraction rate and water demand at the Mangoola Mine is a high risk decision. Besides the mine having possible storage problems during periods of high rainfall, it has been identified that there will be a significant shortfall in available water during periods of prolonged drought.

HEL is concerned that if Mangoola have to begin extracting groundwater using existing groundwater licences during prolonged drought, the cumulative impact on groundwater systems from mine drawdown and increased licenced extraction has not been adequately modelled.

The MCCO Project does not seek to increase the rate of extraction or increase mine water discharges to the Hunter River. Mangoola is seeking approval to maintain the existing approved limit of 13.5Mtpa and for the continued ability to discharge excess water in accordance with the HRSTS as per the existing approval. As noted in the EIS to date Mangoola has not been required to discharge as part of the existing operations.

As discussed in Section 6.7.3.1 of the EIS, a detailed water balance was completed as part of the SWA. The predicted average inflows and outflows for the MCCO Project are similar to the water balance for the existing Mangoola operations. Any additional rainfall generated by the inclusion of the MCCO Additional Project Area catchment will be appropriately managed in the existing water management system. The majority of outflows from the MCCO Project will comprise water usage associated with the existing CHPP facility. As such, no changes are proposed to the approved existing discharge at Mangoola with the inclusion of arrangements for the MCCO Project.

The water balance assessment included an average supply reliability assessment over all climatic realisations including a 'worst case' scenario. A high level of average supply reliability was predicted for all climatic realisations with a low risk of shortfall.

Water take from the groundwater systems will occur during mining operations for the MCCO Project due to the interception of aquifers for coal extraction. Groundwater from intercepted aquifers which reports to mining areas and pits will be managed within the existing mine water management system. Water take will continue post mining due to the residual drawdown created by the flow of groundwater to the final voids. Mangoola already holds sufficient water licence allocations to readily cater for all groundwater take predicted for the MCCO Project and would retire groundwater licences to cater for this take in the long term. Mangoola does not currently or propose to pump from existing licenced groundwater bores to supply mining operations. The licences held are for incidental take (as described above) or monitoring purposes and are not bore fields for extraction.

4.6.2.3 Unauthorised Discharge Event

Ridgelands Residents Inc (NFP NGO) (ORG01)
'unauthorised water release to Wybong Creek.'

Mangoola has never had an incident with "unauthorised water release to Wybong Creek" as stated by the interest group.

4.7 Flooding

One community submission relating to flooding issues was made on the MCCO Project. No flooding issues were raised by interest organisations.

Submission ID SE-93464
'I worry about the water systems along Ridgelands Road. When it rains there is always extensive flooding through that area and I do not look forward to being swamped by a massive dam wall on our beautiful, once scenic drive!'

The flood assessment completed as part of the SWA has confirmed that there will not be any changes to existing flooding on Ridgeland's Road. There are no plans for any major dams, nor are there any dams adjacent to Ridgeland's Road.

As described in the flood assessment Wybong Road is currently affected by potential flooding and the MCCO Project is not predicted to materially increase existing flood levels and the trafficability of Wybong Road will remain unaffected for flood events up to the 1:100 AEP. For larger flood events modelled including the 1:1000 AEP and PMF there would only be a minor change with some parts of Wybong Road likely to be affected by flooding under these extreme events, however, it is noted that under these events the road would likely be closed in any case due to flooding impacts in other areas.

4.8 Final Landform

Issues relating to final landform were raised in 16 community submissions and all of these raised common themes and related issues on the proposed final voids, void water quality, land being unusable and regarding beneficial uses of final voids. No final landform issues were raised by interest organisations.

Community Submissions
'In the proposal of this continuation it is suggested there will be two final voids left after the completion of the project. In my opinion, in this day of age, it is absolutely abhorrent that we as a community, would be left with an eyesore and a lasting environmental issue that could not be considered managed at all, once the mine has completed their business. These final voids must not remain, and must not be considered a solution in any proposal. Environmentally we must acknowledge best practice, and apply them to all rehabilitation after these projects finish up.'
'Yet another final void that will eventually fill with toxic water that the tax payer of the future will have to deal with.'
'The fact that coal has a finite life makes is implausible to continue to mine and decimate the land and communities affected for such a short term and then have the land unusable for 20 years as well as a great big hole in the ground that will have water in it that is not suitable for any agricultural use and in this time of drought would be a difficult sight to see. Imagine being able to see water and not be able to use it?'
'The expansion project will add a further void to be left by coal mining in the Upper Hunter without a long term beneficial use. This wanton damage to the environment to be left as a liability for future generations cannot be allowed to continue. In a manner similar to the revegetation and remediation carried out on

spoil surfaces the proponent should be compelled to undertake beneficial remediation of the void area. Examples of beneficial use of voids are present in Australia and overseas and must be mandated into the mine plan.'

As described in the EIS, once the conceptual mine plan for the MCCO Project was determined, further assessment was undertaken by Mangoola of final landform options, specifically related to final voids, balancing the design inputs and expectations surrounding the establishment of a final landform. These inputs and expectations include:

- maximising resource recovery and financial viability
- ability to minimise void size during the mining process
- available material post mining completion for use in rehabilitation activities
- surrounding constraints such as topography and boundaries
- long term stability, safety and non-polluting landform establishment
- visual considerations
- long-term environmental sustainability and minimisation of impacts associated with the final landform.

A key consideration in the planning and design of the final landform for the MCCO Project was the availability of overburden from the MCCO Project Additional Mining Area to backfill the mining area within the Approved Project Area in order to achieve an improved final landform in the existing approved Mangoola Coal Mine.

The various options that were considered are discussed in Section 1.4.4 of the EIS. Mangoola also considered the option of not having voids as part of the MCCO Project and found that it is not economically feasible to have no voids at all and that the extensive additional mining activity required to rehandle emplaced overburden to backfill the voids would result in additional environmental and social impacts.

The landform within the final voids is defined as all land that is not able to be rehabilitated to a subsequent use and will include highwalls, benches, ramps and the area where water will accumulate to form a pit lake. The low wall, which is the face of emplaced overburden within the pit is planned to be shaped and rehabilitated and available for other land uses (i.e. either conservation or agricultural land uses) and so is not considered part of the final void.

The proposed mine plan for the MCCO Project, including the commitment to rehandle 5 Mbcm of material, is more costly to achieve than the preferred business case (Case 1), and Case 2 which was the initial integrated mining case considered as part of the planning and design phase for the project. However, the proposed mine plan is considered by Mangoola to achieve an appropriately balanced outcome. In summary the proposed mine plan provides the following benefits:

- provides a balanced outcome that achieves economic expectations whilst minimising the size of the final voids
- the void in the existing approved mining area is commensurate with the approved final landform however improved due to the application of a revised natural landform design and shallower slopes on the low wall

- reduces the overall size of the void (thereby maximising return of useable land) and improves the visual appearance of the MCCO Project Additional Mining Area void by backfilling the angular ends of the void and providing rounded ends
- both final voids (non-backfilled mining areas) will partially fill with water and act as long-term hydraulic sinks. Within the existing approved mining area there is potential for water in backfilled areas away from the final void to migrate out and provide recharge to the surrounding bedrock with much of this water moving north and being captured in the northern void
- there will be limited public vantage points from which the remnant highwalls will be visible (particularly once vegetation has been established on adjacent areas)
- minimising the environmental and social impacts that would occur with more extensive rehandling of emplaced overburden including impacts on already rehabilitated areas, dust, noise, water and visual impacts.

Based on the mine planning and final void and landform options assessment, Mangoola has determined that the MCCO Project Case as presented and assessed in the EIS strikes an appropriate balance between mine planning, economic, environmental, social and final landform outcomes.

Further as detailed in **Section 3.3.1** an independent expert examination of the proposed final landform has been undertaken by Andrew Hutton of IEMA. The independent review concluded that Case 3, as presented in the MCCO Project EIS, represents an appropriate outcome which demonstrates that Mangoola has considered the balance between delivering an economic mine plan whilst giving proper regard to leaving beneficial post mining land uses and minimising final voids. Further, the review found that Mangoola has demonstrated through the rehabilitation already completed at the existing Mangoola Coal Mine that it has been able to successfully design and construct the natural landforms along with the revegetation techniques that are proposed in the MCCO Project EIS.

The groundwater assessment of the final landform (at closure) indicates that the proposed final voids (non-back filled mine areas) will form long-term hydraulic sinks and will be comprised of two open water pit lakes. The final void water balance modelling found that these pit lakes will not spill to the surface water system as the predicted water level will reach equilibrium well below the spill point of the voids. Equilibrium levels would be reached slowly over a period of more than two hundred years. Final pit lake salinity levels would increase slowly as a result of evapo-concentration. After approximately 300 years the salinity of the final voids will have an EC of less than 10,000 µS/cm. This salinity is well below that of seawater (approximately 35,000 mg/L) and would therefore be considered suitable for recreational uses as well as some forms of aquaculture.

4.9 Rehabilitation

A described in **Section 2.0**, a number of the supporting submissions (85) provided positive comments regarding the success and progress of rehabilitation at the existing Mangoola Coal Mine with many noting that Mangoola is leading the way with the successful completion of mine site rehabilitation.

Issues relating to rehabilitation were identified in one community submission and two interest group submissions.

An overview of rehabilitation and mine closure for the MCCO Project was provided in Section 6.17 of the MCCO Project EIS. The proposed rehabilitation strategy for the MCCO Project has been developed in consideration of the existing rehabilitation that has been successfully completed at the existing approved operation, environmental opportunities and constraints, input from government stakeholders and operational considerations.

Submission ID SE-92599

'No evidence of existing mining restoring mining sites to any were near originality'

Rehabilitation at the existing Mangoola Coal Mine is completed using natural landform design principles and revegetation techniques that are widely recognised as industry leading practice. Disturbed land is rehabilitated to produce a stable landform and sustainable vegetation communities that are consistent with and enhance the surrounding landscape. The Mangoola Coal Mine Annual Reviews have consistently reported that rehabilitation works are successful and have yielded species diversities that are generally compatible with target vegetation communities. As stated in the 2018 Annual Review, so far, Mangoola has successfully rehabilitated approximately 532 ha of disturbed land.

The rehabilitation strategy for the MCCO Project will be consistent with Mangoola's current approved rehabilitation practices which have been recognised as industry leading. Rehabilitation for the MCCO Project will be undertaken in accordance with a revised MOP and a revised Rehabilitation Management Plan which will be updated prior to operations of the MCCO Project. The revised MOP will detail performance measures and criteria for each rehabilitation area. The monitoring of rehabilitation performance will be regularly reported to the DPIE and DRG.

In addition to regular monitoring of rehabilitation performance, completion criteria will be established and utilised to demonstrate achievement of rehabilitation and final land use objectives. The achievement of the completion criteria will be monitored within regular reports which will be submitted to relevant government agencies.

Mangoola undertakes annual monitoring and reporting on the effectiveness of rehabilitation measures and progress towards the detailed performance and completion criteria. Ecological Monitoring Reports for the last two years indicate that existing rehabilitation at the Mangoola Coal Mine is progressing towards the achievement of completion criteria. Additionally, an Independent Environmental Audit (IEA) undertaken in August 2019 confirmed that the rehabilitation of the Mangoola Coal Mine site was being conducted in accordance with MOP plans for rehabilitation. As a part of the IEA, Clayton Richards a rehabilitation expert from MineSoils conducted a site inspection. Clayton Richards recommended continuing current rehabilitation practices as they appear to be providing successful results. The IEA noted that rehabilitated areas were generally healthy despite the current dry period and that a significant variety of species were observed.

Ridgelands Residents Inc (ORG01)

'The rehabilitation conducted by Mangoola does not replicate the pre-mining biota and ecosystems and cannot support the variety of Listed Species. The plant species used, some 40% wattle, is not typical of the pre-mining vegetation (no other proximate location flowers at the same time as the rehabilitation or has the preponderance of wattle).'

The rehabilitation proposed for the MCCO Project will be ecological rehabilitation and designed to represent native vegetation plant types and will consider both the floristic composition and the structure of the rehabilitation. Section 7.4 of the BAR details the ecological rehabilitation proposed and the preliminary performance measures and closure criteria.

The dominance of wattle in early succession stage rehabilitation is not typical of the benchmark condition of locally occurring vegetation communities, however acacia species are colonising species that dominate successional stage regrowth of vegetation in natural ecosystems, as the communities mature over time, the dominance of acacia (and other successional species) reduces. This pattern is replicated in mine rehabilitation communities and is an expected part of the rehabilitation process.

Ecological Monitoring Reports for the last two years indicates that existing rehabilitation at the Mangoola Coal Mine is progressing well towards the achievement of completion criteria. The 2018 Ecological Monitoring Report found that despite the drought conditions the habitat value provided by the rehabilitation is rapidly increasing and that threatened fauna diversity in 2018 was at the highest level documented since commencement of monitoring in 2008. It also found that bird diversity is generally higher in rehabilitated vegetation than remnant vegetation. These species are being supported by shrubby foraging resources such as Acacia spp. and Dodonaea spp. This is a strong indicator of the value of these areas to local fauna. Bird diversity is supported by stag trees in these areas.

Lock the Gate Alliance (ORG03)

'Muswellbrook Council's Land Use Development Strategy asserts the "need for a whole of life consideration for mining activities, including quality rehabilitation and restoration of mined land." It is clear that the proponent is not considering a whole of life approach to mine management. On the contrary, it is putting Muswellbrook and surrounds at significant risk of economic and social upheaval from the unmanaged decline of coal mining.'

Mangoola has implemented a proactive approach to rehabilitation and mine closure for the existing mining operations and proposes to implement the same approach for the MCCO Project. This includes planning for closure as an integrated part of the life of mine planning process. This approach includes developing, implementing and reviewing a mine closure plan that takes into consideration economic, social and environmental factors so that the operation meets its statutory requirements and achieves sustainable post-closure land uses.

The objective of the Mangoola closure planning process is to establish a process to guide all decisions and actions across the life of the mine such that:

- a post-closure vision is identified early in the mine life, and progressively reviewed and refined throughout the life of the mine
- the mine site as a whole is safe, stable and non-polluting
- the mine is designed, planned and operated in a manner that considers closure obligations throughout the mine life
- closure risks and gaps are identified for the mine and a treatment plan is established
- closure costings and financial provisioning is based on a thorough, transparent and justifiable process to provide for sufficient funds to implement required actions following the cessation of mining until completion criteria and relinquishment is achieved
- at the cessation of mining, the closure liability includes those closure items that could not be undertaken during the operational phase of the mine, as far as practicable
- the post mining land uses for the mine are beneficial and sustainable in the long-term as measured against established rehabilitation objectives and criteria
- adverse socio-economic impacts are minimised and socio-economic opportunities are maximised.

The existing Annual Rehabilitation and Mine Closure Plan for Mangoola Coal Mine will be updated to include the MCCO Project. It will include details regarding final land use objectives and completion criteria, rehabilitation and final void management strategies as well as the process for engaging relevant stakeholders in the closure planning process to be adopted throughout the mine life. When the mine is within five years of the planned closure date the detailed closure planning process will be initiated.

The Detailed Mine Closure Plan will consider relevant policies and guidelines including Muswellbrook Council's Land Use Development Strategy and will be developed in consultation with government and other stakeholders and will commence five years prior to the planned mine closure. As discussed in previous sections, Mangoola has also committed to prepare a Post Mining Land Use Strategy for the Mangoola land holding in consultation with relevant stakeholder including MSC. Given that the MCCO Project involves eight years of mining, this detailed closure planning process is expected to commence within a few years of the commencement of mining activities under the new development consent.

Mangoola will engage with MSC throughout the conceptual and detailed mine closure planning processes for the MCCO Project.

4.10 Historic Heritage

Issues relating to historic heritage were raised in three community submissions. No historic heritage issues were raised by interest groups.

A Historic Heritage Assessment (HHA) was undertaken as part of the EIS and is provided in Section 6.11 and Appendix 15 of the EIS. The HHA was undertaken in accordance with the SEARs for the MCCO Project which required the identification of historic heritage within and in proximity to the MCCO Project Area.

> **Submission ID SE-92607**
>
> The HHA
>
> '1. Failed to identify all the historic heritage within the vicinity of the MCCO Project.
>
> 2. Reliance on existing databases does equate to locating all heritage within the area, as Manning Clark stated, 'a good historian needs a notebook and a stout pair of boots'. In other words, get out and look.
>
> 3. A visual assessment was made of the area to capture items that may have escaped the existing database, but this consisted of two days. Totally inadequate when the area being studied is considered.'

The research undertaken to identify historic heritage within the MCCO Additional Project Area utilised a range of sources, including but not limited to:

- Heritage databases, including the State heritage inventory, the applicable Local Environmental Plans, and the State Heritage Register
- Previous assessments and other background reports
- Consultation with the Muswellbrook Shire Local Family and History Society
- Historical mapping
- Historical and contemporary aerials.

As such, the preparation of the report utilised, but did not rely on, database searches alone. The range of resources used in compiling the historical context of the MCCO Additional Project Area, which included consultation with the Muswellbrook Shire Local Family and History Society and the use of previously collated oral histories sourced from long-time local residents, provided a sound basis on which the survey methodology was developed.

Further to the above, comparisons made between historical mapping, historical aerials and contemporary aerials were used to identify items/properties/areas that required further assessment. As outlined in Section 3.2 of the report, properties targeted for more detailed historical research and/or visual inspection were identified on the basis of one or more of the below criteria:

- being heritage listed (local or state) properties/items
- appearing/being mentioned in the historical research undertaken to inform this assessment (e.g. mentioned by local residents as part of the oral history compiled in 2008, or being noted within previously prepared regional and local historical assessments)
- being visible on either the 1930 historical aerials or the 1974 topographic map (which shows historical structures/elements), or both.

The extent of background research that was undertaken allowed for a targeted field survey program to be conducted over the course of two days by two Senior Heritage Consultants.

It is noted that the targeted field survey was not limited to the MCCO Additional Project Area (where direct impacts are proposed), but encompassed the entirety of the study area, so as to enable an assessment of both direct and indirect impacts associated with the MCCO Project.

Further, Aboriginal archaeological surveys of the MCCO Additional Project Area were undertaken in February and May 2018 by OzArk Environmental and Heritage (OzArk) and RAPs for the MCCO Project. These surveys were extensive in their on-the-ground coverage of the MCCO Additional Project Area, in accordance with the applicable guidelines for Aboriginal archaeological survey in New South Wales.

As a result of these surveys, OzArk identified a number of remnant infrastructure elements such as fences, a broken windmill of poor condition and general building remnants. Upon further assessment, none of these items were identified to be of potential heritage significance; all remnants identified were typical of the rural landscape within which they were found, and none appeared to be in particularly good condition. Overall, no additional potential historical heritage sites or items were identified during the 2018 Aboriginal survey or test excavations, which involved substantial survey coverage within the MCCO Additional Project Area.

Overall, the level of survey coverage was appropriate for the context of the MCCO Project, based on the extent of background research and preparation work that was undertaken to inform the survey methodology. It is noted that targeted survey is a widely accepted methodology for assessments of this type, and particularly for areas that are comparable in size to the current study area.

Submission ID SE-92607

‘4. Appendix 15 Historic Heritage Assessment starts to consider the settlement of the area with Table 4.1 Wybong Land Settlers between 1861 and 1889, but the report does not cover an on the ground assessment for archaeological remains. The Table lists 43 settlers, these sites could not be inspected in two days.’

As noted in the report, it is relatively unlikely for archaeological remains (as opposed to standing or remnant structures/elements) to be identified via visual inspection. This is because of the nature of archaeological remains means that they are typically present in sub-surface (and therefore not readily visible) contexts.

As discussed in Section 7.3 of the HHA, the archaeological potential of the MCCO Additional Project Area (where direct impacts are proposed) was assessed as very low.

As noted above, the field survey methodology that was used was not intended to allow a complete and/or exhaustive visual survey of the entirety of the study area, as the background research undertaken to inform the report did not indicate that this was warranted. Rather, a targeted survey based on historical research was utilised to ensure that a degree of coverage appropriate to the context was achieved.

The suitability of this methodology was borne out by the field survey, with the 10 out of 25 properties targeted for inspection/further assessment proving not to be of heritage significance.

As noted above, the targeted survey undertaken by Umwelt was supplemented by a comprehensive survey undertaken by Ozark for the purposes of assessing Aboriginal archaeology and cultural heritage. Umwelt and Ozark consulted during the preparation of the respective reports, and Ozark communicated the results of their surveys as it related to historical heritage to Umwelt. As noted above, the surveys undertaken by Ozark did not result in the identification of any additional properties, items or areas of potential historical heritage or archaeological significance. The combination of the targeted survey undertaken by Umwelt, the comprehensive surveys undertaken by Ozark and the results of previous assessments (including that undertaken by EMM (2016) collectively provided a sufficient level of survey coverage to inform the assessment.

(Submission ID SE-92607

‘5. There is no mention in the assessment of utilising Crown Plans of the early Portion, which may have provided evidence of settlement.’

Whilst is it acknowledged that Crown Plans were not directly utilised in the preparation of the report, it is noted that the background research that was undertaken utilised a range of resources, including previous assessments and other background reports, which did utilise Crown Plans.

This includes the *Muswellbrook Shire Wide Heritage Study* prepared by EJE Group in 1996, the *Mangoola Coal Wybong Oral Heritage Report* prepared by Hansen Bailey in 2008, multiple assessments undertaken by Umwelt that included field surveys within and around the study area, and the project pre-feasibility study prepared by ERM in 2016, which directly overlapped the study area.

On the basis of all of the above listed assessments, as well as the consultation that was undertaken with the Muswellbrook Shire Local Family and History Society, and the use of historical plans and aerials, it is considered that the background research undertaken to inform the report was sufficient and appropriate.

As outlined at Section 7.3 of the HHA, it is considered unlikely that any potential remains associated with former buildings, structures or elements that were not identified as part of *Historical Heritage Report* or any other reports undertaken for the local area, would have research potential or would be of archaeological significance. Sufficient justification for this conclusion is provided at Section 7.3.1 of the *Historical Heritage Report*.

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‘6. This assessment relied on data in the Umwelt, 2008, Historical Heritage Review, prepared on behalf of Xstrata Mangoola Pty Ltd. It had a number of errors, which have been perpetuated. An example is the information re 4.5.4 Callatoota on page 43, all is incorrect which also contradicts the information in 4.3.1. of the present assessment. If one notes an area as incorrect, how much else in the assessment is incorrect?’

It is acknowledged that the information included in Section 4.3.1 contradicts with that presented in Section 4.5.4 with regards to the timeline of ownership for the ‘Callatoota’ Estate. The information presented in Section 4.3.1 provides a broad historical overview for the wider local area. The information presented at Section 4.5.4 was sourced directly from research undertaken by the Muswellbrook Shire Local Family and History Society, and originally included in the 2008 Umwelt report. The contrary information with regard to the timeline of ownership of this property has no effect on the current assessment.

As the ‘Callatoota’ Estate is located outside of the MCCO Additional Project Area, and therefore will not be subject to direct impacts associated with the MCCO Project, the history of the estate was not subject to detailed analysis. A visual inspection of the property was undertaken to confirm its current status and condition, and this inspection confirmed that all of the historical structures associated with this estate were removed after 2013.

Had the estate been located within the MCCO Additional Project Area, and had the property been assessed to contain historical structures/elements associated with the early history of the estate, a more comprehensive analysis would have been undertaken to inform an assessment of heritage impacts. However, based on the above factors, as well as the availability of background information regarding the homestead and the lack of direct impacts, it was not considered necessary to substantially revise the historical information already available via other sources.

Where possible, the HHA has clarified or corrected previously collated information based on additional research. As discussed above, the content of the report was prepared based on comprehensive background research, and its findings are generally consistent with that of other reports/assessments prepared for the local area.

Submission ID SE-92607

‘7. A number of properties within the Historic Heritage Study Area have not been mentioned i.e. Reynolds Winery (contains 1840s sandstone Bengalla Homestead) and Ridgeland which had been owned by NSW Police.’

Bengalla Homestead is located outside of the study area by approximately 10 km.

None of the historical research undertaken to inform this report, including consultation with the Muswellbrook Shire Local Family and History Society, indicated that a property referred to as ‘Ridgeland’ was present within the study area. There is a property identified as ‘Ridgelands’ which is located approximately 10 km from the MCCO Project and outside of the study area for the historical heritage assessment. At this distance no impacts are predicted on the ‘Ridgelands’ property from the MCCO Project.

4.11 Blasting

Issues relating to blasting were raised in eight community submissions. No blasting issues were identified by interest groups. Six of the submissions identified common issues which were applicable to multiple submitters and two of the submissions identified specific issues which were applicable to the submitter only.

A Blasting Impact Assessment (BIA) was undertaken as part of the EIS and is provided in Section 6.6 and Appendix 10 of the EIS. The assessment was undertaken in accordance with the SEARs for the MCCO Project which required an assessment of the likely blasting impacts on people, animals, buildings, infrastructure and significant natural features with regards to the ANZECC guidelines.

4.11.1 Common Community Blasting Issues

4.11.1.1 Proximity to Blasting

Issues regarding proximity to blasting impacting nearby residents were raised in four community submissions. An example of the submissions regarding proximity to blasting is provided below.

Community Submissions
'The mine blasting being in such close proximity to our property (800m) would be regarded as seriously dangerous.'

The majority of land surrounding the MCCO Additional Project Area is owned by Mangoola. The closest private resident is located approximately 1.15 km to the north of the MCCO Additional Project Area. Potential impacts from blasting practices on private residences that were assessed as part of the EIS included ground vibration, blast overpressure and fly rock. The BIA determined the following in relation to potential impacts on private residences:

- The ground vibration modelling for residential receivers within a 5 km radius revealed that ground vibration impacts can be managed effectively within the specified blasting parameters.

- The blast overpressure modelling indicated that as operations within the MCCO Additional Project Area move closer to residential receivers in the north and north-west that the management of charge masses (i.e. the size of the blast) will be required to manage blast overpressure levels. The blast overpressure model assessed a range of blast charge masses and bench heights and has demonstrated that blasting is able to be designed and managed to ensure that blast overpressure impacts can be managed effectively.

- Due to the distances to residential receivers the potential risk of flyrock impact on the adjacent residential receivers is considered negligible. A 500m exclusion zone is required to manage risk from flyrock with all private residences (and property) outside of this zone.

Mangoola has a demonstrated track record of managing blasting impacts appropriately. There have been no exceedances of the relevant blasting criteria during the previous 5 years. The blasting design practice at Mangoola incorporates a factor of safety to provide for unexpected conditions. As such, blasts are designed to result in impacts which are below the criteria limit rather than on the limit. In accordance with current practices at Mangoola Coal Mine, a detailed blast design process will be undertaken for each blast for the MCCO Project in order to establish the charge masses required to meet the relevant blast emission criteria at all private residences.

As per the commitment in the EIS, Mangoola will offer all private landholders located within 2 km of the Proposed Additional Mining Area a property inspection prior to the commencement of blasting in the MCCO Additional Project Area to establish the baseline condition of private structures. This will enable any future concerns by residences about blasting related impacts to be assessed against the baseline.

4.11.1.2 Damage to Property

Issues regarding blasting causing damage to property were raised in four community submissions. An example of a submission in relation to damage to property is provided below.

Community Submissions
'Being closer to us the impact of mine blasting is a concern. There is the possibility of vibrational movement to our buildings causing cracking and damage. Also a concern about blasting creating more dust and pollutants over our home and area.'

The BIA was undertaken in accordance with ANZECC guidelines *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990). The guideline includes criteria which minimise amenity impacts on residential receivers from blasting due to ground vibration and blast overpressure.

As discussed above, the results of the BIA for the MCCO Project indicate that ground vibration and blast overpressure levels can be managed to meet residential blasting amenity criteria at all private residents. When vibration and overpressure criteria for residential amenity are achieved for blasting operations, compliance with blast damage criteria for residential structures is also achieved. The Australian Standard AS2187.2-2006 for explosives identifies the blast damage limits for residential structures and these limits are higher than the criteria for amenity which are the limits relevant to the MCCO Project.

The blasting operations for the MCCO Project will meet the residential blasting amenity criteria for all private residences and therefore, blasting is not predicted to cause structural damage to residential receivers. Mangoola will implement the appropriate blast management controls necessary to meet the relevant amenity criteria for private residential receivers. A detailed blast design process that considers operational, geological and environmental constraints will be undertaken prior to each blast event. The detailed blast design process will seek to maximise blast efficiency, and minimise potential vibration, overpressure, dust and fume impacts.

In accordance with the commitment in the EIS Mangoola will offer all private landholders located within 2 km of the Proposed Additional Mining Area a property inspection prior to the commencement of blasting in the MCCO Additional Project Area to establish the baseline condition of private structures to enable monitoring against potential damage to residences and private structures.

4.11.1.3 Road Closures

Issues regarding road closures due to blasting activities were raised in one community submission.

Community Submissions
'There has been an increase in traffic on our local roads since the mine started which will intensify with this proposal and also cause inconvenience from road closures due to blasting and construction.'

Temporary closure of roads will be implemented to ensure public safety is not put at risk as a result of blasting operations. This will include periodic closures for blasts within 500 m of Wybong Road, Wybong Post Office Road, and Ridgelands Road which will be managed to minimise disruption to traffic as much as practicable. Road closures will be limited to no more than one per day (noting that more than one road may need to be closed during a closure event) and will be managed in accordance with an updated Road Closure Protocol and updated Blast Management Plan.

4.11.2 Specific Blasting Issues

Two submitters identified specific issues in terms of blasting causing damage to their residence.

Ground vibration and blast overpressure predictive models were developed to assess the potential blasting impacts of the MCCO Project. The models were developed based on a review of vibration and blast overpressure monitoring data collected from the existing mining operation. The modelled blast sizes were selected as being representative of the range of blast sizes that may occur at the mine. It is noted that in practice, each blast will be designed on a case by case basis to comply with relevant vibration and blast overpressure criteria, however, this range of different blast sizes was utilised for assessment purposes.

Residence 157 (Submission ID SE-69325)
'Blasting- noise and ground vibration would cause damage to our residence particularly on pre-split blasting.'

The predictive blasting models used a range of blast designs and sizes to assess potential blast impacts and recorded the following results for Residence 157:

- maximum estimated ground vibration between 0.3 mm/s and 3.9 mm/s depending on the modelled blasting scenario and assuming a worst-case scenario in which blasting is undertaken from the edge of the pit. The predictions were all below the residential amenity criteria of 3.9 mm/s and also below the criteria in the Australian Standard for structural damage which is 15 mm/s. Therefore no vibration impacts on the residence are predicted

- maximum estimated overpressure for the range of modelled scenarios of between 108 dBL and 127 dBL, indicating that blasts will be able to be designed to comply with the relevant criteria of 115 dBL.

The BIA concluded that estimated ground vibration results for Residence 157 were compliant with the residential amenity blasting criteria (i.e. 5 mm/s). The BIA also determined that the overpressure limit in the residential amenity blasting criteria (i.e. 115 dBL) and the criteria in the Australian Standard for structural damage (133 dBL) could be achieved at this residence through the application of appropriate blast design.

Residence 144 (Submission ID SE-93451)
'The EIS fails to consider the impact that blasting will have on my use of my home and my associated licenced areas. The MCCO Project is using my licensed areas, for which I pay and for which I have usage rights, as their buffer zone. That is unacceptable.'

The predictive models recorded the following results for Residence 144:

- maximum estimated ground vibration between 0.1 mm/s and 1.6 mm/s depending on the modelled blasting scenario and assuming a worst-case scenario in which blasting is undertaken form the edge of the pit; and

- maximum estimated overpressure between 101 dBL and 115 dBL depending on the modelled blasting scenario and year of mining.

The BIA concluded that estimated ground vibration results for Residence 144 were compliant with the residential amenity blasting criteria (i.e. 5 mm/s) and overpressure criteria (i.e. 115 dBL) and therefore also below the levels identified in the Australian Standard at which structural damage may occur (i.e. vibration of 15 mm/s and overpressure of 115 dBL).

The blasting operations for the MCCO Project will meet the residential blasting amenity criteria for all private residences. When ground vibration and overpressure criteria for residential amenity are achieved for blasting operations (i.e. 5 mm/s and 115 dBL), compliance with blast damage criteria for residential structures is also achieved. Therefore, blasting is not predicted to cause structural damage to any private residences.

With regard to reference in the comment to licenced areas, this is referring to an area of Crown land to the north west of the proposed mining area. There is no applicable vibration or blast overpressure limit for Crown land, however, blast impacts will be managed as part of the MCCO Project to maintain safe environmental practices for the possible users of the land. Blasting undertaken within the MCCO Additional Project Area, will operate using an appropriate exclusion zone to manage the risk of flyrock (i.e. 500 m exclusion zone). The three blocks of Crown land that Residence 144 holds licence over, are located outside of the 500m exclusion zone.

4.12 Bushfire

One community l submission relating to bushfire issues was made on the MCCO Project. No bushfire issues were identified by interest groups.

A bushfire assessment was undertaken as part of the EIS and is provided in Section 6.20 of the EIS. The bushfire assessment was undertaken in accordance with the SEARs for the MCCO Project which required an assessment of the potential bushfire risks applicable to the MCCO Project.

Residence 144 (Submission ID SE-93451)

'The EIS fails to consider that the operation of a mine, with blasting, heavy machinery and people, significantly increases the bushfire risk in the Wybong area. The impact of a bushfire on me, with my disability, is potentially catastrophic.'

A bushfire threat assessment was completed to identify any potential bushfire threats within or in proximity to the MCCO Project Area. The bushfire threat assessment considered available fuel loads for fires, as well as, the slope and aspect of the land within the MCCO Additional Project Area.

The vegetation formations and the slope of the land were used to identify appropriate Asset Protection Zones (APZs) for the MCCO Additional Project Area. APZs are designed to reduce the potential for flame, radiant heat or embers to ignite a structure and to create a defendable space where occupants or fire-fighters can protect that asset. Vegetation within an APZ is generally managed at a high intensity, to levels below 5 tonnes/ha to minimise the fuel available to a bushfire. APZs were calculated in accordance with the NSW Rural Fire Service *Planning for Bushfire Protection* (PBP) Guideline 2006. The PBP method for calculating APZs has been applied at the Mangoola Coal Mine and approved under the existing Bushfire Management Plan.

APZs will be established for the MCCO Project area. It should be noted that no new significant infrastructure areas requiring asset protection are proposed for the MCCO Project. However, the APZs applicable to existing infrastructure areas at Mangoola Coal Mine will be retained as part of the ongoing operations associated with the MCCO Project.

The application of APZs across the MCCO Additional Project Area will mean that any infrastructure or operational activities with the potential to fuel bushfires are managed appropriately. The potential bushfire risk from proposed blasting activities and the use of heavy machinery for the MCCO Project are considered low. These activities take place in areas which are usually cleared of remnant vegetation to allow for the progression of mining. Heavy machinery used during operations undergoes scheduled maintenance and any issues relating to potential combustion would be addressed. With the continued implementation of the bushfire management controls under the

Bushfire Management Plan, which is subject to continual review and update, in consultation with the NSW Rural Fire Service (RFS), it is considered that bushfire risk can continue to be appropriately managed as part of the MCCO Project.

4.13 Traffic and Transport

Issues relating to traffic and transport were raised in ten community submissions and one interest group submission.

A Traffic and Transport Impact Assessment (TTIA) was undertaken as part of the EIS and was included in Section 6.13 and Appendix 17 of the EIS. The TTIA was prepared in accordance with the MCCO Project SEARs which required an assessment of the likely transport impacts of the development on the existing road and rail networks.

Issues regarding increased traffic conditions and travel time due to the MCCO Project were raised in eight individual submissions. Examples of the submissions in regards to traffic impacts are provided below.

Community Submissions
'Increase in traffic volumes including heavy vehicles, mine shift workers using rural roads not designed or suitable for this increased usage'
'The increased traffic on the already rough country roads will no doubt make the roads worse to drive on and much more dangerous. […]'
'If the project were to be approved, my sisters would have to travel an even greater distance to school with the school bus route on Wybong Post Office Road being moved.'

The MCCO Project does not propose any changes to the existing approved operational employee numbers beyond the maximum employee numbers previously assessed and approved (540 employees) or the approved maximum production rates and therefore no changes to operational traffic movements above those that have previously been assessed and approved are expected. The construction phase will result in additional traffic movements over an approximate 16 month period and these changes have been assessed in the TTIA.

Traffic surveys completed as part of the TTIA found that all relevant intersections currently operate with a good level of service. Further, existing traffic volumes indicate that Wybong Road, Denman Road, Thomas Mitchell Drive, Bengalla Road and the Golden Highway are operating well within the acceptable limits.

Construction activities are proposed to take place over a 16 month period. During this time, an approximate additional 145 workers will travel to site. Further, an average daily increase of 16 heavy vehicles is anticipated, with a daily maximum increase of 35 heavy vehicles. Traffic modelling showed that all relevant intersections are expected to operate with a good level of service. The level of service of the roads being assessed is not anticipated to change as a result of an increase in traffic due to construction activities.

The survey of the existing traffic conditions showed that the existing road network can adequately handle current traffic conditions. Based on modelling of traffic during construction, no significant impact to traffic from the Project is anticipated.

The TTIA found that the proposed realignment of Wybong Post Office Road will extend the trip distance of some road users by approximately 1.6 km, depending on their direction of travel (i.e. and increase if heading to Muswellbrook but a decrease if heading towards Sandy Hollow). Assuming that vehicles travel at a speed of 100 km/h (the proposed sign-posted speed limit) along this realigned route, this will increase travel times by 55 seconds. As such, the proposed realignment of Wybong Post Office Road is expected to have a minor impact on travel times. When travelling to/from Sandy Hollow or Reedy Creek Road the travel distance will decrease.

It is also noted that the surface condition of the current Wybong Post Office Road is poor-quality and is a narrow road with a sub-optimal intersection alignment with Wybong Road. The proposed realignment would be constructed in accordance with Austroads Design Guidelines, including two-line marked travel lanes and sealed shoulders. This would result in a better quality portion of road than the currently existing one and would as a result increase road safety.

Ridgelands Residents Inc (ORG01)
'Ridgelands Residents Inc objects due to the uncertainty of transport links in the EIS as the Muswellbrook Mine Affected Road Network Plan [formerly Western Roads Strategy] is under review and because of previous unsafe Glencore construction traffic use of narrow, winding, and the death of David Patten on Wybong Road (2009) in not dissimilar roadway circumstances to mine and construction vehicle use of Ridgelands Road…'

Mangoola is aware of Muswellbrook Shire Councils plans to update the *Muswellbrook Mine Affected Roads – Stage 1 Road Network Plan* (Cardno 2015). In this regard, Mangoola is continuing to discuss the proposed updates with MSC, however this report is yet to be finalised.

Access to the Mangoola Mine site internal access road is via Wybong Road. As per the existing approval conditions of PA 06_0014 no Mangoola related traffic are to use Reedy Creek Road, Mangoola Road Roxburgh Road or Castlerock Road to get to or from the site, except in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. This condition does not apply to any employees that may reside on Reedy Creek Road, Mangoola Road, Roxburgh Road or Castlerock Road, or the infrequent use of the roads for consultation, environmental monitoring, and inspection and maintenance of nearby infrastructure. This commitment is to be maintained for the MCCO Project.

There are no prohibitions on the use of Ridgelands Road by Mangoola employees or Mangoola project vehicles. In addition to the requirements of PA 06_0014 Mangoola has installed a road sign on Ridgeland's Road stating *'No entry for Mangoola Coal related traffic'*. Associated with the original development of Mangoola Mine traffic was anticipated to largely utilise primary access roads being Wybong Road and then also Bengalla Link Road following its construction. As such, this sign assists in establishing these as the primary access routes and also assists for navigational purposes directing traffic back to the Mangoola Mine site access road located off Wybong Road.

The MCCO Project will require and is seeking approval for access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Additional Project Area for construction and other ongoing operational needs such as emergency services, environmental monitoring and property management.

Direct access to the MCCO Additional Project Area may be required in rare circumstances to provide access for mining equipment maintenance or mining equipment transport requirements dependent on factors such as mining progression and public road works limitations (e.g. for access for oversize loads). Where access is required from public roads outside of the normal site access routes, consultation will be completed with stakeholders and MSC and a traffic management plan implemented if required for these uncommon occasions.

Ridgelands Residents Inc (NFP NGO) (ORG01)
'Mangoola Project vehicles are correctly prohibited from use of Ridgelands Road and should remain so for reasons of human safety.'

Access to the Mangoola Mine site access is via Wybong Road east (from Muswellbrook) or Wybong Road west (from Denman or Sandy Hollow). As per existing approval conditions of PA 06_0014 no Mangoola related traffic are to use Reedy Creek Road, Mangoola Road Roxburgh Road or Castlerock Road to get to or from the site, except in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. As noted above, this condition does not apply to any employees that may reside on Reedy Creek Road, Mangoola Road, Roxburgh Road or Castlerock Road, or the infrequent use of the roads for consultation, environmental monitoring, and inspection and maintenance of nearby infrastructure. This commitment is to be maintained for the MCCO Project.

There are no prohibitions on the use of Ridgelands Road by Mangoola employees or Mangoola project vehicles. As stated above, in addition to the requirements of PA 06_0014 Mangoola has installed a road sign on Ridgeland's Road stating *'No entry for Mangoola Coal related traffic'*. Associated with the original development of Mangoola Mine traffic was anticipated to largely utilise primary access roads being Wybong Road and then also Bengalla Link Road following its construction. As such, this sign assists in establishing these as the primary access routes and also assists for navigational purposes directing traffic back to the Mangoola Mine site access road located off Wybong Road.

Access to Mangoola via Ridgeland's Road is required to be maintained for the MCCO Project. Mangoola own and manage a substantial land holding located on either side of Ridgeland's Road and access is required for a multitude of purposes such as environmental management and monitoring, land management, exploration or other permissible purposes. Further, employees or contractors who reside or travel from locations requiring the use of Ridgeland's Road will require the ongoing use of Ridgeland's Road, then onto Wybong Road, to access Mangoola Mine Site.

Residence 144 (Submission ID SE-69325)

'School bus stop for our kids being approximately 800 meters from the proposed pit.'

Mangoola Coal Mine will operate using an appropriate exclusion zone (i.e. 500 m radius from the mining area) to ensure appropriate buffers from activities are maintained. The closest known bus stop (i.e. 599 Ridgelands Road) is located approximately 950 m from the MCCO Project Proposed Additional Mining Area. Therefore, the potential risks of mining operations on the bus stop are considered negligible.

4.14 Visual Amenity

Issues relating to visual amenity were raised in eight community submissions. There were no submissions relating to visual amenity from interest groups.

A visual amenity assessment was carried out as part of the EIS and is discussed in Section 6.14 of the EIS. The visual assessment was undertaken in accordance with the SEARs for the MCCO Project which required an assessment of likely visual impacts on private landholders and key vantage points in the public domain.

Examples of the submissions in regards to visual impacts are provided below.

Community

'This project will negatively impact the local community due to visual impacts.'

'Our access to town is along Ridgelands Road. We will be forced to drive along the edge of a mining operation every time we leave or return to our home.'

‘Where once we sat on our veranda and looked out at a scenic rural environment we now see a huge open cut mine. Our house is on a hill overlooking the mine and no amount of tree planting will hide this. We see the pit, the heavy machinery and the lights.’

The issues being raised can be grouped into three key areas, namely the visual impact to community in general, impacts from driving on the existing road network and impacts to the visual amenity from private residences.

As discussed in the EIS, the visual assessment predicted that the proposed additional mining operation and proposed infrastructure will not be visible from any private residences surrounding the MCCO Additional Project Area. This is due to the effects of intervening topography and vegetation.

It has been identified that views of the active mining areas, including overburden, will intermittently be present along parts of the existing road network. Photomontages were included in the EIS to provide indications of the range of visual impacts anticipated to occur. The views of the mine along these roads are expected to generally be short term due to the speed limits, the changing orientations of the roads and the effects of existing vegetation that acts as a screen along the road verges.

To reduce impacts to visual amenity, Mangoola proposes to plant tree screens along parts of Wybong Road, the realigned section of Wybong Post Office Road and Ridgelands Road. It is further proposed that visual bunds will be constructed strategically along Wybong Road to minimise the visual impacts.

Progressive rehabilitation will commence in the early stages of the MCCO Project and on the outer faces of emplaced overburden. Shaping of the final landform will conform to the surrounding natural environment and is expected to reduce the visual impact from all areas where views are possible.

To provide a more representative impression of the views that would likely be available to the MCCO Project a revised set of photomontages from the key locations along Wybong Road and Ridgelands Road are provided in **Appendix 8**. These show a rendered photomontage (with realistic colouring) of what is likely to be visible during the operational and post closure phases of the Project. This supports the finding in the EIS that views will be intermittent and generally short term in nature with initial impacts reduced as progressive rehabilitation is completed.

4.15 Light

One community submission relating to light issues was raised on the MCCO Project. No light issues were identified by interest groups.

Residence 130 (Submission ID SE-93723)

‘If the extension was to be approved Jason Martin has confirmed that the light will be significantly worse, however no further mitigation can or will be offered to us!.’

Lighting is required on site as part of the MCCO Project to meet operational and safety requirements but will be kept to a minimum where practicable and will be installed and maintained in accordance with the relevant Australian Standard (Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting).

The existing infrastructure areas and the approved 24-hour mining operations at the approved Mangoola Coal Mine contribute to night light and night time glow (diffuse light) impacts. The majority of lighting utilised at a mine site is associated with the CHPP, workshops and load out infrastructure all of which is located at the existing Mangoola Coal Mine. The lighting utilised in this regard will not change as a result of the MCCO Project and has already been assessed and approved as part of the existing Mangoola Coal Mine. Mobile lighting will be required in active mining and emplacement areas for the MCCO Project during night time operations. The lighting will be provided by mobile lighting plants and equipment headlights. Mobile lighting for the MCCO Project during night operations will expand light requirements further north than existing operations.

The extent of lighting impacts is dependent on the location of receivers in the surrounding area. The closest private resident is located approximately 1.15 km to the north of the MCCO Additional Project Area. Residence 130 is located approximately 2.5 km to the west of the MCCO Additional Project Area. The visual assessment for the MCCO Project identified that no private residences are predicted to have views of the MCCO Additional Project Area due to intervening topography. Therefore, it is considered unlikely that there will be any direct light impacts at any private residences.

Indirect (diffuse) lighting impacts from the MCCO Project are considered to be minor compared to the existing indirect light impacts from the approved Mangoola Coal Mine. Indirect lighting impacts from the MCCO Additional Project Area are considered minimal due to the lack of fixed lighting planned to be used in this area, as well as, the intervening topography and vegetation.

4.16 Employment Benefits

A described in **Section 2.0**, a number of the supporting submissions (126) provided positive comments regarding the employment benefits and the flow on economic benefits generated by the existing Mangoola Coal Mine and the proposed MCCO Project. Many submitters noted that continuation of the Mangoola operations would provide ongoing local employment opportunities and additional jobs.

Issues relating to jobs were raised in four community submissions and one interest group submission.

4.16.1 Common Community and Interest Group Issues

4.16.1.1 MCCO Project Employment Numbers

Issues relating to the predicted MCCO Project employment numbers were raised in two individual submissions. An example of the submissions is provided below.

Community Submissions
'Mangoola has stated that it will employ up to 480 people however 400 people already work at Mangoola and they will only be employing a further 80 at the most and the construction phase will only be contractors and not permanent employees. The information sent out I feel is misleading as it implies that they will be employing a further 480 people which gives people the feeling that there will be more jobs available and be happy for the expansion to go ahead. These will not be guaranteed to be local either which when the final number of employees is revealed people may not be so happy that they supported the expansion but by then it will be too late.'

The MCCO Project will provide ongoing employment opportunities for approximately 400 employees at the existing Mangoola Coal Mine. Without the MCCO Project the existing employment opportunities provided by the Mangoola Coal Mine would likely cease in 2025. As such, it is true that the MCCO Project will provide ongoing employment opportunities for a workforce of approximately 400 employees rising up to approximately 480. The MCCO Project is proposed to operate until about 2030 representing an additional five years of operations.

4.16.1.2 Number of Locals in the Workforce

Issues relating to the number of locals in the workforce were raised in one individual submission.

Community Submissions
'I reject the notion that the mine employs local people. I know for a fact that many of the mine employees live in the lower hunter and travel to the mine each day. If the miners feel so strongly that it is safe and acceptable to live near a mine, they should all live here too!'

The majority of the existing Mangoola workforce of approximately 400 people travel to work from within the Muswellbrook LGA (51.1 per cent), followed by the Upper Hunter (22.2 per cent) with employees largely from the townships of Muswellbrook, Denman, Scone and Singleton. These employees and their families use local services and participate in community groups within these communities.

Mangoola uses its best endeavours to employ people from the local community as Mangoola recognises the benefits of this approach. Mangoola is committed to recruitment practices that are fair and equitable by selecting applicants who demonstrate the best fit for the particular role. The application of equal employment principles, as well as, business priorities at the time of recruitment will govern recruitment outcomes. Mangoola will prioritise the continued employment of the existing workforce for the MCCO Project but where necessary will endeavour to employ people from the local community as per the existing approach.

4.16.1.3 Changes to Mine Life

Issues relating to changes to mine life were raised in one interest group submission.

Lock the Gate Alliance (ORG03)
'We note that the mine operator elected to increase the rate of extraction at the Mangoola mine from 10mtpa to 13.5mtpa and secured consent from the NSW Government to do so just five years ago. As a result, the mine is expected to wind down by 2025, according to this EIS, although it has approval to continue operating until 2029. This undermines the proponent's argument about the chief social and economic contribution claimed for this project – the continuation of mining jobs. Had the proponent been interested in sustaining jobs in mining, it would not have shortened the life of this mine by four years by accelerating its production rate.'

Mining operations at Mangoola Coal Mine commenced in September 2010. Since the granting of the Project Approval, Mangoola Coal Mine has been subject to eight modifications, including gaining approval in 2014 to increase annual ROM coal production from 10.5 to 13.5 Mtpa. The increase in production was granted via a modification (MOD 6) to the Project Approval. Mangoola identified further opportunities to improve efficiency and resource utilisation and sought a modification primarily to permit this change.

Whilst ongoing employment for existing Mangoola employees was identified as a key benefit of the MCCO Project, Mangoola considers it can also contribute substantial economic benefits at local, regional and State levels (as demonstrated by the economic assessment) whilst continuing to coexist with the local community. As identified in the EIS, key benefits of the MCCO Project include:

- maximise efficient recovery of the state's coal resources
- provide a net benefit to the Upper Hunter region of $92.6M in NPV terms
- provide a net benefit of $408.6M to NSW over the life of the MCCO Project in NPV terms

- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project
- provide significant export earnings for Australia
- provide for ongoing use of the existing Mangoola Coal Mine infrastructure which has an operational life beyond the life of the existing mine
- provide for a fully integrated rehabilitation program and final landform in accordance with leading practice natural landform design principles across the existing and proposed mining areas.

4.17 Economics

A described in **Section 2.0**, a number of the supporting submissions (122) provided positive comments regarding the economic benefits generated by the existing Mangoola Coal Mine and the proposed MCCO Project. Many submitters noted that continuation of the Mangoola operations would provide ongoing economic benefits for the local community.

Issues relating to economics were raised in five community submissions. No economic issues were identified by interest groups.

A detailed Economics Assessment was carried out as part of the EIS and is discussed in Section 6.2 and Appendix 7 of the EIS. The Economics Assessment was undertaken in accordance with the NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals (the Economic Assessment Guidelines). The Economic Assessment Guidelines require that economic assessments outline the NPV of the project to the NSW community and provide a Local Effects Analysis (LEA) using the Cost Benefit Analysis (CBA) framework.

The Economics Assessment concluded that overall, the MCCO Project is expected to generate net benefits, and is also expected to generate increased economic activity and employment within the NSW community. The MCCO Project will have a positive economic impact at a local, regional and State level. These benefits include:

- provide a net benefit in the Upper Hunter region of $92.6M in NPV terms
- provide a net benefit $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project
- increase the Hunter Region's GRP by a projected approximately $599M in NPV terms, over the life of the MCCO Project
- increase the NSW GSP (including the Hunter region) by approximately $686M in NPV terms over the life of the MCCO Project.

4.17.1 Common Community Economic Issues

4.17.1.1 Impact of Local Businesses

Issues relating to impacts on local businesses and lack of direct benefits for the Wybong Community were raised in three individual submissions. An example of the submissions is provided below.

Community Submissions 'Loss of small businesses in favour of overseas corporates.' 'Whilst investment is made in the towns of Muswellbrook and Denman there is no direct benefit for what is left of the Wybong community and no direct benefit to the landowners.'

The LEA assesses employment effects of the MCCO Project with reference to the Upper Hunter. The LEA identifies the economic impacts on the communities located near the mine site. The LEA assesses effects on:

- local employment
- non-labour expenditure
- other local industries
- environment and social aspects.

The LEA predicts that the MCCO Project will generate indirect benefits to local suppliers of $14.1M in NPV terms which is based on information from Mangoola that 9.2 per cent of the inputs to production are suppled from the region. Additionally, Mangoola has advised that currently, almost 84.4 per cent of the inputs to the mine are sourced from NSW-based suppliers which will account for $639.1M (in NPV terms) in intermediate inputs over the life of the MCCO Project.

It is expected the MCCO Project will generate indirect benefits to local suppliers and employees of $14.1M and $76.8M respectively and result in the net incremental increase of local council rates totalling $2.7M in NPV terms over the baseline case. Indirect costs associated with the MCCO Project are minor, including transport impact costs and the loss of agricultural output of $1.0M.

Based on these assumptions, the LEA has found that the MCCO Project is estimated to provide a net benefit on the Upper Hunter region of $92.6M in NPV terms.

Some direct benefits for the Wybong community would be through local employment. The SIA identified that mining was the top industry of employment in Mangoola, Castle Rock, Wybong, Denman, Muswellbrook and the Upper Hunter State Electoral District (refer to Section 5.6.6.1 of the SIA).

The MCCO Project would see continued employment opportunities for these workers for the proposed Project term and the subsequent economic flow on effects to the locality.

To provide local benefits to the Wybong community, Mangoola has committed to implement a Community Enhancement Program for residents/landholders located in the defined management zones relating to the MCCO Project. As part of the SIA consultation program a number of suggestions were made by stakeholders that could form potential projects under the Community Enhancement Program.

The key objectives of the Community Enhancement Program would include:

- working collaboratively with near neighbours/proximal landholders to develop environmental and community benefits for the Wybong district that enhance local values of the area
- facilitating enhancement initiatives for those residents living in the management zone
- addressing perceived issues relating to property devaluation given close proximity to the mining operation

- contributing to the local community and better targeting community investment spend locally.

4.17.2 Specific Economic Issues

4.17.2.1 Evaluation of Opportunity Costs

Issues relating to evaluation of opportunity costs were raised in one community submission.

> **Anonymous 21 (SE-93491)**
> 'I believe the continuation of this mine needs to be fairly evaluated against the opportunity costs. The Upper Hunter Community has expressed through its recent submissions to this Department, that it prefers a future based on more sustainable industries including agriculture and tourism.'

As discussed in Section 2.6.2 of the Economics Assessment, an assessment of potential surplus loss to other industries was undertaken to determine any potential indirect costs to NSW. The predominant land uses within the region surrounding the MCCO Project comprise of mining and low intensity agriculture such as beef cattle grazing. The economic assessment considered impacts on the existing agricultural industry in the MCCO Project Area (and surrounds) as part of the assessment of economic impacts.

The Economics Assessment concluded that overall, the MCCO Project is expected to generate net benefits, and is also expected to generate increased economic activity and employment within the NSW community. The MCCO Project is expected to result in minor incremental indirect costs, of $1.03M, on the NSW community which includes costs associated with the loss of agriculture output from the land required for the MCCO Project. Overall, the MCCO Project will provide a net benefit in the Upper Hunter region of $92.6M and a net benefit of $408.6M to NSW in NPV terms.

In terms of potential future use of the Mangoola land holdings and as discussed in earlier sections, Mangoola has committed to development of a Post Mining Land Use Strategy in consultation with MSC and other relevant stakeholders. This strategy will investigate opportunities for further land uses in both the rehabilitated mining area and buffer lands for Mangoola Coal Mine.

> **Anonymous 13 (SE-90530)**
> 'This project EIS should have included the mitigation cost for landholders in its Cost Benefit Analysis as requested by stakeholders.'

Mitigation costs for landholders are included in the CBA where relevant in accordance with relevant policy and legislation. The MCCO Project does generate requirements to either purchase properties or undertake mitigation measures at residences in accordance with the Noise Policy for Industry (NPfI) criteria and requirements of the VLAMP. These costs are included in the costs of the MCCO Project and are not individually identifiable as they are subject to commercial in confidence.

4.18 Land Management

Issues relating to land management practices were raised in three community submissions and one interest group submission.

Issues regarding fauna being displaced and forced onto properties and roads due to clearance activities for the MCCO Project were raised in three individual submissions. An example of the submissions is provided below.

Community Submissions

'I am also concerned that there will be an increase in car accidents from kangaroos, wombats and deer that will be forced closer to Wybong Road, Wybong PO Road and Yarraman Road. The wildlife are currently undermanaged and all of my registered vehicles are currently dinted from the collisions. As the wildlife are further displaced from the proposed mining area they will be forced closer to the roads and my property. My property will again be impacted and I will be forced to undergo further pest management for the farming component of the property.'

570 ha of native vegetation will be impacted by the MCCO Project consisting of 356 ha of woodland or open forest and 214 ha of derived native grassland. The MCCO Project will result in a range of direct impacts on biodiversity including habitat loss and habitat fragmentation which may cause fauna displacement. Mitigation measures are proposed to address impacts of habitat loss and fauna displacement including:

- the delineation of clearance areas to avoid unnecessary impacts and clearance of surrounding vegetation
- preclearance habitat inspections as per the process undertaken at Mangoola Mine currently
- rehabilitation of the Development Footprint post mining as described in the EIS
- habitat enhancement measures to attract native fauna to rehabilitation areas such as the installation of nest boxes, salvaged hollows, fallen timber, hollow logs and rocks
- the implementation of a biodiversity offset strategy in accordance with the FBA, including local biodiversity offsets which include habitat regeneration areas.

As requested by surrounding land holders, Mangoola has a control program in place for kangaroo populations and undertakes population control programs from time to time.

Population of feral fauna populations such as foxes, rabbits, pigs, deer, dogs and cats also require consideration. The existing land management controls at the Mangoola Coal Mine will be implemented for the MCCO Additional Project Area to manage feral species populations. This includes a culling program for feral animal species.

Mangoola has a proven track record of ongoing successful land management and routine pest and weed control. Pest management is addressed in the Biodiversity and Offset Management Plan and Annual Pest Animal Action Plans. Mangoola is an active participant in local pest control groups including the Wybong Wild Dog Association, the Upper Hunter Combined Wild Dog Association and the Hunter Regional Pest Animal Committee. Pest control activities undertaken at Mangoola to date include:

- Biannual (autumn and spring) 1080 baiting for wild dogs and foxes across all landholdings
- Feral deer, rabbit, goat and pig culling across all landholdings
- Commercial culling of eastern grey kangaroos across biodiversity offsets and grazing land by professional shooter
- Regular culling of eastern grey kangaroos across grazing land by authorised Mangoola property lessee
- Regular culling of eastern grey kangaroos across mining rehabilitation areas by authorised shooter.

Baiting is undertaken in accordance with the Pesticides Control (1080 Bait Products) Order 2019, with extensive reports kept on bait locations, trail camera photos and results. The pest control measures are adaptive and responsive to emerging threats across the site. Updates on vertebrate pest control activities are reported during quarterly Community Consultative Committee meetings.

The existing Biodiversity and Offset Management Plan and Annual Pest Animal Action Plans will be updated to include the MCCO Project. Where necessary, pest culling and weed treatment programs will include the MCCO Additional Project Area to manage populations of pests and weeds. These ongoing land management controls in conjunction with proposed pre-clearance habitat checks and rehabilitation habitat enhancement measures will ensure that fauna are appropriately managed across the MCCO Project site.

Ridgelands Resident Inc (ORG01) 'Previous non-compliance of Glencore with the Wybong Uplands Land Management Strategy'

The Wybong Uplands Land Management Strategy (WULMS) formed part of the original *Anvil Hill Project Environmental Assessment* (Umwelt 2006). The aim of the strategy was for the long term sustainable land management within the Wybong Area. In this regard, the then Centennial Coal (now Mangoola Coal) owned operation committed $100,000 per year for 5 years and was to be implemented through an appropriate structure. Associated with the granting of PA 06_0014 and establishment of a VPA with MSC the WULMS was included in these terms.

Mangoola complied with this requirement, and between 2009 and 2013 contributed, in accordance with the terms of the VPA, for the preparation of the WULMS to the total value of $500,000. In August 2014 MSC advised that they had established a Native Vegetation and Tree Management Committee and requested that provided contributions be allocated towards environmental management projects in association with the Stepping Stones program with administration of the funds to come under the Native Vegetation and Tree Management Committee. Mangoola agreed to this revised approach and has therefore complied with the relevant Development Consent condition.

4.19 Comments

Two comment submissions were received from community and interest groups. The comment submissions were not able to be classified as either supporting or objecting submissions and were categorised as comments by DPIE.

One comment submission was from Ausgrid which commented on impacts from the MCCO Project on existing Ausgrid infrastructure (i.e. the proposed relocation of 11Kv lines from within the MCCO Additional Disturbance Area). Ausgrid noted the requirements that need to be assessed during the design phase of the MCCO Project. Mangoola has undertaken consultation with Ausgrid regarding the relocation of powerlines and will continue to engage with Ausgrid to meet relevant requirements during the detailed design phase of the MCCO Project.

The other comment submission was from an individual (Submitter ID:S-93475) which identified the submitter supported the MCCO Project in principle but did not support the EIS documentation. The comment submission questioned the EIS predictions regarding water accessibility, blasting vibrations, noise disturbance, housing displacements, community loss, health and safety. Responses to common issues identified in the comment submission have been provided as part of the community and interest group responses throughout **Section 4.0**. Cross references to relevant sections in the RTS are provided in **Appendix 1**.

Tailored responses are provided below to the specific issues identified in the comment submission (ID:S-93475).

> **Submission ID SE-93497**
>
> 'We consider that our local ground water static water level may have lowered due to the reduced ground water resistance downstream. This lowered resistance may have been caused by open cut mines exposure of underground streams, thus allowing upstream water levels to lower as the held back water is able to release faster.'

The GWIA undertaken as part of the EIS included an assessment of potential drawdown impacts on private groundwater users. A search of publicly available information including the NSW state government groundwater bore database was undertaken for registered bores in proximity to the MCCO Project. The search was undertaken within a 3 km radius of the MCCO Project site and within a zone that has potential to experience over 2 m drawdown of groundwater from the MCCO Project. No registered private bores were identified for the residence owned by Submitter ID:S-93475 within this zone.

With regard to the potential for impacts to private bores within this 3 km zone the numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the Aquifer Interference Policy. One private bore is already predicted to be impacted by mining at the approved Mangoola Coal Mine.

> **Submission ID SE-93497**
>
> 'We request:
>
> 1. The details why the properties of 1756 and 1834 Castlerock Road have been denied residential building approval, and
>
> 2. Why our 1791 residence is harm free when we live so close to properties that are deemed unacceptable to build residential houses due their proximity to Coal Mines?'

The properties of 1756 and 1834 Castlerock Road have been considered to be privately owned properties with no residential dwelling as presented on the MCCO Project landownership plan (refer to **Figure 1.3**). Mangoola is not aware of the individual circumstances that may or may not result in a Development Application being granted for residential buildings on these associated lots. Permissible land uses is a matter pertinent to the applicable landowners and MSC.

Property 'Barrabook' is represented by 174B and 174A (two dwellings) at 1791 and 1801 Castlerock Road respectively as presented on the MCCO Project landownership plan (see Figure 1.5 of the MCCO Project EIS). An assessment of impacts arising from the MCCO Project was completed in accordance with relevant government requirements and assessment criteria. Results from the AQIA and the NIA for the MCCO Project EIS found that both ID 147A and 174B remained below relevant acquisition and mitigation assessment criteria as contained in VLMAP. Further, the BIA found there were no predicted exceedances of applicable airblast overpressure or ground vibration criteria at residence 174A and 174B.

> **Submission ID SE-93497**
>
> 'We challenge the scientific accuracy of MCCO Noise Model. Figure 6.5 in MCCO EIS presents the 35 dB (A) Noise Contour snakes around our residences of 174A and 174B. We fail to comprehend how an open-cut mine project within a few kilometres of our residence and almost in a straight line, cannot cause significant noise issues to our residential houses. We note that noise monitoring occurred during very quiet periods and never when we could hear the current Mangoola Operations. We also note that the noise monitoring took place on Castlerock Road near our 174A residence, close to a small hill obstruction. Minimal land obstruction exists from residence 174B, similar to residence 175, which has been purchased by Muswellbrook Coal Mine'

The noise models for the MCCO Project were prepared in accordance with relevant NSW noise policy and guidelines, and are consistent with industry best practise. A key element of the noise models is consideration of attenuation of noise due to shielding provided by man-made and natural topographical features. Residences 174A and 174B are located adjacent to Spring Creek, with a number of higher intervening topographical features between the residences and the Mangoola Mine. This factor, combined with a prevailing wind direction that tends to mitigate noise propagation towards these residences, and a separation distance of more than 4 kilometres, results in a maximum predicted noise level of LAeq,15minute 35 dB.

Comments regarding historical noise monitoring are noted.

Submission ID SE-93497

'The Noise Contour presented at the MCCO Community Day at the Wybong Community Hall on Friday 9 August 2019, exhibited a rural residence on 1834; This information is incorrect and misleading.'

1834 Castlerock Road is considered to be a privately owned property with no residential dwelling as presented on the MCCO Project landownership plan (see **Figure 1.3**). It is believed the submission is relating to a previous draft map which identified a rural shed that had conservatively been identified as a house. Further investigation later confirmed it was not a house and it is no longer labelled as such.

5.0 Proposed Additional Management Measures

Section 8.0 of the MCCO Project EIS included a summary of all the proposed environmental management and monitoring measures for the Project. As a result of submissions received on the EIS, Mangoola has committed to additional environmental management and monitoring measures and refined some of the measures outlined in the EIS in this RTS. These additional or refined measures are outlined below.

Groundwater

- Mangoola commit to complete additional baseline monitoring along Big Flat Creek in the area adjacent the eastern flank of the out-of-pit emplacement area for a minimum of 12 months prior to the commencement of mining as requested. This monitoring is proposed to be conducted at a selection of the existing bores that have been installed along Big Flat Creek in this area and may include GW01, MN 1006, GW047877, REG001 and GW07 as deemed appropriate (see Figure 8.1 in the GWIA Appendix 12 of the EIS). Mangoola commit to include this proposed monitoring within the revised water monitoring program for the MCCO Project. The monthly monitoring frequency is only proposed prior to the commencement of mining with the monitoring frequency and commitments made in the MCCO Project EIS and GWIA to be followed once the baseline program has been completed and mining commences.
- Mangoola commits to include details in the revised Water Management Plan relating to the monitoring, management and mitigation of potential impact risk associated with drawdown of water level to registered water users and potential leachate generation from out-of-pit spoil emplacement area adjacent to Big Flat Creek.

Surface Water

- As part of updating the existing Erosion and Sediment Control Plan for Mangoola Coal Mine, the management measures for infrastructure and other works within waterfront land will consider the published guidelines for controlled activities for works within waterfront land.

Aboriginal Cultural Heritage

- Mangoola commit to reflect on the cultural values identified within the Aboriginal Cultural Values Assessment Report as prepared by Australian Cultural Heritage Management (ACHM) including those in the Tocomwall report in the updated ACHMP. The identified Aboriginal cultural values will also be considered in the formation of management actions in the updated ACHMP which will be prepared in consultation with the Registered Aboriginal Parties.

Historic Heritage

- Mangoola commits to undertaking archival recording of the Millville property prior to any demolition works. Archival recording during demolition works will be undertaken if deemed to be warranted as a result of information obtained during the recording prior to demolition.

Traffic

- Mangoola commits that there will be no car parking for construction workforce vehicles within the road easements of the existing public roads surrounding the site.

- Access gates to construction points and car-parking areas will be set back a distance to at least, allow a full B-double sized truck to turn off the public road network without remaining encroached on the road easement.
- Mangoola commits to being guided by the requirements of the NSW Government Roads and Maritime Services Technical Manual, Traffic control at work sites, for works associated with road works.

Noise

- For any construction activities occurring outside of standard construction hours, Mangoola commits to implement appropriate management measures as required to maintain compliance with current approval limits, should higher noise levels be generated due to meteorological enhancement, or through any other circumstance.

Rehabilitation Planning

When preparing the Mine Closure Plan Mangoola commit to consider the procedure set out in A Rehabilitation Manual for Australian Streams, Cooperative Centre for Catchment Hydrology, Land and Water Resources Research and Development Corporation, 2000 and will undertake consultation with BCD as part of this process.

6.0 Updated Evaluation of Project Merits

Following consideration of the submissions received Mangoola has prepared the detailed response report to address the issues raised in agency, community and interest group submissions. This process has included undertaking some additional works, providing clarifications and, where relevant, explaining the findings of the technical studies that have been completed as part of the EIS in order to address all of the issues raised. Mangoola has also made additional commitments (refer to **Section 5.0**) as a response to some of the issues raised in the submissions. The overall outcomes of this response to submissions process have not changed the overall assessment of merits of the MCCO Project as outlined in the EIS.

In this regard, it is considered that the MCCO Project as proposed is a logical continuation of Mangoola Coal Mine into a new mining area immediately north of the existing operation. The proposed continuation involves mining the same coal seams as the existing mine, using the same techniques and equipment. The MCCO Project has been designed to maximise resource recovery and operational efficiencies between the MCCO Additional Project Area and existing Mangoola Coal Mine operations whilst aiming to minimise environmental and social impacts.

The MCCO Project provides an opportunity to efficiently integrate the mining of the Proposed Additional Mining Area with the existing Mangoola Coal Mine operations and will utilise the approved mining infrastructure including the approved capacity within the Mangoola CHPP and train loading facilities thus avoiding the need for new infrastructure. The proposed haul road overpass for Big Flat Creek and Wybong Road allows Big Flat Creek to remain and minimises disruption to traffic on Wybong Road.

The integrated operation of the two mining areas together will allow for the distribution of overburden between the mining areas allowing for improved final landform outcomes. Some further refinements have been made to the final landform as part of this RTS process resulting in a minor reduction to the areas of the final voids. As an integrated mining operation, there is adequate capacity within existing emplacement areas for tailings disposal while additional available overburden will provide flexibility in the conceptual final landform design.

The same leading practice environmental management approach and controls used at the existing operation will continue to apply to the MCCO Project. This includes integrated mine design and management to minimise dust and noise, manage water, and implementation of the same industry leading rehabilitation techniques. As part of implementing the MCCO Project, Mangoola will continue to manage and respond to issues or community concerns that arise as it does for the existing operations.

Not proceeding with the MCCO Project would significantly increase the cost of extracting the identified resources at a later date relative to the MCCO Project due to the efficiencies inherent in the continued use of the Mangoola Coal Mine plant and its infrastructure. The extraction of this resource now, while there is existing mining equipment operating at the site, a trained and experienced workforce and available mining infrastructure, is substantially more efficient than seeking to mine the resource at some future date following closure of the existing operations. Such future operations may not be commercially viable.

As outlined in the EIS, the MCCO Project has been assessed against the principles of ESD as required by the EP&A Act and EP&A Regulation. This assessment has indicated that while the MCCO Project, like any large scale development, will have impacts, these impacts can be effectively managed, mitigated and offset and the development will result in significant economic benefits. The assessment therefore concluded that the MCCO Project is consistent with the principles of ESD and after consideration of the submissions made and the responses provided in this RTS, there is no change to that conclusion.

The Economic Assessment completed as part of the EIS (refer to Appendix 7 of the EIS) describes a range of positive benefits from the MCCO Project that will result at a local, regional and State level. These benefits include:

- provide ongoing employment opportunities for the Mangoola workforce of approximately 400 employees, rising to a peak of approximately 480
- creation of up to approximately 145 additional construction jobs (peak) over the construction phase of the MCCO Project
- provide a net benefit in the Upper Hunter region of $92.6M in NPV terms
- provide a net benefit $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project.

The revenue, expenditure and employment associated with the construction and operation of the MCCO Project will stimulate economic activity in the regional economy, as well as for the broader NSW economy. Over the life of the MCCO Project, the Hunter Region's Gross Regional Product is projected to increase by $599M in NPV terms. NSW's Gross State Product (including the Hunter) increases by around $686M (NPV terms).

As part of the EIS a cost benefit analysis was undertaken for the MCCO Project which assessed the net benefit of the Project when all external and internal costs were considered, including environmental and social externality costs. The cost benefit analysis determined that the MCCO Project would result in a net benefit of $408.6M in NPV terms over the life of the MCCO Project. The MCCO Project will also provide considerable additional benefits in the form of royalties, taxation and other government revenue which will be recycled through the economy. There are no changes to these predicted outcomes as part of this response to submissions process.

With the implementation of the management, mitigation and offset measures proposed by Mangoola in the EIS and this RTS, it has been concluded that the MCCO Project would result in a net benefit to the NSW community.

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APPENDIX 1
Register of Submitters

Appendix A: Register of Objection and Comment Submissions Responded To

Submission ID	Name	Where issues are addressed in RTS
Agency Submissions		
AG01	Biodiversity and Conservation Division (BCD)	Section 3.1
AG02	Dams and Safety Committee	Section 3.12
AG03	Lands, Water and Department of Primary Industries	Section 3.2
AG04	Division of Resources and Geoscience (DRG)	Section 3.3
AG05	Environment Protection Authority (EPA)	Section 3.4
AG06	Heritage – Department of Premier and Cabinet	Section 3.5
AG07	Resources Regulator	Section 3.6
AG08	Transport for NSW	Section 3.7
AG09	Muswellbrook Shire Council	Section 3.8
AG10	Roads and Maritime Services (RMS)	Section 3.9
AG11	NSW Health	Section 3.11
AG12	Department of Primary Industries – Agriculture	Section 3.10
AG13	Independent Expert Scientific Committee (IESC)	Response will be provided in an addendum to the RTS.

Submission ID	Name	Issue and where addressed in RTS (Sections)																						
Category		Air Quality	Property Value	Noise	Social	Climate Change	Biodiversity	Water	Final Landform	Blasting	Traffic	Visual Amenity	Safety	Jobs	Economics	Health	Rehabilitation	Historic Heritage	Transport	Flooding	Bushfire	Light	Land Management	Comment
SE-69325	Kim Nightingale	4.1	4.3	4.2				4.6		4.11	4.13		4.13											
SE-69326	Anonymous 1	4.1	4.3	4.2				4.6		4.11	4.13				4.17									
SE-69633	Anonymous 2					4.4																		
SE-69813	Anonymous 3			4.2																				
SE-76822	Nicola Robertson	4.1	4.3	4.2	4.3	4.4		4.6																
SE-76824	Douglas Robertson	4.1			4.3	4.4		4.6																
SE-76825	Anonymous 4	4.1	4.3			4.4		4.6																
SE-76827	Anonymous 5	4.1	4.3	4.2	4.3	4.4																		
SE-76921	Anonymous 6	4.1	4.3	4.2	4.3	4.4		4.6				4.14												
SE-80789	Anonymous 7	4.1		4.2	4.3			4.6		4.11	4.13													
SE-80790	Neil Hurst	4.1	4.3	4.2	4.3		4.5	4.6																
SE-80791	Alisha Hurst	4.1	4.3	4.2	4.3		4.5	4.6																
SE-89834	Anonymous 8	4.1	4.3		4.3	4.4																		
SE-90152	Anonymous 9		4.3	4.2	4.3			4.6																
SE-90153	Anonymous 10	4.1	4.3	4.2	4.3		4.5																	
SE-90155	Gregory Leslie	4.1		4.2					4.8															
SE-90486	Anthony Rawnsley	4.1	4.3	4.2																				

Category		Air Quality	Property Value	Noise	Social	Climate Change	Biodiversity	Water	Final Landform	Blasting	Traffic	Visual Amenity	Safety	Jobs	Economics	Health	Rehabilitation	Historic Heritage	Transport	Flooding	Bushfire	Light	Land Management	Comment
SE-90499	Anonymous 11		4.3																					
SE-90521	Taryn Hayne	4.1	4.3	4.2	4.3	4.4			4.8															
SE-90528	Anonymous 12	4.1	4.3	4.2																				
SE-90530	Anonymous 13		4.3		4.3										4.17									
SE-90531	Anonymous 14		4.3																					
SE-90532	Georgia Goninan	4.1	4.3	4.2	4.3	4.4	4.5																	
SE-92498	David Hayne		4.3	4.2					4.8															
SE-92540	Cheyenne Doughty					4.4																		
SE-92547	Anonymous 15						4.5																	
SE-92551	Carlin Plumb		4.3																					
SE-92556	Michael White	4.1	4.3	4.2	4.3		4.5	4.6	4.8			4.14												
SE-92557	Margot White	4.1	4.3	4.2	4.3	4.4	4.5		4.8															
SE-92564	Shinead Gillespie						4.5																	
SE-92569	Anonymous 16	4.1		4.2	4.3		4.5	4.6																
SE-92577	Lee Curran	4.1	4.3	4.2	4.3		4.5		4.8															
SE-92588	James Morgan	4.1	4.3	4.2		4.4																		
SE-92590	Anonymous 17		4.3	4.2	4.3	4.4																		
SE-92599	Graham Nightingale	4.1	4.3				4.5				4.13						4.9							
SE-92607	Rob Tickle																	4.10						

Category		Air Quality	Property Value	Noise	Social	Climate Change	Biodiversity	Water	Final Landform	Blasting	Traffic	Visual Amenity	Safety	Jobs	Economics	Health	Rehabilitation	Historic Heritage	Transport	Flooding	Bushfire	Light	Land Management	Comment
SE-92797	Robert Kennedy	4.1				4.4																		
SE-93062	Olivia van den Heuvel	4.1	4.3	4.2	4.3	4.4																		
SE-93070	Beverley Atkinson						4.5																	
SE-93072	Jason Connor	4.1			4.3	4.4			4.8															
SE-93407	Rebecca Bailey	4.1	4.3	4.2	4.3																			
SE-93415	Brendon Buckman		4.3	4.2	4.3							4.14												
SE-93419	Sue Abbott					4.4			4.8							4.3								
SE-93420	Belinda Lycett			4.2			4.5		4.8															
SE-93421	Catherine Le Breton	4.1		4.2	4.3	4.4	4.5																	
SE-93422	Michael Le Breton	4.1		4.2	4.3	4.4	4.5																	
SE-93444	Anonymous 18					4.4		4.6								4.3								
SE-93449	Anonymous 19	4.1	4.3		4.3			4.6																
SE-93451	Kim Manwarring	4.1	4.3	4.2				4.6		4.11		4.14									4.12			
SE-93459	Gerald Dimmock	4.1	4.3	4.2																				
SE-93460	Micheal Blackhall	4.1	4.3	4.2							4.13												4.18	
SE-93464	Karen Dimmock		4.3	4.2	4.3			4.6				4.14		4.16						4.7				
SE-93469	Isabelle Dimmock	4.1	4.3	4.2	4.3			4.6																
SE-93473	Jess Dimmock	4.1	4.3	4.2	4.3						4.13	4.14												
SE-93474	Robert McLaughlin	4.1	4.3	4.2	4.3	4.4	4.5		4.8															

Category		Air Quality	Property Value	Noise	Social	Climate Change	Biodiversity	Water	Final Landform	Blasting	Traffic	Visual Amenity	Safety	Jobs	Economics	Health	Rehabilitation	Historic Heritage	Transport	Flooding	Bushfire	Light	Land Management	Comment
SE-93476	Anthony Lonergan	4.1				4.4	4.5																	
SE-93477	Anne Maree McLaughlin	4.1	4.3	4.2	4.3	4.4	4.5																	
SE-93481	Melissa Blackhall	4.1	4.3	4.2											4.17								4.18	
SE-93483	Anonymous 20	4.1	4.3	4.2	4.3				4.8					4.16										
SE-93484	Wendy Morgan		4.3		4.3	4.4			4.8															
SE-93491	Anonymous 21	4.1			4.3	4.4			4.8						4.17									
SE-93493	Anonymous 22					4.4																		
SE-93494	Anonymous 23	4.1																						
SE-93495	Claire Bettington					4.4																		
SE-93496	Anonymous 24				4.3			4.6		4.11														
SE-93498	David Le Breton	4.1				4.4	4.5																	
SE-93499	Matthew OConnell					4.4			4.8															
SE-93565	Anonymous 25	4.1	4.3					4.6																
SE-93705	Anonymous 26	4.1		4.2																				
SE-93707	Anonymous 27	4.1	4.3	4.2	4.3																			
SE-93709	Anonymous 28	4.1	4.3	4.2	4.3					4.11														
SE-93716	Linda McIntosh	4.1	4.3	4.2	4.3		4.5			4.11		4.14											4.18	
SE-93717	Amber McIntosh	4.1		4.2	4.3		4.5				4.13	4.14												

Category		Air Quality	Property Value	Noise	Social	Climate Change	Biodiversity	Water	Final Landform	Blasting	Traffic	Visual Amenity	Safety	Jobs	Economics	Health	Rehabilitation	Historic Heritage	Transport	Flooding	Bushfire	Light	Land Management	Comment
SE-93718	Kent & Deborah Campbell	4.1	4.3	4.2	4.3		4.5	4.6							4.17				4.13					
SE-93719	Kathy Johnstone	4.1	4.3	4.2	4.3																			
SE-93720	Neil & Rosemary Munn	4.1	4.3	4.2	4.3	4.4			4.8															
SE-93722	Claire Morgan	4.1	4.3	4.2		4.4																		
SE-93723	Tom & Wendy Henderson	4.1	4.3	4.2	4.3																	4.15		
SE-93749	Geoff Pettett		4.3		4.3			4.6						4.16										
SE-93809	Louise Shewan			4.2																				
SE-93810	Anonymous 29	4.1	4.3	4.2	4.3	4.4	4.5		4.8															
SE-93811	Anonymous 30					4.4																		
SE-93497	Scott Jennar																							4.19
Interest Groups																								
ORG01	Ridgelands Residents Inc (NFP NGO)		4.3	4.2		4.4	4.5	4.6			4.13					4.3	4.9						4.18	
ORG02	Wybong Concerned Landowners Group	4.1	4.3	4.2			4.5									4.3								
ORG03	Lock the Gate Alliance			4.2	4.3	4.4								4.16			4.9							

Category		Air Quality	Property Value	Noise	Social	Climate Change	Biodiversity	Water	Final Landform	Blasting	Traffic	Visual Amenity	Safety	Jobs	Economics	Health	Rehabilitation	Historic Heritage	Transport	Flooding	Bushfire	Light	Land Management	Comment
ORG04	Denman Aberdeen Muswellbrook Scone Healthy Environment Group	4.1				4.4	4.5																	
ORG05	Hunter Environment Lobby Inc	4.1	4.3			4.4	4.5	4.6																
ORG16	Ausgrid																							4.19

APPENDIX 2

Plant Identification by National Herbarium of NSW

The Royal
BOTANIC GARDENS
& Domain Trust

National Herbarium of New South Wales

Shaun CORRY
Umwelt Aust. Pty Ltd
PO Box 838
Toronto, NSW 2283

BIS Enquiry No: 21247
Botanical.Is@rbgsyd.nsw.gov.au
Ph. No: (02) 9231 8111
Date: 12 December 2019

Dear Shaun,

Re: Plant identification – 3 eucalypt specimens from Wybong

EC1 - *Eucalyptus camaldulensis* subsp. *acuta* – det. A.E. Orme 12th Dec 2019
EO2 - *Eucalyptus camaldulensis* subsp. *acuta* – det. A.E. Orme 12th Dec 2019
EC3 – inadequate – image does look like a Red Gum – det. A.E. Orme 12th Dec 2019

An invoice for $66.00 (incl. GST) will be forwarded to you separately by our finance section to cover cost of identification.

Thank you for your enquiry.

Yours sincerely

Andrew Orme
Identification Technical Officer
Botanical Information Service

APPENDIX 3
Stephen Bell Expert Report

Expert Report

Expected Presence of Threatened Terrestrial Orchids (*Diuris tricolor* & *Prasophyllum petilum*):

Mangoola Coal Continued Operations Project

December 2019

Final Report

Umwelt (Australia) Pty Ltd
75 York Street
Teralba NSW 2284

Dr Stephen Bell

Eastcoast Flora Survey
PO Box 216
Kotara Fair NSW 2289

SUMMARY

Mangoola Coal Mine is an open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW. Mangoola has operated the Mangoola Coal Mine in accordance with Project Approval (PA) 06_0014 (as modified) since mining commenced at the site in September 2010. The Mangoola Coal Continued Operations Project (MCCO Project) will allow for the continuation of mining at Mangoola into a new mining area to the immediate north of the existing operations. The MCCO Project will mine an additional 52Mt of coal, and utilise the existing infrastructure and equipment at Mangoola Coal Mine to extend the life of the existing operation, providing for ongoing employment opportunities for the existing Mangoola workforce.

With the endorsement of the Office of Environment and Heritage (OEH), I have been engaged by Umwelt Australia Pty Ltd (Umwelt) on behalf of Mangoola Coal Operations Pty Limited (Mangoola) to complete an expert review in relation to two threatened orchids (*Diuris tricolor* and *Prasophyllum petilum*), to be incorporated into an impact assessment for the MCCO Project. The expert review is as required and in accordance with Section 6.5.2.3 of the NSW Governments Biodiversity Assessment Method, and will form part of an Environmental Impact Statement being prepared by Umwelt, aiming to support an application for development consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the MCCO Project.

The MCCO Project, if approved, will result in the removal of both *Diuris tricolor* and *Prasophyllum petilum*. Completed surveys by Umwelt show that 1,326 *Diuris* and 691 *Prasophyllum* will be directly impacted upon by proposed activities, and additional lands are consequently required to offset this impact ('proposed offset lands'). Based on targeted field surveys completed by myself in 2015, and Umwelt staff in 2016 and 2017, a minimum of 9,030 *Diuris* and 904 *Prasophyllum* individuals are known to be present within the proposed 1290 ha offset lands. Results obtained during 2017 surveys of the proposed offsets were poor due to drought conditions, hence the need for this expert report.

Following field inspections on 31 July and 4 October 2018, I used data collected then and existing floristic plot data to construct a map of orchid habitat quality across the proposed offsets. This resulted in the designation of 509 ha of high quality habitat, 253 ha of moderate quality, and 322 ha of low quality. The balance (206 ha) was considered to comprise negligible orchid habitat (e.g. sandstone hills, farm dams, roads, dwellings). Combining the areas of high and moderate quality habitat, **762 ha of the total 1290 ha combined offsets provide suitable habitat for *Diuris* and *Prasophyllum*.** This represents 59% of the total proposed offset lands. Using existing point record data on orchid occurrence (n=11,006 *Diuris*; n=3,606 *Prasophyllum*), I then calculated representative densities of orchids across eight different areas surveyed in previous years to determine appropriate lower and upper bounds for the expected population size within the proposed offsets. This analysis resulted in a range of 2 to 74 *Diuris* per hectare and 2 to 4 *Prasophyllum* per hectare. Extrapolating these densities across the mapped high and moderate quality habitat within the proposed offset areas, the **expected population size for *Diuris* likely falls within the range of 1,506 to 44,300 individuals, and for *Prasophyllum* 1,506 to 2,506 individuals**.

In order to provide more definitive estimates of both species that can be used in credit calculations, I used two different multipliers (median density from previous surveys for high/moderate quality habitat; lowest density for low quality habitat) to calculate the expected number of individuals across the combined offset area. Following this process, 20,837 *Diuris* and 2,168 *Prasophyllum* are expected to be present. Allowing for the 9,934 orchids already recorded in previous surveys, the proposed offset lands can be expected to support **an additional 11,807 *Diuris* and 1,264 *Prasophyllum***.

Table of Contents

1. Introduction

1.1 Background

1. I have been engaged by Umwelt Australia Pty Ltd (Umwelt) on behalf of Mangoola Coal Operations Pty Limited (Mangoola) to complete an expert review in relation to two threatened orchids (*Diuris tricolor* and *Prasophyllum petilum*), to be incorporated into an impact assessment for the Mangoola Coal Continued Operations Project (MCCO Project). The expert review is as required and in accordance with Section 6.5.2.3 of the NSW Governments Biodiversity Assessment Method (OEH 2017). It will form part of an Environmental Impact Statement being prepared by Umwelt, which aims to support an application for development consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the MCCO Project.

2. As part of my brief, I have been asked to examine search effort and existing orchid records against environmental and floristic data from proposed offset lands (the Subject Area) to assess the likely population size of both species within these lands. Collectively, these offset lands occupy 1290 hectares (ha), and lie in close proximity to the existing Mangoola operations. My assessment is required as drought conditions within the Subject Area in recent years may have restricted overall counts of the total orchid population size, leading to the perception that proposed offset lands supported fewer individuals than may be expected. In addition to the review and analysis of available data, a two day inspection of the offset lands has also been undertaken (on 31 July and 4 October 2018). For contextual purposes, I also inspected the proposed disturbance area on 7 May 2019 to assess orchid habitat there in the same manner that was done for the offset lands.

1.2 Project Overview

3. Mangoola Coal Mine is an open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW (Figure 1). Mangoola has operated the Mangoola Coal Mine in accordance with Project Approval (PA) 06_0014 (as modified) since mining commenced at the site in September 2010.

4. The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The MCCO Project will mine an additional 52Mt of coal, and utilise the existing infrastructure and equipment at Mangoola Coal Mine to extend the life of the existing operation, providing for ongoing employment opportunities for the existing Mangoola workforce. The MCCO Project Area includes the existing approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area.

5. The MCCO Project generally comprises:

   - open cut mining at up to the same rate as that currently approved [13.5 Million tonnes per annum (Mtpa) of run of mine (ROM) coal] using truck and excavator mining methods.
   - mining operations in a new mining area located north of the existing Mangoola Coal Mine on Wybong Road, south of Ridgelands Road and east of the 500 kV Electricity Transmission Line (ETL).

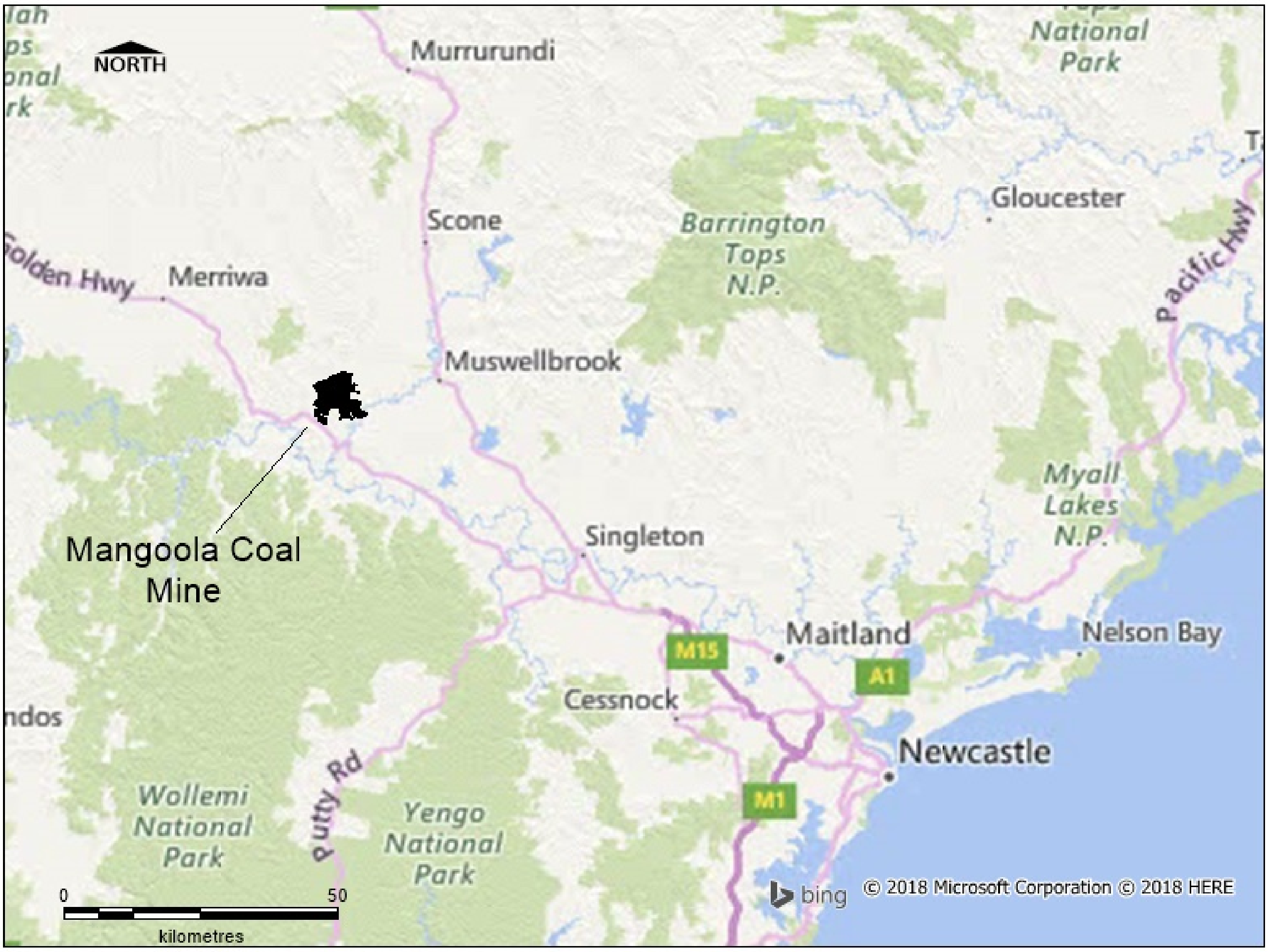

Figure 1 Location of Mangoola Coal Mine.

- construction of a haul road overpass over Big Flat Creek and Wybong Road to provide access from the existing mine to the proposed Additional Mining Area.
- establishment of an out-of-pit overburden emplacement area.
- distribution of overburden between the proposed Additional Mining Area and the existing mine in order to optimise the final landform design of the integrated operation.
- realignment of a portion of Wybong Post Office Road.
- the use of all existing or approved infrastructure and equipment for the Mangoola Coal Mine with some minor additions to the existing mobile equipment fleet.
- construction of a water management system to manage sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine.
- establishment of a final landform in line with current design standards at Mangoola Coal Mine including use of micro-relief consistent with the existing site.
- rehabilitation of the proposed Additional Mining Area using the same revegetation techniques as at the existing mine.

- a likely construction workforce of approximately 145 persons. No change to the existing approved operational workforce.
- Continued use of the mine access for the existing operational mine and access to/from Wybong Road, Wybong Post Office Road or Ridgelands Road to the MCCO Additional Project Area for construction, emergency services and ongoing operational environmental monitoring.

6. The focus of my report is on the 1290 ha of proposed offset lands lying largely to the immediate north and south-west of the existing Mangoola operations (Figure 2). For contextual reasons, however, I have also assessed known orchid records and habitat data from the wider Mangoola lands (including the proposed disturbance area). To assist in later discussions, I have broken up the 1290 ha proposed offset lands into five separate parcels of land (Table 1).

Table 1 Land parcels comprising the proposed Biodiversity Offset Lands.

Land Parcel	Size (ha)	Details
Ridgelands Road	563	three parcels of land immediately north and south of Ridgelands Road
Mangrove	259	immediately west of Wybong Road, adjoining approved project boundary
Wybong PO Road	208	immediately north of Wybong PO Road, and west to upper Yarraman Road
Castle Rock Road	156	two parcels of land either side of Castle Rock Road near its intersection with Wybong Road
Yarraman Road	104	five parcels of land either side of Yarraman Road and Wybong Road, at their intersection
Total	1,290	

1.3 Report Criteria & Structure

7. As detailed in the Biodiversity Assessment Method (OEH 2017), an expert report is required to address the following criteria, and these form the basis of the structure of this report:

   a. identify the relevant species or population (see Section 2);
   b. provide a justification for the use of an expert report (see Section 3);
   c. indicate and justify the likelihood of presence of the species or population and prepare a species polygon showing the location and area of the species polygon (see Section 4);
   d. estimate the number of individuals or area of habitat (as identified in the Credit Calculator) for the development site (see Section 5);
   e. include the information considered in relation to the determination made in the report (see Section 6), and;
   f. identify the expert and provide evidence of their credentials (see Section 7).

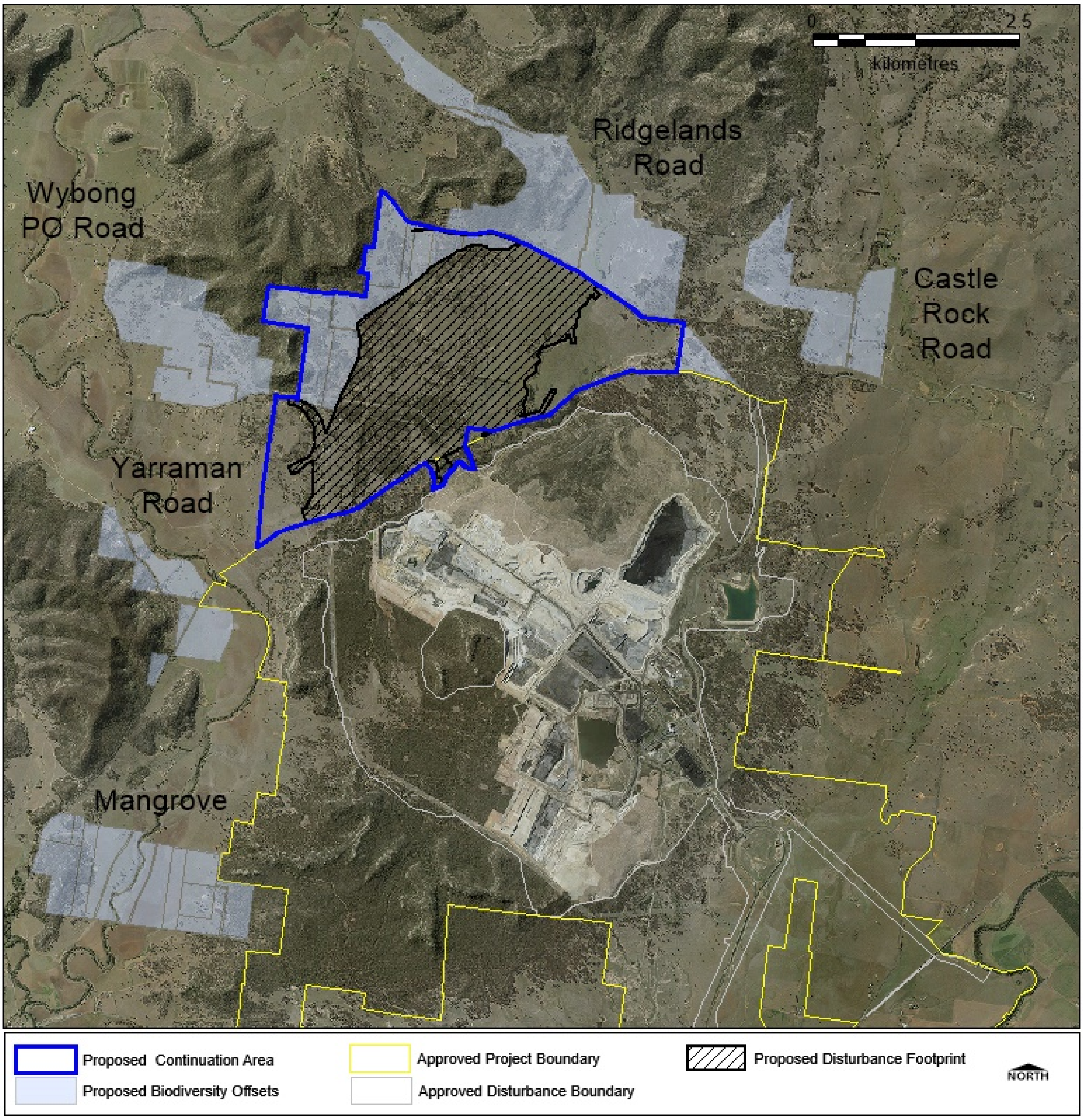

Figure 2 Proposed biodiversity offset areas (the Subject Area).

1.4 OEH Approval to Prepare Expert Report

8. I have been approved to prepare this expert report by the relevant officers at the Newcastle Office of Environmental and Heritage (OEH), as shown in Appendix 1.

2. Criterion (a) - The Relevant Species

2.1 Legal Status

9. *Diuris tricolor* and *Prasophyllum petilum* are both threatened species included in relevant State, Territory and Commonwealth legislation. *Diuris tricolor* is listed both as vulnerable in NSW and as an endangered population in the Muswellbrook local government area under the *Biodiversity Conservation Act 2016* (BC Act), while *Prasophyllum petilum* is listed as endangered in NSW (BC Act), the ACT (*Nature Conservation Act 2014*) and the Commonwealth (*Environment Protection and Biodiversity Conservation Act 1999*, EPBC Act).

10. In recent years, there has been some taxonomic confusion over the identity of *Prasophyllum* plants growing in the upper Hunter (Wybong) area. Following an informal review of these plants by NSW orchid taxonomists in the past decade, these plants were placed in synonymy with the more widespread *Prasophyllum petilum* (see PlantNet[1]), a finding also supported by other orchid experts elsewhere in Australia (e.g. Backhouse et al 2016a) and OEH (see Appendix 1). As a consequence, *Prasophyllum* sp. Wybong (C. Phelps ORG5269) is now an accepted synonym of *Prasophyllum petilum*, but remains listed as critically endangered on the EPBC Act.

2.2 Distribution and Known Populations

11. *Diuris tricolor* and *Prasophyllum petilum* (Figure 3) are present and co-occur in the Hunter Valley region of New South Wales (NSW), but the two species also occupy considerably wider geographical ranges throughout eastern Australia.

2.2.1 Diuris tricolor

12. *Diuris tricolor* (Pine Donkey Orchid) is a widespread terrestrial orchid, occurring on the western slopes and plains and tablelands of NSW, and also in the Moreton and Darling Downs districts of Queensland (Stanley & Ross 1989; Jones 1993). Populations of *Diuris tricolor* in the upper Hunter Valley around Denman and Muswellbrook (including at Mangoola Coal) form the eastern extent of an east-west trending meta-population extending along the Goulburn River valley to Mudgee (Figure 4). Records exist for this species at ~20 km intervals along this 200 km extent, suggesting that some exchange of genetic material is likely to be occurring with more westerly stands. A single, small disjunct population of *Diuris tricolor* has also recently been discovered at North Rothbury (noted in Bell 2017), and represents the most easterly population known within New South Wales.

13. Elsewhere in New South Wales, *Diuris tricolor* is extensive across the north, central and south western slopes, and extends into south-eastern Queensland. A single record from the Hume region of Victoria suggests that the species is very rare in that state, and indeed Backhouse et al (2016b) indicate that it is known from just three plants.

[1] http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Prasophyllum~petilum

Figure 3 *Diuris tricolor* (left) and *Prasophyllum petilum* (right), photographed *in situ* at Mangoola.

2.2.2 Prasophyllum petilum

14. *Prasophyllum petilum* (Tarengo Leek Orchid) occupies a smaller distributional range, with most records from the Australian Capital Territory (ACT) but with outliers in the Kandos, Denman, Premer and Inverell districts on the tablelands and western slopes of NSW. Until recently, Hunter Valley plants were considered a distinct taxon, *Prasophyllum* sp. 'Wybong' (C.Phelps ORG 5269), but are now placed in synonymy with *P. petilum* by NSW taxonomic authorities. Additionally, Backhouse et al (2016a) do not include *Prasophyllum* sp. 'Wybong' in their comprehensive list of Australian orchid taxa, despite the inclusion of three other un-named taxa with close affinities to *P. petilum*, therefore supporting the NSW concept of synonymy in this group.

15. Relative to the Wybong district the next nearest populations of *Prasophyllum petilum* occur near Kandos, some 140 km to the south-west, and Premer 190 km to the north-west (Figure 5). Hunter Valley populations of *Prasophyllum* are consequently isolated from all others, and opportunities for genetic exchange are minimal. Note that Jeanes (2015) considers Victorian populations of *Prasophyllum* to represent a different taxon, implying that *Prasophyllum petilum* is endemic to New South Wales. This view is also supported by Backhouse et al (2016a).

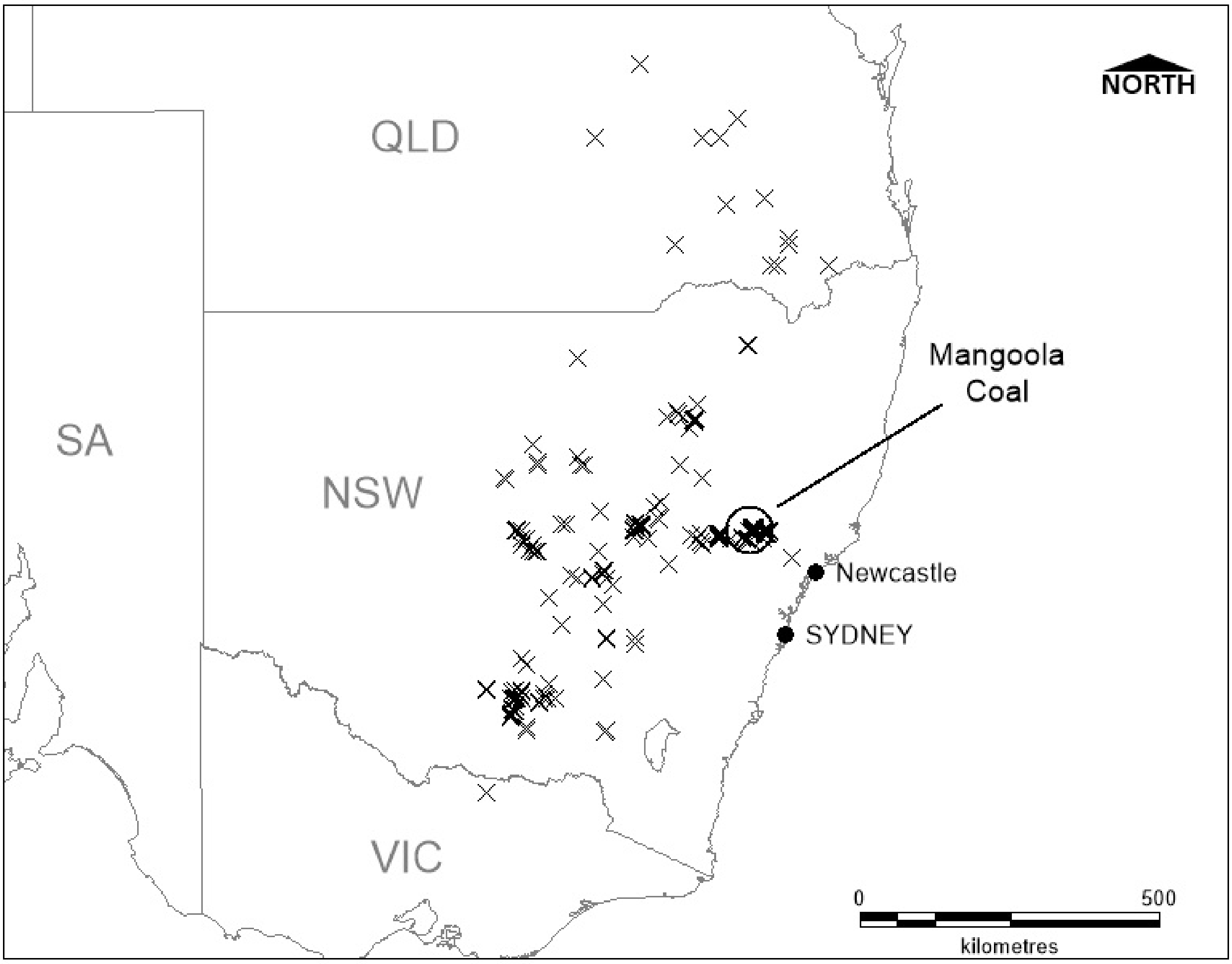

Figure 4 **Distribution of *Diuris tricolor* (X) across eastern Australia, shown relative to populations at Mangoola Coal.** Data is sourced from Australia's Virtual Herbarium and the NSW Wildlife Atlas database (OEH).

2.3 Habitat

2.3.1 Diuris tricolor

16. Most texts dealing with *Diuris tricolor* document favoured habitat as grassy *Callitris* woodlands (eg: Jones 1993; Burrows 1999; Bishop 2000), although in Queensland it is 'eucalypt open forest' (Stanley & Ross 1989). In a study of remnant vegetation stands in the South Western Slopes of New South Wales, Burrows (1999) recorded *Diuris tricolor* at several sites, but all within *Callitris glaucophylla* dominated vegetation.

17. Anecdotal evidence and unpublished data from subpopulations of *Diuris* in the Hunter Valley suggest that it occurs most commonly within grassy woodlands and grasslands derived from former Ironbark (*Eucalyptus crebra*) and Box (*E. moluccana*) woodlands. Herd and Herd (2005), for example, reported a single flowering specimen near Wybong as being in 'grassland/open woodland', and Abel Ecology (2005) also recorded this species in grassland at nearby Bell's Lane.

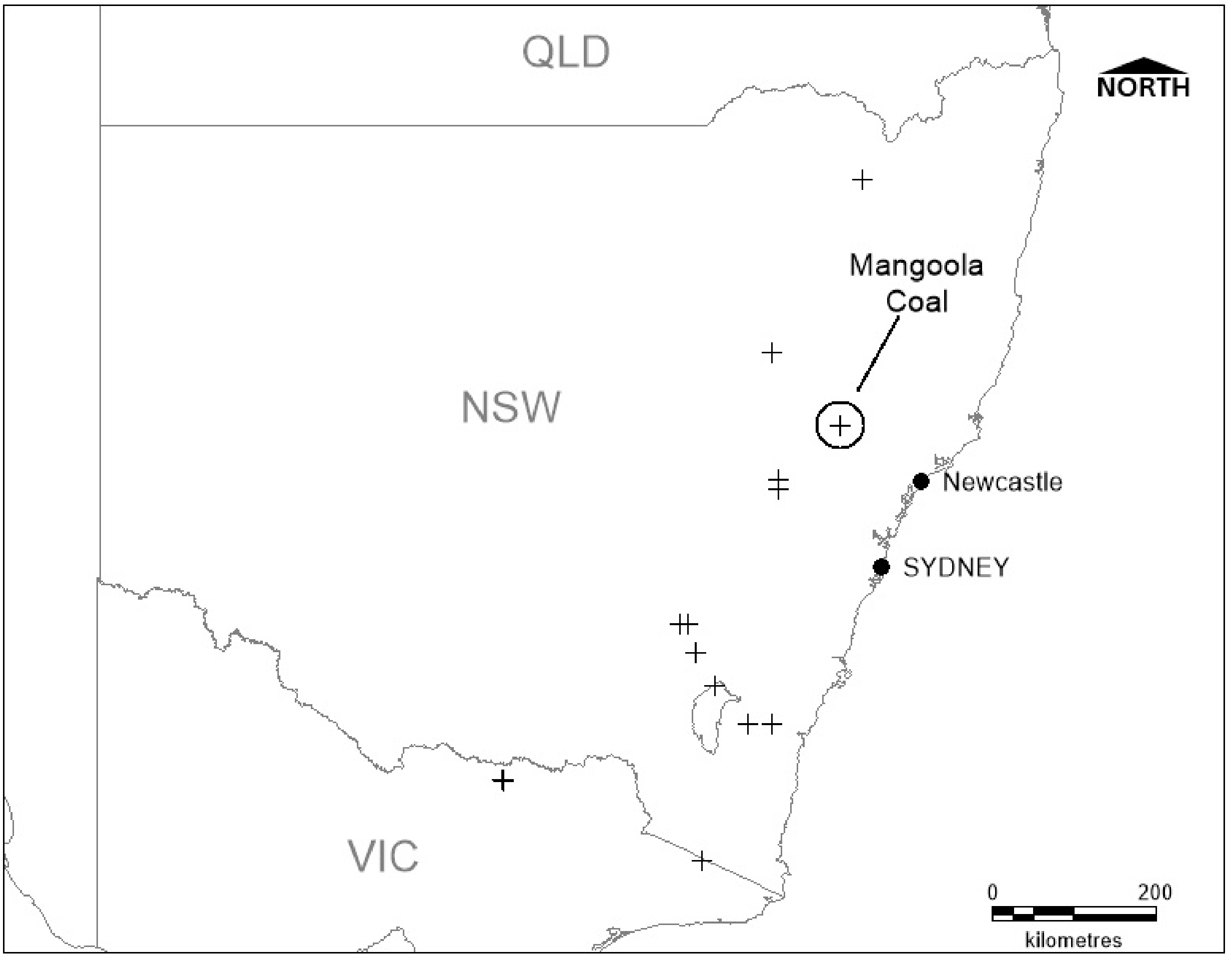

Figure 5 **Distribution of *Prasophyllum petilum* (+) across eastern Australia, shown relative to populations at Mangoola Coal.** Data is sourced from Australia's Virtual Herbarium and the NSW Wildlife Atlas database (OEH). Note that Victorian records purportedly represent a different taxon (Jeanes 2015).

2.3.2 Prasophyllum petilum

18. Information on the habitat of *Prasophyllum petilum* throughout its range is brief but documents variable associations. When describing the species, Jones (1991) reported the known habitat at that time (the type locality only, in the ACT) as being "moist grassy patches in sparse woodland developed on fertile soils", while Bishop (2000) describes it as remnant *Themeda* grassland on silty clay loams.

19. The national recovery plan for this species (DECCW 2010) provides more detail on floristic associations at the five known sites for which it was written, mostly on the Southern and Central Tablelands of NSW. At Captains Flat cemetery, grassy woodland dominated by *Eucalyptus pauciflora* and *Eucalyptus aggregata*, with a patchy shrub layer of *Hakea microcarpa*, *Acacia dealbata* and *Leptospermum brevipes* and a ground layer of *Poa sieberiana, Themeda australis* and *Schoenus apogon*, is documented. At Hall and Ilford cemeteries, habitat includes grassy woodland of *Eucalyptus blakelyi* and *Eucalyptus melliodora*, over *Poa sieberiana* and *Themeda australis* at Hall but *Themeda australis* and *Sorghum leiocladum* at Ilford. The Tarengo TSR site supports natural grassland of *Bothriochloa macra, Pentapogon quadrifidus, Austrodanthonia* spp., *Themeda australis, Schoenus apogon, Drosera peltata, Sebaea ovata* and *Haloragis*

heterophylla on a treeless grassy plain, while at Steves TSR *Prasophyllum* occurs in a treeless frost hollow, surrounded by *Eucalyptus pauciflora*.

20. Notes associated with collections included in Australia's Virtual Herbarium indicate that most southern records of *Prasophyllum petilum* occur in grasslands dominated by *Themeda australis, Bothriochloa* spp. and *Danthonia* spp, with associated forbs of *Bulbine* sp., *Dichopogon* sp., *Wurmbea* sp., *Swainsonia* sp., *Pimelea curviflora*, *Chrysocephalum* sp., *Ajuga australis*, *Craspedia* sp., *Stackhousia monogyna*, *Eryngium* sp., *Burchardia* sp., *Arthropodium* sp., and *Juncus* sp. Northern records occur in grassland of *Aristida* sp., *Themeda australis* and *Stackhousia monogyna*.

21. With the exception of populations on the North Western Slopes, these habitats are very different to those where *Prasophyllum petilum* occurs in the Hunter Valley. In this region plants occur most commonly in grasslands derived from former Ironbark (*Eucalyptus crebra*) and Box (*E. moluccana*) woodlands, dominated by species such as *Cymbopogon refractus, Aristida ramosa, Dichanthium sericeum* and *Chloris ventricosa* (further detailed in Section 2.3.3).

2.3.3 At Mangoola Coal

22. A floristic analysis of derived grasslands undertaken at Mangoola Coal by me between 2009 and 2011 found that *Diuris tricolor* and *Prasophyllum petilum* occurred within three of seventeen grassland types, in descending order of importance (Bell 2012):

- *Aristida/ Cymbopogon* Grassland (Unit 2);
- *Bothriochloa biloba/ Carthamnus/ Danthonia* Grassland (Unit 4);
- *Dichanthium/ Sporobolus/ Chloris* Grassland (Unit 1a).

Both species were also present in three woodland communities, those characterised by *Eucalyptus crebra, Eucalyptus dawsonii* or *Allocasuarina luehmannii*. Combined, the three derived grassland habitats defined encompassed a significantly large proportion of the grasslands included in that study (84% of 1069 ha). Detailed floristic composition of each of these key grassland communities are replicated in Appendix 2.

23. The knowledge gained from this floristic analysis of grassland types within the Mangoola area, comprising 168 plots sampled over a 2000 ha study area, has been incorporated into my assessments of suitable orchid habitat discussed later in this report.

2.4 Ecology

2.4.1 Flowering & Orchid Detection

24. As a rule of thumb, dry winters in the Hunter Valley generally result in below average flowering in terrestrial orchids. Low rainfall in the three months leading up to flowering place individual orchids under stress, meaning that flowering may be postponed for that season for all but the most robust individuals. Because of this trait, terrestrial orchids have been described of as 'time-travellers' (Brundrett 2016), encapsulating the uncertainty in determining their presence in any given area.

25. The unpredictability of orchid flowering from year-to-year has been highlighted over the eight year translocation project of *Diuris tricolor* and *Prasophyllum petilum* that has been undertaken at Mangoola Coal (Bell 2019; Bell in review; also reported annually to reports to Mangoola

Coal). Over the course of eight years of monitoring, the June-to-August pre-flowering rainfall in approximately half of them have been above average, and half have been below average. Dry years have been reflected in low rates of detection within recipient plots, while wetter years have shown an increase in detection (Figure 6). There are of course other factors contributing to the extent of orchid detection observed (expanded upon in Bell in review), but there is a clear trend associated with winter rainfall. Of the nine recipient plots, all displayed lower detection rates in the drought year of 2017, following three seasons of above average winter falls. Results obtained for the 2018 surveys showed a continuing decline in detection despite marginally better rainfall. A similar downward trend was observed for the five recipient plots (n=440) established within mine rehabilitation, monitored over 2-3 years since 2015 (not presented here).

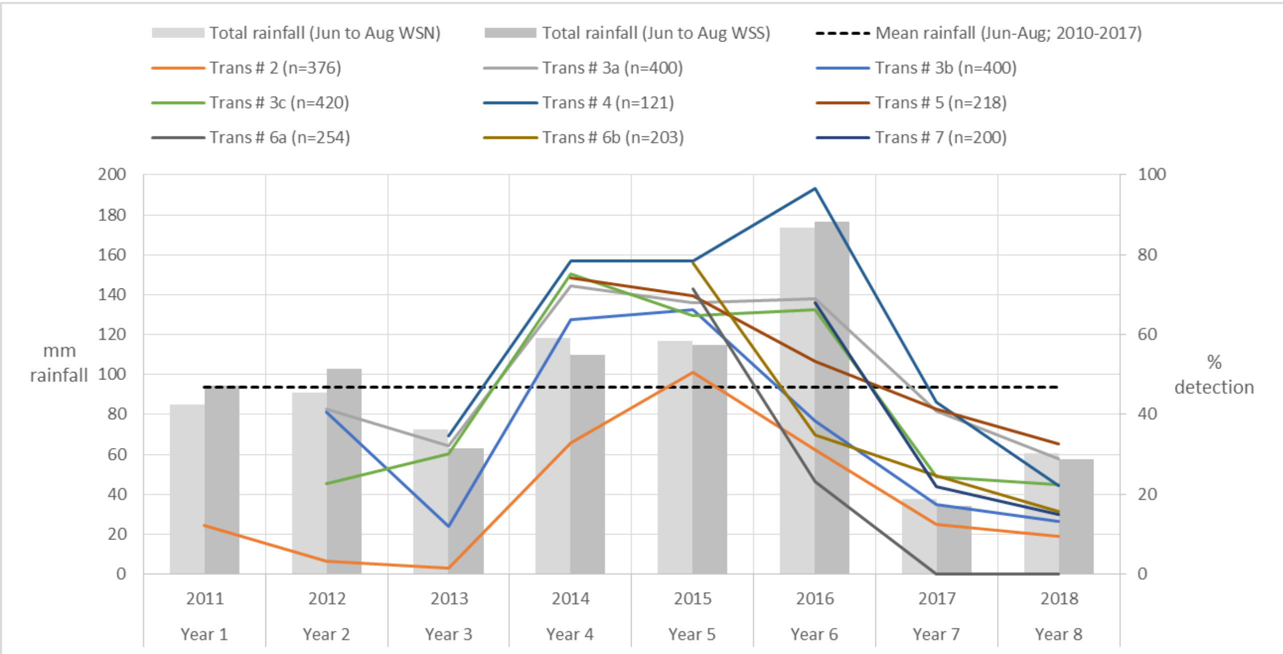

Figure 6 **Rainfall received (with 3-month average, June to August) and orchid detection during the course of monitoring across nine recipient plots within derived grassland, over a period of three to eight years (n=2,592 orchids).** Rainfall data from Mangoola Coal weather stations north (WSN) and south (WSS), shown relative to the Subject Area in Figure 7.

26. Vizer (2013) investigated a range of aspects of the ecology and biology of *Diuris tricolor* and *Prasophyllum petilum* at Mangoola Coal. He found peak flowering to occur from mid- to late-September, but that less than 20 % of plants would be flowering on any particular day at this time. This implies that a 'one-off' survey, even if conducted on the day of peak flowering, would likely overlook more than 80 % of individuals in that population. Capsule production was also found during this study to occur in less than 3 % of plants for both species, with herbivory identified as an important limiting factor in seed production.

27. For *Prasophyllum petilum*, Wilson et al. (2016) analysed annual monitoring data over a 25 year period from the largest known population on the southern tablelands of NSW, and identified the incidence of frost (nights ≤ -4ºC) as being instrumental in preventing flowering in any one season. Frost damage to emerging plant parts prior to reaching flowering stage prevents detection during monitoring surveys, influencing annual counts. Warm winters are

consequently of benefit to the orchids in this population, although it is unknown if the same applies to the Hunter Valley population.

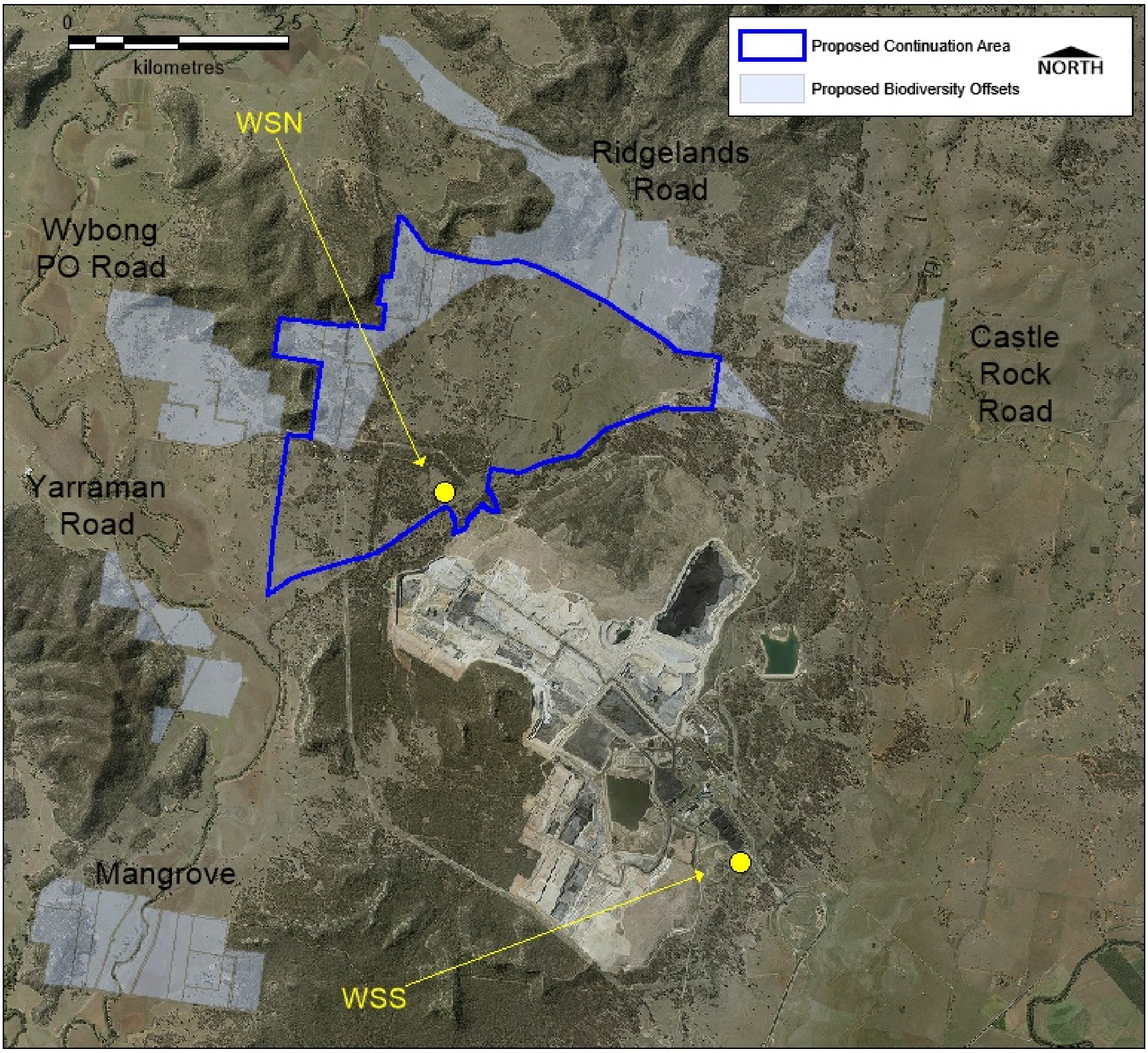

Figure 7 Location of Mangoola Coal weather station north (WSN) and south (WSS), relative to the Subject Area.

2.4.2 Mycorrhizal Fungi

28. Orchid presence in any area is dependent on the availability of co-occurring mycorrhizal fungi present within the soil, and different fungi are required by different orchid species. Indeed, Weston et al (2005) noted a high degree of specificity between a particular species of orchid and their associated species of mycorrhiza, but that there are also commonalities between and within genera. For *Diuris*, they indicate that the *Tulasnella* genus is important, while for *Prasophyllum* it is *Ceratobasidium*.

29. At Mangoola, seed-baiting techniques were used by Vizer (2013) in an attempt to map the distribution of mycorrhizal fungi, finding that the distribution of *Diuris* was actually more restricted than the relevant fungi. This implies that there may be extensive suitable habitat,

complete with mycorrhizal fungi, within a wider area than is currently known to support the species. Mycorrhizal seed-baiting for *Prasophyllum* was not successful in the study of Vizer (2013), which is not unusual for this genus. There was some doubt, however, if the specific mycorrhiza required for this species was correctly isolated, reflected in poor germination of seed under laboratory conditions. Further research on the fungi associated with *Prasophyllum* is required.

2.4.3 Pollination and Capsule Development

30. Pollination in both *Diuris* and *Prasophyllum* (and most other orchids) is enacted by insects. Many orchids rely on mimicry to trick unsuspecting insects, either by the development of flowers that appear identical to those of co-occurring species in their habitat (food mimicry), or by individual flowers resembling the females of certain insects (sexual mimicry). Other species offer a nectivorous reward and lure pollinators by scent. Most *Diuris* mimic co-occurring species of pea to attract pollinators, and for *D. tricolor* at Mangoola this is likely to be *Templetonia stenophylla* or *Daviesia genistifolia* (pers. obs.; Vizer 2013). *Prasophyllum* employ a different strategy to attract pollinators, using nectar and scent. Weston et al (2005) indicate that the pollinators of *Diuris* are likely to be various colletid bees from the *Trichocolletes* and *Leioproctus* genera, while colletid and halictid bees, ichneumonid, tiphiid, scoliid and sphecid wasps, syrphid flies, and beetles are the likely pollinators of *Prasophyllum*.

31. Once pollination has been enacted, the development of seed capsules progresses over the following weeks. Based on observations made at translocation sites at Mangoola over several years (e.g. Bell 2016a), capsule development is unhindered and many individual orchids have produced seed. Fruit:Flower ratios of around 30% were achieved in a pilot study of capsule production for both target species (Bell 2013). Evidently, despite the level of historical and current-day disturbance to the Mangoola landscapes, the necessary pollinators persist in the area.

2.4.4 Translocation

32. Two recent papers detail experiences with the translocation of more than 3000 *Diuris tricolor* and *Prasophyllum petilum* at Mangoola Coal (Bell 2019; Bell in review). No translocation studies into either of these two species have been previously published in the literature, although some on the related *Diuris fragrantissima* and *Diuris behrii* have (Dilley 2007; Nevill 2008; Smith et al 2009; and see Reiter et al 2016 for other genera). No other Australian orchid translocation study has monitored the emergence and flowering of over 3000 individual orchids, and globally the largest study prior to the Mangoola project involved only 700 individuals (Reiter et al 2016).

3. Criterion (b) – Justification for an Expert Report

33. Targeted surveys for *Diuris tricolor* and *Prasophyllum petilum* undertaken by staff from Umwelt (Australia) during the 2017 flowering season resulted in very low detections (136 *Diuris* and 0 *Prasophyllum*). As advised by Shaun Corry (Umwelt), four teams of observers were utilised for surveys over a three week period (18 September – 6 October 2017), involving eight ecologists with ecological survey experience ranging from 2 to 10 years. Survey timing was governed by the flowering progress of reference populations of both species from within the wider Mangoola area. Each two-person team was led by an ecologist with at least 6 years survey experience, with a colleague generally with less experience (2-9 years). All teams and staff were briefed on the identification of both orchid species prior to survey, and in the case of the cryptic *Prasophyllum petilum* flowering individuals (from within translocation sites) were viewed by all surveyors to confirm familiarity. Two *Prasophyllum* individuals were also monitored twice weekly from early September to guide the commencement of targeted surveys.

34. As highlighted in Section 2.4.1 above, the June to August period in 2017 was exceptionally dry at Mangoola Coal (the lowest for at least seven consecutive years). In addition, with a single exception (March 2017) the preceding eleven months prior to flowering also received well below average rainfall (Figure 8), meaning that all plants, including terrestrial orchids, had been under severe water stress for a prolonged period of time. Moisture in the soil following the exceptionally wet March 2017 could not be maintained over the autumn and winter periods. Most orchid species will not emerge to flower during stressful periods, or if leaves are produced at this time then flower stalks may not form. Given the drought conditions experienced throughout most of 2017, and in particular during the June-August period prior to flowering, there is clear justification for the preparation of this expert report rather than reliance on collected survey data which may fail to detect numerous viable individuals. Evidence from studies of translocated orchids over a period of eight years at Mangoola clearly show the trend between winter rainfall and orchid detection.

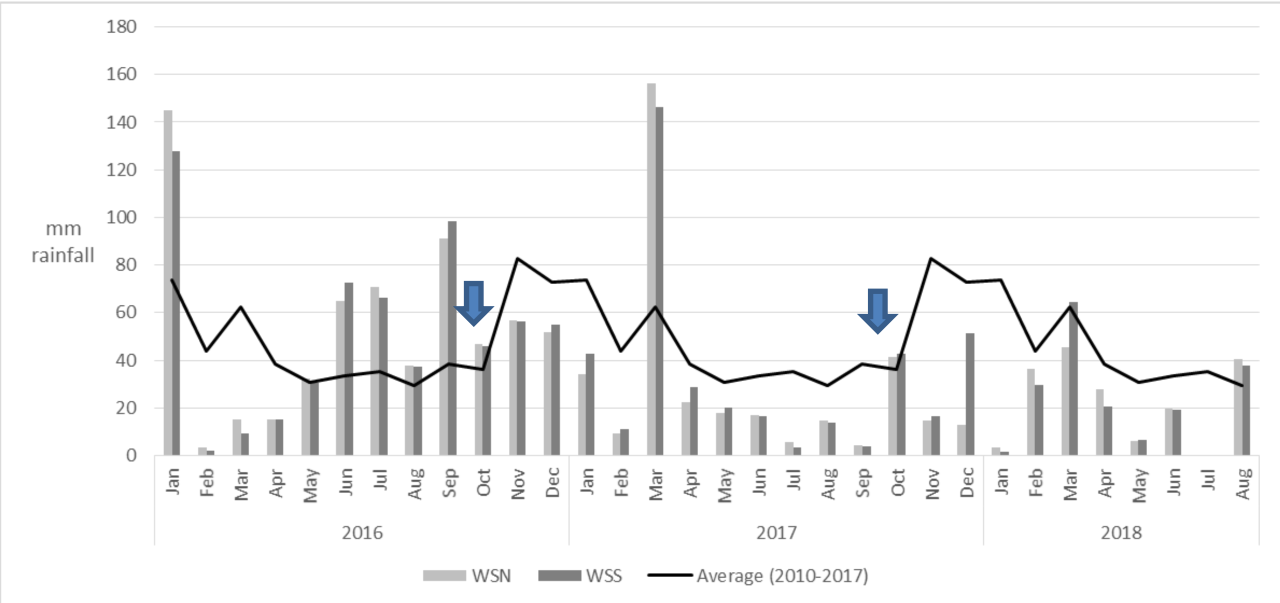

Figure 8 **Rainfall received for the 2016 and 2017 calendar years (and up to August 2018) at Mangoola Coal weather stations north (WSN) and south (WSS), showing the prolonged period of below-average rainfall from November 2016 to December 2017. Arrows show approximate orchid flowering times for both years, allowing comparison of winter rainfalls.**

35. Additionally, pressure from herbivory during drought periods escalates considerably (Duncan et al 2005), not only from vertebrate grazers such as macropods and rabbits, but also invertebrates including grasshoppers and caterpillars (Light & MacConnaill 2011; Vizer 2013). Bird species too are known to selectively feed on orchid species, with White-winged Choughs for example extracting orchids out of the ground to consume tubers (Duncan et al 2005; Faast & Facelli 2009). Any vegetation present during dry times will be the focus of herbivore browsing, meaning a reduction in the time orchids will be present above ground and hence reduced detection rates during survey. Desiccation through heat and wind in periods of drought will also reduce above-ground periods of flowering orchids.

4. Criterion (c) – Likelihood of Species Presence in the Subject Area

4.1 Land-use History of the Subject Area

36. Umwelt (2006a) provides a brief overview of the land use history of the locality in and around the Subject Area, as part of the original environmental assessment of the Mangoola mine. They indicate that by at least 1930 substantial clearing of vast areas had already taken place, primarily for grazing purposes.

37. A more detailed historical study (Umwelt 2006b) summarises the early settlement of the Wybong district, commencing with its first reporting by Henry Dangar in 1824. By the late nineteenth century, large estates dominated the Wybong landscape, including those named *Yarraman*, *Callatoota*, *Pickering*, *Milgara* and *Bundaraga*. The majority of lands within these large estates were largely cleared of woody vegetation to support various agricultural industries, including dairying, horse and sheep grazing, and cultivation on the better soils. From the mid twentieth century, regrowth of native vegetation has occurred sporadically within the Subject Area depending on land use and tenure, which in recent years has accelerated following ownership by Mangoola Coal. All parts of the Subject Area, with the exception of the rugged sandsone hills, have undergone some level of clearing associated with agricultural industries since European occupation.

4.2 Existing Orchid Records within the Subject Area

38. Based on the results of targeted field surveys undertaken within and surrounding the current Mangoola Coal lease area over several years, both *Diuris tricolor* and *Prasophyllum petilum* are known and expected to occur within the Subject Area. A review of all location data of both species revealed a total of 4,631 point records (4,236 *Diuris*, 395 *Prasophyllum*) from within the Subject Area. Based on collection notes associated with these data, this represents 9,030 *Diuris* and 904 *Prasophyllum* individuals. The actual number of orchids present in the Subject Area is likely to be considerably higher than this, given earlier suggestions that less than one half of all orchids present are likely to be detected in any targeted survey, due to separation distances between walked transects and variable flower emergence over the season (Bell & Copeland 2010). This is particularly so for *Prasophyllum*, given its small stature and small, indistinct flowers. Additionally, Vizer (2013) found that more than 80% of individuals were likely to be overlooked in any single-day survey of an orchid population, even if conducted at peak flowering.

39. Figure 9 shows the extent of orchids recorded across the Subject Area and proposed continuation area since 2009. Clearly, the Wybong PO Road offset supports the largest number of orchid records (4,948), followed by Ridgelands Road (2,895), Mangrove (1,490), Yarraman Road (577) and Castle Rock Road (24).

40. The number of orchid records revealed in any targeted search will always be a reflection of the extent of search effort for these species. As discussed elsewhere, the likelihood of detecting the target orchid species will be contingent on suitable growing and flowering conditions. Figure 10 summarises the extent of search effort expended within the Subject Area between 2015 and 2017. These searches were undertaken by myself at the Wybong PO Road offset and part of Yarraman Road offset in 2015, and Umwelt staff at all other offsets during the 2016 and

2017 flowering seasons. All surveys were timed to coincide with flowering in nearby reference populations.

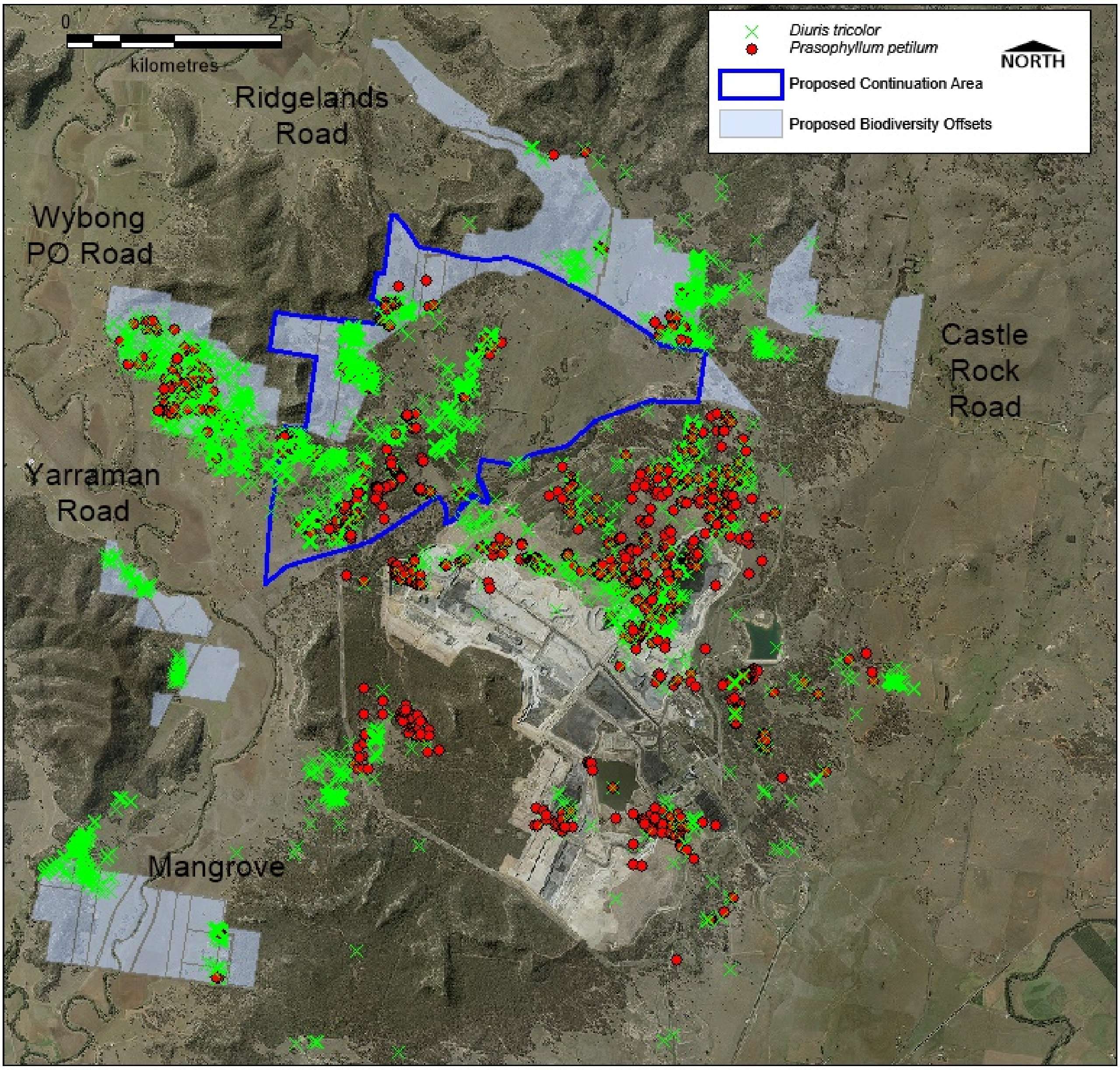

Figure 9 **Distribution of *Diuris* and *Prasophyllum* across the proposed offset and continuation areas, 2009 – 2017.**

4.3 Analysis of Floristic Data from within the Subject Area

41. Understanding the floristic patterns in the Subject Area is important in gaining an impression of how suitable the lands are to supporting one or both of the target orchid species. Although 2017 was a very dry year, examining floristic data collected during this time can still be compared with other data from the wider Mangoola area where both orchids are known to occur.

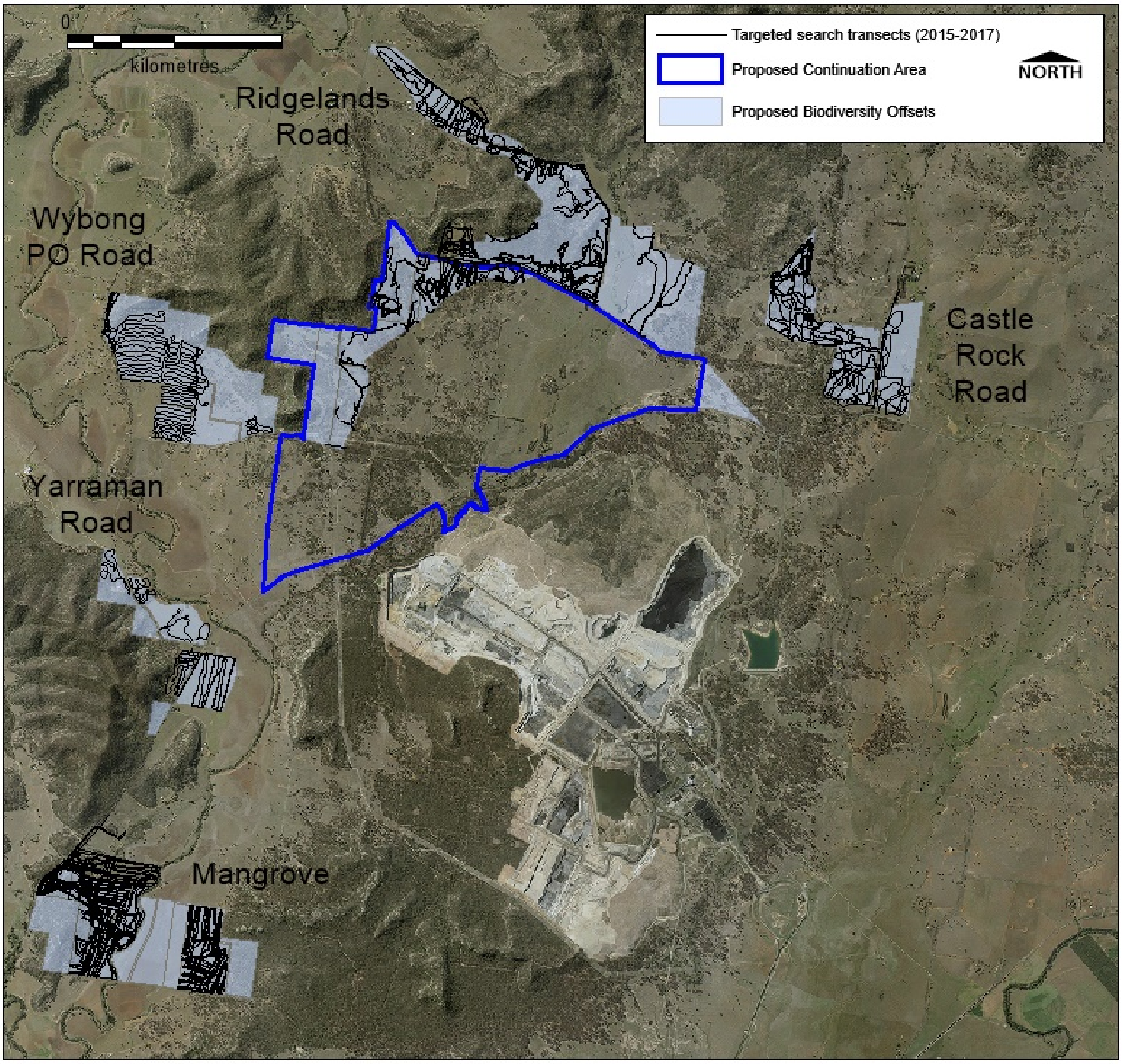

Figure 10 Extent of targeted survey for *Diuris* and *Prasophyllum* across the proposed offset areas, 2015 – 2017.

42. Three phases of plot data collection have been undertaken by Umwelt within the Subject Area and the proposed continuation. Fifty (50) plots have been sampled within the proposed continuation area in 2017, while twenty-eight (28) plots have been sampled from proposed offset areas in 2017 and 2018. Additionally, plot data from the same areas were also collected in 2014 (20 plots; 18 within offsets, 2 in continuation area) as part of Upper Hunter Strategic Assessment (UHSA) surveys (Figure 11).

43. In total, the proposed continuation area has seen 52 plots sampled, while the proposed offset areas have had 47 plots (total survey effort = 99 plots). Some offsets (e.g. Castle Rock Rd, parts of Yarraman Rd and Ridgelands Rd) have had no plot sampling to date; assessment of these has been guided by my own field inspection (see Section 4.5). Plot data collected by Umwelt from the Mangrove offset was not available at the time of data analysis, so assessment is based entirely on my field inspection undertaken on 4 October 2018.

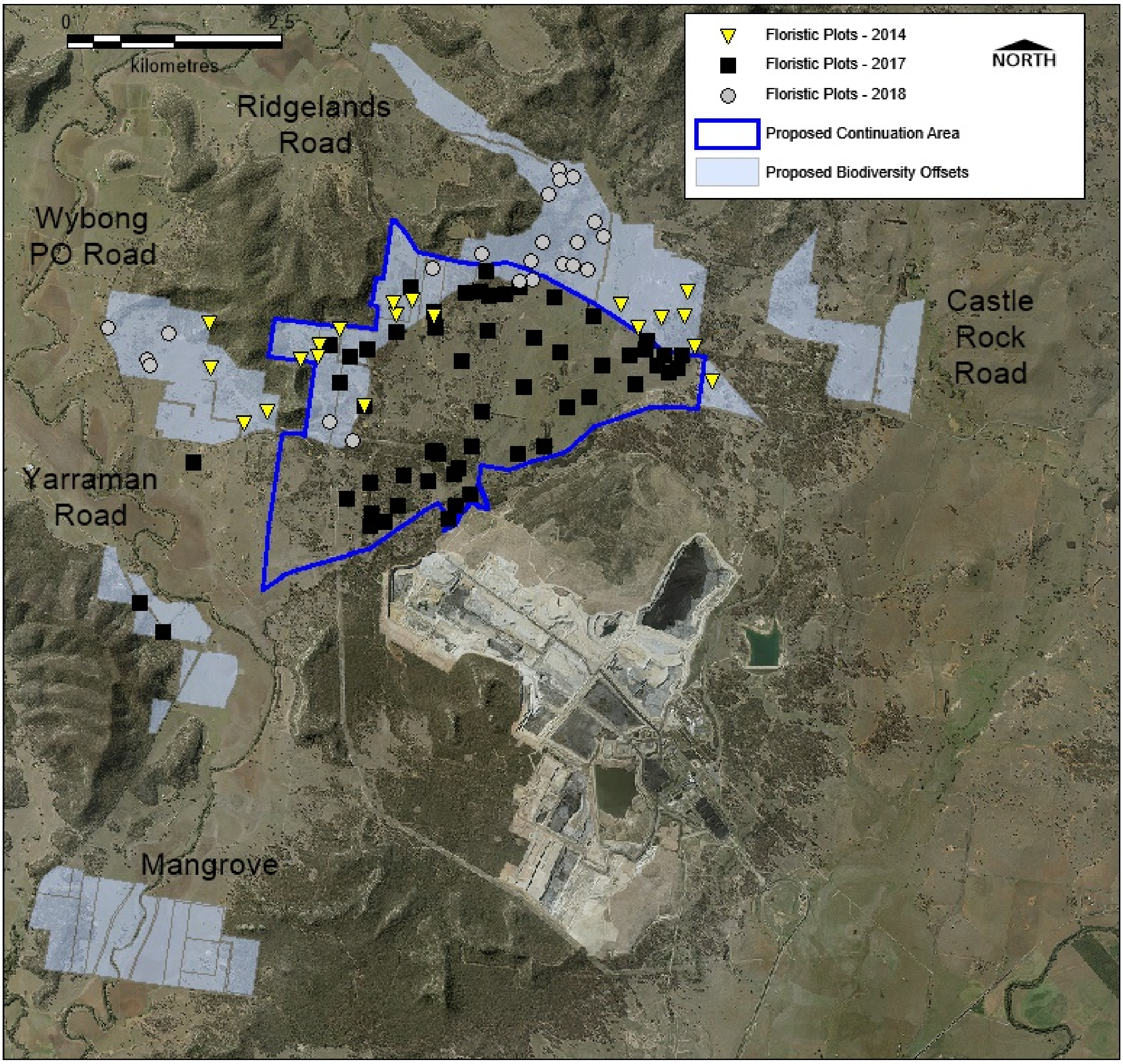

Figure 11 Distribution of floristic plot data (n=99) collected by Umwelt across the proposed offset and continuation areas, 2014 – 2018.

44. Apart from 30 plots collected in March 2017, all plots assessed during the 2017-2018 period have been surveyed in very dry periods when the rainfall received has been well below average (Figure 12). Given the very dry January to February period of 2017, commencing surveys in March after some decent falls (c. 37mm at the commencement of surveys on 20 March) was appropriate. However, all remaining plots sampled in Winter 2017 and Summer 2017-18 occurred following prolonged drought conditions (unavoidable under the circumstances), hence floristic diversity is not expected to be high.

45. Conversely, all of the 20 plots sampled as part of the UHSA in 2014 occurred in Autumn (April) following a 3-month period of above-average rainfall (Figure 13), where it may be expected that floristic diversity would be high.

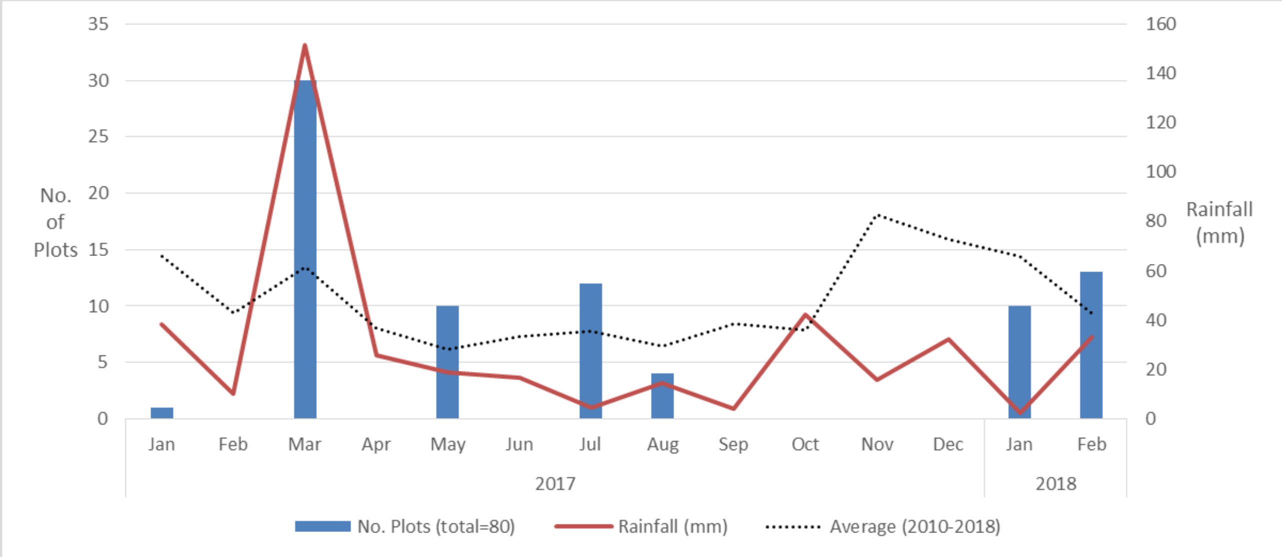

Figure 12 Timing of floristic plot data collection across 2017-2018, shown with rainfall received and the 8-year average. Rainfall data is averaged from the Mangoola Coal weather stations north (WSN) and south (WSS).

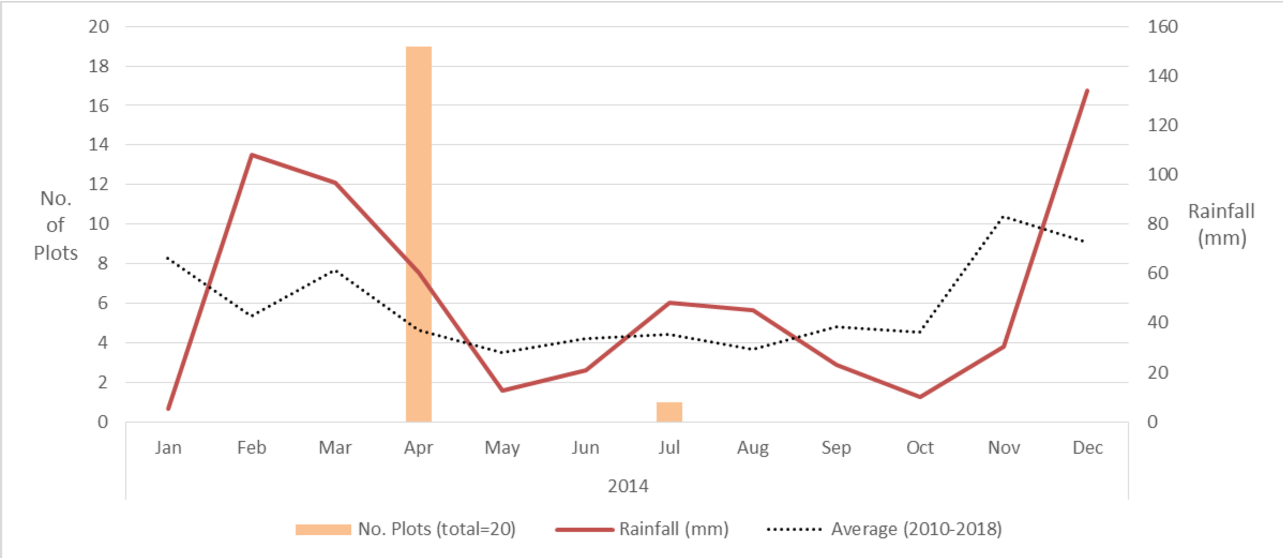

Figure 13 Timing of floristic plot data collection during UHSA surveys in 2014, shown with rainfall received and the 8-year average. Rainfall data is averaged from the Mangoola Coal weather stations north (WSN) and south (WSS).

4.3.1 Dataset 1: Proposed Continuation Area

46. In total, 50 floristic plots were sampled within the proposed continuation area by Umwelt in 2017 (47 plots) and 2018 (3 plots). Five field staff collected this data (Ryan Parsons, Kate Riley, Amy Nelson, Brooke Weber, James Garnham), with between 3 and 12 years of experience in undertaking floristic surveys. Thirty-eight of the 50 plots (76%) were led by one observer of 6 years of experience, assisted by two ecologists of 3 or 5 years of experience. The remaining 12 plots (24%) were sampled by a lead ecologist of 12 years' experience, assisted by ecologists of 3 or 6 years of experience.

47. As shown in Figure 12 above, these floristic plots were sampled predominantly in the Autumn and Winter of 2017, with the bulk of them (33 plots, 66%) collected in Autumn (20-24 March & 15-16 May 2017) during the very wet month of March. Of the remaining data, 13 plots (26%) were collected in Winter (4-6 July & 1-2 August 2017) and 4 plots (8%) were collected in late Summer (12 January 2017 & 29-30 January 2018), all under drought conditions. All data collected followed the BBAM methodology of OEH (2017), which entails recording all vascular plant species in 20 x 20m plots, and applying actual percentage cover and abundance counts for each taxon. Appendix 13 in Umwelt (2019) contains all floristic plot data relevant to this analysis.

48. Approximately 50% of all flora observations within the supplied dataset are forbs or herbs, followed by grasses (17%), shrubs (13%), trees (6%), sedges (4%), graminoids (3%), vines (2%), small trees and mistletoes (both 1%), and ferns and orchids (both <1%) (Figure 14). This break down of species diversity is typical of derived grassland habitats in the upper Hunter Valley, and despite the Autumn-Winter period of sampling has captured a representative snapshot of the areas floral biodiversity.

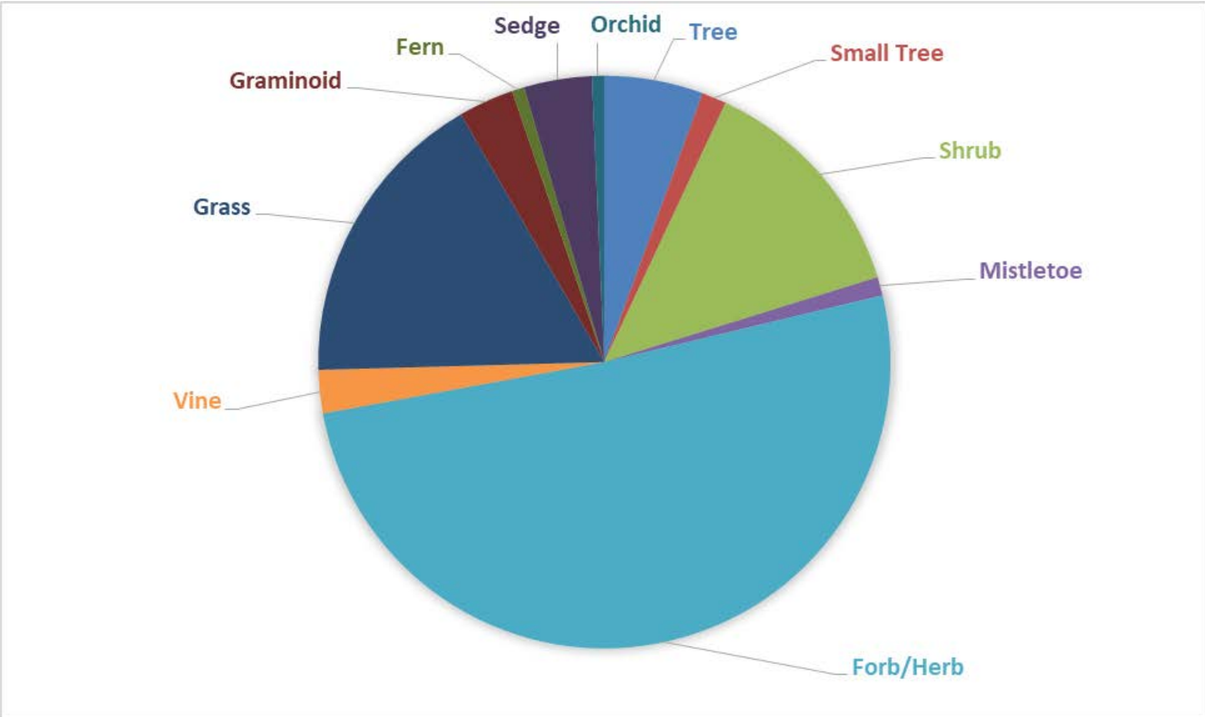

Figure 14 Relative proportion of major habit classes within the supplied floristic dataset of 57 plots comprising Dataset 1, sampled in 2017 (n=287). See Umwelt (2019) for original plot data.

49. Seventy-five (75) percent of the species included in the supplied dataset are native species, suggesting that although weed species form a common component of the sampled data there is sufficient native biodiversity to potentially support populations of *Diuris tricolor* and/or *Prasophyllum petilum*.

4.3.2 Dataset 2: Proposed Biodiversity Offset Areas (2018)

50. Twenty (20) floristic plots were sampled in the proposed offset areas by Umwelt in late January/early February 2018, with an additional three (3) within the proposed continuation area at the same time (a total of 23 plots). Two field staff (Kate Riley, James Garnham) collected this data, with 6 and 3 years of experience in undertaking floristic surveys at that time.

51. All 23 floristic plots were sampled in the late Summer of 2018. This period coincided with prolonged drought following c. 9 months of below average rainfall (see Figure 12 above). As a consequence, it may be expected that species diversity will be low in this dataset, but as noted previously under the circumstances this was unavoidable. A total diversity of 108 native and 39 weed species (147 total) were represented in the data, the relatively low weed count likely due to the dry conditions.

52. The breakdown of species habit within this dataset is shown in Figure 15. Seventy-three (73) percent of all taxa are native, and twenty-seven (27) percent are weeds.

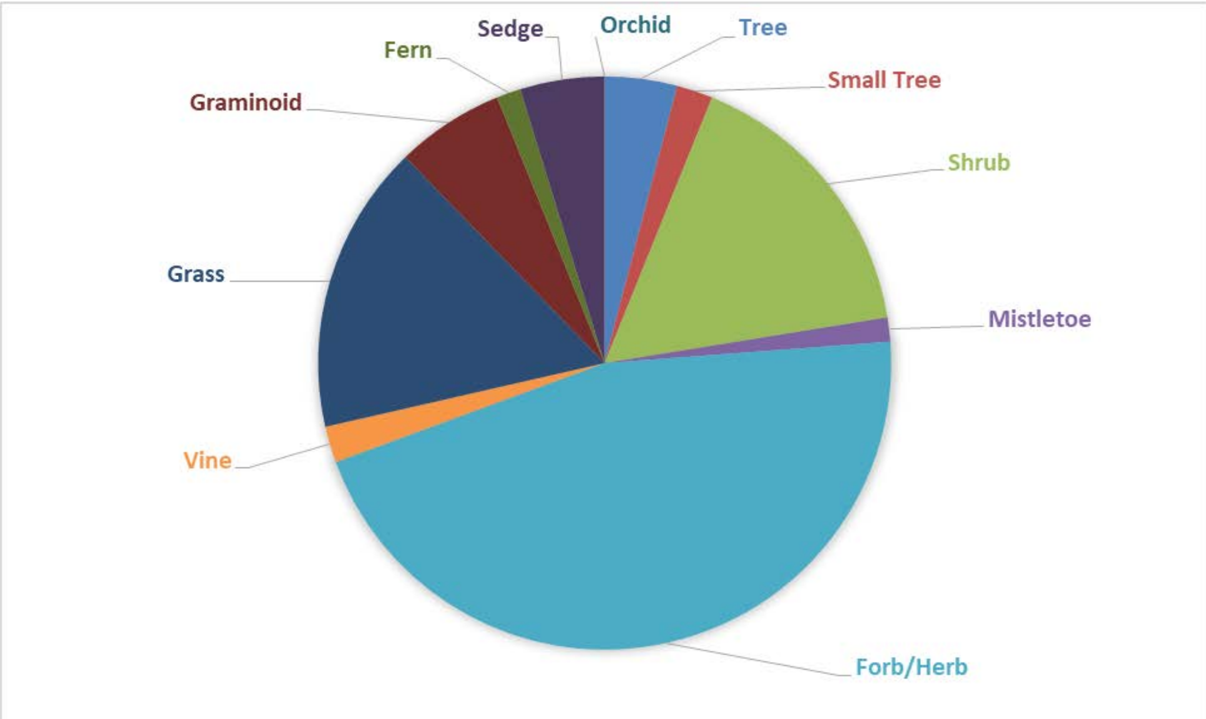

Figure 15 Relative proportion of major habit classes within the supplied floristic dataset of 23 plots comprising Dataset 2, sampled in 2018 (n=147). See Umwelt (2019) for original plot data.

4.3.3 Dataset 3: Proposed Biodiversity Offset Areas (UHSA)

53. Twenty (20) floristic plots were sampled in the proposed offset areas by Umwelt in April 2014, as part of the Upper Hunter Strategic Assessments (UHSA) initiative. Two field staff (Kate Riley, Bill Wallach) collected this data, with 2 and 4 years of experience in undertaking floristic surveys at that time.

54. Figure 16 shows the breakdown of habit classes for this 2014 dataset. Eighty-four (84) percent of all taxa in this dataset are native, while sixteen (16) percent are weeds.

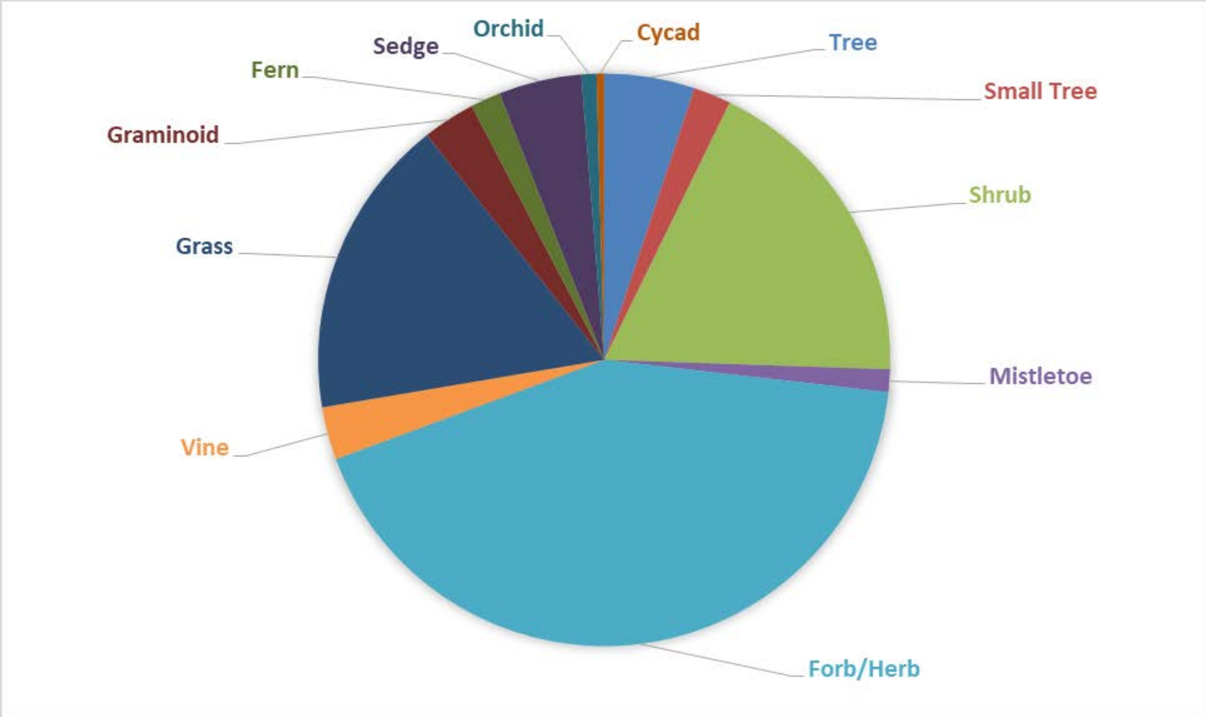

Figure 16 Relative proportion of major habit classes within the supplied floristic dataset of 20 plots comprising Dataset 3, sampled in 2014 (n=234). See Umwelt (2019) for original plot data.

4.3.4 Combined Continuation Area and Offsets Data

55. I combined the supplied floristic datasets from the proposed continuation and offsets areas of Dataset 1 (57 plots) with that from the proposed offset areas of Dataset 2 (23 plots) and earlier data collected as part of the UHSA process (Dataset 3, 20 plots) to enable a complete overview of the habitats present in both the proposed continuation and offsets areas. This provided a total effective dataset of 99 plots (one plot was common to both Dataset 2 & 3, so one of these replicates was removed from the total 100 supplied plots). The combined dataset allowed a numerical analysis to be undertaken which could examine both areas equally, acknowledging the differing dates and observers involved, and the different data collection methods.

56. Prior to analysis, I converted all cover abundance data to a common scale (Braun-Blanquet 1-6), following the same transformation rules applied by OEH (Native Vegetation Information Science Branch) in their analysis of new and legacy plot data. I also reviewed the taxonomy of the combined dataset and made a few minor changes to clean up species entries where, for example, the same taxon was entered under two or more different names. Some of these changes were based on my own knowledge of plant species presence at Mangoola obtained from working in the area since 2007. Appendix 3 summarises the changes I made to the dataset prior to analysis.

57. Weed species were included in the analysis dataset, because in long-disturbed habitats such as around Mangoola this group of species play an important role in delineating different vegetation types. The level of weed species present can also impact on the quality of suitable orchid habitat. It was noted that weed species were prevalent across all three datasets, irrespective of the recent history of rainfall relative to survey dates (although abundance was low during drought).

58. Some species included in Dataset 3 contained a cover abundance value of 9, which fell outside of the 1-6 cover scale used for this dataset. I was advised by Umwelt (R. Parsons) that these represented species occurrences that were observed outside of plot boundaries, so I have consequently removed these from analysis.

59. With this cleaned dataset, I used Primer (Clarke & Gorley 2006) to examine the floristic patterns and identify floristic groups which may represent vegetation communities across the area. The delineation of floristic groups was undertaken acknowledging the potential influence of different observers and levels of experience, survey times, seasonal impacts and the data transformation process, but nevertheless provides a solid overview of the habitats present. I used the SIMPROF routine in combination with the CLUSTER module to identify statistically significant splits in the dataset ($p<0.01$). This provided a cluster diagram where sites supporting similar floristic combinations and cover values were grouped and linked to their most similar neighbours. I also ran the MDS routine with a minimum stress level of 0.01 and 25 restarts to produce an ordination plot of the same data (Figure 17). Clustering of similar sample plots (communities) can be better appreciated across this two-dimensional ordination space than in a cluster diagram. The stress level of 0.24 shown in Figure 17 is an indication of the difficulty in which all data can be accommodated within two-dimensions. In general, a stress level of <0.2 is considered acceptable in these sorts of analyses, but increases in line with complexities associated with multiple observers and seasons.

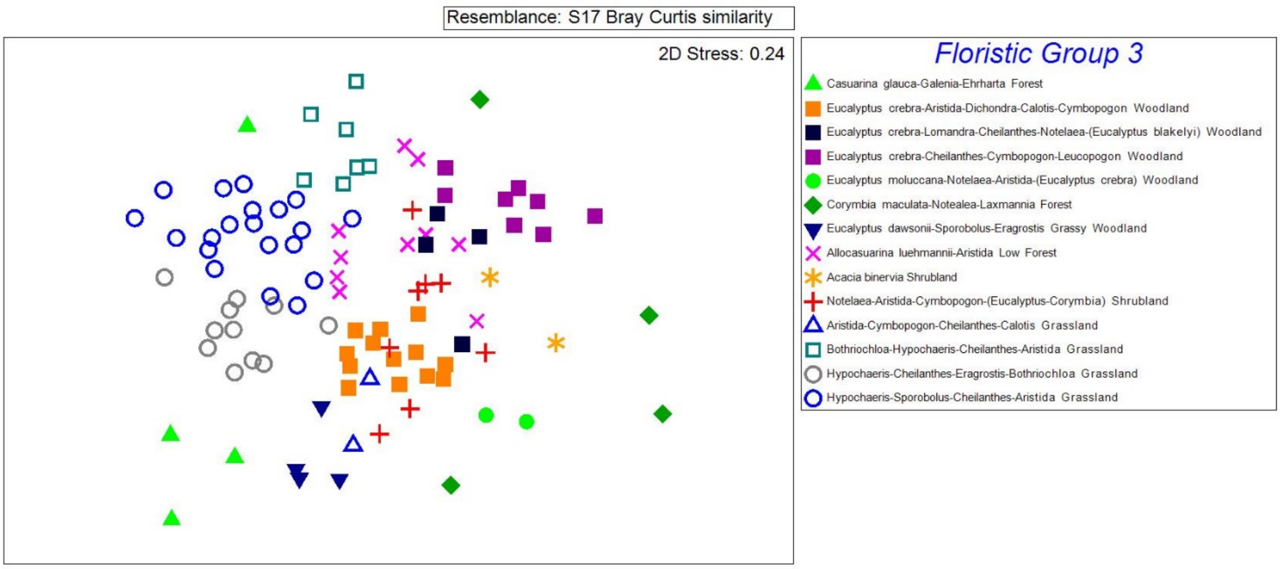

Figure 17 nMDS ordination of the supplied floristic dataset of 99 plot samples from the proposed extension area (see Table 2 for further details).

60. Analysis of this combined dataset revealed fourteen (14) significant splits which for the current review have been accepted as different communities or habitats. These groups provide insights into the extent of potential orchid habitat within the proposed continuation and offset areas. The fourteen defined groups are summarised in Table 2, while Appendix 4 contains more detailed floristic information. Of these fourteen, ten can be considered to provide potential habitat for *Diuris* and *Prasophyllum*, based on knowledge of the habitats in which they occur across the Mangoola area, and the previous analysis discussed earlier in Section 2.3.3.

Table 2 Summary of floristic groups from numerical analysis of 99 plots.

Structure	Floristic Group	Notes	Orchid Habitat
Riparian Forest	1. *Casuarina glauca – Galenia – Ehrharta* Forest	Along riparian zones and adjacent areas. High incidence of weed species.	no
Woodland / Forest	2. *Eucalyptus crebra – Aristida – Dichondra – Calotis – Cymbopogon* Woodland		yes
	3. *Eucalyptus crebra – Lomandra – Cheilanthes – Notelaea* - (*Eucalyptus blakelyi*) Woodland		yes
	4. *Eucalyptus crebra – Cheilanthes – Cymbopogon - Leucopogon* Woodland		yes
	5. *Eucalyptus moluccana – Notelaea – Aristida* - (*Eucalyptus crebra*) Woodland		yes
	6. *Corymbia maculata – Notealea - Laxmannia* Forest	Restricted areas, often on conglomerate	no
	7. *Eucalyptus dawsonii – Sporobolus - Eragrostis* Grassy Woodland	Across low lying plains	yes
Low forest	8. *Allocasuarina luehmannii - Aristida* Low Forest	Regrowth following previous clearing	no
Shrubland	9. *Acacia binervia* Shrubland	Elevated areas on sandstone	no
	10. *Notelaea – Aristida – Cymbopogon* - (*Eucalyptus-Corymbia*) Shrubland		yes
Grassland	11. *Aristida – Cymbopogon – Cheilanthes - Calotis* Grassland		yes
	12. *Hypochaeris – Sporobolus – Cheilanthes - Aristida* Grassland		yes
	13. *Hypochaeris – Cheilanthes – Eragrostis - Bothriochloa* Grassland		yes
	14. *Bothriochloa – Hypochaeris – Cheilanthes - Aristida* Grassland		yes

61. The geographical distribution of sample plots that comprise the ten floristic groups providing orchid habitat are shown in Figure 18. In the absence of more accurate vegetation community mapping, this provides an indication of the geographical spread of potentially suitable habitat for the two target orchid species. From this dataset, the bulk of lands within both the proposed continuation area and the proposed offset lands appear to provide good orchid habitat. Note that for the eastern half of the proposed continuation area and some of the proposed biodiversity offsets immediately to the north, floristic plots which I consider to represent orchid habitat appear not to correspond well with known orchids records (see Figure 9). However, this is because those plots were surveyed outside of the flowering period (September-October) of these orchids (see Figure 12 and Figure 13), and therefore would not be expected to detect these species. Additionally, targeted orchid surveys undertaken by Umwelt within the proposed

continuation area occurred in 2013 (below average June-August rainfall), and in 2010, 2014 and 2015 (average or above rainfall, but under heavy stock grazing pressure). Stock grazing in any area supporting orchids will mean fewer individuals are likely to be detected above ground. Based on my inspection of the proposed continuation area in May 2019 and review of the floristic plot data collected there by Umwelt, the apparent discrepancy in known orchid records and my designated orchid habitat as indicated in Table 2 does not alter my view of the areas habitat suitability.

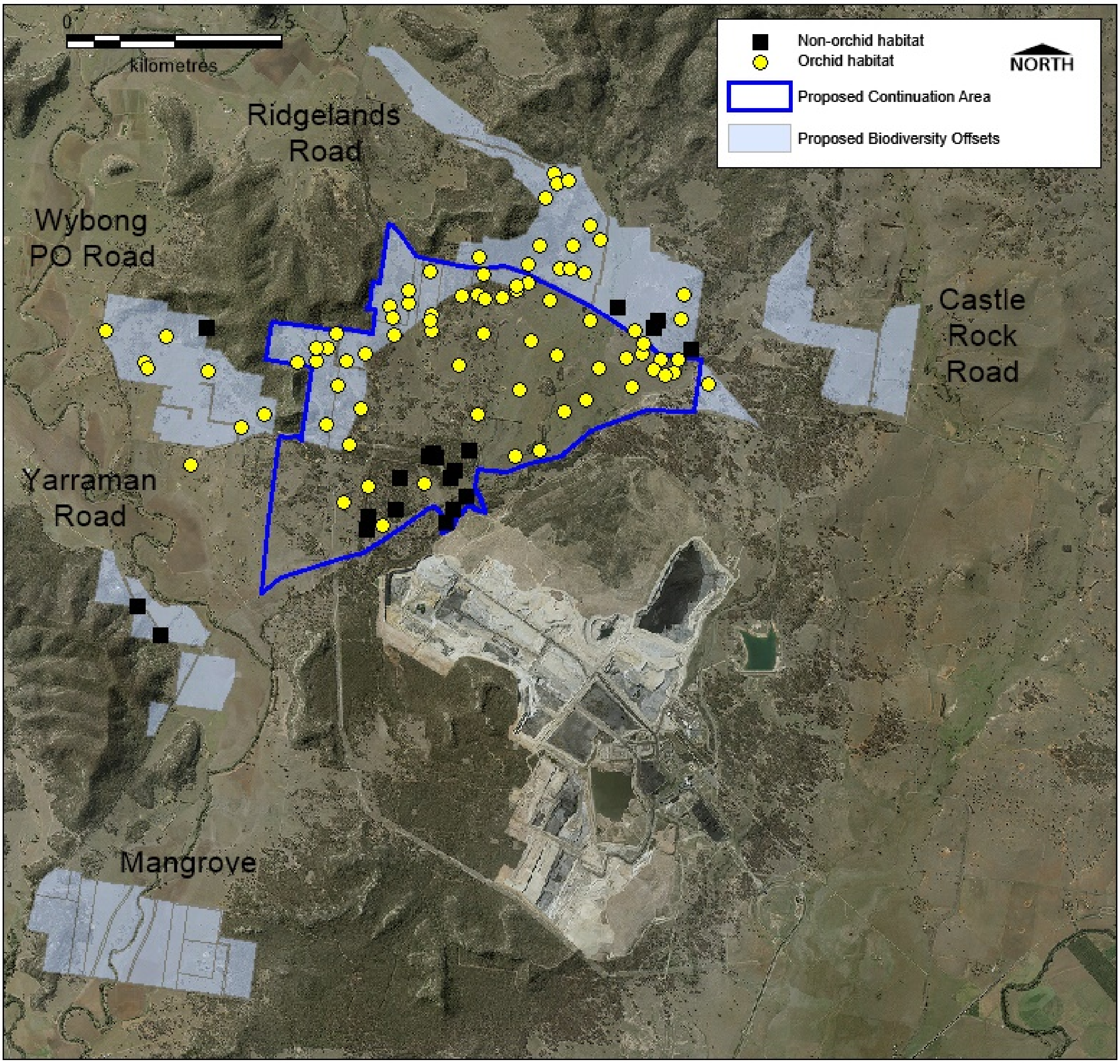

Figure 18 **Potential orchid habitat as indicated by floristic plot data (n=99) collected by Umwelt across the proposed offset and continuation areas, 2014 – 2018.**

4.4 Analysis of Soil Data within the Subject Area

62. No detailed soil sampling program has been undertaken across the Subject Area and the surrounding lands. Soil landscape mapping is available (Kovac & Lawrie 1991), but is provided

at 1:250,000 scale and is of little use for high resolution investigations. Nevertheless, the 1:250k soil landscape mapping shows the Subject Area to predominantly support solodic soils from the Sandy Hollow (sy; 648 ha or 50% of Subject Area) and Wappinguy (wp; 478 ha or 37%) landscapes, with a small proportion of shallow soils from the Lees Pinch (lp; 120 ha or 9%) landscape, and alluvial soils from the Wollombi (wo: 45 ha or 4%) landscape (Figure 19). These landscapes (with the exclusion of Wollombi) are consistent with the surrounding lands that are known to support populations of *Diuris tricolor* and *Prasophyllum petilum*, with the addition of some areas of the Castle Rock and Growee soil landscapes (solodic soils) (further discussed below).

63. Using the combined records collated during the wider Mangoola orchid survey project (Bell 2016b) and results from the most recent 2017 surveys conducted by Umwelt (Australia), an analysis of occurrence across mapped soil landscapes (Kovak & Lawrie 1991) has been undertaken to assist in defining occupied habitat. This is of course contingent on the amount of search effort and timing of surveys that has been extended across all landscapes in the area, but nevertheless provides a sound basis on which to assess likely occurrence in the Subject Area.

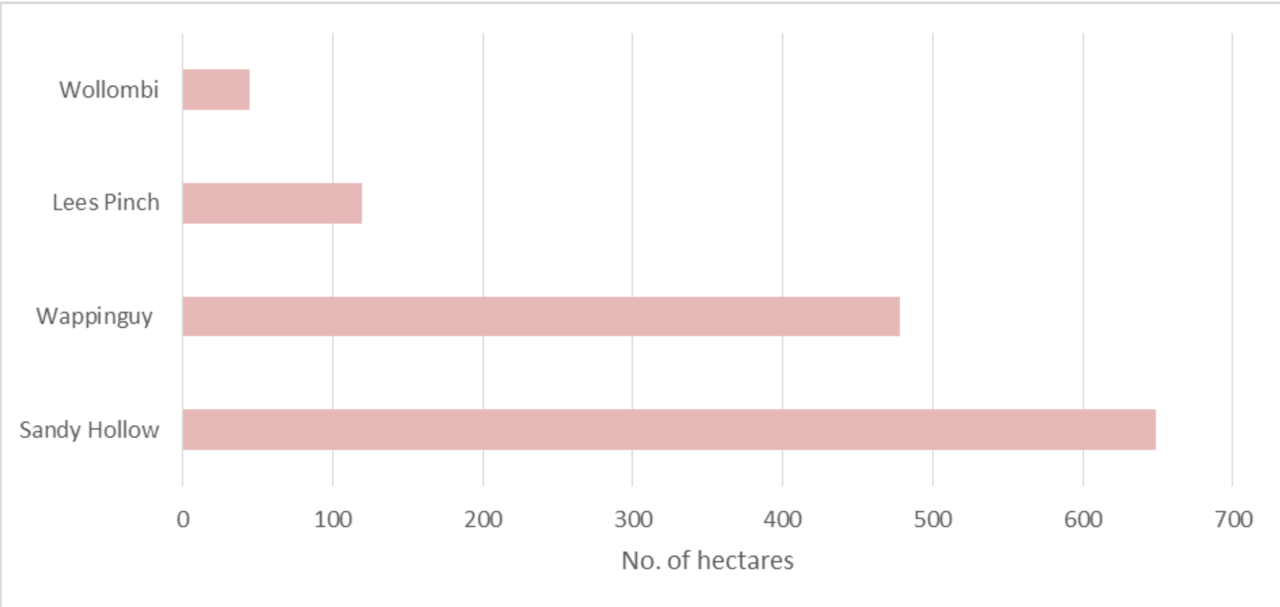

Figure 19 Extent (hectares) of soil landscapes across the proposed offset lands.

64. As detailed in Bell (2016b), up until and including the 2015 flowering season, a combined total of 8548 *Diuris* and 1812 *Prasophyllum* were recorded across all Mangoola Coal-instigated surveys since 2009. The poor flowering season in 2017 resulted in only 136 additional *Diuris* records detected by Umwelt (Australia), but no *Prasophyllum*. In total, 8684 *Diuris* and 1812 *Prasophyllum* have been detected over a ten year period, over several thousand km of search transects. No orchid surveys were completed during the 2016 flowering period. Note also that from the supplied 2017 Umwelt data, 85 records of *Diuris tricolor* from the 2017 flowering season were from a location near Jerrys Plains, some 30km to the south-east of Mangoola,

occurring on the Jerrys Plains soil landscape. These records have been excluded from the current analyses, leaving a total of 136 *Diuris* recorded during 2017 surveys.

65. Figure 20 summarises the relative distribution of orchid records across the six soil landscapes in which they have been recorded. The majority of occurrences are on the Wappinguy and Sandy Hollow landscapes, which both support solodic soils. These two landscapes are also the primary soil landscapes present within the Subject Area (84% of the total area). Based on existing records, *Diuris* more-or-less equally occur on Wappinguy and Sandy Hollow soils, while *Prasophyllum* shows a strong preference for Sandy Hollow soils, with Wappinguy and Castle Rock soils also important for this species. Minor occurrences on Lees Pinch, Growee and Dartbrook soil landscapes may be an artefact of the poor resolution of soils mapping (1:250k scale).

66. Limited more detailed soil analysis has also been undertaken in part of the Mangoola lands. Bell (2016a) outlines the results of the soil sampling program undertaken across areas of naturally occurring *Diuris* and *Prasophyllum* habitat (control) and sites where translocated populations had been newly established at Mangoola Coal. During that study, involving soil analysis from four different locations, soil pH was found to be slightly acidic and between 5.5 and 7.2, total nitrogen ranged from 470 to 1150 mg/kg, total phosphorous from 98 to 200 mg/kg, and total organic matter from 1.1 to 2.4%. Moisture content was low at the time of sampling (30 October 2015), ranging from 5.7 to 13.9%, and followed a five month period of mostly below average rainfall.

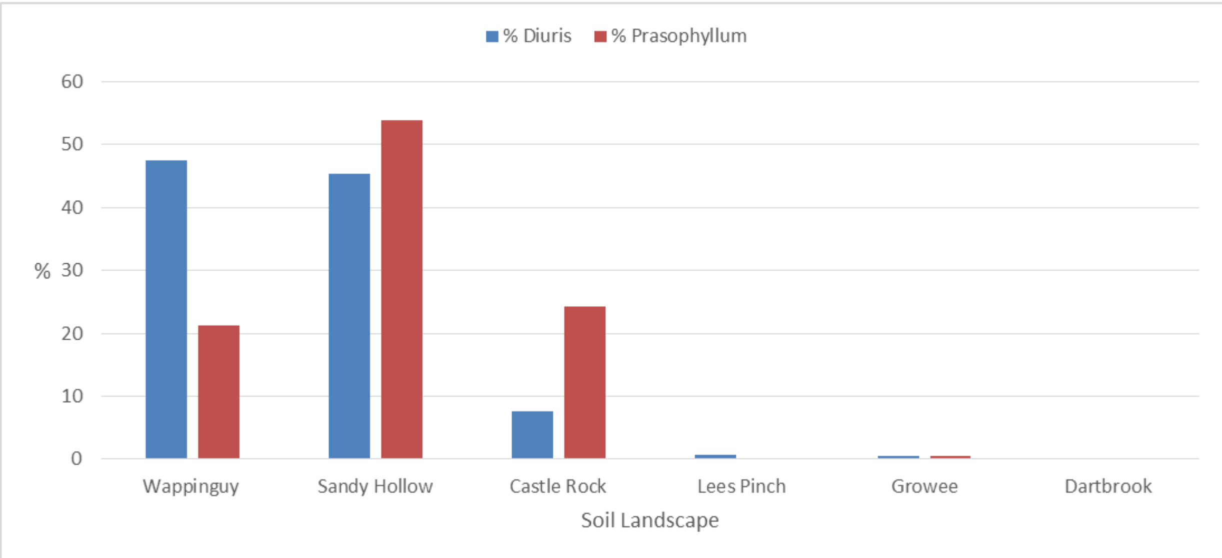

Figure 20 Relative proportion of known orchid presence (2009 – 2017) across six soil landscapes (n=8684 *Diuris*; 1812 *Prasophyllum*).

67. Compared to soils data from the Subject Area, there is a good correlation between known locations of *Diuris* and *Prasophyllum* in the wider Mangoola area with soil landscapes (Figure 21). For *Diuris*, almost all known records (93%) occur on the Wappinguy and Sandy Hollow soil landscapes (both well represented in proposed offsets), while the most important landscapes for *Prasophyllum* are Sandy Hollow, Castlerock and Wappinguy (99%). There are no areas of the Castle Rock landscape present in the proposed offset lands, but this is a rare unit shown in

Kovak & Lawrie (1991) for only three areas: one within the current Mangoola approval area, but the other two some distance to the east in the Elderslie and Pokolbin localities. Apart from this anomaly, there is a strong match between known soil preferences and the landscapes contained in the proposed offsets.

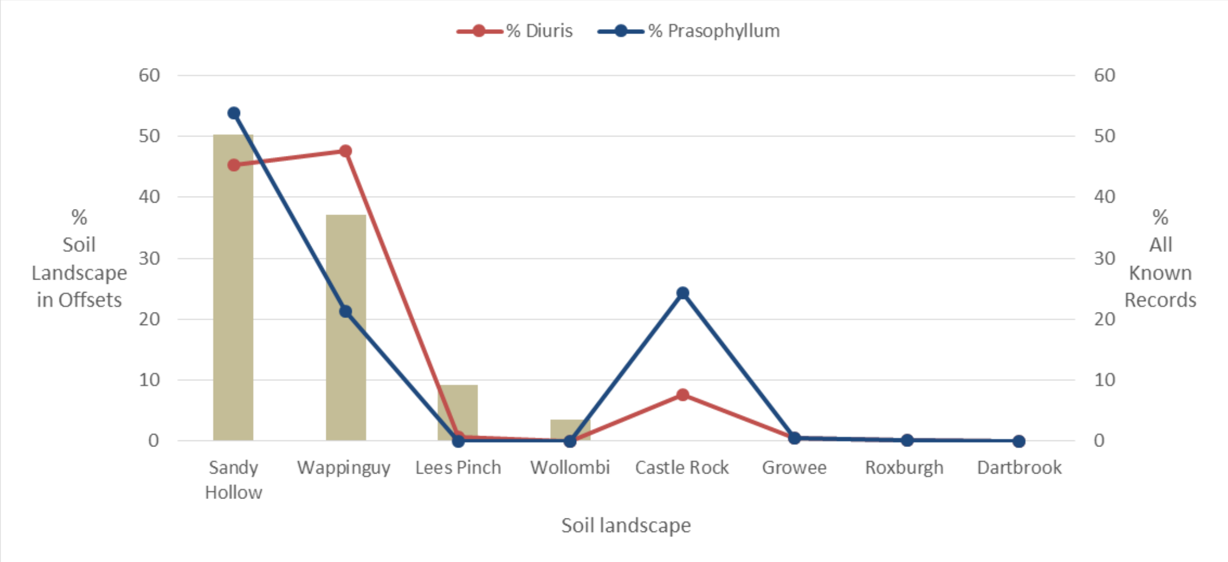

Figure 21 Correlation between known orchid presence (2009 – 2017) and soil landscapes present within the proposed offsets (n=8684 *Diuris*; 1812 *Prasophyllum*).

4.5 Field Inspection of the Subject Area

68. I inspected most parcels of land that comprise the proposed offsets on 31 July 2018, in the company of Ryan Parsons (Umwelt). I did not inspect the Wybong PO Road offset and parts of the Yarraman Road offset as I have previously surveyed those in 2015 and was familiar with their attributes and the orchid populations residing there. Additionally, I inspected the Mangrove property on 4 October 2018, after this parcel of land was added to the project brief, and the proposed continuation area on 7 May 2019.

Field inspection on 31 July and 4 October 2018 generally involved traversing large portions of each offset in vehicle, periodically stopping to record data on habitat and to take photographs. An assessment on the likelihood of the two target orchid species being present, together with a GPS location, was recorded on a mobile device for later use in GIS. Notes were also made on the perceived level of grazing history at each of 98 sites across the offsets, and how this may influence the presence of a residing orchid population.

69. On the GIS, I created maps of likely orchid habitat quality based on my field observations and the floristic plot data supplied by Umwelt, so that estimates of the number of hectares anticipated to support a viable orchid population could be calculated (Section 5). My field notes and the Umwelt floristic plot data were overlain as point locations across the study area, and these were used to guide the creation of habitat quality maps. Additional guidance was provided by aerial imagery to refine boundaries between areas of differing quality, such as where clearly distinct photopatterns were evident along fenced paddock boundaries.

70. In determining the suitability of offsets as orchid habitat, I drew on my experience from surveying for both species in the wider Mangoola area over many years. Part of this experience included observations of orchids growing in somewhat surprising situations, which may

otherwise be glossed over as unsuitable. For example, observations of orchids growing on contour banks constructed by previous land owners (Figure 22), in heavily weed-infested derived grasslands where no other native species were apparent (Figure 23), and proliferating on the manicured lawns of farm homesteads (Figure 24). I have also observed *Diuris* growing within a former vineyard on raised garden beds, and along the margins of management trails. Collectively, observations of orchids growing in such disturbed habitats suggest that few areas can be confidently excluded from supporting any orchids, and I therefore include many such disturbed areas within my 'low' habitat class (see below).

Figure 22 *Diuris tricolor* and other orchids growing over a constructed contour bank, Mangoola.

Figure 23 ***Diuris tricolor*** **growing with exotic weeds in low quality grassland at Mangoola.**

Figure 24 ***Diuris tricolor*** **proliferating in mown lawns of a farm homestead at Mangoola.**

71. I constructed four classes of potential orchid habitat based on field point data and GIS analysis:

- **high** (dominance of native grasses and forbs, relatively undisturbed ground, little evidence of heavy agricultural grazing, orchids known to be present)
- **moderate** (dominance of native grasses and forbs but with obvious weed species, some observable ground disturbance, evidence of recent agricultural grazing)
- **low** (dominance by weed species although natives still present, obvious ground disturbance, evidence of high intensity agricultural grazing, past or present cropping)
- **none** (forested habitats, typically on sandstone, or areas with high ground disturbance such as farm dams, farm dwellings, regularly-used access roads and trails, disturbed creeklines)

Note that these four classes of orchid habitat were equally applicable to *Diuris* and *Prasophyllum*, as in my experience surveying these species since 2009 both co-occur in very similar habitat (*viz*. derived native grasslands). At the micro-scale, *Prasophyllum* tends to occur at the wetter end of the occupancy spectrum where *Diuris* is often absent, however both occur across dryer and intermediate grassland types. In any case, these observed trends have not been validated through testing of soil moisture levels hence should be considered a working hypothesis only. Despite this, I investigated whether or not there were suitable GIS environmental layers that may attempt to replicate these micro-scale trends, however none were available.

72. The distribution of these four mapped potential orchid habitats were as shown in Figure 25 and Table 3. Note that Figure 25 is based on my own field observations and interpretation of aerial imagery and not the existing vegetation community mapping of Umwelt, nor of soil landscape mapping. Representative photographs, taken under drought conditions during field inspections in July 2018, of the three levels of potential orchid habitat are shown in Figure 26 to Figure 28. A few areas were considered to be particularly suitable for *Prasophyllum* due to the presence of moss on the ground surface, indicative of better moisture retention (e.g. Figure 29). During the October 2018 inspection of the proposed Mangrove offset, plentiful *Diuris* were observed flowering in the eastern and western sections considered to represent high quality habitat, and scattered *Diuris* were also detected in western parts of the moderate quality habitat.

Table 3 Extent of potential and actual orchid habitat across all offsets.

	No. hectares				
Offset	**High**	**Moderate**	**Low**	**None**	**Total (ha)**
Mangrove	75	58	83	45	261
Castle Rock Rd	65	42	43	6	156
Yarraman Rd	11	25	45	23	104
Wybong PO Rd	168	0	0	41	209
Ridgelands Rd	190	128	151	91	560
Total (ha)	**509**	**253**	**322**	**206**	**1290**

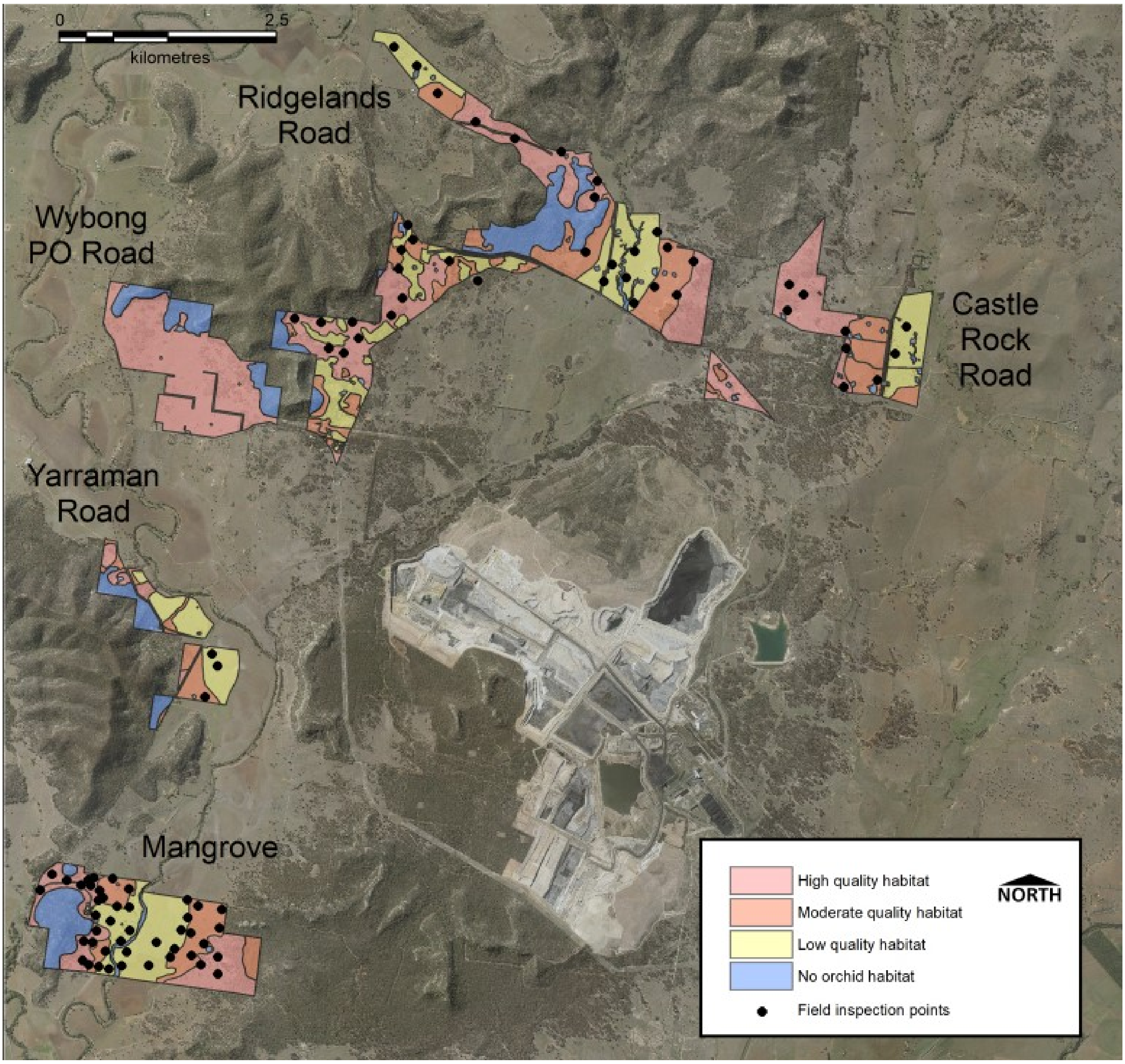

Figure 25 **Orchid habitat quality across the proposed offset lands, based on field inspection, existing floristic plot data and known orchid locations.**

Figure 26 Example of low quality orchid habitat (Castle Rock Road offset), July 2018.

Figure 27 Example of moderate quality orchid habitat (Castle Rock Road offset), July 2018.

Figure 28 Example of high quality orchid habitat (Ridgelands Road offset), July 2018.

Figure 29 Example of high quality *Prasophyllum* habitat supporting live moss (Ridgelands Road offset), expected to support a range of native forbs and orchids during wetter periods, July 2018.

5. Criterion (d) – Size of Population or Habitat

73. In order to estimate the potential size of the orchid populations within the proposed offsets, I examined various patches of high quality habitat where population size has been tallied previously during wetter years to calculate an estimate of orchid density (Table 4). For earlier targeted searches (2010 & 2011) I also calculated orchid densities against search effort area irrespective of habitat quality (these lands have now been mined). I performed these calculations across several different geographical and habitat types to establish some lower and upper bounds for an estimate of expected population size within the proposed offsets. Densities calculated should be considered a minimum in each case, as many point records did not contain a count of individuals so were assumed to only represent one individual.

Table 4 Orchid density from previous counts in better years.

			Diuris		*Prasophyllum*	
Offset	**Size (ha)**	**Year**	**No.**	**Density (/ha)**	**No.**	**Density (/ha)**
Yarraman Rd (part)	3	2015	222	74	0	0
Yarraman Rd (part)	4	2015	157	39	0	0
Ridgelands Rd (part)	27	2014	1148	43	61	2
Ridgelands Rd (part)	29	2014	272	9	65	2
Ridgelands Rd (part)	35	2014	989	28	110	3
Wybong PO Rd	168	2014/15	4266	25	626	4
existing mine (south)	460	2011	649	2	722	2
existing mine (north)	764	2010	3303	4	2022	3
Density range	**-**	**-**	**-**	**2 to 74 / ha**	**-**	**2 to 4 / ha**

74. Based on previous searches conducted between 2010 and 2015, the density of *Diuris* detection ranges dramatically from 2 individuals/hectare in 2011 (below average rainfall Jun-Aug; see Figure 6) to 74 individuals/hectare in 2015 (above average rainfall). For *Prasophyllum* detection, the considerably more restricted range varies from 2 individuals/hectare in 2011 (below average rainfall) to just 4 individuals/hectare in 2014/15 (above average rainfall). As noted elsewhere, *Prasophyllum* detection is substantially more difficult than *Diuris* due to the small stature and insignificant flowers of this species when compared to *Diuris*, and consequently I suspect that many *Prasophyllum* individuals were overlooked during these targeted surveys.

75. Given that my assessment of the proposed 1290 ha offset lands comprise a total of 509 ha of **high quality habitat** (see Table 3), it follows that these habitats alone would be expected to support many thousands of individuals of both *Diuris* and *Prasophyllum*. More specifically, using the ranges indicated in Table 4 it can be expected that between 1000 and 37,600 *Diuris*, and between 1000 and 2000 *Prasophyllum* are likely to be present across the combined high quality offset areas. Again, I expect these numbers to be an under-estimate of the true population size due to difficulties of detection (particularly for *Prasophyllum*), separation distances between survey transects, the staged nature of flowering across each season, and variation in climate (principally winter rainfall) from year to year.

76. Additionally, the 253 ha of **moderate orchid habitat** shown in Figure 25 and Table 3 can also be expected to support between 506 and 6,700 individuals of *Diuris* and around 506 *Prasophyllum*. These estimates have used the lower bound figure of 2 individuals/hectare shown in Table 4 for both species, but the median of scores shown in Table 5 (26.5

individuals/hectare for *Diuris*; 2 individuals/hectare for *Prasophyllum*) to be more reflective of the moderate habitat quality status. Note that for *Prasophyllum*, the median and lower figure are equal (both 2). Combined across the high and moderate quality classes within the proposed offsets, a minimum of 1,500 *Diuris* and *Prasophyllum* may be expected to be present, with perhaps as many as 44,300 *Diuris* and 2,500 *Prasophyllum*. Table 5 summarises these expected ranges.

Table 5 Expected population size ranges of *Diuris* and *Prasophyllum* within proposed offset lands.

Assessed Offset Habitat	ha	*Diuris*		*Prasophyllum*	
		Lower	**Upper**	**Lower**	**Upper**
High quality habitat	509	1000	37,600	1000	2000
Moderate quality habitat	253	506	6700	506	506
Total	**762**	**1506**	**44,300**	**1506**	**2506**

77. Some of the proposed offset lands have already been surveyed for orchids during non-drought years, particularly in 2014 and 2015. These surveys resulted in the detection of 9,030 *Diuris* (well exceeding my lower estimate of 1,506 individuals) and 904 *Prasophyllum* individuals (just over half of my lower estimate of 1,506 individuals). If we deduct these totals from the overall predicted upper bounds population size shown in Table 5, this leaves approximately 35,270 *Diuris* and 1,602 *Prasophyllum* additionally expected within the offsets. Lower bounds would stand at 9,030 for *Diuris* (assuming the unlikely scenario that no further individuals are present than those already detected in 2014 and 2015), and 602 *Prasophyllum* (a deduction of 904 from 1,506).

78. Therefore, my estimate of the number of orchids likely to be present within the proposed offset lands, following the logic outlined in the above paragraphs relating to density of detection in previous years and extent of moderate-to-high quality habitat, stands at:

- between 9,030 and 35,270 *Diuris* (moderate to high habitat only)
- between 602 and 1,602 *Prasophyllum* (moderate to high habitat only)

79. In addition to these expected orchids, there will also be a number of both species likely within areas designated as low quality habitat (322 ha), but this number is difficult to confidently quantify due to variations in past and current disturbances, weed densities or floristic associations.

80. To settle on a single expected figure for the quantum of both *Diuris* and *Prasophyllum* within the proposed offset lands (to be incorporated as I understand in the calculation of species credits), I have used two separate metrics to predict orchid density across high/moderate quality habitat and low quality habitat. For **high/moderate habitat** (combined for this purpose as distinctions between the two are heavily rainfall- and disturbance history-related), I used the median density score for each species (26.5 for *Diuris*, 2 for *Prasophyllum*) from the eight previous count areas shown in Table 4 as an appropriate multiplier. I have selected median as the preferred measure of central tendancy, as it is not influenced greatly by outliers in a dataset and it accommodates skewed datasets better than does the mean. As it turns out, the median in the orchid density dataset is identical to the mean score for *Prasophyllum* (both 2), and only slightly lower than the mean score for *Diuris* (26.5 vs 28). For **low quality habitat** (despite my trepedations noted above regarding the calculation of a confident estimate in such habitat), I

have taken the lowest density score of *Diuris* and *Prasophyllum* from Table 4 to use as an appropriate multiplier (but ignoring the zero returns attained for the two Yarraman Road survey areas), using the assumption that very few orchids can be expected in these lands but that some are likely.

81. Table 6 summarises the final expected density of *Diuris* and *Prasophyllum* for the proposed offset lands across high/moderate and low quality habitat (non-orchid habitat, such as sandstone ridges and farm dams and infrastructure, have not been considered), and incorporates data and observations on orchid presence, habitat quality and preferred floristic associations gathered over several years of survey. In total, **20,837 *Diuris*** and **2,168 *Prasophyllum*** are expected to be present there.

Table 6 Expected density of *Diuris* and *Prasophyllum* within proposed offset lands. See text for explanation of multiplier selection.

		Diuris			***Prasophyllum***		
		Multiplier			**Multiplier**		
Habitat Quality	**Extent (ha)**	Median Density	Minimum Density	Expected Density	Median Density	Minimum Density	Expected Density
High/Moderate	762	26.5	-	20,193	2	-	1524
Low	322	-	2	644	-	2	644
Total	**1084**		***Diuris* =**	**20,837**		***Prasophyllum* =**	**2,168**

82. Allowing for the 9,934 orchids already recorded (9,030 *Diuris*; 904 *Prasophyllum*), the proposed offset lands can be expected to support **an additional 11,807 *Diuris* and 1,264 *Prasophyllum***.

6. Criterion (e) – Documents & Data Reviewed

83. I have been provided with following reports and datasets from Umwelt (Australia) Pty Ltd to assist in this review:

- spatial GIS files showing orchid survey search tracks for the 2017 flowering season.
- an email from Umwelt detailing the dates of field survey during the 2017 flowering season, together with the names and years of ecological experience of team members.
- a spreadsheet detailing weather observation collected from two weather stations at Mangoola Coal, spanning the period 2010 to May 2018 (and some minor updates). The location of these weather stations are shown on Figure 2.
- two digital photographs of flowering *Prasophyllum petilum*, taken within one of my translocation sites in the Spring of 2017 and used for reference purposes for their field surveys.
- vegetation survey plot data from the proposed continuation area and biodiversity offset areas, various projects.
- spatial GIS files of proposed extension and biodiversity offset areas.

Other published and unpublished reports and papers that form part of this report have been cited in the normal way, with publication details contained in Section 9. Floristic data analyses undertaken by me as part of this report are based solely on that collected by Umwelt (Australia) from the Mangoola Coal site.

7. Criterion (f) – Expert Credentials

84. Under the requirements of the Biodiversity Assessment Method, an expert report can be prepared by an endorsed person in the place of undertaking field survey. This report must include information on the credentials of the expert, including the following:

a. *the expert's qualifications such as relevant degrees, post graduate qualifications*;

I possess three degrees in the science field: a Bachelor of Science (1988), Bachelor of Science (Honours) (1990) and a Doctor of Philosophy (Vegetation Science) (2013).

b. *the expert's history of experience in the ecological research and survey method, for the relevant species*;

In regard to the threatened orchid species that are the subject of this expert report (*Diuris tricolor, Prasophyllum petilum*), I have been surveying and monitoring both of these species over nine consecutive years at the Mangoola site, including the annual monitoring of over 3000 translocated specimens since 2010. In addition, I have searched for and monitored other populations of *Diuris tricolor* at separate sites in the Muswellbrook and Singleton local government areas, at one of these sites for five consecutive years. Methods used for all of these studies have incorporated systematic open-ended transect surveys in appropriate habitat, using GPS devices to record tracks searched and orchids located. Separation distances between adjacent search transects vary in relation to quality of habitat and visibility. Search times have only occurred when other known reference populations have been in flower.

c. *a resume detailing projects pertaining to the survey of the relevant species (including the locations and dates of the work) over the previous 10 years*;

My full Curriculum Vitae are appended as Appendix 5 to this report. In relation to the relevant species that are the subject of this report (*Diuris tricolor, Prasophyllum petilum*), the following projects pertain to survey for these (2009 to 2018):

- Bell, S.A.J., Murray, M., & Sims, R. (2018) *Flora and Fauna Monitoring at Condran, Muswellbrook LGA: 2017 Results*. Unpublished Report to Bulga Surface Operations (Glencore). March 2018. Eastcoast Flora Survey & Forest Fauna Surveys Pty Ltd.
- Bell, S.A.J. (2018) *Monitoring of translocated threatened orchids (*Diuris tricolor, Prasophyllum petilum*) at Mangoola Coal: 2017 Results*. Unpublished Report to Mangoola Coal. February 2018.
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- Bell, S.A.J. & Murray, M. (2017) *Flora and Fauna Monitoring at Condran, Muswellbrook LGA: 2016 Results*. Unpublished Report to Bulga Surface Operations (Glencore). January 2017. Eastcoast Flora Survey & Forest Fauna Surveys Pty Ltd.
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- Bell, S.A.J. & Carty, A. (2012) *Vegetation mapping of the Singleton Military Area*. Unpublished report to Commonwealth Department of Defence. Eastcoast Flora Survey & SKM, March 2012.
- Bell, S.A.J. (2012) *Targeted terrestrial orchid surveys at Mangoola Coal, Upper Hunter Valley: Spring 2011*. Unpublished Report to Mangoola Coal. Eastcoast Flora Survey, January 2012.
- Bell, S.A.J. & Copeland, L. (2010) *Targeted terrestrial orchid surveys at Mangoola Coal, Upper Hunter Valley: Spring 2010*. Unpublished Report to Mangoola Coal, October 2010. Eastcoast Flora Survey.
- Bell, S.A.J. & Copeland, L. (2010) *A strategy for the translocation of threatened terrestrial orchids at Mangoola Coal, Upper Hunter Valley*. Unpublished Report to Mangoola Coal, September 2010. Eastcoast Flora Survey.
- Bell, S.A.J. & Copeland, L. (2009) *Targeted terrestrial orchid survey, Mangoola, Upper Hunter Valley*. Spring 2009. Unpublished Report to Mangoola Coal. Eastcoast Flora Survey, November 2009.
- Bell, S.A.J. (2009) *Targeted terrestrial orchid survey of the ex-Nipol property, near Denman, Upper Hunter Valley*. Unpublished report to Mangoola Coal. Eastcoast Flora Survey, November 2009.

d. *their employer's name and period of employment (where relevant)*;

I am the principal and owner of *Eastcoast Flora Survey*, established in the Hunter Valley in October 1996, and spanning a continual period of dedicated flora consulting of over 21 years. Since 2014, I have also been a Conjoint Fellow at the University of Newcastle, in the School of Environmental and Life Sciences.

e. *relevant peer reviewed publications*;

No publications to date specifically addressing *Diuris tricolor* or *Prasophyllum petilum* (these are currently in press or preparation), however several dealing with other threatened orchid species (e.g. *Cryptostylis hunteriana*: Bell 2001a, de Lacey et al 2012a,b, de Lacey et al 2013;

Thelymitra adorata: Bell et al 2005) and non-orchid threatened taxa (e.g. *Acacia dangarensis*: Bell & Elliott 2013; *Acacia pendula*: Bell et al 2007, Bell & Driscoll 2014, Bell & Driscoll 2016; *Acacia wollarensis*: Bell & Driscoll 2017, Bell & Kodela 2018; *Angophora inopina*: Bell 2004; *Banksia conferta*: Bell 2017; *Commersonia rosea*: Bell & Copeland 2004, Bell & Holzinger 2015; *Dracophyllum macranthum*: Bell & Sims submitted; *Eucalyptus expressa*: Bell & Nicolle 2012; *Hibbertia procumbens*: Bell 2002, Bell & Driscoll 2005; *Leionema lamprophyllum* subsp. *fractum*: Bell & Walsh 2015; *Monotaxis macrophylla*: Bell & Holzinger 2015), together with those examining a range of significant and threatened species in sandstone habitats of the Hunter Valley (23 taxa; Bell 2001b) and those present in Wollemi National Park (87 taxa; Bell 2008). I am also the lead author on an *in press* book manuscript with CSIRO Publications detailing some of the endemic plant species of the Hunter Region on behalf of the University of Newcastle, many of which are threatened species.

f. *evidence that the person is a well-known authority on the relevant species to which the survey relates*.

   I have been surveying and monitoring the two target species for over 9 years in the Hunter Valley, and am acutely aware of their habitat requirements and variability in flowering from year to year. Additionally, Dr Lachlan Copeland (EcoLogical Australia & orchid taxonomist) has endorsed me as a recognised authority on the field ecology of *Diuris tricolor* and *Prasophyllum petilum* (see letter appended in Appendix 6).

8. Conclusion

85. The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The MCCO Project will utilise the existing infrastructure, emplacement areas and equipment at Mangoola Coal Mine, and will extend the life of the existing operation providing for ongoing employment opportunities for the existing Mangoola workforce. The MCCO Project Area includes the existing approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area.

86. The MCCO Project, if approved, will result in the removal of two threatened orchid species, *Diuris tricolor* and *Prasophyllum petilum*. Completed surveys in the project area by Umwelt show that 1,325 *Diuris* and 634 *Prasophyllum* will be directly impacted upon by proposed activities, and additional lands are consequently required to offset this impact.

87. Five separate parcels of land (Mangrove, Castle Rock Road, Ridgelands Road, Wybong PO Road, Yarraman Road) are proposed as offsets, comprising a total of 1290 ha. These offsets are located to the north and west of existing operations, and comprise various habitats including grasslands, woodlands and forests. I have inspected these properties and assessed the potential for the provision of habitat for the two target species. Other offset areas are proposed as part of the Mangoola Coal Continued Operation Project, however only the offset areas listed above were the focus of this report.

88. I have undertaken survey and monitoring of *Diuris* and *Prasophyllum* at Mangoola since 2010, and as a consequence have a solid understanding of the occupied habitat of both species in this locality. Through annual monitoring of translocation sites, where the fate of individual orchids has been followed for several years, detection rates have been shown to reflect rainfall received in the three months to September (Jun-Aug) each year. The last two flowering seasons (2017 & 2018) were exceptionally dry at Mangoola, with the area receiving as little as one third of the average for this 3-month pre-flowering period. The poor survey results obtained during targeted searches in 2017 reflected the dry winter (and indeed the previous two consecutive dry years), and justifies the need for this expert report.

89. If required as part of an offsets package for the MCCO Project, the possibility of translocating orchids out of the proposed continuation area should be considered. Translocation of both orchid species has been shown to be successful over a period of eight years at Mangoola, and will provide an added management action for the conservation of these species. Based on data published in Reiter et al (2016), the translocation project at Mangoola, involving over 3,000 individual orchids, is the largest known attempt involving orchids within Australia (highest reported in that publication is 400 individuals) and the world (700 individuals). Scientific papers outlining the Mangoola translocation project have been published or are currently in review (Bell 2019; Bell in review).

90. Based on targeted field surveys completed by myself in 2015, and Umwelt staff in 2016 and 2017, a minimum of 9,030 *Diuris* and 904 *Prasophyllum* individuals are known to be present within the proposed offset lands. Results obtained during 2017 surveys were poor due to drought conditions.

91. In addition to my two day field inspection of the proposed offset lands, I examined floristic plot data collected by Umwelt staff to help inform my opinion on the suitability or otherwise for the target orchids. Ninety-nine plots were supplied for this purpose (collected between 2014 and 2018, and covering both the proposed offset and continuation areas), and after examining

survey times in relation to rainfall, assessing relative proportions of key plant habits and weed species, and rationalising taxonomy and cover abundance values these data were considered representative and adequate for analysis purposes. I subsequently ran a numerical classification of these data to identify the main floristic groups (communities) present, delineating fourteen communities. Four of these were grasslands, eight were woodlands or forests, and two were shrublands. Of the fourteen, I determined that ten would provide potential habitat for *Diuris* and *Prasophyllum*, based on my own experiences with habitat occupied by these species at Mangoola in previous years.

92. I also examined the available soil landscape information (a surrogate for soil, otherwise not available) for the proposed offset and continuation areas, and compared it to other areas at Mangoola where the two orchid species occur. Over a ten year period, point records for 8,684 *Diuris* and 1,812 *Prasophyllum* have been collated, and these were used to intersect soil landscape units. Based on these records, *Diuris* more-or-less equally occur on Wappinguy and Sandy Hollow soil landscapes, while *Prasophyllum* shows a strong preference for the Sandy Hollow soil landscape, with Wappinguy and Castle Rock landscapes also important for this species. Minor occurrences on Lees Pinch, Growee and Dartbrook soil landscapes may be an artefact of the poor resolution of soils mapping (1:250k scale).

93. The primary soil landscapes present within the proposed offset lands were found to be the Wappinguy and Sandy Hollow landscapes (a combined total of 87% of all offsets), which corresponds well to the analysis of known point records noted above. For *Diuris*, almost all known records (93%) occur on the Wappinguy and Sandy Hollow soil landscapes (both well represented in proposed offsets), while the most important landscapes for *Prasophyllum* are Sandy Hollow, Castlerock and Wappinguy (99%). There is a strong match between known soil preferences and the landscapes contained in the proposed offsets.

94. Following my field inspections on 31 July and 4 October 2018, I used data collected then and existing floristic plot data to construct a map of orchid habitat quality across the proposed offsets. This resulted in the designation of 509 ha of high quality habitat, 253 ha of moderate quality habitat, and 322 ha of low quality habitat. The balance (206 ha) was considered to comprise negligible orchid habitat (e.g. sandstone hills, farm dams, roads, dwellings). Combining the areas of high and moderate quality habitat, 762 ha of the total 1290 ha combined offsets provide good quality habitat for *Diuris* and *Prasophyllum*. This represents 59% of the total proposed offset lands.

95. Using existing point record data on orchid occurrence (n=11,006 *Diuris*; n=3,606 *Prasophyllum*), I calculated representative densities of orchids across eight different areas surveyed in previous years to determine appropriate lower and upper bounds for the expected population size within the proposed offsets. This analysis resulted in a range of 2 to 74 *Diuris* per hectare and 2 to 4 *Prasophyllum* per hectare. Extrapolating these densities across the mapped high and moderate quality habitat within the proposed offset areas, the expected population size for *Diuris* likely falls within the range of 1,506 to 44,300 individuals, and for *Prasophyllum* 1,506 to 2,506 individuals.

96. Given the fact that some of the proposed offset lands have already been surveyed for orchids in previous years, I deducted these 9,030 *Diuris* and 904 *Prasophyllum* individuals from the above ranges to determine population sizes in lands yet to be sampled during wetter climatic conditions. This resulted in the adjusted expected population sizes of between 9,030 and 35,270 *Diuris* (the lower bound assuming the unlikely scenario that no further individuals are

present than those already detected in 2014 and 2015), and between 602 and 1,602 *Prasophyllum*.

97. In order to provide more definitive estimates of both species that can be used in credit calculations, I used two different multipliers (median density from previous surveys for high/moderate quality habitat; lowest density for low quality habitat) to calculate the expected number of individuals across the combined offset area. Following this process, 20,837 *Diuris* and 2,168 *Prasophyllum* are expected to be present. Allowing for the 9,934 orchids already recorded, the proposed offset lands can be expected to support **an additional 11,807 *Diuris* and 1,264 *Prasophyllum***.

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Appendix 1 – Letter of Approval from OEH

NSW GOVERNMENT | Office of Environment & Heritage

DOC18/211176-1

Mr Shaun Corry
Senior Ecologist
Umwelt (Australia) Pty Ltd
scorry@umwelt.com.au

Dear Shaun

Recognition of Dr Stephen Bell as an expert for *Diuris tricolor* and *Prasophyllum petilum* (Syn. *Prasophyllum* sp. 'Wybong')

Thank you for your e-mail of the 9 April 2018 in which you request that Dr Stephen Bell be recognised as an expert for *Diuris tricolor* (Pine Donkey Orchid) and *Prasophyllum petilum* (Syn. *Prasophyllum* sp. 'Wybong') (Tarengo Leek Orchid) for the Mangoola Coal Continued Operations project.

The Office of Environment and Heritage (OEH) has reviewed the information provided by you in support of this request. OEH is satisfied that Dr Stephen Bell satisfies the definition of species expert for *Diuris tricolor* and *Prasophyllum petilum* (Syn. *Prasophyllum* sp. 'Wybong'), in accordance with Section 6.5.2.3. of the Biodiversity Assessment Method.

Please note that this formal recognition of Dr Stephen Bell as an expert only applies to *Diuris tricolor* and *Prasophyllum petilum* (Syn. *Prasophyllum* sp. 'Wybong').

If you require any further information regarding this matter, please contact Steven Cox, Senior Team Leader, Planning Hunter Central Coast, on 4927 3140.

Yours sincerely

Sharon Molloy 14/5/2018

SHARON MOLLOY
Director Hunter Central Coast Branch
<u>Regional Operations Division</u>

Contact officer: STEVEN COX
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Appendix 2 – Floristic Composition of Grassland Habitat (Bell 2012)

The derivation of diagnostic species for each defined floristic group has been defined using the SIMPER routine in *Primer* on available full floristic plot data. SIMPER analysis provides the relative contributions of each species to the Bray-Curtis similarity within each of the defined vegetation communities. Only those species contributing to a total cumulative contribution of 99% of the average similarity (i.e. the value shown at the top of each floristic table) for each community are listed. These species can be described of as *typical* of that community, and have a consistently large presence within the data as reflected in the ratio of their contribution to the standard deviation (the Sim/SD field in each table) across the within-group similarities (the average similarity). Key canopy species are highlighted.

In the tables:

- Average similarity — is the within-group similarity for all pairs of sample plots comprising the community. Higher average similarity indicates a better defined community.
- Av.Abund — is the average cover abundance of that species within sample plots comprising the community
- Av.Sim — is the average similarity (contribution) made by each species to the within-group similarity (the overall average similarity).
- Sim/SD — is the ratio of average similarity to standard deviation for each species across all pairs of samples. A high ratio represents a good discriminating species. At least three samples are required for this ratio to be calculated (not available for four communities).
- Contrib % — is the percentage contribution of each species to the overall average similarity for the community.
- Cum.% — is the cumulative percentage contribution of each species, up to a maximum of 99%.

Unit 1a: Dichanthium/ Sporobolus/ Chloris Grassland - Key Diagnostic Species [based on 63 plots]:

Group 1a: Dichanthium/ Sporobolus/ Chloris Average similarity: 45.72					
Species	**Av.Abund**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Dichanthium sericeum subsp. sericeum	2.92	2.68	1.09	5.87	12.92
Senecio madagascariensis *	1.89	2.58	3.58	5.64	18.56
Sporobolus creber	2.02	2.22	1.79	4.87	23.42
Anagallis arvensis *	1.75	2.13	1.86	4.66	28.09
Chrysocephalum semipapposum	1.71	1.92	1.48	4.20	32.29
Centaurium tenuiflorum *	1.67	1.88	1.40	4.10	36.39
Bothriochloa decipiens var. decipiens	2.02	1.82	1.06	3.98	40.37
Glycine tabacina	1.56	1.78	1.47	3.90	44.27
Chloris truncata	1.79	1.41	0.93	3.09	47.36

Gamochaeta americana *	1.38	1.38	1.04	3.02	50.39
Cyclospermum leptophyllum *	1.35	1.22	1.19	2.67	53.05
Fimbristylis dichotoma	1.30	1.21	0.88	2.66	55.71
Aristida ramosa var. ramosa	1.52	1.21	0.89	2.64	58.35
Vittadinia muelleri	1.41	1.20	0.84	2.63	60.99
Cheilanthes sieberi subsp. sieberi	1.27	1.12	0.86	2.44	63.43
Dichelachne micrantha	1.59	1.09	0.76	2.38	65.80
Vulpia muralis *	1.38	1.05	0.77	2.30	68.10
Hypochaeris radicata *	1.21	0.90	0.73	1.97	70.08
Trifolium arvense *	0.97	0.83	0.93	1.81	71.88
Petrorhagia dubia *	1.08	0.81	0.73	1.78	73.66
Asperula conferta	1.06	0.78	0.68	1.70	75.36
Plantago debilis	1.03	0.77	0.67	1.69	77.05
Hypochaeris microcephala var. albiflora *	1.00	0.74	0.62	1.61	78.66
Dichondra repens	0.94	0.61	0.64	1.33	80.00
Oxalis perenans	0.94	0.61	0.61	1.33	81.33
Carthamnus lanatus *	0.81	0.39	0.50	0.86	82.19
Briza minor *	0.76	0.38	0.46	0.84	83.02
Eulalia aurea	0.92	0.37	0.36	0.81	83.83
Wahlenbergia communis	0.62	0.35	0.54	0.77	84.61
Convolvulus erubescens	0.62	0.35	0.49	0.76	85.36
Cymbopogon refractus	0.63	0.31	0.46	0.68	86.04
Daucus glochidiatus	0.65	0.31	0.40	0.67	86.71
Sida corrugata	0.65	0.31	0.39	0.67	87.38
Austrodanthonia tenuior	0.65	0.30	0.36	0.65	88.03
Polycarpon tetraphyllum *	0.62	0.28	0.39	0.62	88.65
Triptilodiscus pygmaeus	0.62	0.28	0.33	0.62	89.27
Calocephalus citreus	0.78	0.27	0.33	0.58	89.85
Brunoniella australis	0.57	0.23	0.31	0.51	90.36

Unit 2: Aristida/ Cymbopogon Grassland - Key Diagnostic Species [based on 44 plots]:

Group 2: Aristida/ Cymbopogon
Average similarity: 39.82

Species	**Av.Abund**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Aristida ramosa var. ramosa	3.43	4.60	2.17	11.55	11.55
Linum trigynum *	2.18	3.01	2.04	7.56	19.11
Cheilanthes sieberi subsp. sieberi	2.07	2.84	2.01	7.14	26.25
Anagallis arvensis *	1.70	2.42	1.73	6.09	32.34
Senecio madagascariensis *	1.66	2.32	1.65	5.84	38.18
Aristida vagans	1.95	1.83	0.90	4.60	42.78
Hypochaeris radicata *	1.75	1.77	1.00	4.44	47.22
Cymbopogon refractus	1.48	1.73	1.19	4.35	51.58
Glycine tabacina	1.14	1.32	1.25	3.32	54.90
Bothriochloa decipiens var. decipiens	1.43	1.23	0.69	3.08	57.98
Vulpia muralis *	1.27	1.20	0.97	3.02	61.00
Sporobulus creber	1.14	0.99	0.68	2.48	63.48

Briza minor *	1.07	0.96	0.79	2.41	65.89
Chrysocephalum apiculatum	1.02	0.81	0.54	2.03	67.92
Triptilodiscus pygmaeus	0.84	0.58	0.50	1.47	69.39
Vittadinia muelleri	0.93	0.58	0.44	1.45	70.83
Dichondra repens	0.77	0.54	0.53	1.35	72.18
Gamochaeta americana *	0.80	0.53	0.52	1.34	73.52
Dichelachne micrantha	0.82	0.52	0.49	1.31	74.83
Taraxacum officionale *	0.80	0.50	0.43	1.26	76.08
Lomandra confertifolia subsp. pallida	0.75	0.48	0.53	1.21	77.30
Tolpis barbata *	0.77	0.46	0.44	1.16	78.46
Lachnagrostis filiformis	0.75	0.44	0.39	1.10	79.56
Centaurium tenuiflorum *	0.70	0.41	0.41	1.03	80.59
Oxalis perenans	0.68	0.39	0.41	0.97	81.56
Richardia stellaris *	0.66	0.38	0.41	0.94	82.51
Chrysocephalum semipapposum	0.77	0.37	0.38	0.94	83.44
Fimbristylis dichotoma	0.68	0.37	0.37	0.93	84.38
Cyclospermum leptophyllum *	0.66	0.36	0.44	0.90	85.27
Petrorhagia dubia *	0.68	0.35	0.37	0.88	86.15
Asperula conferta	0.59	0.31	0.35	0.77	86.93
Sida corrugata	0.57	0.30	0.39	0.75	87.67
Linaria pelisseriana *	0.57	0.25	0.33	0.64	88.31
Glycine clandestina	0.41	0.23	0.41	0.58	88.89
Murdannia graminea	0.50	0.21	0.31	0.53	89.42
Centaurium erythraea *	0.50	0.20	0.25	0.50	89.92

Unit 4: Bothriochloa biloba/ Carthamnus/ Danthonia Grassland - Key Diagnostic Species [based on 7 plots]:

Group 4: Bothriochloa biloba/ Carthamnus/ Danthonia Average similarity: 50.03					
Species	**Av.Abund**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Bothriochloa biloba	5.14	13.03	5.61	26.04	26.04
Carthamnus lanatus *	2.57	6.41	2.45	12.82	38.86
Chloris truncata	1.86	4.86	4.58	9.72	48.57
Austrodanthonia tenuior	2.14	4.54	1.32	9.08	57.65
Einadia nutans subsp. linifolia	1.71	4.16	3.83	8.31	65.97
Lolium perenne *	1.57	3.31	1.35	6.61	72.58
Austrostipa aristiglumis	1.57	2.20	0.74	4.40	76.97
Vittadinia cuneata var. cuneata	0.86	1.55	0.90	3.11	80.08
Oxalis perenans	1.14	1.34	0.62	2.68	82.76
Senecio madagascariensis *	0.86	1.22	0.92	2.43	85.19
Sporobulus creber	1.00	1.07	0.59	2.13	87.32
Medicago truncatula *	0.86	0.95	0.60	1.90	89.22
Carex inversa	0.86	0.92	0.58	1.84	91.05

Appendix 3 – Taxonomic Review of Datasets

Summary of taxonomic changes made to supplied dataset prior to analysis.

Taxon Form 1 (No. plots)	Taxon Form 2 (No. plots)	Adopted Name (justification)
Acacia deanei (3)	*Acacia deanei* subsp. *deanei* (1)	*Acacia deanei* (weight of numbers)
Austrostipa scabra (19)	*Austrostipa scabra* subsp. *falcata* (8)	*Austrostipa scabra* (weight of numbers)
Bossiaea prostrata (2)	*Bossiaea* spp. (2)	Bossiaea prostrata (only Bossiaea present at MC)
Brachychiton populneus (3)	*Brachychiton populneus* subsp. *populneus* (7)	*Brachychiton populneus* subsp. *populneus* (only subp. present at MC)
Brachychiton spp. (1)	*Brachychiton populneus* subsp. *populneus* (7)	*Brachychiton populneus* subsp. *populneus* (only subp. present at MC)
Brachyscome ciliaris (1)	*Brachyscome ciliaris* var. *ciliaris* (2)	*Brachyscome ciliaris* (more than one var. present at MC)
Bursaria spinosa (8)	*Bursaria spinosa* subsp. *spinosa* (2)	*Bursaria spinosa* (weight of numbers)
Cheilanthes sieberi (6)	*Cheilanthes sieberi* subsp. *sieberi* (89)	*Cheilanthes sieberi* subsp. *sieberi* (only subsp. present at MC)
Dendrophthoe spp. (1)	*Dendrophthoe vitellina* (1)	*Dendrophthoe vitellina* (only spp. present at MC)
Denhamia spp. (5)	-	*Denhamia silvestris* (only spp. present at MC)
Dodonaea spp. (1)	*Dodonaea viscosa* (7)	*Dodonaea viscosa* (most likely spp. at MC)
Einadia nutans (10)	*Einadia nutans* subsp. *linifolia* (1)	*Einadia nutans* (weight of numbers)
Einadia nutans (10)	*Einadia nutans* subsp. *nutans* (8)	*Einadia nutans* (weight of numbers)
Eriochloa pseudoacrotricha (3)	*Eriochloa* spp. (1)	*Eriochloa pseudoacrotricha* (most likely spp. at MC)
Eucalyptus blakelyi (3)	*Eucalyptus blakelyi* <--> *tereticornis* (16)	*Eucalyptus blakelyi* (most likely identity)
Evolvulus alsinoides (9)	*Evolvolus alsinoides* var. *decumbens* (5)	*Evolvulus alsinoides* var. *decumbens* (only var. at MC)

Taxon Form 1 (No. plots)	**Taxon Form 2 (No. plots)**	**Adopted Name (justification)**
Haloragis heterophylla (12)	*Haloragis* spp. (1)	*Haloragis heterophylla* (most likely spp. at MC)
Lomandra filiformis (32)	*Lomandra filiformis* subsp. *coriacea* (14)	*Lomandra filiformis* (weight of numbers)
Lomandra filiformis (32)	*Lomandra filiformis* subsp. *filiformis* (3)	*Lomandra filiformis* (weight of numbers)
Maireana microcarpa (1)	-	*Maireana microphylla* (likely typo during data entry)
Maireana microphylla (8)	*Maireana* spp. (2)	*Maireana microphylla* (likely spp.)
Microlaena stipoides (13)	*Microlaena stipoides* var. *stipoides* (16)	*Microlaena stipoides* var. *stipoides* (most likely var. at MC)
Notelaea microcarpa (46)	*Notelaea microcarpa* var. *microcarpa* (14)	*Notelaea microcarpa* var. *microcarpa* (only var. present at MC)
Oenothera sp. (1)	*Oenothera stricta* subsp. *stricta* (6)	*Oenothera stricta* subsp. *stricta* (weight of numbers, most likely spp)
Opercularia diphylla (3)	*Opercularia* spp. (1)	Opercularia diphylla (most likely spp.)
Opuntia stricta (32)	*Opuntia stricta* var. *stricta* (21)	*Opuntia stricta* var. *stricta* (only var. present at MC)
Ozothamnus diosmifolius (1)	*Ozothamnus* spp. (1)	*Ozothamnus diosmifolius* (most likely spp. at MC)
Psydrax odorata (35)	*Psydrax* spp. (3)	*Psydrax odorata* (only spp. present at MC)
Rostellularia adscendens (1)	*Rostellularia adscendens* var. *adscendens* (1)	*Rostellularia adscendens* var. *adscendens* (most likely var. at MC)
Setaria parviflora (13)	*Setaria* spp. (1)	*Setaria parviflora* (weight of numbers)
Vittadinia cuneata (6)	*Vittadinia cuneata* var. *cuneata* (1)	*Vittadinia cuneata* var. *cuneata* (most likely var. at MC)
Xanthorrhoea johnsonii (1)	*Xanthorrhoea* spp. (4)	*Xanthorrhoea johnsonii* (only spp. at MC)

MC = Mangoola Coal

Appendix 4 – Floristic Composition of Delineated Groups (Umwelt data)

The derivation of diagnostic species for each defined floristic group has been defined using the SIMPER routine in *Primer* on available full floristic plot data. SIMPER analysis provides the relative contributions of each species to the Bray-Curtis similarity within each of the defined vegetation communities. Only those species contributing to a total cumulative contribution of 99% of the average similarity (i.e. the value shown at the top of each floristic table) for each community are listed. These species can be described of as *typical* of that community, and have a consistently large presence within the data as reflected in the ratio of their contribution to the standard deviation (the Sim/SD field in each table) across the within-group similarities (the average similarity). Key canopy species are highlighted.

In the tables:

- Average similarity — is the within-group similarity for all pairs of sample plots comprising the community. Higher average similarity indicates a better defined community.
- Av.Abund — is the average cover abundance of that species within sample plots comprising the community
- Av.Sim — is the average similarity (contribution) made by each species to the within-group similarity (the overall average similarity).
- Sim/SD — is the ratio of average similarity to standard deviation for each species across all pairs of samples. A high ratio represents a good discriminating species. At least three samples are required for this ratio to be calculated (not available for four communities).
- Contrib % — is the percentage contribution of each species to the overall average similarity for the community.
- Cum.% — is the cumulative percentage contribution of each species, up to a maximum of 99%.

1. Casuarina glauca-Galenia-Ehrharta Forest

Average similarity: 34.36

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Casuarina glauca	4.25	7.6	6.3	22.11	22.11
Galenia pubescens	2.75	4.06	7.05	11.81	33.92
Ehrharta erecta	2.75	3.12	0.9	9.09	43.01
Austrostipa verticillata	1.5	2.08	0.9	6.06	49.07
Cynodon dactylon	1.5	2.08	0.9	6.06	55.13
Microlaena stipoides var. stipoides	1.75	1.65	0.91	4.81	59.94
Sida rhombifolia	1.5	1.65	0.91	4.81	64.75
Stellaria media	1.75	1.65	0.91	4.81	69.56
Spartothamnella juncea	1.25	1.43	0.77	4.16	73.72
Lycium ferocissimum	1.5	1.2	0.88	3.5	77.22
Hypochaeris radicata	1.5	1.1	0.82	3.2	80.42

Bidens subalternans	1.25	1.09	0.84	3.16	83.57
Cheilanthes sieberi subsp. sieberi	1	0.78	0.41	2.26	85.83
Aristida vagans	1	0.72	0.41	2.09	87.92
Einadia hastata	1	0.65	0.41	1.9	89.82
Dichondra repens	1	0.59	0.41	1.72	91.54
Glycine tabacina	1	0.52	0.41	1.5	93.04
Senecio madagascariensis	1	0.52	0.41	1.5	94.54
Calotis lappulacea	0.75	0.36	0.41	1.04	95.59
Opuntia stricta var. stricta	0.75	0.36	0.41	1.04	96.63
Chloris ventricosa	0.5	0.29	0.41	0.86	97.49
Einadia spp.	0.75	0.29	0.41	0.86	98.35
Notelaea microcarpa var. microcarpa	0.75	0.29	0.41	0.86	99.2

2. Eucalyptus crebra-Aristida-Dichondra-Calotis-Cymbopogon Woodland

Average similarity: 44.41

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Dichondra repens	2	1.87	2.23	4.21	4.21
Calotis lappulacea	1.85	1.81	2.25	4.07	8.28
Aristida vagans	2	1.76	1.88	3.97	12.25
Desmodium varians	1.77	1.71	1.97	3.85	16.1
Cymbopogon refractus	2	1.62	1.47	3.65	19.75
Microlaena stipoides var. stipoides	1.85	1.56	1.49	3.52	23.26
Cheilanthes sieberi subsp. sieberi	1.92	1.51	1.5	3.41	26.67
Glycine tabacina	1.85	1.51	1.5	3.39	30.06
Oxalis perennans	1.77	1.5	1.51	3.38	33.44
Phyllanthus virgatus	1.62	1.45	1.68	3.27	36.71
Eucalyptus crebra	2.23	1.36	0.81	3.06	39.77
Aristida ramosa	1.69	1.29	1.14	2.9	42.67
Digitaria diffusa	1.69	1.25	1.13	2.81	45.48
Laxmannia gracilis	1.46	1.14	1.28	2.58	48.06
Notelaea microcarpa var. microcarpa	1.69	1.12	1.08	2.52	50.59
Cyperus gracilis	1.46	1.11	1.08	2.49	53.08
Senecio madagascariensis	1.38	1.06	1.34	2.39	55.47
Austrostipa scabra	1.54	1.01	1.04	2.28	57.76
Eragrostis leptostachya	1.54	0.98	0.91	2.21	59.97
Wahlenbergia communis	1.46	0.98	1.05	2.21	62.18
Psydrax odorata	1.38	0.96	1.38	2.17	64.35
Glycine clandestina	1.31	0.88	0.85	1.99	66.34
Chrysocephalum apiculatum	1.54	0.82	0.72	1.84	68.17
Sporobolus creber	1.31	0.76	0.74	1.72	69.89
Eulalia aurea	1.31	0.76	0.86	1.72	71.61
Brunoniella australis	1.23	0.7	0.7	1.57	73.18
Lomandra filiformis	1.15	0.67	0.68	1.52	74.7
Sida subspicata	1.15	0.65	0.71	1.45	76.15
Eragrostis brownii	1.08	0.63	0.67	1.43	77.58

Panicum effusum	1.08	0.6	0.6	1.34	78.92
Sida corrugata	1.08	0.51	0.56	1.16	80.08
Einadia nutans	1	0.5	0.58	1.12	81.19
Sida rhombifolia	0.92	0.46	0.69	1.04	82.24
Veronica plebeia	0.92	0.45	0.57	1.01	83.25
Hypochaeris radicata	1.08	0.43	0.48	0.96	84.21
Bothriochloa macra	1.15	0.42	0.48	0.94	85.15
Zornia dyctiocarpa var. dyctiocarpa	0.92	0.41	0.55	0.93	86.08
Einadia hastata	0.92	0.39	0.48	0.89	86.97
Cassinia arcuata	0.85	0.31	0.56	0.7	87.67
Stackhousia viminea	0.77	0.29	0.44	0.65	88.32
Fimbristylis dichotoma	0.77	0.28	0.38	0.62	88.94
Richardia stellaris	0.85	0.27	0.46	0.61	89.55
Allocasuarina gymnanthera	0.85	0.26	0.45	0.59	90.14
Opuntia stricta var. stricta	0.69	0.25	0.45	0.57	90.71
Glossocardia bidens	0.54	0.22	0.48	0.49	91.2
Evolvulus alsinoides var. decumbens	0.69	0.2	0.36	0.45	91.64
Murdannia graminea	0.62	0.17	0.29	0.38	92.02
Breynia oblongifolia	0.69	0.17	0.36	0.37	92.39
Digitaria brownii	0.69	0.16	0.28	0.36	92.76
Bidens pilosa	0.62	0.15	0.37	0.35	93.1
Leucopogon muticus	0.69	0.15	0.29	0.34	93.45
Paspalidium distans	0.62	0.15	0.29	0.34	93.79
Cheilanthes distans	0.62	0.14	0.29	0.32	94.11
Eucalyptus tereticornis	0.85	0.13	0.2	0.3	94.4
Galenia pubescens	0.54	0.13	0.27	0.28	94.69
Chloris truncata	0.62	0.13	0.26	0.28	94.97
Ajuga australis	0.54	0.12	0.27	0.27	95.25
Maytenus silvestris	0.54	0.12	0.27	0.26	95.51
Commelina cyanea	0.54	0.12	0.28	0.26	95.77
Paronychia brasiliana	0.54	0.11	0.27	0.26	96.03
Lomandra multiflora subsp. multiflora	0.54	0.11	0.27	0.24	96.27
Lepidium africanum	0.46	0.1	0.27	0.23	96.5
Anagallis arvensis	0.46	0.09	0.26	0.21	96.71
Vittadinia cuneata var. cuneata	0.46	0.09	0.27	0.2	96.91
Chrysocephalum semipapposum	0.46	0.08	0.2	0.19	97.1
Dianella spp.	0.31	0.08	0.28	0.18	97.27
Digitaria divaricatissima	0.46	0.07	0.2	0.16	97.44
Myoporum montanum	0.31	0.07	0.29	0.16	97.6
Spartothamnella juncea	0.38	0.06	0.18	0.13	97.73
Vittadinia spp.	0.38	0.05	0.19	0.12	97.85
Hypericum gramineum	0.38	0.05	0.18	0.12	97.97
Allocasuarina luehmannii	0.46	0.05	0.19	0.12	98.09
Dodonaea viscosa	0.38	0.05	0.18	0.12	98.21
Angophora floribunda	0.46	0.05	0.18	0.12	98.32

Maireana microphylla	0.31	0.05	0.2	0.11	98.43
Wahlenbergia gracilis	0.31	0.05	0.2	0.1	98.54
Pratia purpurascens	0.38	0.05	0.19	0.1	98.64
Cyperus brevifolius	0.23	0.04	0.2	0.1	98.74
Conyza bonariensis	0.31	0.04	0.2	0.1	98.84
Solanum nigrum	0.23	0.04	0.2	0.1	98.94
Sonchus oleraceus	0.31	0.04	0.2	0.09	99.02

3. Eucalyptus crebra-Lomandra-Cheilanthes-Notelaea-(Eucalyptus blakelyi) Woodland

Average similarity: 39.61

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Lomandra filiformis	2.5	3.93	4.32	9.93	9.93
Cheilanthes sieberi subsp. sieberi	2	3.61	20.23	9.12	19.04
Einadia hastata	2	3.61	20.23	9.12	28.16
Eucalyptus crebra	2.5	3.55	1.92	8.97	37.13
Notelaea microcarpa var. microcarpa	2.25	3.01	2.05	7.6	44.72
Opuntia stricta var. stricta	1.75	2.71	2.69	6.84	51.57
Lomandra multiflora subsp. multiflora	1.75	2.7	2.78	6.82	58.39
Aristida vagans	2.25	2.05	0.87	5.17	63.56
Chrysocephalum apiculatum	1.5	1.88	0.91	4.74	68.3
Senecio madagascariensis	1.25	1.26	0.81	3.18	71.47
Eragrostis brownii	1.25	1.18	0.8	2.97	74.44
Breynia oblongifolia	1	0.94	0.91	2.37	76.81
Eucalyptus blakelyi	1.75	0.89	0.41	2.25	79.06
Amyema miquelii	1	0.87	0.91	2.2	81.27
Maytenus silvestris	0.75	0.87	0.91	2.2	83.47
Allocasuarina luehmannii	1.5	0.85	0.41	2.14	85.61
Cheilanthes distans	1	0.64	0.41	1.62	87.23
Cymbopogon refractus	1	0.64	0.41	1.62	88.85
Cynodon dactylon	1.25	0.61	0.41	1.53	90.38
Juncus spp.	1	0.61	0.41	1.53	91.91
Digitaria spp.	1	0.57	0.41	1.45	93.36
Persoonia linearis	0.5	0.31	0.41	0.79	94.15
Brachychiton populneus subsp. populneus	0.5	0.3	0.41	0.75	94.91
Psydrax odorata	1	0.3	0.41	0.75	95.66
Sporobolus creber	0.75	0.3	0.41	0.75	96.41
Gahnia aspera	0.75	0.29	0.41	0.73	97.13
Galenia pubescens	0.75	0.29	0.41	0.73	97.86
Calotis lappulacea	0.5	0.28	0.41	0.71	98.57
Commelina cyanea	0.75	0.28	0.41	0.71	99.29

4. Eucalyptus crebra-Cheilanthes-Cymbopogon-Leucopogon Woodland

Average similarity: 49.47

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%

Cheilanthes sieberi subsp. sieberi	2	4.89	9.63	9.89	9.89
Cymbopogon refractus	2.14	4.89	9.63	9.89	19.78
Eucalyptus crebra	2.43	4.46	3.14	9.02	28.81
Leucopogon muticus	2.29	4.08	1.41	8.24	37.05
Chrysocephalum apiculatum	1.71	3.44	1.52	6.95	43.99
Lomandra filiformis	1.86	3.44	1.52	6.95	50.94
Sida subspicata	1.71	3.39	1.52	6.85	57.79
Notelaea microcarpa var. microcarpa	1.86	3.17	2.54	6.4	64.19
Psydrax odorata	1.43	2.4	1.36	4.86	69.05
Laxmannia gracilis	1.43	2.3	0.92	4.65	73.69
Cheilanthes distans	1.43	2.26	0.92	4.56	78.25
Allocasuarina gymnanthera	1.57	1.63	0.6	3.3	81.55
Aristida spp.	1.43	1.56	0.6	3.15	84.7
Callitris endlicheri	1.14	0.91	0.52	1.84	86.54
Styphelia triflora	0.86	0.76	0.59	1.55	88.09
Stackhousia viminea	0.86	0.72	0.4	1.45	89.54
Opuntia stricta var. stricta	0.71	0.69	0.62	1.39	90.93
Lissanthe strigosa	0.86	0.65	0.4	1.31	92.23
Melichrus urceolatus	0.86	0.65	0.4	1.31	93.54
Austrostipa spp.	1	0.64	0.4	1.3	94.85
Allocasuarina verticillata	0.57	0.38	0.4	0.76	95.61
Alphitonia excelsa	0.43	0.37	0.4	0.75	96.36
Aristida ramosa	0.86	0.37	0.22	0.75	97.11
Cynodon dactylon	0.57	0.25	0.22	0.5	97.61
Panicum spp.	0.57	0.22	0.22	0.45	98.06
Austrostipa scabra	0.57	0.21	0.22	0.43	98.49
Phyllanthus virgatus	0.57	0.2	0.22	0.41	98.9
Xanthorrhoea johnsonii	0.57	0.2	0.22	0.4	99.3

5. Eucalyptus moluccana-Notelaea-Aristida-(Eucalyptus crebra) Woodland

Average similarity: 43.22

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Notelaea microcarpa var. microcarpa	4	4.02	#######	9.3	9.3
Eucalyptus moluccana	3	3.02	#######	6.98	16.28
Aristida ramosa	2	2.01	#######	4.65	20.93
Bidens pilosa	2	2.01	#######	4.65	25.58
Brunoniella australis	2.5	2.01	#######	4.65	30.23
Callitris endlicheri	2.5	2.01	#######	4.65	34.88
Cheilanthes distans	2.5	2.01	#######	4.65	39.53
Cheilanthes sieberi subsp. sieberi	2	2.01	#######	4.65	44.19
Desmodium varians	2	2.01	#######	4.65	48.84
Dichondra repens	2	2.01	#######	4.65	53.49
Eucalyptus crebra	2	2.01	#######	4.65	58.14
Hibiscus sturtii var. sturtii	2.5	2.01	#######	4.65	62.79
Maytenus silvestris	2	2.01	#######	4.65	67.44

Phyllanthus virgatus	2	2.01	#######	4.65	72.09
Psydrax odorata	2	2.01	#######	4.65	76.74
Sida subspicata	2.5	2.01	#######	4.65	81.4
Spartothamnella juncea	2.5	2.01	#######	4.65	86.05
Commelina cyanea	1.5	1.01	#######	2.33	88.37
Cyperus gracilis	1.5	1.01	#######	2.33	90.7
Einadia hastata	1.5	1.01	#######	2.33	93.02
Glossocardia bidens	1.5	1.01	#######	2.33	95.35
Opuntia stricta var. stricta	1.5	1.01	#######	2.33	97.67
Vittadinia cuneata var. cuneata	1	1.01	#######	2.33	100

6. Corymbia maculata-Notealea-Laxmannia Forest

Average similarity: 20.25

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Corymbia maculata	2.5	3.61	0.88	17.84	17.84
Laxmannia gracilis	1.5	3.28	3.62	16.21	34.05
Notelaea microcarpa var. microcarpa	1.75	3.27	3.79	16.16	50.2
Cynodon dactylon	1.25	2.35	0.87	11.59	61.79
Einadia nutans	1.25	1.83	0.9	9.06	70.85
Einadia hastata	1.5	1.79	0.87	8.83	79.68
Aristida ramosa	1	1.36	0.41	6.72	86.4
Commelina cyanea	1	0.7	0.41	3.47	89.87
Bursaria spinosa	1	0.68	0.41	3.36	93.23
Senecio madagascariensis	0.75	0.68	0.41	3.36	96.59
Opuntia stricta var. stricta	0.75	0.35	0.41	1.73	98.32
Psydrax odorata	1	0.34	0.41	1.68	100

7. Eucalyptus dawsonii-Sporobolus-Eragrostis Grassy Woodland

Average similarity: 40.99

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Eucalyptus dawsonii	4	5.6	4.55	13.65	13.65
Cyperus gracilis	2	2.8	4.55	6.83	20.48
Eragrostis leptostachya	2	2.8	4.55	6.83	27.31
Sporobolus creber	2	2.8	4.55	6.83	34.13
Brunoniella australis	1.5	1.63	0.9	3.99	38.12
Alternanthera denticulata	1.5	1.57	4.42	3.84	41.96
Commelina cyanea	1.5	1.45	0.87	3.54	45.5
Sida corrugata	1.5	1.45	0.87	3.54	49.04
Einadia hastata	1.5	1.28	0.89	3.13	52.17
Einadia nutans	1.5	1.28	0.89	3.13	55.3
Austrostipa scabra	1.5	1.23	0.9	2.99	58.29
Chloris truncata	1.5	1.23	0.9	2.99	61.29
Chrysocephalum apiculatum	1.5	1.23	0.9	2.99	64.28
Fimbristylis dichotoma	1.5	1.23	0.9	2.99	67.28
Wahlenbergia communis	1.5	1.23	0.9	2.99	70.27

Galenia pubescens	1.5	1.08	0.83	2.62	72.9
Glycine tabacina	1.25	1.08	0.83	2.62	75.52
Glycine clandestina	1.25	0.94	0.84	2.28	77.8
Dichondra repens	1	0.61	0.9	1.5	79.3
Senecio madagascariensis	1	0.61	0.9	1.5	80.8
Cynodon dactylon	1	0.52	0.41	1.26	82.06
Eremophila debilis	1	0.52	0.41	1.26	83.32
Rytidosperma spp.	1	0.52	0.41	1.26	84.58
Aristida vagans	1	0.42	0.41	1.02	85.6
Lomandra multiflora subsp. multiflora	1	0.42	0.41	1.02	86.62
Panicum effusum	1	0.42	0.41	1.02	87.65
Aristida ramosa	1	0.4	0.41	0.97	88.61
Bothriochloa macra	1	0.4	0.41	0.97	89.58
Chamaesyce drummondii	1	0.4	0.41	0.97	90.55
Digitaria diffusa	1	0.35	0.41	0.85	91.4
Maireana microphylla	1	0.35	0.41	0.85	92.25
Maireana spp.	1	0.35	0.41	0.85	93.09
Plantago lanceolata	1	0.35	0.41	0.85	93.94
Polygonum aviculare	1	0.35	0.41	0.85	94.79
Richardia stellaris	1	0.35	0.41	0.85	95.63
Sida rhombifolia	1	0.35	0.41	0.85	96.48
Laxmannia gracilis	0.75	0.26	0.41	0.63	97.11
Myoporum montanum	0.75	0.24	0.41	0.59	97.7
Phyllanthus virgatus	0.75	0.2	0.41	0.48	98.18
Solenogyne bellioides	0.75	0.2	0.41	0.48	98.67
Stackhousia viminea	0.75	0.2	0.41	0.48	99.15

8. Allocasuarina luehmannii-Aristida Low Forest

Average similarity: 38.01

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Allocasuarina luehmannii	3.1	5.78	1.72	15.22	15.22
Aristida ramosa	2.2	3.89	1.82	10.24	25.46
Cheilanthes sieberi subsp. sieberi	1.9	3.51	1.84	9.22	34.68
Lomandra filiformis	1.6	3.07	1.23	8.08	42.76
Chrysocephalum apiculatum	1.8	2.69	1.62	7.07	49.83
Aristida vagans	1.4	1.82	0.84	4.79	54.62
Digitaria diffusa	1.5	1.73	0.87	4.55	59.17
Cymbopogon refractus	1.4	1.72	1.11	4.53	63.69
Eragrostis brownii	1.2	1.46	0.69	3.84	67.53
Lomandra multiflora subsp. multiflora	0.9	1.1	0.89	2.9	70.43
Oxalis perennans	1	0.95	0.61	2.51	72.94
Zornia dyctiocarpa var. dyctiocarpa	0.8	0.81	0.66	2.12	75.06
Opuntia stricta var. stricta	0.7	0.79	0.68	2.08	77.15
Cassinia arcuata	1.1	0.69	0.48	1.81	78.95
Bothriochloa macra	0.8	0.63	0.51	1.65	80.61

Panicum effusum	0.8	0.56	0.49	1.47	82.08
Phyllanthus virgatus	0.7	0.52	0.51	1.38	83.46
Hypochaeris radicata	0.8	0.47	0.39	1.23	84.69
Glycine tabacina	0.6	0.46	0.52	1.21	85.9
Eragrostis leptostachya	0.6	0.39	0.26	1.04	86.93
Opuntia aurantiaca	0.4	0.38	0.38	1	87.94
Sporobolus creber	0.7	0.36	0.37	0.96	88.9
Eucalyptus crebra	0.8	0.35	0.26	0.93	89.82
Amyema miquelii	0.5	0.32	0.39	0.83	90.66
Commelina cyanea	0.4	0.31	0.38	0.8	91.46
Murdannia graminea	0.4	0.28	0.38	0.74	92.2
Brunoniella australis	0.5	0.2	0.23	0.53	92.73
Arthropodium spp.	0.3	0.18	0.26	0.48	93.21
Conyza bonariensis	0.5	0.17	0.24	0.44	93.64
Laxmannia gracilis	0.5	0.16	0.25	0.42	94.07
Notelaea microcarpa var. microcarpa	0.3	0.16	0.26	0.42	94.49
Eucalyptus blakelyi	0.6	0.16	0.15	0.42	94.92
Einadia hastata	0.4	0.15	0.26	0.4	95.31
Calotis lappulacea	0.5	0.15	0.25	0.39	95.7
Glycine clandestina	0.4	0.14	0.26	0.37	96.07
Senecio madagascariensis	0.4	0.14	0.26	0.37	96.43
Evolvulus alsinoides var. decumbens	0.4	0.12	0.26	0.33	96.76
Sida cunninghamii	0.4	0.12	0.26	0.32	97.08
Phyllanthus hirtellus	0.4	0.11	0.15	0.3	97.38
Eulalia aurea	0.5	0.08	0.15	0.22	97.6
Digitaria spp.	0.4	0.08	0.15	0.2	97.8
Eragrostis elongata	0.4	0.07	0.15	0.19	97.99
Setaria parviflora	0.4	0.07	0.15	0.19	98.18
Chamaesyce drummondii	0.2	0.06	0.15	0.15	98.33
Euchiton sphaericus	0.2	0.05	0.15	0.14	98.47
Rytidosperma spp.	0.3	0.05	0.15	0.14	98.62
Allocasuarina gymnanthera	0.3	0.05	0.15	0.13	98.75
Fimbristylis dichotoma	0.3	0.05	0.15	0.12	98.87
Cassinia aculeata	0.2	0.05	0.15	0.12	98.99
Einadia nutans	0.3	0.05	0.15	0.12	99.11

9. Acacia binervia Shrubland

Average similarity: 41.44

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Acacia binervia	3.5	5.41	#######	13.04	13.04
Amyema spp.	2.5	3.6	#######	8.7	21.74
Cheilanthes distans	2	3.6	#######	8.7	30.43
Cheilanthes sieberi subsp. sieberi	2	3.6	#######	8.7	39.13
Cyperus spp.	2	3.6	#######	8.7	47.83
Einadia hastata	2	3.6	#######	8.7	56.52

Eragrostis leptostachya	2	3.6	#######	8.7	65.22
Oxalis perennans	2	3.6	#######	8.7	73.91
Phyllanthus virgatus	2	3.6	#######	8.7	82.61
Evolvulus alsinoides var. decumbens	1.5	1.8	#######	4.35	86.96
Leucopogon muticus	1.5	1.8	#######	4.35	91.3
Notelaea microcarpa var. microcarpa	1	1.8	#######	4.35	95.65
Opuntia stricta var. stricta	1.5	1.8	#######	4.35	100

10. Notelaea-Aristida-Cymbopogon-(Eucalyptus-Corymbia) Shrubland

Average similarity: 41.77

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Notelaea microcarpa var. microcarpa	2.75	3.9	4.42	9.35	9.35
Cheilanthes sieberi subsp. sieberi	2	3.08	11.17	7.37	16.72
Aristida vagans	2.13	2.57	1.57	6.16	22.88
Cymbopogon refractus	1.88	2.32	1.67	5.56	28.44
Hypochaeris radicata	1.5	1.86	2.86	4.46	32.9
Maytenus silvestris	1.38	1.7	3.58	4.07	36.97
Phyllanthus virgatus	1.25	1.37	1.41	3.29	40.25
Digitaria diffusa	1.38	1.32	0.97	3.16	43.41
Glycine tabacina	1.38	1.3	0.99	3.12	46.53
Breynia oblongifolia	1.38	1.28	1.5	3.07	49.61
Chrysocephalum apiculatum	1.25	1.22	0.92	2.93	52.54
Carex appressa	1.5	1.22	0.88	2.92	55.46
Cyperus gracilis	1.25	1.11	0.93	2.65	58.11
Dichondra repens	1.38	1.08	0.73	2.58	60.69
Leucopogon muticus	1.25	0.94	0.67	2.25	62.95
Lomandra filiformis	1.13	0.94	0.68	2.25	65.19
Psydrax odorata	1	0.91	1.01	2.19	67.38
Opuntia stricta var. stricta	1	0.85	0.98	2.04	69.42
Aristida ramosa	1.38	0.84	0.5	2.01	71.43
Microlaena stipoides var. stipoides	1.25	0.84	0.68	2.01	73.44
Eucalyptus blakelyi	1.63	0.83	0.43	1.98	75.42
Oxalis perennans	1	0.71	0.67	1.71	77.13
Corymbia maculata	1.5	0.64	0.34	1.53	78.66
Eucalyptus crebra	1	0.61	0.7	1.45	80.11
Desmodium varians	0.75	0.58	0.73	1.39	81.5
Einadia hastata	0.88	0.57	0.7	1.37	82.87
Hydrocotyle laxiflora	0.75	0.51	0.73	1.23	84.1
Commelina cyanea	0.88	0.49	0.47	1.16	85.26
Eragrostis leptostachya	0.88	0.48	0.47	1.16	86.42
Sida rhombifolia	1	0.45	0.48	1.09	87.5
Lomandra multiflora subsp. multiflora	0.75	0.38	0.49	0.92	88.42
Brachychiton populneus subsp. populneus	0.75	0.38	0.47	0.92	89.34
Dichondra sp. A	0.75	0.38	0.48	0.9	90.25
Cassinia arcuata	0.75	0.37	0.49	0.87	91.12

Gahnia aspera	0.63	0.36	0.51	0.85	91.97
Bidens pilosa	0.75	0.35	0.49	0.84	92.81
Laxmannia gracilis	0.63	0.22	0.32	0.53	93.34
Calotis lappulacea	0.63	0.21	0.32	0.51	93.85
Pratia purpurascens	0.63	0.2	0.32	0.47	94.33
Verbena bonariensis	0.63	0.2	0.32	0.47	94.8
Anagallis arvensis	0.5	0.18	0.34	0.42	95.22
Gomphocarpus fruticosus	0.38	0.18	0.34	0.42	95.64
Persoonia linearis	0.38	0.16	0.34	0.38	96.03
Senecio madagascariensis	0.5	0.16	0.34	0.37	96.4
Rumex brownii	0.5	0.15	0.34	0.36	96.76
Conyza bonariensis	0.38	0.15	0.34	0.36	97.12
Lomandra longifolia	0.5	0.15	0.34	0.36	97.47
Echinopogon caespitosus	0.63	0.11	0.19	0.26	97.73
Acetosella vulgaris	0.5	0.1	0.19	0.23	97.96
Euchiton spp.	0.38	0.06	0.19	0.15	98.1
Allocasuarina gymnanthera	0.38	0.06	0.19	0.14	98.24
Angophora floribunda	0.25	0.06	0.19	0.14	98.38
Veronica plebeia	0.25	0.06	0.19	0.14	98.52
Eucalyptus tereticornis	0.63	0.05	0.19	0.13	98.65
Sida cunninghamii	0.25	0.05	0.19	0.13	98.77
Dianella spp.	0.25	0.05	0.19	0.13	98.9
Wahlenbergia gracilis	0.25	0.05	0.19	0.13	99.03

11. Aristida-Cymbopogon-Cheilanthes-Calotis Grassland

Average similarity: 39.06

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Aristida vagans	3	4.69	#######	12	12
Calotis lappulacea	2.5	3.13	#######	8	20
Chamaesyce drummondii	2	3.13	#######	8	28
Cheilanthes sieberi subsp. sieberi	2.5	3.13	#######	8	36
Cymbopogon refractus	2.5	3.13	#######	8	44
Digitaria diffusa	2	3.13	#######	8	52
Einadia nutans	2	3.13	#######	8	60
Eucalyptus punctata	2	3.13	#######	8	68
Fimbristylis dichotoma	2	3.13	#######	8	76
Glycine tabacina	2.5	3.13	#######	8	84
Galenia pubescens	1	1.56	#######	4	88
Haloragis heterophylla	1.5	1.56	#######	4	92
Phyllanthus virgatus	2	1.56	#######	4	96
Sida subspicata	1.5	1.56	#######	4	100

12. Hypochaeris-Sporobolus-Cheilanthes-Aristida Grassland

Average similarity: 37.48

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%

Hypochaeris radicata	2.45	4.54	2.36	12.11	12.11
Sporobolus creber	1.85	3.25	1.52	8.67	20.77
Cheilanthes sieberi subsp. sieberi	1.95	3.14	1.51	8.37	29.14
Senecio madagascariensis	1.65	3.03	1.89	8.09	37.23
Chrysocephalum apiculatum	1.4	2.03	0.9	5.41	42.64
Aristida vagans	1.6	1.87	0.81	5	47.64
Bothriochloa macra	1.6	1.83	0.91	4.88	52.52
Aristida ramosa	1.7	1.79	0.74	4.78	57.3
Romulea rosea var. australis	1.4	1.78	0.81	4.75	62.05
Cymbopogon refractus	1.45	1.68	0.81	4.48	66.52
Galenia pubescens	1.1	1.29	0.61	3.44	69.97
Panicum effusum	1.05	1.07	0.68	2.86	72.83
Cynodon dactylon	1.15	1.04	0.47	2.77	75.6
Sida rhombifolia	1	0.99	0.59	2.64	78.24
Anagallis arvensis	0.9	0.76	0.48	2.04	80.28
Eragrostis leptostachya	0.95	0.75	0.47	1.99	82.27
Arctotheca calendula	0.85	0.71	0.41	1.89	84.16
Opuntia stricta var. stricta	0.65	0.59	0.52	1.59	85.75
Eragrostis brownii	0.75	0.5	0.39	1.34	87.09
Eulalia aurea	0.7	0.38	0.35	1.01	88.09
Verbena rigida var. rigida	0.65	0.37	0.33	0.98	89.07
Oxalis perennans	0.65	0.3	0.34	0.81	89.88
Cyperus aggregatus	0.6	0.28	0.29	0.76	90.63
Soliva sessilis	0.5	0.25	0.23	0.68	91.31
Medicago polymorpha	0.55	0.25	0.23	0.67	91.98
Conyza spp.	0.4	0.21	0.28	0.55	92.53
Conyza bonariensis	0.45	0.2	0.26	0.52	93.05
Erodium cicutarium	0.55	0.2	0.18	0.52	93.57
Austrostipa spp.	0.45	0.14	0.18	0.39	93.96
Fimbristylis dichotoma	0.5	0.14	0.22	0.38	94.34
Parentucellia latifolia	0.4	0.14	0.18	0.37	94.72
Echium plantagineum	0.4	0.14	0.18	0.37	95.09
Lomandra filiformis	0.4	0.13	0.18	0.35	95.44
Austrostipa scabra	0.45	0.13	0.18	0.34	95.78
Phyllanthus virgatus	0.4	0.12	0.22	0.31	96.09
Sida subspicata	0.4	0.12	0.18	0.31	96.4
Arthropodium spp.	0.35	0.09	0.17	0.23	96.63
Oenothera stricta subsp. stricta	0.35	0.08	0.17	0.2	96.83
Trifolium repens	0.3	0.07	0.12	0.19	97.02
Briza minor	0.3	0.07	0.13	0.18	97.2
Eucalyptus crebra	0.2	0.07	0.18	0.18	97.37
Cotula spp.	0.3	0.07	0.13	0.17	97.55
Glycine tabacina	0.2	0.06	0.18	0.17	97.72
Microlaena stipoides var. stipoides	0.3	0.06	0.12	0.17	97.88
Paronychia brasiliana	0.25	0.06	0.18	0.16	98.04

Hyparrhenia hirta	0.3	0.06	0.13	0.16	98.2
Eragrostis spp.	0.25	0.05	0.12	0.13	98.33
Juncus spp.	0.2	0.04	0.13	0.1	98.43
Notelaea microcarpa var. microcarpa	0.15	0.04	0.13	0.1	98.53
Lomandra multiflora subsp. multiflora	0.25	0.04	0.12	0.1	98.62
Setaria parviflora	0.2	0.04	0.13	0.09	98.72
Verbena bonariensis	0.2	0.03	0.13	0.09	98.81
Zornia dyctiocarpa var. dyctiocarpa	0.25	0.03	0.12	0.08	98.89
Facelis retusa	0.25	0.03	0.07	0.07	98.96
Chondrilla juncea	0.2	0.03	0.07	0.07	99.03

13. Hypochaeris-Cheilanthes-Eragrostis-Bothriochloa Grassland

Average similarity: 38.92

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Hypochaeris radicata	2.27	4.07	5.33	10.46	10.46
Cheilanthes sieberi subsp. sieberi	2	3.95	8.39	10.16	20.62
Eragrostis leptostachya	2	3.24	1.99	8.33	28.95
Bothriochloa macra	1.82	2.58	1.33	6.62	35.58
Phyllanthus virgatus	1.64	2.47	1.35	6.35	41.93
Aristida vagans	2	2.39	0.94	6.14	48.07
Conyza bonariensis	1.55	2.31	1.25	5.94	54.01
Fimbristylis dichotoma	1.45	1.96	1	5.04	59.05
Cynodon dactylon	1.73	1.93	0.89	4.95	64
Sporobolus creber	1.55	1.48	0.76	3.81	67.81
Aristida ramosa	1.18	1.13	0.61	2.9	70.71
Digitaria diffusa	1.18	1.07	0.6	2.75	73.45
Chrysocephalum apiculatum	1.18	1.03	0.6	2.66	76.11
Galenia pubescens	1	0.89	0.57	2.29	78.4
Setaria parviflora	0.91	0.75	0.46	1.94	80.34
Glycine tabacina	0.91	0.68	0.46	1.75	82.09
Lactuca saligna	0.82	0.62	0.44	1.59	83.69
Chamaesyce drummondii	0.91	0.61	0.47	1.58	85.26
Digitaria spp.	0.73	0.45	0.35	1.15	86.42
Paspalum dilatatum	0.73	0.43	0.34	1.1	87.52
Enteropogon acicularis	0.82	0.39	0.35	0.99	88.51
Solenogyne bellioides	0.73	0.38	0.35	0.98	89.49
Opuntia stricta var. stricta	0.55	0.37	0.46	0.94	90.43
Glycine clandestina	0.64	0.32	0.33	0.81	91.24
Convolvulus erubescens	0.64	0.28	0.32	0.72	91.96
Panicum effusum	0.64	0.24	0.24	0.63	92.59
Chondrilla juncea	0.55	0.23	0.24	0.59	93.18
Oxalis perennans	0.55	0.22	0.24	0.57	93.75
Haloragis heterophylla	0.55	0.21	0.24	0.55	94.3
Digitaria divaricatissima	0.55	0.21	0.24	0.55	94.85
Wahlenbergia communis	0.55	0.19	0.24	0.48	95.33

Cyperus gracilis	0.55	0.18	0.24	0.47	95.79
Rumex brownii	0.45	0.14	0.23	0.37	96.16
Sida cunninghamii	0.55	0.14	0.23	0.36	96.52
Richardia stellaris	0.45	0.13	0.23	0.33	96.86
Desmodium varians	0.45	0.13	0.22	0.33	97.19
Cyperus spp.	0.36	0.09	0.13	0.23	97.42
Oxalis pes-caprae	0.36	0.09	0.13	0.23	97.65
Juncus spp.	0.36	0.08	0.13	0.19	97.84
Chloris truncata	0.36	0.07	0.13	0.17	98.01
Sida rhombifolia	0.36	0.07	0.13	0.17	98.19
Vittadinia muelleri	0.36	0.07	0.13	0.17	98.36
Plantago lanceolata	0.36	0.06	0.13	0.17	98.52
Romulea rosea var. australis	0.36	0.06	0.13	0.16	98.68
Austrostipa scabra	0.36	0.06	0.13	0.16	98.83
Gomphrena celosioides	0.36	0.06	0.13	0.14	98.98
Plantago debilis	0.36	0.06	0.13	0.14	99.12

14. Bothriochloa-Hypochaeris-Cheilanthes-Aristida Grassland

Average similarity: 45.27

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Bothriochloa spp.	2.71	5.92	4.68	13.07	13.07
Cheilanthes sieberi subsp. sieberi	2	4.78	16.31	10.56	23.62
Hypochaeris radicata	2	4.78	16.31	10.56	34.18
Aristida vagans	2.14	3.46	0.93	7.65	41.82
Lomandra filiformis	1.86	3.39	1.53	7.48	49.3
Cynodon dactylon	1.86	2.67	0.89	5.9	55.21
Laxmannia gracilis	1.43	2.29	0.93	5.05	60.26
Verbena rigida var. rigida	1.43	2.25	0.93	4.98	65.23
Phyllanthus virgatus	1.29	1.8	0.86	3.98	69.21
Linum trigynum	1.29	1.77	0.86	3.9	73.11
Aristida ramosa	1.57	1.7	0.6	3.76	76.87
Cymbopogon refractus	1.29	1.35	0.62	2.98	79.85
Eragrostis brownii	1.14	1.31	0.62	2.89	82.75
Senecio madagascariensis	0.86	0.79	0.59	1.76	84.5
Romulea rosea var. australis	0.86	0.72	0.4	1.58	86.08
Chrysocephalum apiculatum	0.86	0.67	0.4	1.48	87.57
Austrostipa spp.	0.86	0.66	0.4	1.46	89.03
Stackhousia viminea	0.86	0.66	0.4	1.46	90.49
Conyza spp.	0.57	0.66	0.62	1.45	91.94
Sida subspicata	0.86	0.65	0.4	1.43	93.36
Anagallis arvensis	0.71	0.44	0.38	0.96	94.33
Zornia dyctiocarpa var. dyctiocarpa	0.71	0.43	0.37	0.94	95.27
Bromus spp.	0.57	0.24	0.22	0.53	95.8
Allocasuarina luehmannii	0.71	0.23	0.22	0.51	96.31
Chloris ventricosa	0.57	0.23	0.22	0.51	96.83

Hyparrhenia hirta	0.71	0.23	0.22	0.51	97.34
Oenothera stricta subsp. stricta	0.57	0.22	0.22	0.48	97.82
Petrorhagia nanteuilii	0.57	0.22	0.22	0.48	98.31
Opuntia stricta var. stricta	0.57	0.2	0.22	0.45	98.76
Chondrilla juncea	0.43	0.12	0.22	0.26	99.02

Appendix 5 – Resume: Dr Stephen Bell

CONTACT DETAILS

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https://www.researchgate.net/profile/Stephen_Bell10

PRÉCIS

Stephen has been involved in native vegetation survey, classification and mapping in the Greater Sydney and Hunter Regions since 1990. During this time, he has undertaken comprehensive surveys for the National Parks and Wildlife Service in over 30 conservation reserves, and has been contracted to the NSW Office of Environment & Heritage as Senior Botanist and Team Leader for several large scale regional projects within the Sydney Basin bioregion. Under contract to local Councils, Stephen has co-ordinated and completed LGA-wide vegetation classification and mapping projects for Wyong, Gosford, Cessnock, Pittwater and Lake Macquarie LGAs, and has assisted in similar mapping projects for Blue Mountains LGA. Stephen has also completed several studies on Threatened Ecological Communities and threatened plant species, and published the results of some of these in the scientific literature.

On behalf of the Ecological Society of Australia, Stephen was the ecological expert on the Hunter Regional Vegetation Committee (2003), and from 2017 represents that organization on the NSW Threatened Species Scientific Committee (administering the *Biodiversity Conservation Act 2016*). Stephen was also a past member of the Hunter Threatened Flora Recovery Team, a founding member of the Hunter Rare Plants Committee (a sub-committee of the Hunter Region Botanic Gardens), and since 2014 has been a member of the Office of Environment & Heritage Species Technical Group which oversees management and expenditure of threatened species throughout NSW via its *Saving our Species* initiative. He is also often called upon by Government for advice regarding the significance of vegetation communities and plant species within the northern Sydney Basin bioregion, and has sat on numerous expert panels in this regard. Stephen has been called upon as an Expert Witness for several cases heard in the NSW Land and Environment Court, where his knowledge on the vegetation of the Sydney Basin bioregion has been used to argue contentious land-use decisions.

Stephen has published several scientific papers on various aspects of the vegetation of the Sydney Basin, including classifications of vegetation within conservation reserves, threatened and rare plant species, and the description of new plant taxa. Stephen has completed over 4500 standard full floristic sampling plots within the Sydney Basin, which are stored and used in vegetation classification analyses. Other skills include extensive multivariate data analysis experience, and GIS mapping. Stephen's PhD thesis, completed on a part-time basis through the University of Newcastle, presented improvements in the recognition, identification and classification of restricted and significant vegetation communities, such as Threatened Ecological Communities (TECs).

In October 1996, Stephen established *Eastcoast Flora Survey*, a specialist botanical consultancy providing high quality services to government and the private sector. Since June 2014, Stephen has been a Conjoint Fellow in the School of Environmental & Life Sciences at the University of Newcastle (NSW), seeking to raise the output of ecological research on plants and vegetation within the Hunter region.

ACADEMIC QUALIFICATIONS

Doctor of Philosophy (PhD), 2013	*Defining and mapping rare vegetation communities: Improving techniques to assist land-use planning and conservation* (University of Newcastle)
Bachelor of Science (Honours), 1991	*Effects of the weed Scotch Broom on bird communities in open forests on Barrington Tops* (University of Newcastle)
Bachelor of Science, 1989	*Majors in Geography and Biology* (University of Newcastle)

EMPLOYMENT HISTORY

University of Newcastle	Conjoint Fellow (Plant Sciences Group)	June 2014 - Present
Eastcoast Flora Survey	Consultant Botanist (Principal)	Oct. 1996 - Present
Ecotone Ecological Consultants Pty Ltd	Manager - Flora Studies	Jan. 1996 - Oct. 1996
Private Ecological Consultant	Sole trader	Jan. 1991 - Dec. 1995
NSW National Parks and Wildlife Service	Project Officer	Sept. 1993 - Jan. 1994
University of Newcastle, Geography Dept.	Field Tutor (Scientific)	July 1993 - Aug. 1993
NSW National Parks and Wildlife Service	Project Officer	Jan. 1993 - June 1993
University of NSW, School of Biol. Sciences	Research Assistant (Bird ecology)	Sept. 1992 - Jan. 1993
NSW National Parks and Wildlife Service	Technical Officer (Scientific)	Jan. 1992 - June 1992
RZ Mines (Newcastle)	Environmental Research Officer	Oct. 1990 - Dec. 1991
Wayne Perry & Associates P/L	Environmental Officer (Casual)	June 1990 - Oct. 1990

RESEARCH INTERESTS

- Vegetation classification and mapping, at local and regional scales
- Definition and mapping of rare and threatened vegetation communities
- Restoration of threatened grassy woodlands from derived grasslands
- Improving data sampling methods for monitoring and classification
- Re-constructing vegetation distribution using information from historical botanical explorers
- Population ecology and habitat of rare and threatened plants
- Taxonomy and significance of Hunter Region plants

MINISTERIAL APPOINTMENTS

- Committee Member, NSW Threatened Species Scientific Committee (July 2017-present)
- Committee Member, NSW Species Technical Group, Flora (*Save Our Species Program*) (2014-present)
- *Ecological Society of Australia* representative on the Hunter Regional Vegetation Committee (2001-2003)

CONFERENCE & WORKSHOP PRESENTATIONS

- Best Practice Mine Rehabilitation Conference, September 2014, Singleton, NSW; The Tom Farrell Institute for the Environment, University of Newcastle: "*Effective Biodiversity Offsets: Improving planning, valuation and monitoring practice*" (with Martin Fallding).
- Plant Identification for Flora of the Hunter Valley, 7th - 8th April 2014, Kurri Kurri, Australian Network for Plant Conservation: "*Introduction to the flora of the Hunter Valley - history, diversity and ecology*".
- HOTSPOTS Fire Project: Awabakal and Worimi Fire Forum, 27th July 2011, Williamtown, Never Never Resources: "*Vegetation of the Worimi Conservation Lands*".
- HOTSPOTS Fire Project: Wanaruah Fire Forum, 17th – 19th August 2010, Sandy Hollow, Upper Hunter Valley, Nature Conservation Council: "*Vegetation of Wanaruah Lands, Sandy Hollow*".
- Coastal Groundwater Dependent Ecosystems Workshop, 3rd – 4th September 2009, South West Rocks, NSW (Geoscience Australia): "*Surveying, classifying and mapping vegetation on the Tomago Sandbeds*".
- Vegetation Management and Biodiversity Conservation in the Hunter Region, May 2000, Singleton, NSW (Hunter Environment Lobby Inc.): "*An evaluation of vegetation survey and threatened plant species listings in the Hunter Region*"

PROFESSIONAL MEMBERSHIPS

- Ecological Society of Australia (ESA)
- Australian Network for Plant Conservation Inc. (ANPC)
- International Association for Vegetation Science (IAVS)
- International Association for Vegetation Science Vegetation Classification Working Group (IAVS VCWG)
- Australasian Native Orchid Society Inc. (ANOS)
- Australasian Systematic Botany Society (ASBS)

PUBLICATION REVIEWER

- *Diversity* (MDPI, Switzerland)
- *Journal of Vegetation Science* (International Association for Vegetation Science)
- *Phytocoenologia* (International Association for Vegetation Science)
- *Resources* (MDPI, Switzerland)
- *Sustainability* (MDPI, Switzerland)
- *Telopea* (National Herbarium of New South Wales)

PUBLICATIONS (PEER REVIEWED)

Bell, S.A.J. (in prep) Experiences in translocating threatened terrestrial orchids (*Diuris tricolor* and *Prasophyllum petilum*) into non-mined and post-mined lands in the upper Hunter Valley of New South Wales, Australia. *Austral Ecology* (in prep).

Bell, S.A.J. & Nicolle, D. (in prep) Taxonomic clarification of an unusual, disjunct, mallee-form population of *Eucalyptus dealbata* (Myrtaceae) from the Hunter Valley of New South Wales, with comparative notes on other populations in the Sydney Basin bioregion. *Telopea* (in prep).

DeLacey, C., Bell, S., Chamberlain, S., & Bossard, K. (in review) Prediction of and realised habitat for a cryptic plant species: the Leafless Tongue Orchid *Cryptostylis hunteriana* Nicholls. *Cunninghamia* (in review)

Bell, S.A.J. (2019) *Macrozamia flexuosa* C. Moore (Zamiaceae): a review of distribution, habitat and conservation status of an endemic cycad from the Hunter Region of New South Wales. *Cunninghamia* 19: 7-27.

Bell, S.A.J. (2018) Fate of a rare flowering event in a population of the endangered *Acacia pendula* (Weeping Myall) from the Hunter Valley of New South Wales. *Cunninghamia* 18: 79-88.

Bell, S.A.J. & Driscoll, C. (2017) *Acacia wollarensis* (Fabaceae, Mimosoideae sect. Botrycephalae), a distinctive new species endemic to the Hunter Valley of New South Wales, Australia. *Telopea* 20: 125-136.

Bell, S.A.J. & Driscoll, C. (2016) Hunter Valley Weeping Myall Woodland – is it really definable and defendable with and without Weeping Myall (*Acacia pendula*)? *Cunninghamia* 16: 15-30.

Bell, S.A.J. & Walsh, N. (2015) *Leionema lamprophyllum* subsp. *fractum* (Rutaceae); a new and highly restricted taxon from the Hunter Valley of New South Wales. *Telopea* 18: 505-512.

Bell, S.A.J. & Driscoll, C. (2014) *Acacia pendula* (Weeping Myall) in the Hunter Valley of New South Wales: early explorers' journals, database records and habitat assessments raise doubts over naturally occurring populations. *Cunninghamia* 14: 179-200.

Bell, S.A.J. & Nicolle, D. (2012) *Eucalyptus expressa* (Myrtaceae): a new and distinctive species from the sandstone ranges north-west of Sydney, New South Wales. *Telopea* 14: 69-76.

Bell, S.A.J. & Stables, M. (2012) Floristic variability, distribution and an extension of range for the endangered Pittwater Spotted Gum Forest, Central Coast, New South Wales. *Cunninghamia* 12(2): 143-152.

Bell, S.A.J. (2009) Vegetation and floristics of Columbey National Park, lower Hunter Valley, New South Wales. *Cunninghamia* 11(2): 241-275.

Bell, S.A.J. (2008) Rare or threatened vascular plant species of Wollemi National Park, central eastern New South Wales. *Cunninghamia* 10(3): 331-371.

Bell, S., Branwhite, B., & Driscoll, C. (2005) *Thelymitra 'adorata'* (Orchidaceae): population size and habitat of a highly restricted terrestrial orchid from the Central Coast of New South Wales. *The Orchadian* 15(1): 6-10.

Bell, S.A.J. (2004) Distribution and habitat of the vulnerable tree species, *Angophora inopina* (Myrtaceae), on the Central Coast of New South Wales. *Cunninghamia* 8(4): 477-484.

Bell, S.A.J. (2004) Vegetation of Werakata National Park, Hunter Valley, New South Wales. *Cunninghamia* 8(3): 331-347.

Bell, S.A.J. & Copeland, L.M. (2004) *Commersonia rosea* (Malvaceae *s.l.*: Lasiopetaleae): a new, rare fire-ephemeral species from the upper Hunter Valley, New South Wales. *Telopea* 10(2): 581-587.

Bell, S.A.J. (2002) Habitat of the endangered *Hibbertia procumbens* (Labill.) DC (Dilleniaceae) from the Central Coast of New South Wales. *Victorian Naturalist* 119(2): 69-74.

Bell, S.A.J. (2001) Notes on population size and habitat of the vulnerable *Cryptostylis hunteriana* Nicholls (Orchidaceae) from the Central Coast of New South Wales. *Cunninghamia* 7(2): 195-204.

Bell, S.A.J. (2001). Notes on the distribution and conservation status of some restricted plant species from sandstone environments of the upper Hunter Valley, New South Wales. *Cunninghamia* 7(1): 77-88.

Bell, S. (2000) An evaluation of vegetation survey and threatened plant species listings in the Hunter Region. Pp. 19-34 IN *Vegetation Management and Biodiversity Conservation in the Hunter Region - Where to from here?* Ed. by M.Fallding. Proceedings of the Public Workshop. Hunter Environment Lobby. Singleton, 12 May 2000.

PUBLICATIONS (OTHERS)

Bell, S. (in press) Translocation 'success' is all about detection: experiences with two threatened orchids from the Hunter Valley of NSW. *Australasian Plant Conservation* (in press).

Bell, S. (2018) The responsibilities of ecological consultants in disseminating outcomes from threatened species surveys: a call to arms. *Australasian Plant Conservation* 27:3-6.

Bell, S. & Sims, R. (2018) Extensive populations of *Dracophyllum macranthum* (Ericaceae) in Coorabakh NP suggest a review of threat status. *Australasian Plant Conservation* 27: 11-14.

Bell S.A.J. & Kodela P.G. (2018) *Acacia wollarensis*. In: *Flora of Australia*. Australian Biological Resources Study, Department of the Environment and Energy, Canberra. https://profiles.ala.org.au/opus/foa/profile/Acacia%20wollarensis

Bell, S. (2017) New insights into the ecology of the critically endangered *Banksia conferta* (Proteaceae) from the mid-north coast of NSW. *Australasian Plant Conservation* 26(1): 15-18.

Bell, S. & Holzinger, B. (2015) Wildfire reveals new populations of the endangered *Commersonia rosea* and *Monotaxis macrophylla* in northern Wollemi National Park, NSW. *Australasian Plant Conservation* 23: 2-4.

Bell, S. & Elliott, M. (2013) Preliminary results suggest fire is required to maintain *Acacia dangarensis*, a threatened single-population endemic from the Hunter Valley of NSW. *Australasian Plant Conservation* 22(1): 9-10.

de Lacey, C, Bell, S, Chamberlain, S. & Bossard, K. (2013) Finding the leafless tongue orchid *'Cryptostylis hunteriana'* Nicholls. *Nature New South Wales* Vol. 57 (1) Autumn 2013: 24-25. [online]

de Lacey, C., Bell, S., & Chamberlain, S. (2012) Habitat of the Leafless Tongue Orchid *Cryptostylis hunteriana* Nicholls throughout its known Australian distribution. *Australasian Plant Conservation* 20(4): 23-25.

de Lacey, C., Bell, S., Chamberlain, S., & Bossard, K. (2012) Habitat of the Leafless Tongue Orchid *Cryptostylis hunteriana* Nicholls throughout its known Australian distribution. *The Orchadian* 17(4): 162-174.

Bell, S.A.J. (2010) Defining and mapping an endangered ecological community within Lake Macquarie Local Government Area, New South Wales. *Australasian Plant Conservation* 18(3): 18-19.

Bell, S., Peake, T. & Driscoll, C. (2007) Dealing with taxonomic uncertainty in Weeping Myall *Acacia pendula* from the Hunter catchment, New South Wales. *Australasian Plant Conservation*. 16(1): 14-15.

Bell, S. & Driscoll, C. (2005) New records of the endangered *Hibbertia procumbens* from the Central Coast of NSW. *Australasian Plant Conservation* 13(4): 24-25.

Bell, S.A.J., Parsons, J., & Meldrum, R. (2005) Towards the protection and management of hanging swamps on the Somersby Plateau, Central Coast, New South Wales. *Australasian Plant Conservation* 13(3): 10-11.

Bell, S. (2003) Another new and highly restricted mallee from the Hunter Valley, *Eucalyptus castrensis*. *Hunter Flora* 11: 2.

Peake, T., Bell, S., Tame, T., Simpson, J., & Curran, T. (2003) *The Hunter Rare Plants Database: Identification and listing of regionally significant flora for the Hunter Region, New South Wales*. Poster Presentation at the Ecological Society of Australia Annual Conference 2003, Armidale NSW.

Peake, T., Bell, S., Tame, T., Simpson, J., & Curran, T. (2002) *Warkworth Sands Woodland – An Endangered Ecological Community: Distribution, Ecological Significance and Conservation Status*. Hunter Region Botanic Gardens Technical Paper [www.huntergardens.org.au/]

Bell, S. (2002) Plant profile: The Leafless Tongue Orchid, *Cryptostylis hunteriana. Hunter Flora* 9: 2.

SELECTED UNPUBLISHED TECHNICAL REPORTS (1993 – 2018)

Bell, S.A.J. (2018) *Vegetation and floristics of the Huntlee Offset Lands, Hunter Valley, NSW: Sweetwater (North Rothbury).* Unpublished Report to Office of Environment & Heritage. June 2018. Eastcoast Flora Survey.

Bell, S.A.J. & Sims, R. (2018) *Targeted Surveys for the Vulnerable* Dracophyllum macranthum *(Ericaceae) in Coorabakh National Park, Lansdowne Plateau, NSW*. Unpublished Report to NSW Office of Environment & Heritage. 21 June 2018. Eastcoast Flora Survey.

Bell, S.A.J. (2018) *Baseline demography of a significant new population of the Critically Endangered* Banksia conferta *(Proteaceae), Coorabakh National Park, NSW*. Unpublished Report to NSW Office of Environment & Heritage. June 2018. Eastcoast Flora Survey. Final Report.

Bell, S.A.J. (2018) *Vegetation and floristics of the Huntlee Offset Lands, Hunter Valley, NSW: 4. Warrawalong (Cessnock LGA)*. Unpublished Report to Office of Environment & Heritage. April 2018. Eastcoast Flora Survey.

Bell, S.A.J. (2018) *Vegetation and floristics of the Huntlee Offset Lands, Hunter Valley, NSW: 3. Corrabare (Cessnock LGA).* Unpublished Report to Office of Environment & Heritage. April 2018. Eastcoast Flora Survey.

Bell, S.A.J. (2018) *Vegetation and floristics of the Huntlee Offset Lands, Hunter Valley, NSW: 2. Elderslie (Singleton LGA)*. Unpublished Report to Office of Environment & Heritage. April 2018. Eastcoast Flora Survey.

Bell, S.A.J. (2018) *Monitoring of translocated threatened orchids (*Diuris tricolor, Prasophyllum petilum*) at Mangoola Coal: 2017 Results*. Unpublished Report to Mangoola Coal. February 2018.

Bell, S.A.J. (2017) *Monitoring of the endangered* Pterostylis gibbosa *(Orchidaceae) at Milbrodale, Hunter Valley: Year 2 Results*. Unpublished Report to NSW Office of Environment & Heritage. November 2017. Eastcoast Flora Survey.

Bell, S.A.J. (2017) *A strategy for assessing population size in threatened plant surveys*. Unpublished Report to NSW Office of Environment and Heritage. November 2017.

Bell, S.A.J. (2017) *Targeted survey for the threatened* Diuris tricolor *at Persoonia Park, North Rothbury, Hunter Valley.* Unpublished Report to Office of Environment & Heritage. November 2017. Eastcoast Flora Survey.

Bell, S.A.J. (2017) *Baseline monitoring and survey of the vulnerable* Pterostylis chaetophora *(Orchidaceae) at North Rothbury, Hunter Valley, NSW*. Unpublished Report to NSW Office of Environment & Heritage. October 2017. Eastcoast Flora Survey.

Bell, S.A.J. (2017) *Vegetation and floristics of the Huntlee Offset Lands, Hunter Valley, NSW: 1. Cedar Creek (Cessnock LGA).* Unpublished Report to NSW Office of Environment and Heritage. October 2017.

Bell, S.A.J. (2017) *Baseline monitoring and survey of the Critically Endangered* Pomaderris reperta *(Rhamnaceae) and Vulnerable* Lasiopetalum longistamineum *(Malvaceae), Upper Hunter Valley, New South Wales*. Unpublished Report to NSW Office of Environment and Heritage. October 2017.

Bell, S.A.J. (2017) *Field Validation of Wetlands Mapping on the Central Coast of New South Wales*. Unpublished Report to NSW Office of Environment and Heritage.

Bell, S.A.J. (2017) *Mt Dangar Multi-species Saving our Species Project: Year 1 (2016-2017) Summary Report.* Unpublished Report to NSW National Parks and Wildlife Service. June 2017.

Bell, S.A.J. (2017) *Monitoring of the Critically Endangered* Banksia conferta *(Proteaceae) at Coorabakh National Park, NSW*. Unpublished Report to NSW Office of Environment and Heritage.

Bell S.A.J. (2016) *Monitoring of the endangered* Pterostylis gibbosa *(Orchidaceae) at Milbrodale, Hunter Valley, NSW*. Unpublished Report to NSW Office of Environment and Heritage.

Bell S.A.J. (2016) *Distribution and condition of the threatened* Melaleuca biconvexa *(Myrtaceae) on the Central Coast of NSW*. Unpublished Report to NSW Office of Environment and Heritage.

Bell, S.A.J. (2016) *Additional notes on distribution and fragmentation of Warkworth Sands Woodland, from the Hunter Valley of New South Wales*. Unpublished Report to Department of Environment, Ecological Communities Section, Protected Species & Communities Branch, Canberra. April 2016.

Bell, S.A.J. (2016) *An assessment of the vegetation occurring on coastal sands at Pelican Flats, Lake Macquarie LGA*. Lake Macquarie Research Grant Project 2004/2005-01.

Bell, S.A.J. & Driscoll, C. (2016) *Volume 1: Vegetation Mapping Report, Lake Macquarie Local Government Area. Stages 1 - 6.* Unpublished Report to Lake Macquarie City Council. March 2016. Eastcoast Flora Survey.

Bell, S.A.J. (2016) *Volume 2: Vegetation Community Profiles, Lake Macquarie Local Government Area. Working Draft v2*. Unpublished Report to Lake Macquarie City Council. March 2016. Eastcoast Flora Survey.

Bell, S.A.J. (2016) *Vegetation and floristics of the Columbey Conservation Lands (NP & SCA), lower Hunter Valley, New South Wales.* Unpublished Report to Office of Environment & Heritage (Gloucester). January 2016. Eastcoast Flora Survey.

Bell, S.A.J. (2015) *Review of Offset Multipliers (Tg values) for Selected Threatened Species*. Unpublished Report to NSW Office of Environment and Heritage. November 2015. Eastcoast Flora Survey.

Bell, S.A.J. (2015) *Distribution, habitat and conservation status of* Macrozamia flexuosa *(Zamiaceae) in Lake Macquarie LGA and the lower Hunter Valley of New South Wales*. Lake Macquarie Research Grant Project 1999/2000-02.

Bell, S.A.J. (2015) *External Review: Draft Threatened Plant Survey Guidelines*. Unpublished Report to Office of Environment & Heritage, NSW Department of Premier and Cabinet. May 2015. Eastcoast Flora Survey.

Bell, S.A.J. (2015) *Lower Hunter Spotted Gum-Ironbark Forest: Verification Survey, Proposed Newcastle Inner City Bypass (Rankin Park to Jesmond), Newcastle LGA*. Unpublished Report to Roads and Maritime Services. March 2015. Eastcoast Flora Survey.

Bell, S.A.J. (2014) *Tablelands Snow Gum TEC: Field Survey & Classification Analysis, Southern Tablelands, New South Wales. Tallaganda & Badja State Forest Trial Areas*. Unpublished DRAFT Report to NSW Office of Environment & Heritage. Eastcoast Flora Survey. November 2014.

Bell, S.A.J. (2014) *Preliminary data analysis of Slaty Gum (*Eucalyptus dawsonii*) Forests & Woodlands in the Hunter Valley*. Unpublished Report to Department of Environment, Ecological Communities Section, Protected Species & Communities Branch, Canberra. August 2014. Prepared as part of deliberations emanating from the Expert Panel assessing the proposed Central Hunter Valley Eucalyptus Forest and Woodland Complex endangered ecological community.

Bell, S.A.J. (2014) *Submission on Warkworth Sands Woodland EEC: Warkworth / Mt Thorley Continuation Project*. Unpublished Submission to NSW Department of Planning and Environment. Eastcoast Flora Survey. July 2014.

Bell, S.A.J. (2013) *Ecological studies on* Acacia dangarensis*: Baseline data to inform management*. Unpublished Report to NSW Office of Environment & Heritage, Mudgee. October 2013. Eastcoast Flora Survey.

Bell, S.A.J. (2013) *Assessment of Alluvial Riparian Blackbutt Forest in Wyong LGA against River Flat Eucalypt Forest EEC*. Unpublished Report to Wyong Shire Council. June 2013. Eastcoast Flora Survey.

Bell, S.A.J. (2013) *A strategy for monitoring revegetation of rehabilitation after coal mining, Ravensowrth Operations, Hunter Valley*. Unpublished Report to Ravensworth Operations, Xstrata Coal, April 2013. Eastcoast Flora Survey.

Bell, S.A.J. (2013) *Summary Report of Baseline* Pomaderris reperta *Monitoring Data, Mangoola Coal*. Unpublished Report to Mangoola Coal. Eastcoast Flora Survey.

Bell, S.A.J. (2012) *Update of Listing Advice and Fact Sheet for* Weeping Myall - Coobah - Scrub Wilga Woodland/Low Forest of the Hunter Valley. Unpublished Report to the Commonwealth Department of Sustainability, Environment, Water, Populations and Communities. Eastcoast Flora Survey, June 2012.

Bell, S.A.J. (2012) *Comment on potential Blue Gum High Forest CEEC at Jesmond Park, Newcastle LGA*. Report to Newcastle City Council. Eastcoast Flora Survey. April 2012.

Bell, S.A.J. & Carty, A. (2012) *Vegetation mapping of the Singleton Military Area*. Unpublished report to Commonwealth Department of Defence. Eastcoast Flora Survey & SKM, March 2012.

Bell, S.A.J. (2011) *Implementing the NSW Vegetation Classification and Assessment (VCA) Scheme in the Hunter-Central Rivers Region: Attribution of Priority Vegetation Types*. Unpublished Database to Hunter-Central Rivers Catchment Management Authority. Eastcoast Flora Survey.

Bell, S.A.J. (2011) *Review of Greater Hunter Vegetation Mapping: Version 0.1*. Unpublished Report to Office of Environment & Heritage, Department of Premier & Cabinet. August 2011. Eastcoast Flora Survey.

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DeLacey, C., Bell, S.A.J., & Chamberlain, S. (2011) *Pittwater Vegetation Classification, Vegetation Mapping, pre-1750 Vegetation Mapping and Vegetation Profiles*. Unpublished Report prepared for Pittwater Council.

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Bell, S.A.J. (2009) *Equivalence analysis of Hunter and Central Coast vegetation communities for the Hunter VCA Project*. Report to EcoLogical Australia & Hunter-Central Rivers Catchment Management Authority. Eastcoast Flora Survey.

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Bell, S.A.J. (2009) *Vegetation and floristics of Murrurundi Pass and Crawney Pass National Parks, upper Hunter Valley, New South Wales*. Unpublished Report to Department of Environment & Climate Change (Scone Area). February 2009.

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Driscoll, C. & Bell, S.A.J. (2009) *The experimental translocation of* Tetratheca juncea *Sm. (Tremandraceae) at Gwandalan, Wyong Shire. Final Report.* Unpublished Report to Crighton Properties Pty Ltd, Wyong Shire Council, and Department of Environment and Climate Change. April 2009.

Bell, S.A.J. (2008) *Review of flora issues relating to proposed Coal & Allied development on the Wallarah Peninsula*. Unpublished report to Department of Environment & Climate Change, Newcastle. March 2008.

Bell, S. & Driscoll, C. (2008) *Revised Vegetation Mapping of Wyong LGA: Stage 1 – West of F3 Freeway*. Unpublished report and map to Wyong Shire Council.

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Bell, S.A.J. & Driscoll, C. (2006) *Vegetation of the Tomago and Anna Bay Sandbeds, Port Stephens, New South Wales: Management of Groundwater Dependent Ecosystems. Part 1 – Vegetation Classification*. Unpublished Report to Hunter Water. Eastcoast Flora Survey. September 2006.

Bell, S.A.J. & Driscoll, C. (2006) *Vegetation of the Salt Ash Air Weapons Range, Medowie, New South Wales*. Unpublished Final Report to Department of Defence. May 2006. Eastcoast Flora Survey.

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Bell, S.A.J. (2004) *Data audit of vegetation survey within the Central Coast LGA's: 2000 - 2004*. Eastcoast Flora Survey - Report to Hunter Councils. July 2004.

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Bell, S.A.J. & Driscoll, C. (2004) *Population count and habitat assessment of* Rutidosis heterogama *(Asteraceae), Lower Hunter and Central Coast*. Unpublished Report to Wyong Shire Council, April 2004. Eastcoast Flora Survey.

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NSW LAND & ENVIRONMENT COURT (EXPERT WITNESS)

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Appendix 6 – Endorsement: Dr Lachlan Copeland

eco logical AUSTRALIA
A TETRA TECH COMPANY

5th April, 2018

<u>Reference for orchid expertise of Dr Stephen Bell</u>

To whom it may concern

This letter serves to introduce Dr Stephen Bell of Eastcoast Flora Survey as worthy to fill the role of 'expert' for matters concerning the threatened terrestrial orchids *Diuris tricolor* and *Prasophyllum petilum*. I myself have an extensive knowledge of the orchid flora of New South Wales, Victoria and Queensland gained over several decades of field survey. With Gary Backhouse, Robert Bates and Andrew Brown, I have co-authored the "Checklist of the Orchids of Australia including its Island Territories". In separate publications I have also described 15 new orchid species. I am personally very familiar with *Diuris tricolor* and *Prasophyllum petilum* from throughout their known distributional ranges, and have worked with Stephen on these two species previously.

Stephen has a wealth of experience and professional ability in botany and threatened species management, having worked in the consultancy field since the mid 1990's. In 1996, he established Eastcoast Flora Survey, a small consultancy focusing on vegetation surveys, classification, mapping and threatened species research and management. Over a 20 year period, Stephen has shown himself to be dedicated to presenting an accurate portrayal of the distribution and abundance of native plant species, particularly threatened plant species and ecological communities. He has researched a number of threatened plant species, including several orchids, and has published regularly in the scientific literature on these. In the past, I have personally approached Stephen on numerous occasions to discuss the distribution, abundance and threats of a wide variety of threatened plant species including several orchid taxa.

I first worked with Stephen on surveys for *Diuris* and *Prasophyllum* in the upper Hunter Valley in 2009, and since that time I am aware that he has undertaken annual surveys for these species across a number of offset and development sites, including overseeing and conducting a large translocation program at one mine site requiring detailed monitoring of individual plants, and the monitoring of natural populations elsewhere. Over a nine year period of surveying and monitoring for these species, Stephen is clearly highly regarded as an expert for these taxa in the Hunter Valley. I believe that Stephen would have personally seen more individuals of these two species and know their ecology more intimately than anyone else.

Given the experience detailed above, I have no hesitation in recommending Stephen as an expert in any matters concerning *Diuris tricolor* and *Prasophyllum petilum*, particularly with regard to habitats and status within the Hunter Valley of NSW.

Yours sincerely

Dr Lachlan Copeland
Senior Botanist,
Eco Logical Australia

APPENDIX 4

Hydro Engineering and Consulting RTS Responses

HYDRO ENGINEERING & CONSULTING PTY LTD

16 December 2019

Executive Manager Environment NSW & ACT
Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284
via Email
Attention: John Merrell

John,

Re: Mangoola Coal Continued Operations Project (SSD 8642) – Response to Agencies Submissions

Further to our recent correspondence, Hydro Engineering & Consulting Pty Ltd (HEC) has considered the submissions of the Biodiversity and Conservation Division (BCD)[1] of the NSW Department of Planning, Industry & Environment (DPIE) and the NSW Environment Protection Authority (EPA)[2] in regard to the Surface Water Assessment (SWA) for the above Project. The following sections address issues raised in those submissions and have been prepared as an addendum to the SWA report (HEC, 2019)[3].

1. Water Quality and Discharges

Agency: EPA

Submission references:

P4 Attachment A 1st paragraph	"The SWA needs to adequately assess the potential impact of discharges on the environmental values of the receiving waterways The SWA proposes a water management system that would include controlled discharges from the Pit Water Dam to the Hunter River and managed overflows from sediment retention basins to Big Flat Creek, Anvil Creek and Sandy Creek. The SWA does not include a quantitative assessment of the effect of discharges from the Pit Water Dam on pollutant concentrations in the receiving waterway and the potential impact on the environmental values. The SWA indicates that the Pit Water Dam would contain elevated pH and electrical conductivity and concentrations of aluminium and zinc would be slightly elevated".
P4 Attachment A 5th paragraph	The applicant should revise the discharge impact assessment to include: • "a characterisation of the controlled discharges to waters in terms of the concentrations and loads of all pollutants expected to be present at non-trivial levels • comparison of the expected pollutant concentrations in the immediate receiving waterway during discharges to the relevant *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* guideline values under typical and worst-case conditions • where relevant, identification of practical measures to address identified impacts"

[1] Letter from S. Errington, BCD Director Hunter Central Coast Branch to Resource Assessments Compliance Division, NSW Planning Industry & Environment, 5 September 2019.
[2] Letter from M. Bennett, EPA Head Strategic Operations Unit – Hunter to NSW Planning Industry & Environment, 28 August 2019.
[3] Hydro Engineering & Consulting Pty Ltd (2019). "Mangoola Coal Continued Operations Environmental Impact Statement Surface Water Assessment", prepared for Mangoola Coal Pty Ltd, rev H, May.

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1.1 Sediment Dams

Three sediment dams are proposed as part of the MCCO Additional Project Area. These have been sized and would be operated in accordance with the 'Blue Book'[4], with a proposed total capacity of 180 ML. These dams would be similar to existing sediment dams which are part of the existing approved Mangoola Coal Mine. These three sediment dams would be integrated into the mine water management system, with pumped transfer of any accumulated water to the existing Pit Water Dam (PWD) in order to reinstate sediment dam storage capacity within 5 days of a rainfall event during their operational lifetime. Once rehabilitation has successfully established on mine landforms and the sediment dam catchment areas have stabilised, sediment controls would no longer be necessary and the rehabilitated area runoff can be returned to the existing catchment. A 'buffer' volume of 569 ML would be maintained in the PWD (between 'normal' operating volume and 'high' operating volume) to store water during and following rainfall periods (refer Table 23 in HEC [2019]). Consequently, the risk of overflows that occur when the design capacity of the sediment dams is exceeded is low as indicated by modelling of the MCCO Project water management system. Model simulated overflow from the three sediment dams is summarised in Table 1.

Table 1 Simulated Project Sediment Dam Overflow

Storage	Percentage of Model Realizations in Which Overflow Occurs	Number of Overflow Events in Those Realizations in Which Overflow Occurs	Average Overflow Volume (ML)	Average Big Flat Creek Flow During Overflow (ML)
MNSD1	6%	1	37.5	747
MNSD2	<1%	1	280	1,611
MNSD3	9%	1	38.6	801

The modelled data indicates that overflow from the sediment dams should occur infrequently if at all. The data also indicates that overflow, should it occur, would be small in comparison to flow in Big Flat Creek.

The low risk of spill is reinforced by the fact that in nine years of operation there has been no overflow from the existing Northern Out Of Pit (NOOP) sediment dam at the Mangoola Coal Mine. The existing Southern Out Of Pit (SOOP) south and north sediment dams are known to have exceeded their design criteria and overflow (via spillway flow) on only one occasion following a rainfall event on 30/3/2019. This event was reported to the EPA, with no monitored deterioration in water quality from upstream to downstream in the receiving creek.

During any unlikely overflow events, the concentration of environmentally significant constituents in the sediment dams is likely to be low because, during such events, inflow from catchment surface runoff will predominate over baseflow (seepage). Surface runoff from overburden and rehabilitated catchment areas would be less likely to contain elevated concentrations of environmentally significant constituents than seepage which has the potential to leach such constituents from the overburden. An increased rate of seepage could be expected following such an event however this would be managed by pumping to the PWD.

Therefore the likelihood of any impact of sediment dam discharge on downstream water quality and hence environmental values is considered low.

[4] Landcom (2004). "Managing Urban Stormwater: Soils & Construction Volume 1", 4th edition, March.

1.2 Pit Water Dam

The existing Mangoola Coal Mine has approval for discharge from site into the Hunter River under the provisions of the Hunter River Salinity Trading Scheme (HRSTS). The MCCO Project is seeking the continued ability to discharge excess water in accordance with the HRSTS using the currently approved discharge facility/arrangements and no changes to these approved facilities or arrangements are proposed. It should be noted that to date the requirements for discharge have not been triggered and Mangoola has not yet installed the relevant infrastructure that would enable this controlled discharge to occur from the PWD. However Mangoola has a trigger action response plan (TARP) in place that will initiate construction of the discharge system from the PWD to the Hunter River if the total site water inventory exceeds 2,250 ML. No discharge of mine water to Big Flat Creek is approved or planned as part of the MCCO Project. The existing Mangoola operational water management system also has in place a TARP that governs when water should be discharged from the PWD to the Hunter River in accordance with the HRSTS once the discharge infrastructure is in place. The trigger for initiating discharge is based on the stored water volume in the PWD and these triggers are not planned to change as part of the Project.

It should also be noted that controlled discharge from the PWD via the HRSTS will comprise a very small component of the flow in the Hunter River (as governed by the discharge rules of the HRSTS) and that dilution will be substantial. Water balance modelled results (HEC, 2019) provide forecast annual release volumes. With reference to Figure 42 in HEC (2019) the forecast median annual controlled discharge volume varies from zero to 120 ML. This compares with a median annual flow recorded in the Hunter River at Denman[5] of approximately 181,000 ML, meaning the forecast maximum median discharge represents 0.07% of the recorded median annual river flow. Similarly Figure 42 in HEC (2019) indicates a 95th percentile annual controlled discharge volume of between 558 ML and 1,469 ML. This compares with a 95th percentile annual flow recorded in the Hunter River at Denman of approximately 660,000 ML, meaning the forecast 95th percentile discharge represents between 0.08% and 0.22% of the recorded 95th percentile annual river flow.

It is recognised that the above analysis does not allow for the fact that controlled discharge does not occur on each day and that there are substantial periods of river flow when controlled discharge does not occur. Therefore simulated controlled daily discharge volumes were sourced from the Project water balance model in order to calculate the percentage of flow in the Hunter River at Denman that these forecast discharges would represent for each discharge day – i.e. the forecast discharge dilution.

A modelled mine life realization corresponding to the median overall total controlled discharge volume was selected. For each simulated day, the controlled discharge volume was compared with the flow rate for the Hunter River at Denman. Discharge was found to occur only on 1.6% of days on average. For the 12¼ year simulation period, on average the controlled discharge volumes equated to 3.9% of river flow on those (rare) discharge days. On a single day selected from the model output with a 'typical' (median) discharge volume, the discharge equated to less than 0.1% of river flow.

The above illustrates that any contaminants present in the PWD at the time of controlled discharge would therefore be highly diluted by flow in the Hunter River. As also noted above, the opportunity to discharge is governed by the HRSTS, as well as by the conditions of Mangoola's Environment Protection Licence and discharge can only occur during permissible periods when there is sufficient flow to cater for discharge.

[5] Recorded data at GS210055 - https://realtimedata.waternsw.com.au/ downloaded 28/10/2019.

In addition, during any infrequent controlled discharge events, the concentration of environmentally significant constituents in the PWD is likely to be low because, during such events, inflow from mine landform surface runoff will predominate over baseflow (seepage). Surface runoff from mine landform catchments would be less likely to contain elevated concentrations of environmentally significant constituents than seepage which has the potential to leach such constituents from mine landforms.

Further, the water quality of seepage from the overburden emplacement areas in the Additional Project Area is expected to be similar to or better than seepage from the existing Mangoola Coal Mine. This is evidenced from the results of water extracts analyses conducted as part of the Project Geochemical Assessment[6]. Samples were analysed from both overburden and interburden samples obtained from drill core from two boreholes in the Additional Project Area as well as from overburden and interburden samples from the existing Mangoola Coal Mine. Average analysis results for the two sets of samples are summarised in Table 2. The data in Table 2 indicates that for electrical conductivity and the vast majority of metals, water extracts of samples from Additional Project Area drill core gave lower values than for samples from the existing Mangoola Coal Mine. The notable exception was molybdenum which gave an average water extract value of 0.02 mg/L for the Additional Project Area drill core samples with a maximum single value of 0.075 mg/L, compared with the ANZECC (2000) guideline trigger value for irrigation of 0.05 mg/L. However, the maximum value was the only value recorded above the ANZECC (2000) guideline trigger value for irrigation and is well below the ANZECC (2000) guideline trigger value for livestock drinking water of 0.15 mg/L (no ANZECC (2000) default guideline trigger value is given for molybdenum for protection of aquatic ecosystems).

Table 2 Summary of Chemical Composition of Water Extracts – Overburden and Interburden Samples

Parameter	Units	Additional Project Area Drill Core Sample Average	Existing Mangoola Coal Mine Sample Average
Electrical Conductivity	dS/cm	0.427	0.635
Silver	mg/L	<0.001	<0.001
Aluminium	mg/L	0.094	0.678
Arsenic	mg/L	0.006	0.008
Boron	mg/L	0.057	0.077
Cadmium	mg/L	<0.0001	0.0002
Cobalt	mg/L	0.001	0.053
Chromium	mg/L	<0.001	0.003
Copper	mg/L	0.002	0.014
Iron	mg/L	0.053	0.562
Mercury	mg/L	<0.0001	<0.0001
Manganese	mg/L	0.039	2.382
Molybdenum	mg/L	0.020	0.003
Nickel	mg/L	0.002	0.103
Lead	mg/L	<0.001	<0.001
Selenium	mg/L	0.010	0.015

[6] EGi (2019). "Geochemical Assessment of the Mangoola Coal Continued Operations Project". Environmental Geochemistry International Pty Ltd report 2354/1245, prepared for Umwelt (Australia) Pty Limited on behalf of Mangoola Coal Pty Limited, July.

Table 2 Summary of Chemical Composition of Water Extracts – Overburden and Interburden Samples (Continued)

Parameter	Units	Additional Project Area Drill Core Sample Average	Existing Mangoola Coal Mine Sample Average
Strontium	mg/L	0.196	0.185
Zinc	mg/L	0.009	0.132

On the basis of the above, it is considered that there is a low likelihood of any change to the water quality in the PWD as a result of the MCCO Project and therefore no changes have been identified that would change the approved discharge arrangements and impacts. Therefore, no further assessment of discharges from Mangoola is considered necessary. It is also noted that considering the low frequency of discharge, the impact of PWD controlled discharge on downstream water quality and hence environmental values in the Hunter River is low.

2. Site Specific Trigger Values

Agency: EPA

Submission references:

P4 Attachment A 7th, 8th & 11th paragraphs	"Tables 8 and 9 of the SWA compare monitoring data from local waterways to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality guideline values and in some cases 'site-specific trigger values'. It is unclear how these 'site specific trigger values' were derived."
	"The Australian and New Zealand Guidelines for Fresh and Marine Water Quality states that in some cases, default guideline values can be appropriately modified to account for naturally elevated background concentrations (natural toxicant concentrations unrelated to human disturbance). The guidelines recommend that site-specific guideline values should be based on at least 2 years of monthly monitoring data from an appropriate site, representative of water bodies unimpacted by human disturbance."
	"If site specific guideline values are used to assess the impact of discharges, the applicant should demonstrate these have been derived consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality."

Site specific trigger values (SSTVs) have been derived from the monitored data as the 80th percentile of monitored values where sufficient monitored data are available to derive this statistic (a minimum of ten records). The range of metals analysed was expanded in late 2017 to seek to obtain additional data for analysis purposes, however since then there have been limited opportunities for sample collection due to prevailing no flow conditions resulting from low rainfall.

The aim of the SSTVs is to provide a baseline against which to compare future monitored water quality in order to assess if a mining-related impact *may be* occurring. This approach has been approved as part of existing water management plans for many coal mining operations in the Hunter Valley (including Mangoola) and elsewhere in NSW (triggers are also known as impact assessment criteria). If exceeded, these lead to the gathering of additional information or further investigation to determine whether an impact has occurred and if there is a risk to the environment. SSTVs are not water quality objectives. It is also noted that water quality baseline data from monitoring locations unimpacted by existing mining activity in many cases exceed the ANZECC (2000) default guideline trigger values.

ANZECC (2000), Volume 1, Section 3.1.1.2, Step 3 states:

"*Determine appropriate guideline trigger values*. Determine guideline trigger values for all indicators, taking into account level of protection. For physical and chemical stressors and toxicants in water and sediment, the preferred approach to deriving trigger values follows the order: use of biological effects data, then local reference data (mainly physical and chemical stressors), and finally (least preferred) the tables of default values provided in the Guidelines (see figure 3.1.2)."

In the absence of specific biological effects data, it is the second approach that has been adopted here (local reference data).

ANZECC (2000), Volume 1, Section 3.1.4.1 states:

"…the best reference conditions are set by locally appropriate data. If the disturbance to be assessed has not yet occurred, then pre-disturbance data provide a valuable basis from which to define the reference condition."

"In summary, the reference condition must be chosen using information about the physical and biological characteristics of both catchment and aquatic environment to ensure the sites are relevant and represent suitable target conditions. Some of the important factors that should be considered are these:

…

- the definition of a reference condition must be consistent with the level of protection proposed for the ecosystem in question - unimpacted, or slightly modified or relatively degraded…"

This is also in accordance with the revised Water Quality Guidelines (ANZG, 2018)[7] which are progressively superseding the ANZECC (2000) Guidelines. ANZG (2018) states:

"For modified ecosystems, 'best available' reference sites may provide the only choice for the reference condition. If the test or assessment site departs in a meaningful way from the condition of the reference site or designated reference condition, then that site is assessed to be affected in some way."

It is clear that a reference site need not be unimpacted by human activity, particularly in a catchment such as Big Flat Creek where previous activity (e.g. grazing and historical land uses) has had an impact and water quality is naturally poor (refer Section 2.6.2.1 in HEC [2019]). There has been no recorded discharge by Mangoola to Big Flat Creek at the location of the Project and therefore, to paraphrase ANZECC (2000), the disturbance being assessed (the Project) has not yet occurred and therefore pre-disturbance data provide a valuable basis from which to define the reference condition.

Given the monitored substantial change in baseline water quality along the length of Big Flat Creek (refer Section 2.6.2.1 in HEC [2019]), the use of water quality data from an upstream site such as SW18 (refer Figure 3 in HEC [2019]) is not appropriate in defining the reference condition. Apart from the fact that water quality at SW18 is also affected by upstream grazing activity and historical land uses, if the SSTV for SW18 for EC (1,208 µS/cm) were adopted for Big Flat Creek downstream of the Project, this would be exceeded much of the time for existing conditions (this value is exceeded in approximately 86% of records for SW07). It is therefore considered appropriate to adopt specific trigger values for specific locations on Big Flat Creek.

[7] ANZG 2018. "Australian and New Zealand Guidelines for Fresh and Marine Water Quality". Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

The ANZG (2018) also states:

> "When using guideline values derived using reference-site data, comparison of the annual median of measured test site data is made with the guideline value."
>
> "As a default, our recommended approach for deriving guideline values in this way is to calculate an appropriate percentile of reference-site data. Typically, the 80th percentile."

In addition to comparison of the annual median of measured data with the SSTVs, Mangoola propose to compare the measured data with the SSTVs (80th percentile of monitored values) following each round of monitoring. Should an exceedance be identified, this will lead to the gathering of additional information or further investigation to determine whether an impact has occurred and if there is a risk to the environment. This will allow for any potential 'spikes' or short-term water quality impacts to be identified and investigated, in addition to assessing gradual trends/changes in water quality of the surrounding surface water systems.

In conclusion the SSTVs have been derived as the 80th percentile of monitored values, in accordance with ANZECC (2000). These will be used as a baseline against which to compare future monitored water quality.

3. Flood Mapping and Flood Impact Assessment

Agency: BCD

Submission references:

P3 Attachment A comment 14	"…flood maps are provided at a scale that provides for better visibility of impacts (for example, using A3 sizing)."
P3 Attachment A comment 15	"The flood impact assessment should analyse the differences in flooding for each mining stage and, at a minimum, compare pre-mining conditions with the stage that has the greatest flood impact."

Flood maps are provided at A3 scale as Attachment A herein. These include enlargements in the vicinity of Wybong Road to improve visibility of impacts.

As confirmed by the assessment in the SWA (HEC [2019]) the proposed haul road crossing of Big Flat Creek (which is present at all stages of the MCCO Project) will have the greatest impact on flood hydraulics in the creek and overbank areas. The only changes from stage to stage that could affect flood levels are the development of the flood levee downstream of the proposed haul road crossing of Big Flat Creek and the progressive removal of the western upslope diversion which discharges downstream of the proposed haul road crossing. Given that both of these are downstream of the proposed haul road crossing of Big Flat Creek the effects on flood model predictions will be minor. The choice of which mine stage to simulate therefore does not materially affect the flood model results, as the crossing of Big Flat Creek is in place for all stages of the Additional Mining Area. Given the relatively short duration of the MCCO Project (eight years of mining in the Additional Mining Area), it is considered appropriate to consider a representative "worst case" stage. It is considered that the modelled 'with project' scenario is representative of the greatest flood impact associated with the MCCO Project.

Modelling has been undertaken for the proposed Project and existing conditions (as at 2017, refer Section 2.7.1 of HEC [2019]) in order to assess the impact of the MCCO Additional Project Area to the approved operation. A comparison to pre-mining conditions is not relevant to the assessment because the existing Mangoola Coal Mine is approved and present in the existing landscape. A comparison to the pre-project conditions has therefore been provided and this approach is considered appropriate.

4. Wybong Post Office Road Diversion Crossing and Culverts

Agency: BCD

Submission reference:

P3 Attachment A comment 17	"The surface water assessment should consider potential flooding impacts associated with the diversion of water towards and below Wybong Post Office Road. This should include the likelihood and impact of blockage of proposed culverts under the road."

The proposed western upslope clean water diversion drain will intersect the realigned portion of Wybong Post Office Road (refer Figure 16 in HEC [2019]) and a culvert crossing is proposed to direct flow in the diversion under the realigned road. A conceptual design cross-section for the road crossing is shown in Figure 1 (provided by Arkhill Engineers). Figure 1 can also be seen as a long section of the diversion with 0 m chainage representing the upstream or eastern side of the culverts.

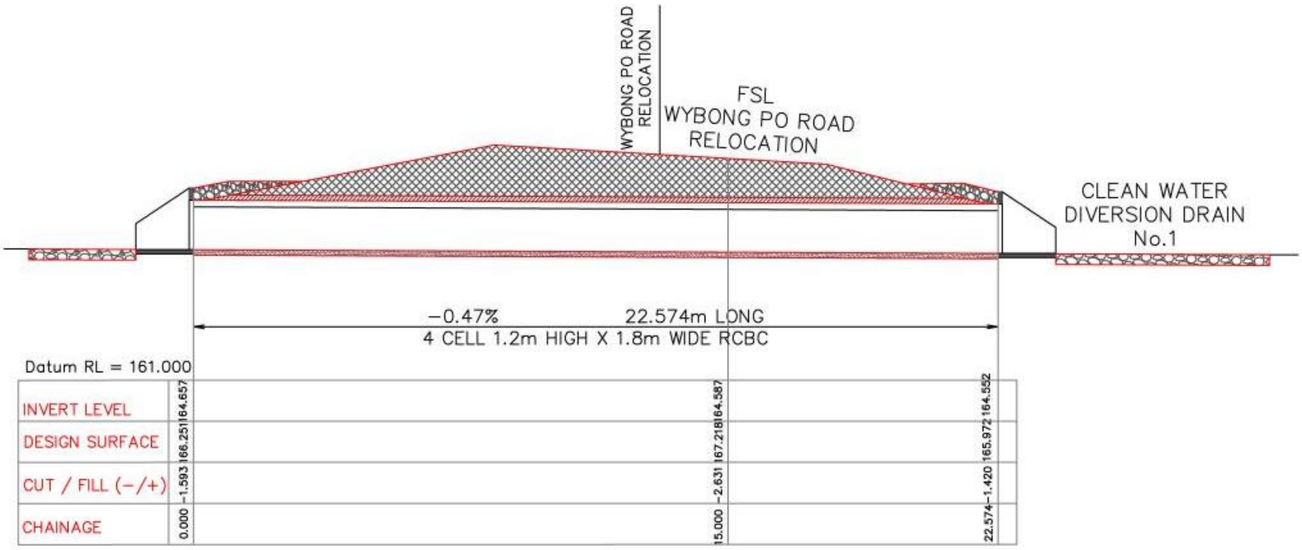


Figure 1 Wybong Post Office Road Conceptual Design Cross-Section at Culverts

The proposed crossing shown in Figure 1 includes four, 1.2 m high, 1.8 m wide box culverts, with the diversion channel comprising a trapezoidal channel 10 m in width with a 1 m high bund on the downstream side. The hydraulic capacity of the crossing has been estimated at 18.1 m^3/s. The estimated peak flow rate for a 5% annual exceedance probability (AEP) for the southern upslope diversion (with the catchment at its maximum extent of approximately 385 ha) is 17.1 m^3/s. Therefore the capacity of the proposed crossing is in excess of a 5% AEP peak flow rate for the case of the maximum diversion catchment. The diversion catchment is projected to be at its maximum extent up to and including Project Year 3. A 5% AEP peak flow rate has approximately a 14% chance of being exceeded in a 3 year period. By Year 5 (refer Figure 18 in HEC [2019]) the catchment reporting to the crossing would reduce tenfold to approximately 38.5 ha (due to expansion of the mine footprint and shortening of the diversion) and the crossing would then be able to pass peak flow rates well in excess of the 1% AEP (1% AEP peak flow rate estimated to be approximately 1 m^3/s for this catchment area).

5. Wybong Road Flooding

Agency: BCD

Submission reference:

P3 Attachment A comment 20 & P13 Attachment B recommendation 20	"Flood mapping should be provided for the 1:10 event with the project. Values of depth and velocity should be extracted from the model so that potential impacts to the trafficability and frequency of inundation of Wybong Road can be accurately assessed."

Predicted peak flood levels along Wybong Road for a 5% AEP are given in Figure 24 of HEC (2019). Predicted peak flood levels along Wybong Road for a 10% AEP are given in Figure 2. These indicate very small predicted changes in flood levels, with a maximum forecast increase in any one location of 0.16 m.

Velocity and depth data from the model have been extracted and used to produce flood hazard maps which are used to assess trafficability – refer Section 10.

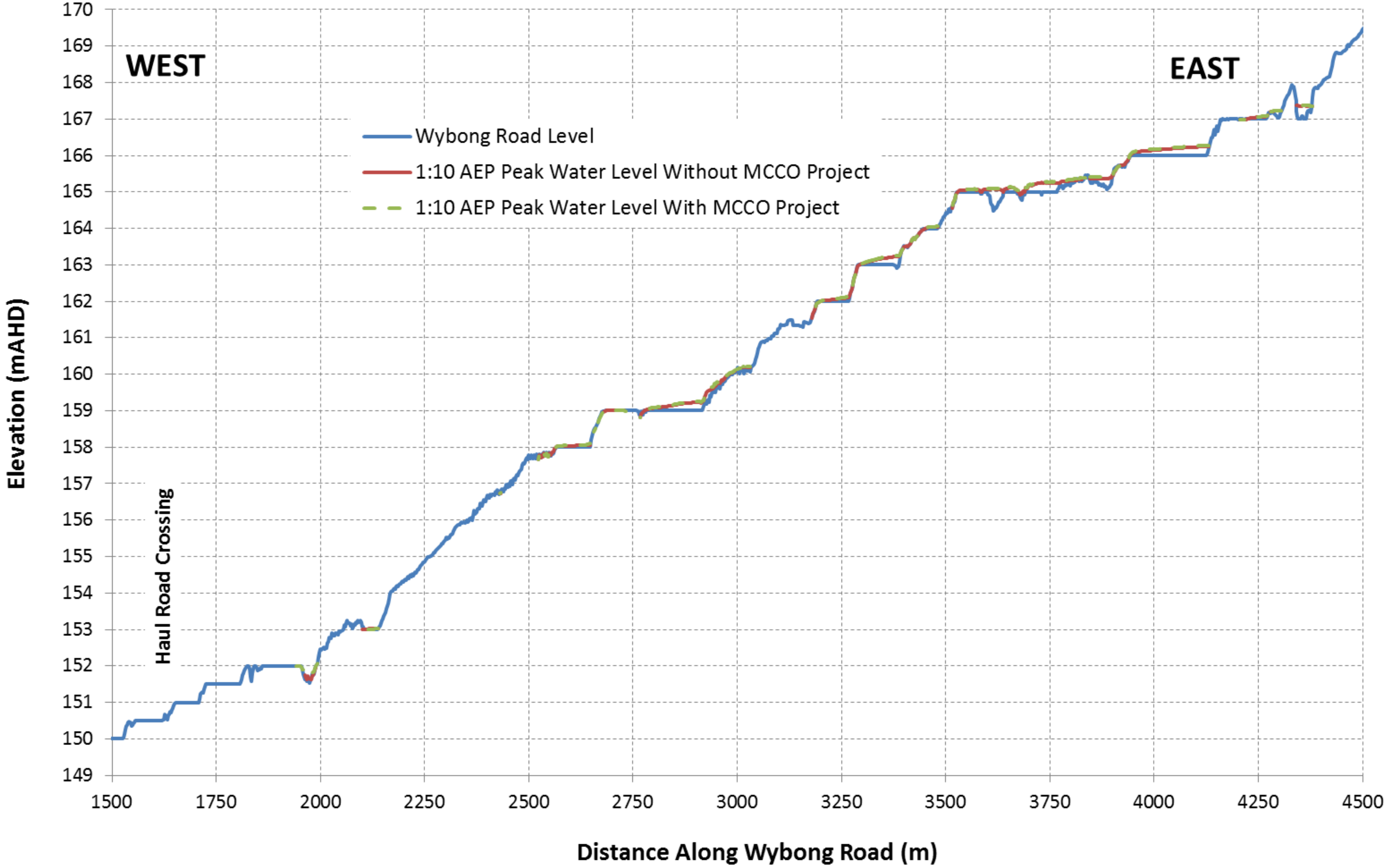


Figure 2 Longitudinal Section Along Wybong Road with Predicted Big Flat Creek Flood Levels – 10% AEP

6. Unexpected Flood Behaviour

Agency: BCD

Submission reference:

P11 Attachment B point 14	"A review of the Surface Water Assessment … does not show expected flood behaviour. For example, there appears to be little difference between the extent of floods ranging between 1:10 Annual Exceedance Probability (AEP) and 1:1,000 AEP. Flood mapping usually shows that flood extents follows creek alignments with overbank flooding extending beyond (to the sides of) the mapped creek line. The flood extent will generally be wider for larger floods. The mapped flood extents for this study do not follow the creek line in some areas and the flood extent lines shown appear to cross over the creek line in some locations. Figure B7 and B8 are both labelled 'Predicted Changes to Flood Extend -1:200 AEP' yet they show different impacts."

The predicted increase in the peak flow rate from the 10% AEP to the 0.1% AEP is less than threefold (Table 13 in HEC [2019]). Comparing Figures B-1 and B-5 in HEC (2019) indicates that there is a reasonable change in both flood levels and extent bearing in mind that the creek channels in the upstream reaches are poorly defined (refer Photo 3 and Photo 6 in HEC [2019]), typically comprising a mixture of ill-defined depressions, shallow swales and small incised channel profiles. The mapped creek lines do not necessarily follow an actual 'creek' and have been mapped approximately from topographic contours. A significant proportion of flow in these reaches would comprise overbank flow over a wide area and hence increases in flooding with decreasing AEP would be relatively small. The change in flood extent in the lower reaches of Big Flat Creek is notable with the 0.1% AEP covering a much wider area. Therefore, it is considered that the modelled flood behaviour is not unexpected.

It is noteworthy that the only area of non-Mangoola owned land within the model extent is a small parcel of Crown Land (Travelling Stock Reserve) which is located on the north side of Big Flat Creek just upstream of the proposed haul road crossing and this is the only parcel of non-Mangoola owned land that could potentially be affected. There are no private landholdings or dwellings that could be affected.

Some of the figures in Appendix B (flood maps) were incorrectly labelled. All flood maps (with corrected labels) have been reproduced as Attachment A herein.

7. ARR2016 Terminology

Agency: BCD

Submission reference:

P12 Attachment B point 16	"Australian Rainfall and Runoff 2016 (ARR2016) is used as the basis for current flood assessments and refers to AEP to describe frequency of flooding. The SWA uses a mixture of annual recurrence interval (ARI) and AEP, for example - 1:20 AEP. This should be referred to as 5% AEP. References to AEP should be reviewed throughout the SWA and EIS to ensure they are correct and adjusted where relevant, for example the 10-year recurrence interval is a 9.49% AEP."

Terminology that is consistent with ARR2016 is used throughout HEC (2019). An AEP of 1:100 = 0.01 = 1%. The term "ARI" is not used at all in HEC (2019). The use of ratios (e.g. 1:100) rather than percentages is considered a matter of semantics and is immaterial to the results of the modelling and the assessment.

8. Flood Mapping Along Roadway Below the Proposed Wybong Road Overpass

Agency: BCD

Submission reference:

P12 Attachment B point 18	"The proposed flood bund runs adjacent and parallel to Wybong Road in the vicinity of the proposed Wybong Road overpass. The bund wall ties into the higher ground of the proposed overpass. Pre-development mapping shows significant overbank flows on the bund wall side of Wybong Road. These will be deflected by the bund wall and embankment for the overpass. Flood mapping provided in the SWA shows a decrease in flooding at the overpass location. This indicates that the surface levels used in the flood model in this location reflect the overpass levels not the roadway levels. An increase in flooding is shown immediately downstream of the overpass."

Modelling indicates that overbank flows on the northern side of Big Flat Creek do not extend relatively far into the MCCO Additional Project Area for existing conditions – refer Map A-8 in Attachment A (0.5% AEP) which shows the existing peak flood extending approximately 80 m (maximum) into the MCCO Additional Project Area (north-east corner of Map A-8), compared with an approximate 320 m total flooding extent in Big Flat Creek adjacent.

A decrease in flood extent within the proposed haul road crossing (i.e. overpass extent) in going from the existing situation to the situation with the crossing in place is to be expected (e.g. Map A-18) – where there is currently flooded area that will be occupied by the embankment once the crossing is developed.

As stated in Section 3.2.2 of HEC (2019), for the 1% AEP (Figure 22 in HEC [2019]), the increased inundation area downstream of the proposed haul road crossing is associated with flow which would pass through the proposed Wybong Road overpass – the depth of this predicted increase in inundation area diminishes with distance downstream (e.g. Map A-21) . For the 0.1% AEP (Map A-28) the increased inundation area downstream of the proposed haul road crossing extends further downstream because more flow would pass through the proposed Wybong Road overpass. This is elaborated further in the responses below. Note that all of the predicted flood increases up to the 1% AEP are located on Mangoola-owned land except for Wybong Road.

9. Flood Behaviour along Wybong Road Under the Proposed Overpass

Agency: BCD

Submission reference:

P13 Attachment B recommendation 18	"The flood behaviour along Wybong Road under the proposed overpass should be reviewed to ensure that safety of the roadway is not compromised by the bund wall and overpass embankment."

A typical section of the proposed Wybong Road overpass is shown in Figure 3 (provided by Arkhill Engineers). Also shown in Figure 3 is the predicted peak flow depth for the 1% AEP flow with the presence of the overpass. The flow depth in a 1% AEP event versus time on Wybong Road just upstream of the overpass is shown by the hydrograph in Figure 4.

Roadway flood hazard is addressed in the following section (Section 10). Note that Wybong Road would be flood affected and unsafe for vehicles and people in several places in a 1% AEP flow in the existing situation.

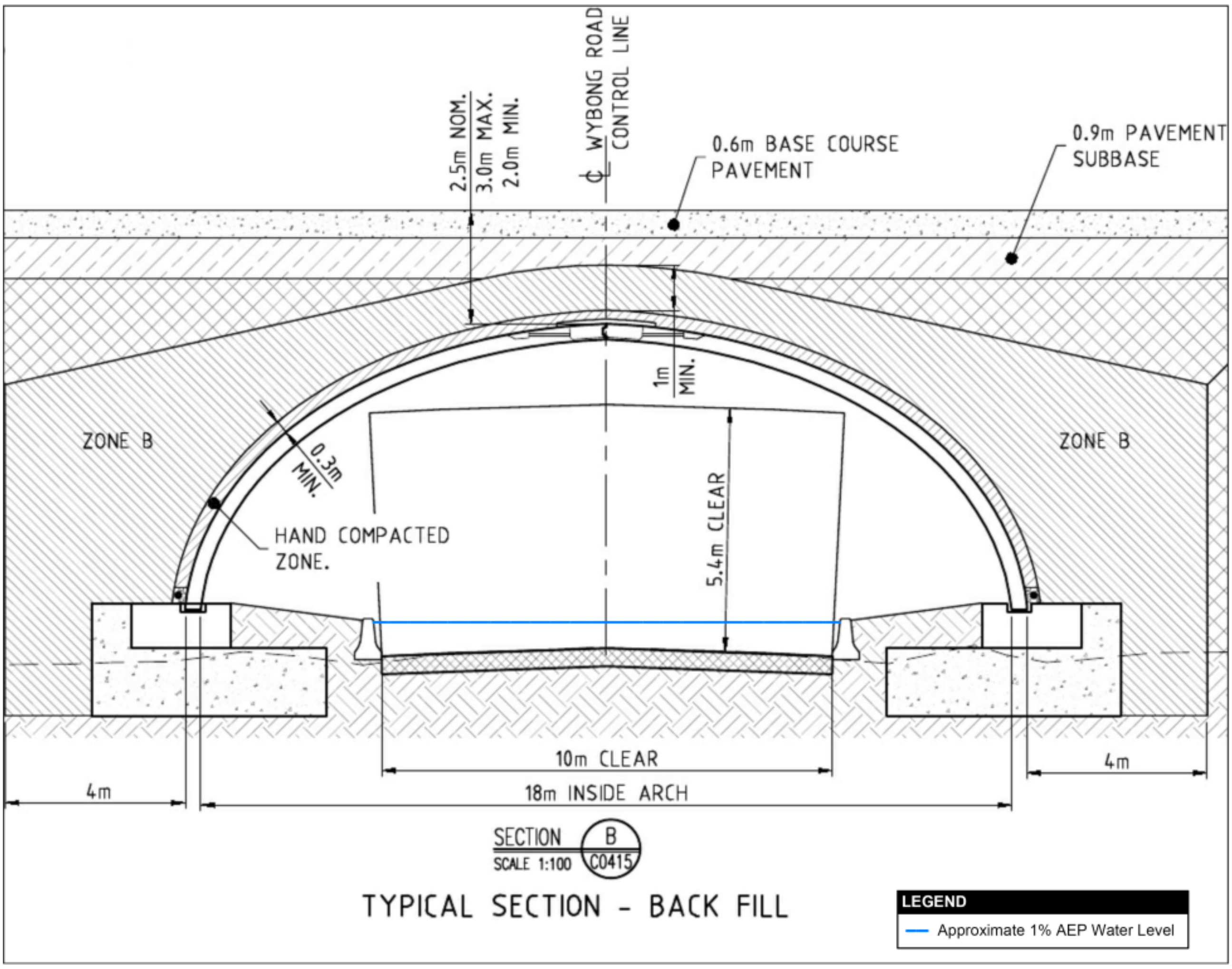


Figure 3 Wybong Road Overpass Conceptual Design Cross-Section

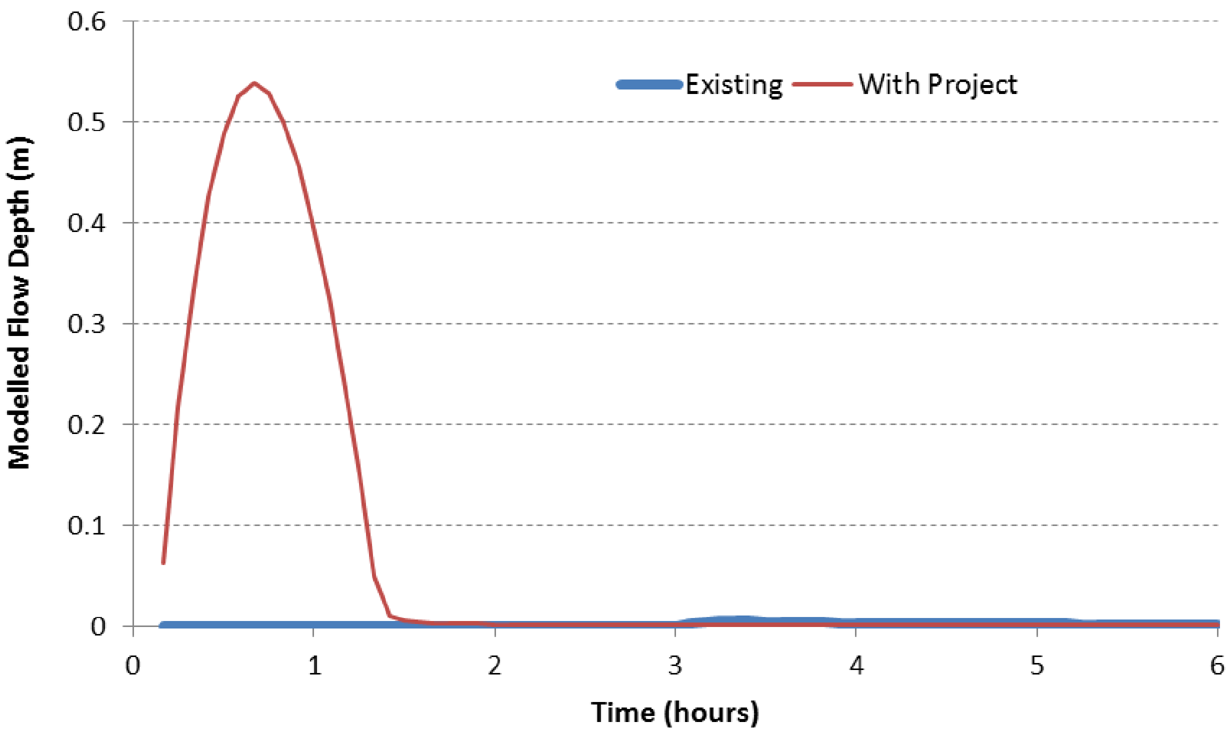


Figure 4 1% AEP Flood Hydrograph on Wybong Road Upstream of Overpass

10. Wybong Road Trafficability and Flood Hazard

Agency: BCD

Submission reference:

P13 Attachment B point 19 and Recommendation 20	"The flood model should be interrogated to provide point measurements for flood depth and velocities at points on Wybong Road to ensure trafficability is accurately assessed." "The trafficability should be undertaken in accordance with the *Australian Institute for Disaster Resilience's Australian Emergency Management Handbook 7* or an equivalent standard to determine if the combination of increased depth and velocity changes the hazard rating." "Flood mapping should be provided for the 1:10 event with the project. Values of depth and velocity should be extracted from the model so that potential impacts to the trafficability and frequency of inundation of Wybong Road can be accurately assessed".

A flood hazard assessment has been undertaken as outlined in the Australian Institute for Disaster Resilience's (AIDR) Australian Emergency Management Handbook 7 (2017)[8]. Flood model results were used to generate the product of peak depth and velocity along Wybong Road. Tables 1 and 2 and Figure 6 in AIDR (2017) were used to define the flood hazard vulnerability classification along Wybong Road for the following flood events: 10% AEP, 1% AEP and probable maximum flood (PMF). According to Table 1 in AIDR (2017), hazard vulnerability classifications range from H1 to H6, with classifications described as follows:

- H1: Generally safe for vehicles, people and buildings;
- H2: Unsafe for small vehicles;
- H3: Unsafe for vehicles, children and the elderly;
- H4: Unsafe for vehicles and people;
- H5: Unsafe for vehicles and people; all building types vulnerable to structural damage; some less robust building types vulnerable to failure; and
- H6: Unsafe for vehicles and people; all building types considered vulnerable to failure.

Predicted hazard classifications for Wybong Road for the three flood events are given in Figure 6 to Figure 8, while Figure 5 shows chainages along Wybong Road used in the hazard classification plots.

[8] Australian Institute for Disaster Resilience (2017), "Australian Disaster Resilience Guideline 7-3 Flood Hazard", East Melbourne, 2nd edition.

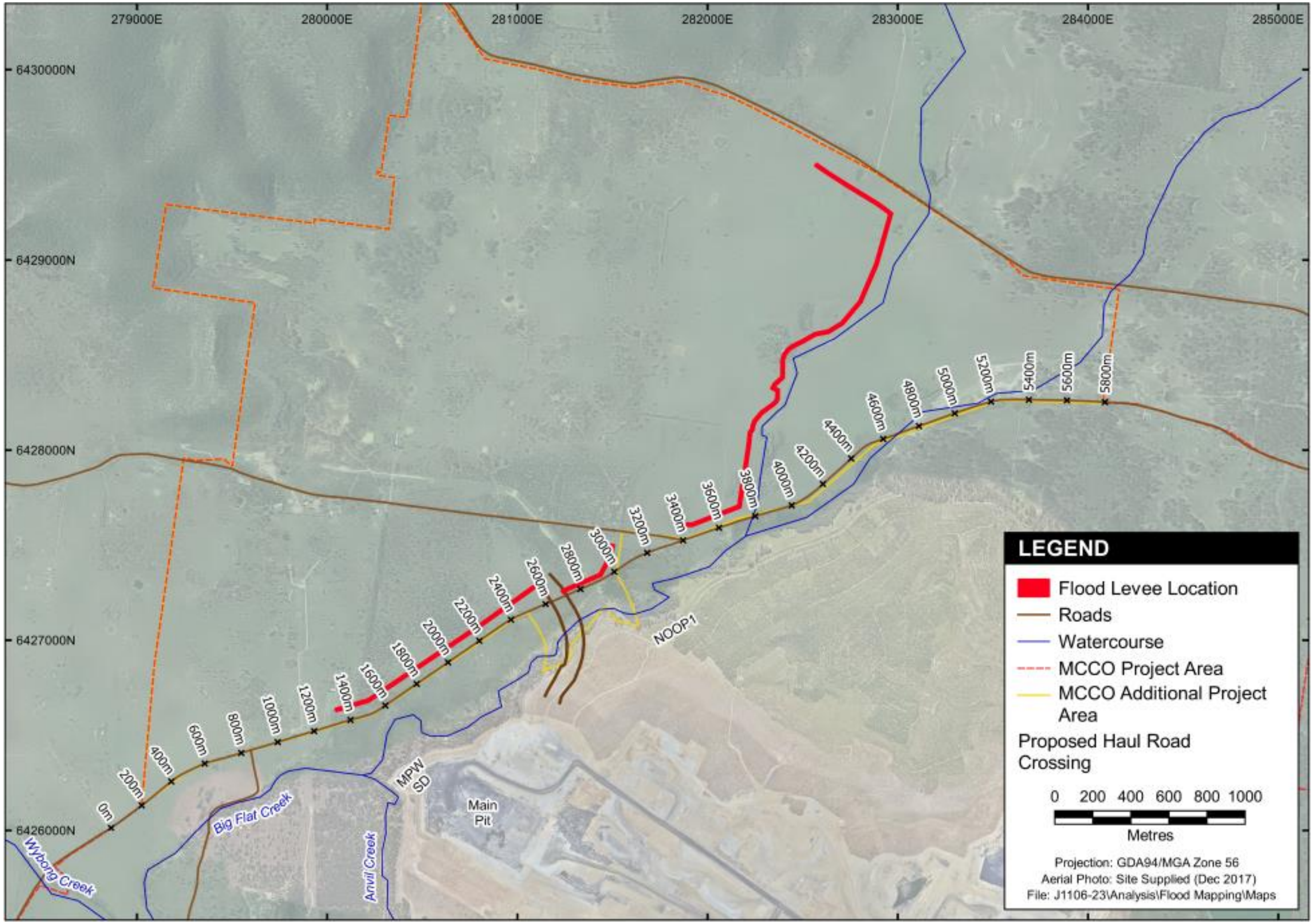


Figure 5 Wybong Road Chainages used in Flood Hazard Classification Plots

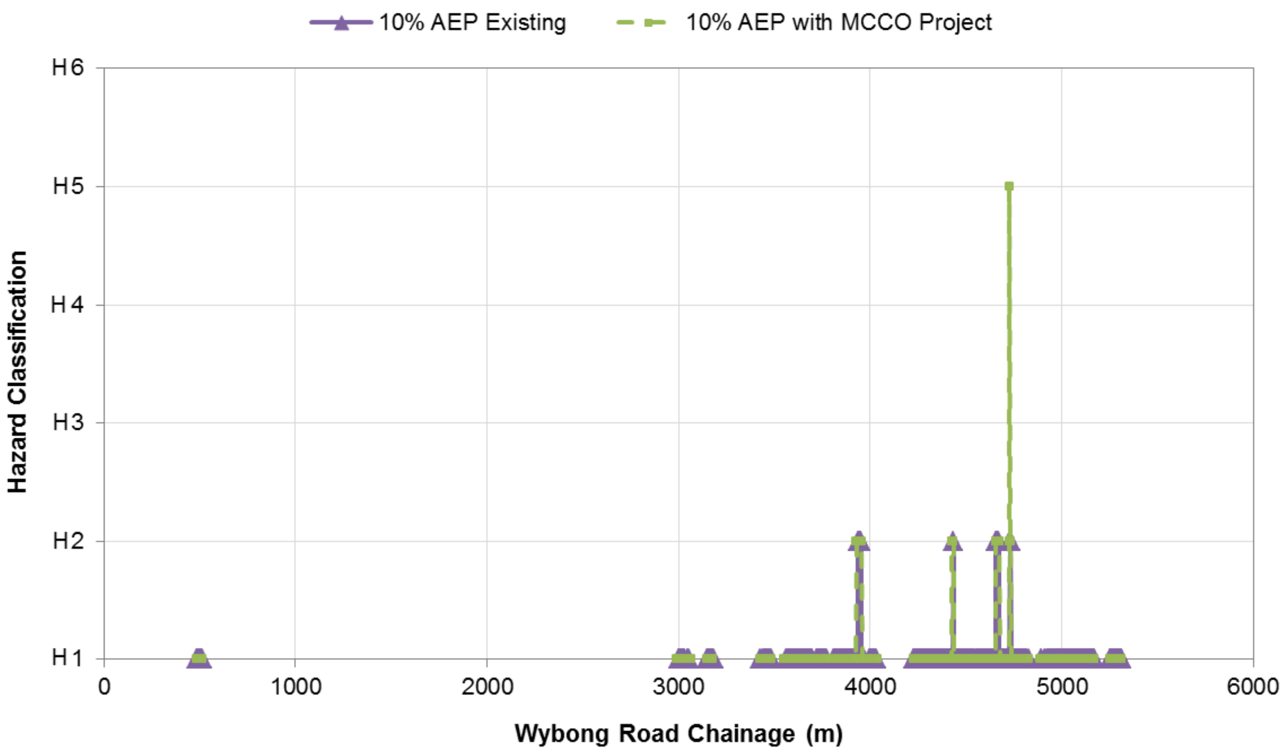


Figure 6 Wybong Road Predicted Flood Hazard Classification: 10% AEP

The single H5 point in Figure 6 results from exceedance of the 2.0 m/s velocity threshold. The predicted road velocity at this point for the existing case is 1.97 m/s while the predicted velocity with the MCCO Project is 2.02 m/s – an increase of only 2.5%. The corresponding depth increase at this point is 0.03 m. Apart from this, predicted changes comprise an increase in one hazard classification over short lengths of road.

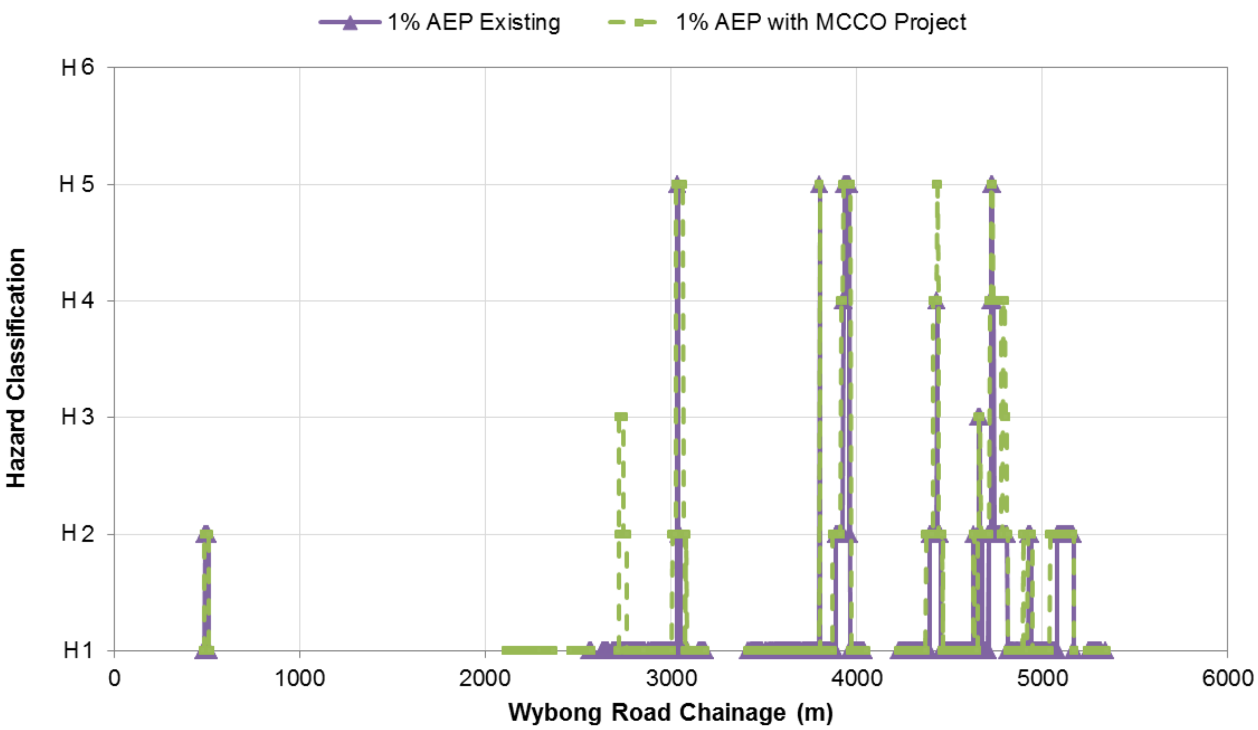


Figure 7 Wybong Road Predicted Flood Hazard Classification: 1% AEP

The most notable changes evident in Figure 7 are an increase from a H1 hazard classification to either H2 or H3 for approximately 40 m length of road near chainage 2,750 m (just upstream of the proposed overpass) and an increase from a H1 or H2 hazard classification to H5 for approximately 35 m length of road near chainage 3,050 m. There is also an increase of typically 1 classification level for a distance of approximately 60 m near chainage 4,400 m. Taken together, these lengths comprise approximately 6% of the already affected length of road that is predicted to be more affected by floodwaters in a 1% AEP than for the existing situation. A 6% length of road that would be more affected by floodwaters is not considered a significant increase. It should also be noted that the road is predicted in the existing situation to have a hazard classification of H3 to H5 in some areas and therefore would not be trafficable in a 1% AEP event. Therefore the inability of traffic to travel along Wybong Road in a 1% AEP would be unaffected by the Project.

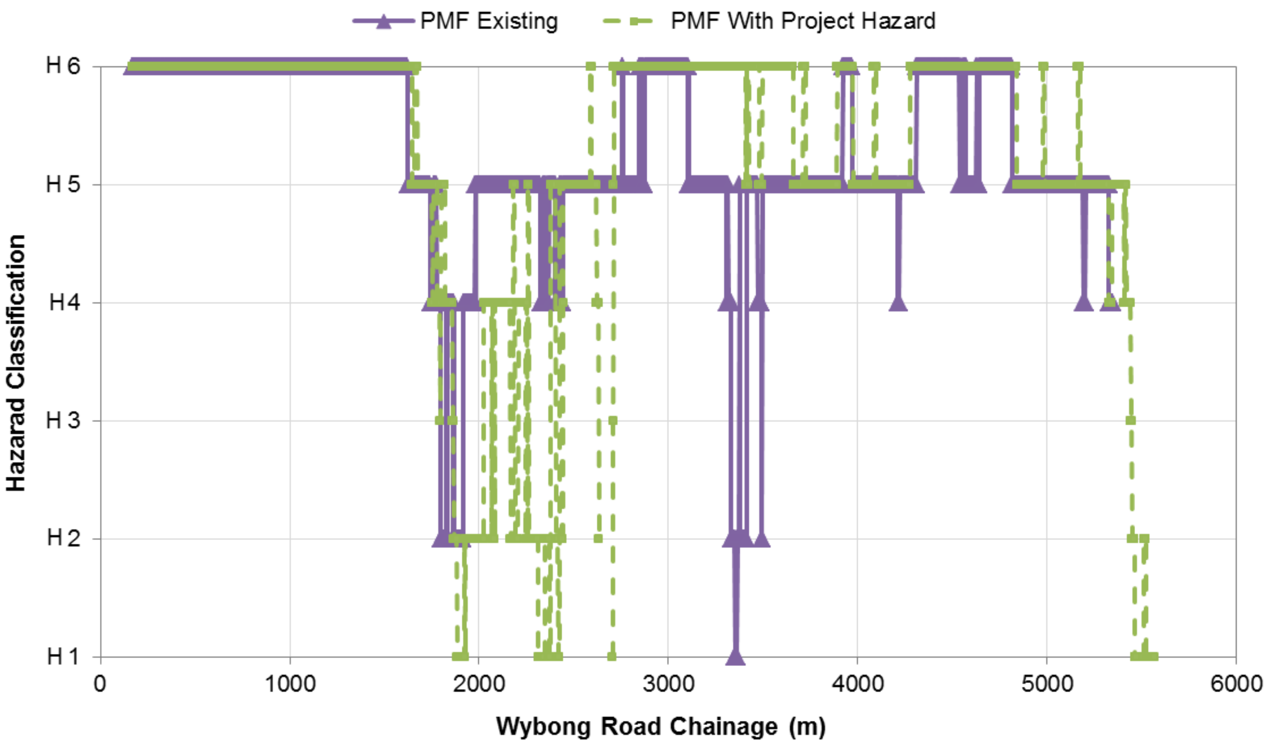


Figure 8 Wybong Road Predicted Flood Hazard Classification: PMF

The PMF is a hypothetical flood estimate whose magnitude is such that there is negligible chance of it being exceeded. It represents a notional upper limit of flood magnitude – i.e. the largest flood that could conceivably occur at a particular location. Such a flood could be expected to cause widespread major damage to both the landscape generally as well as infrastructure and would pose a high risk of injury and possible loss of life depending on the population density at the location at the time.

For the peak of the PMF (Figure 8) the majority of Wybong Road in the existing situation is predicted to have a hazard classification of H5 or H6. For the length of road from approximately chainage 1,900 m to 2,700 m, the hazard classification for the situation with the MCCO Project is predicted to reduce due to the presence of the haul road crossing causing inflow to the MCCO Additional Project Area (the proposed levee has been set at a level to prevent inflow from the 0.1% AEP peak flow and would be overtopped in a PMF). Further upstream the majority of the road length would experience no change in hazard classification or an increase in hazard of 1 classification level. An approximate 100 m length of road near chainage 3,400 m is predicted to experience an increase of more than 1 classification level.

A summary of the predicted change in Wybong Road length in each flood hazard category is given in Table 3.

Table 3 Wybong Road Modelled Flood Hazard Summary

Flood Event		Length of Wybong Road with Given Flood Hazard Classification (m)					
		H1	**H2**	**H3**	**H4**	**H5**	**H6**
10% AEP	Existing	1,397	39	0	0	0	0
	With MCCO Project	1,434	69	0	0	2	0
1% AEP	Existing	1,638	332	7	20	41	0
	With MCCO Project	1,727	416	44	102	101	0
PMF	Existing	23	172	6	320	2,604	2,180
	With MCCO Project	159	277	18	309	1,416	3,123

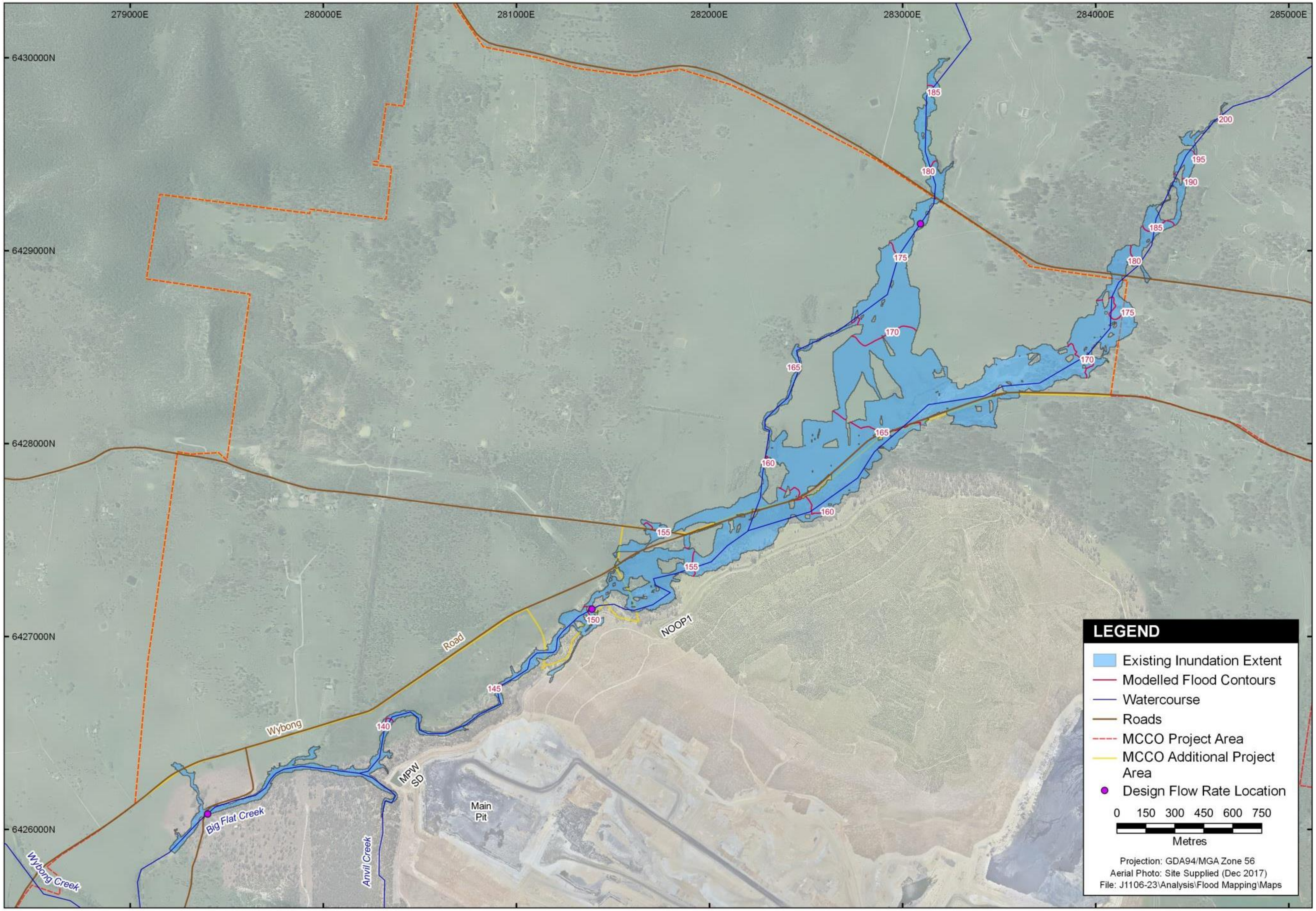
We trust that the above addresses the relevant agencies submissions. Please contact the undersigned if you have any queries.

Yours faithfully,

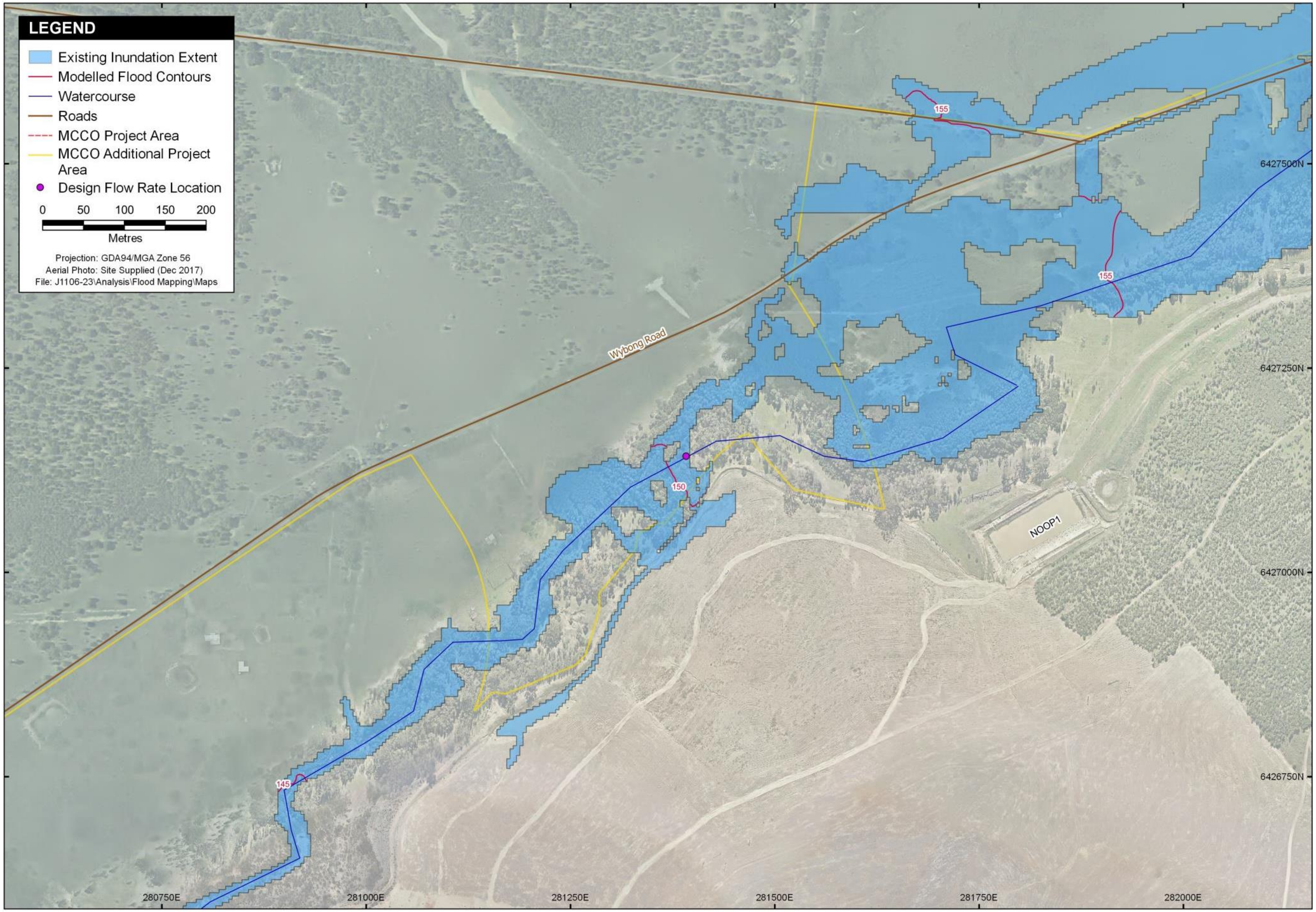
Tony Marszalek
Director

ATTACHMENT A

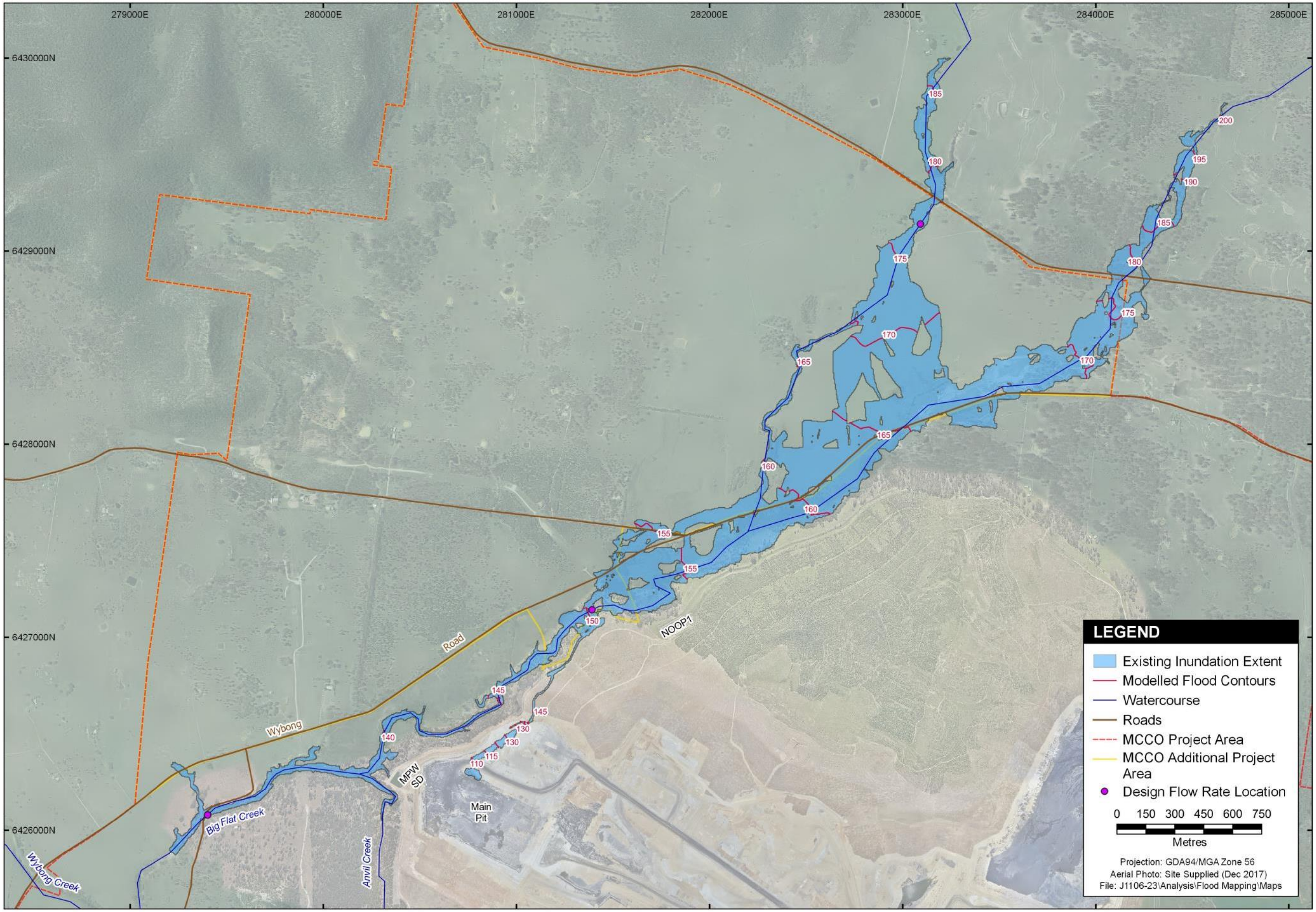
FLOOD MAPS



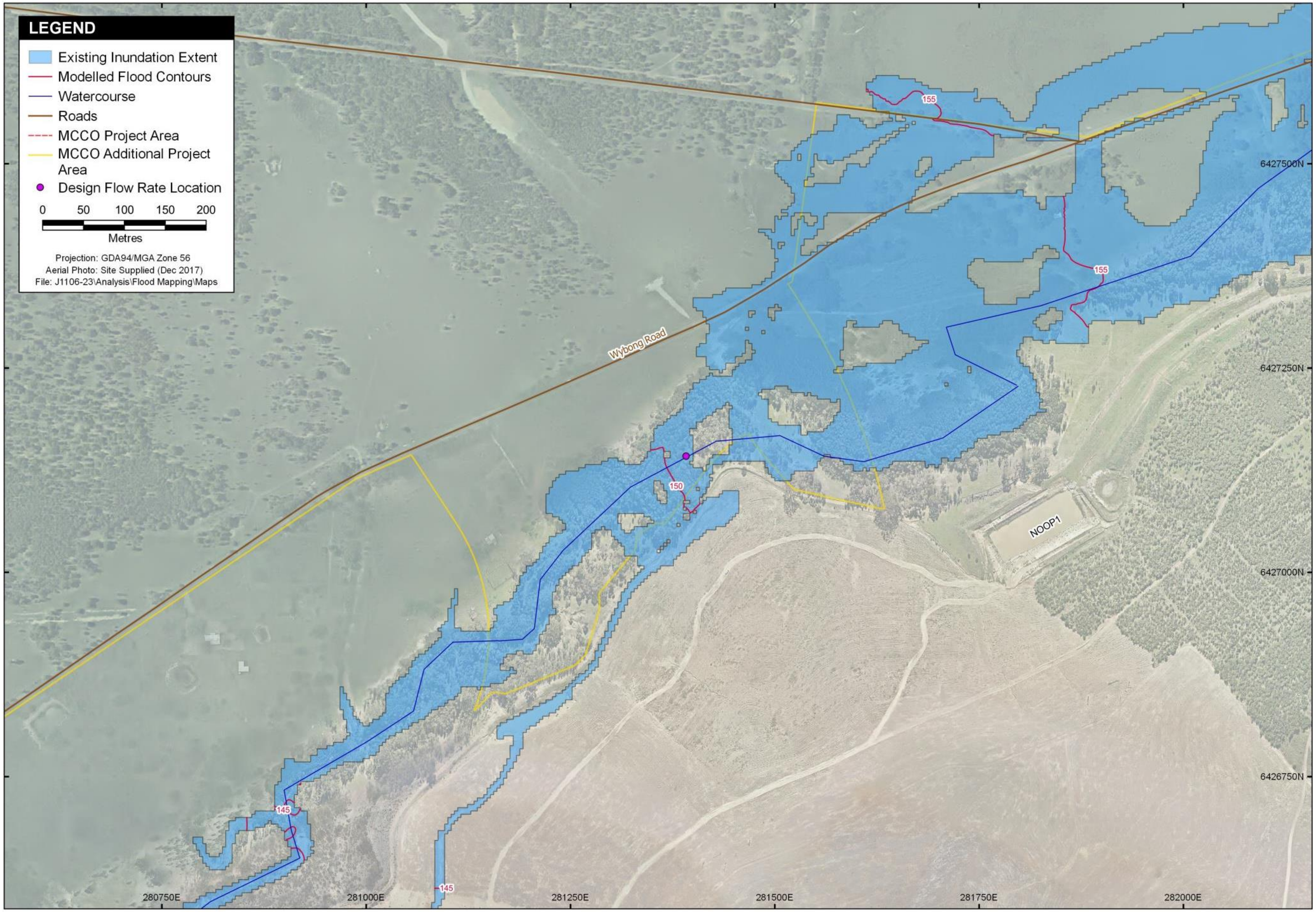
Map A-1 Predicted Existing Flood Levels (mAHD) and Flooding Extent – 10% AEP



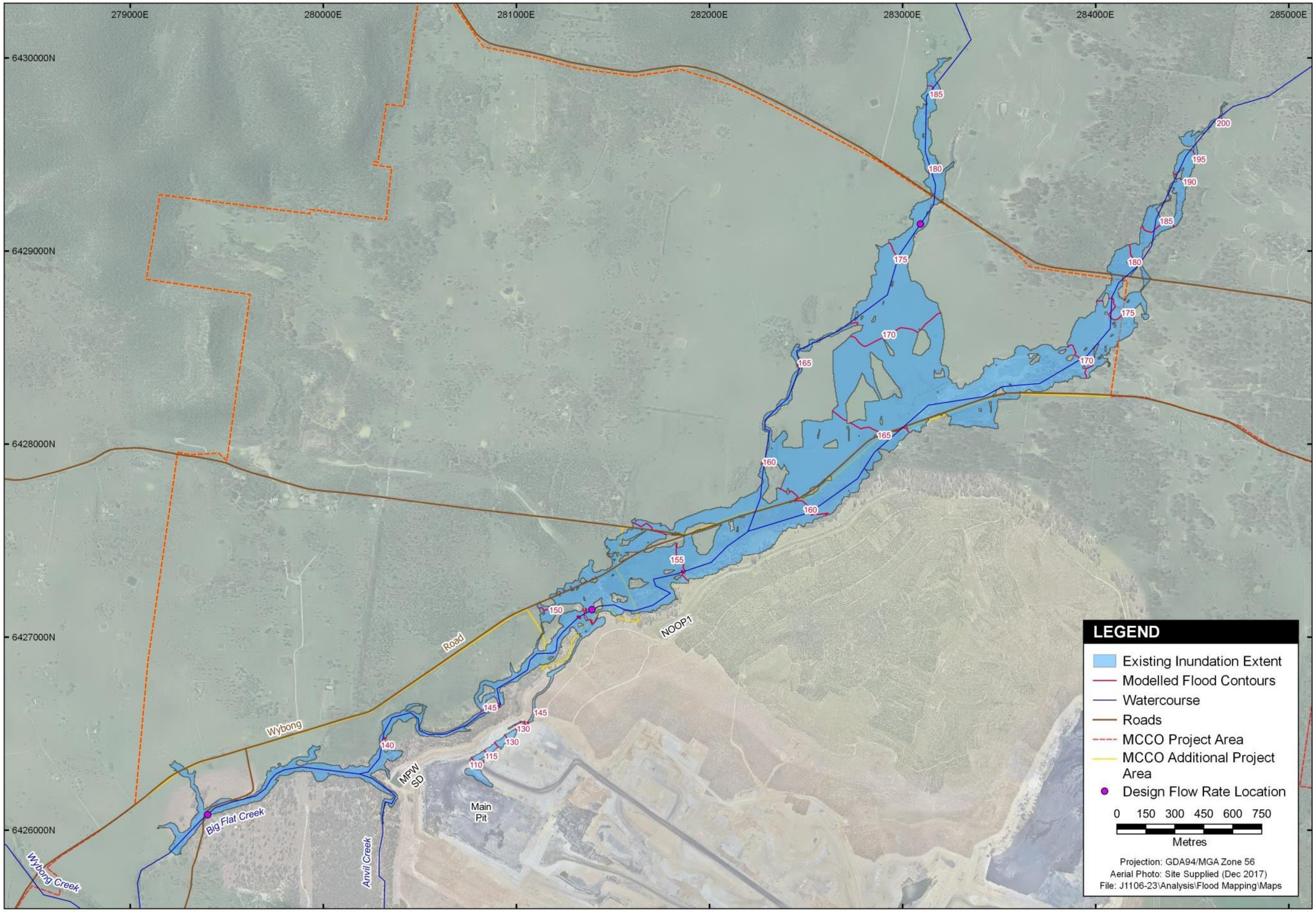
Map A-2 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – 10% AEP



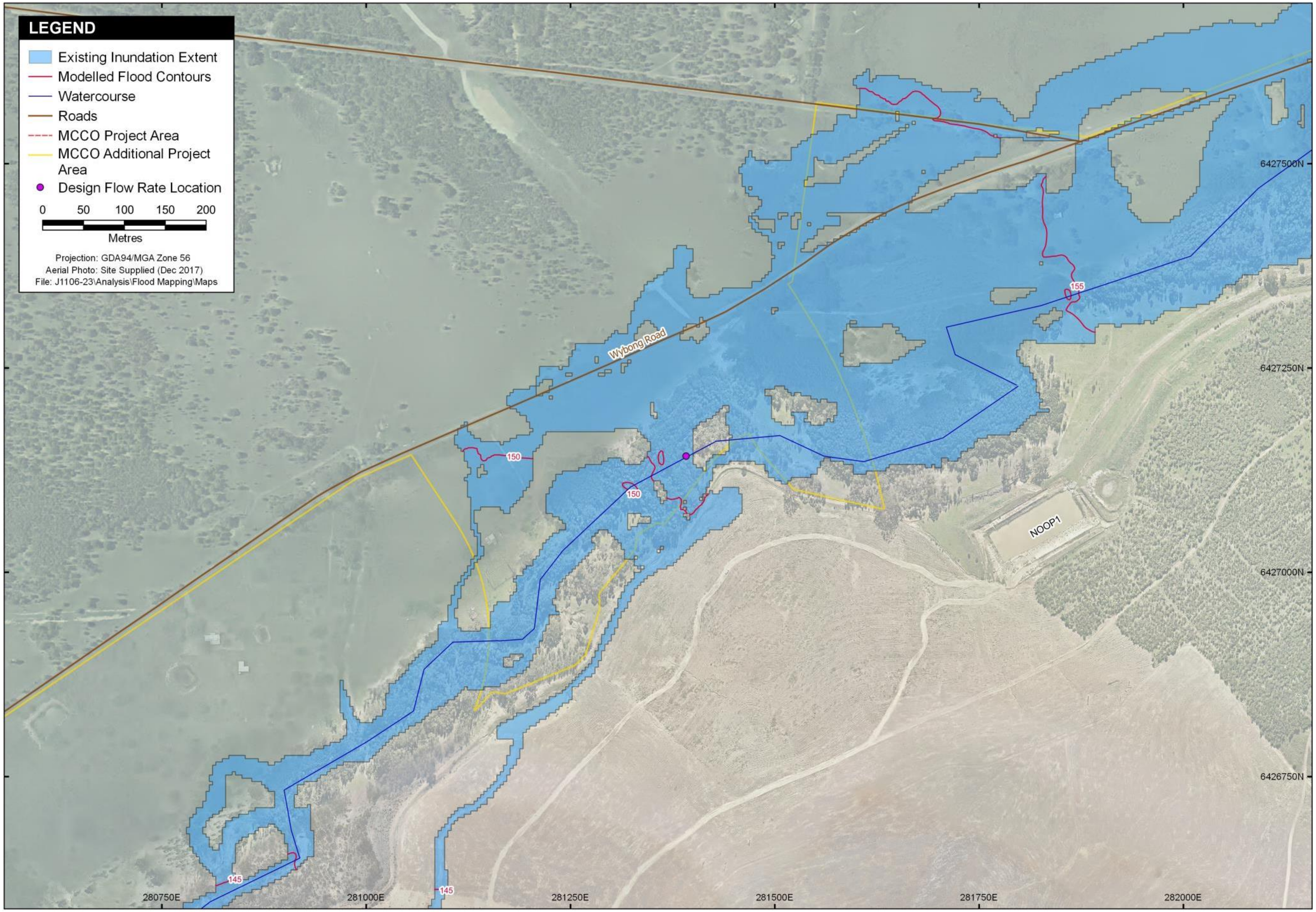
Map A-3 Predicted Existing Flood Levels (mAHD) and Flooding Extent – 5% AEP



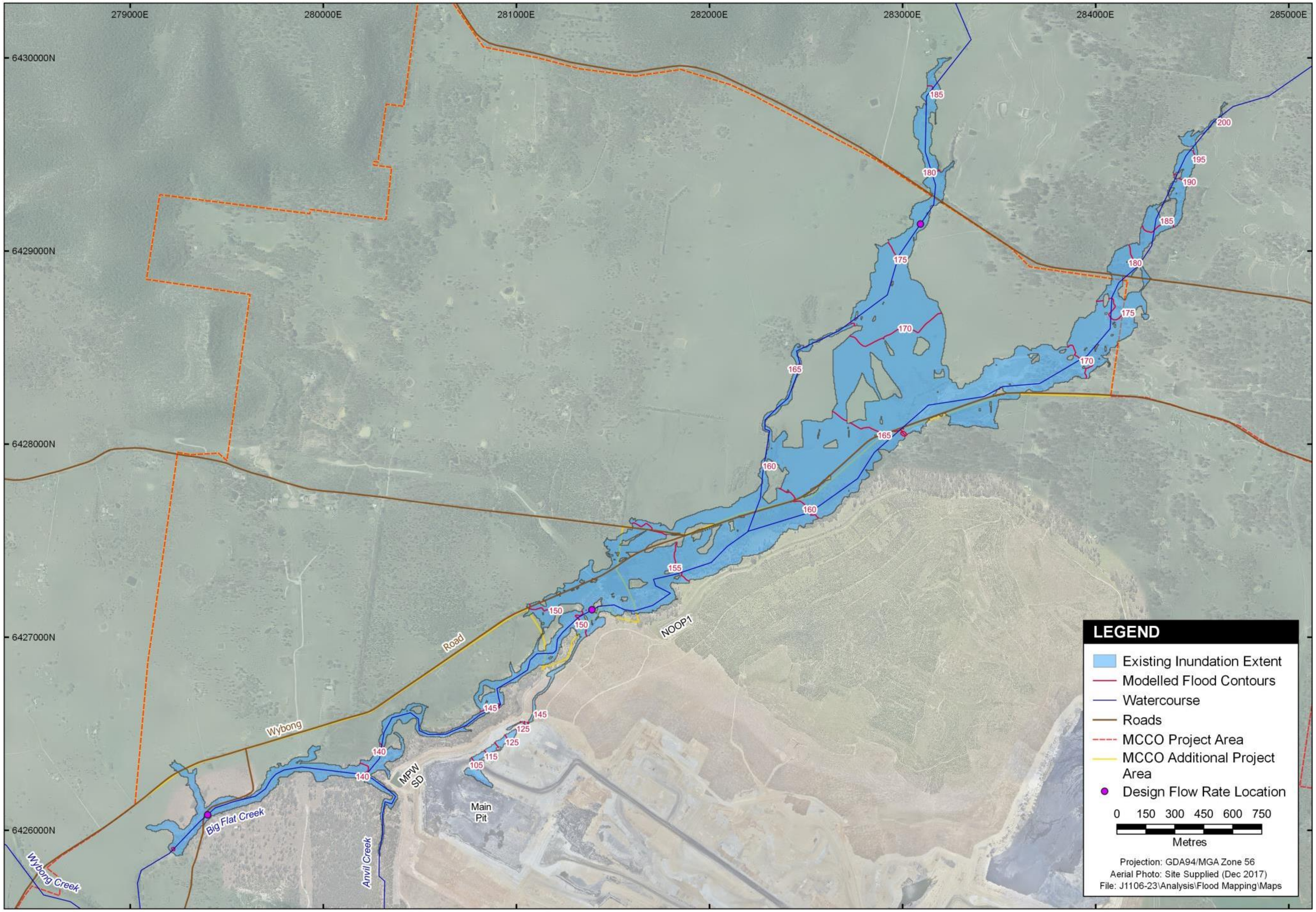
Map A-4 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – 5% AEP



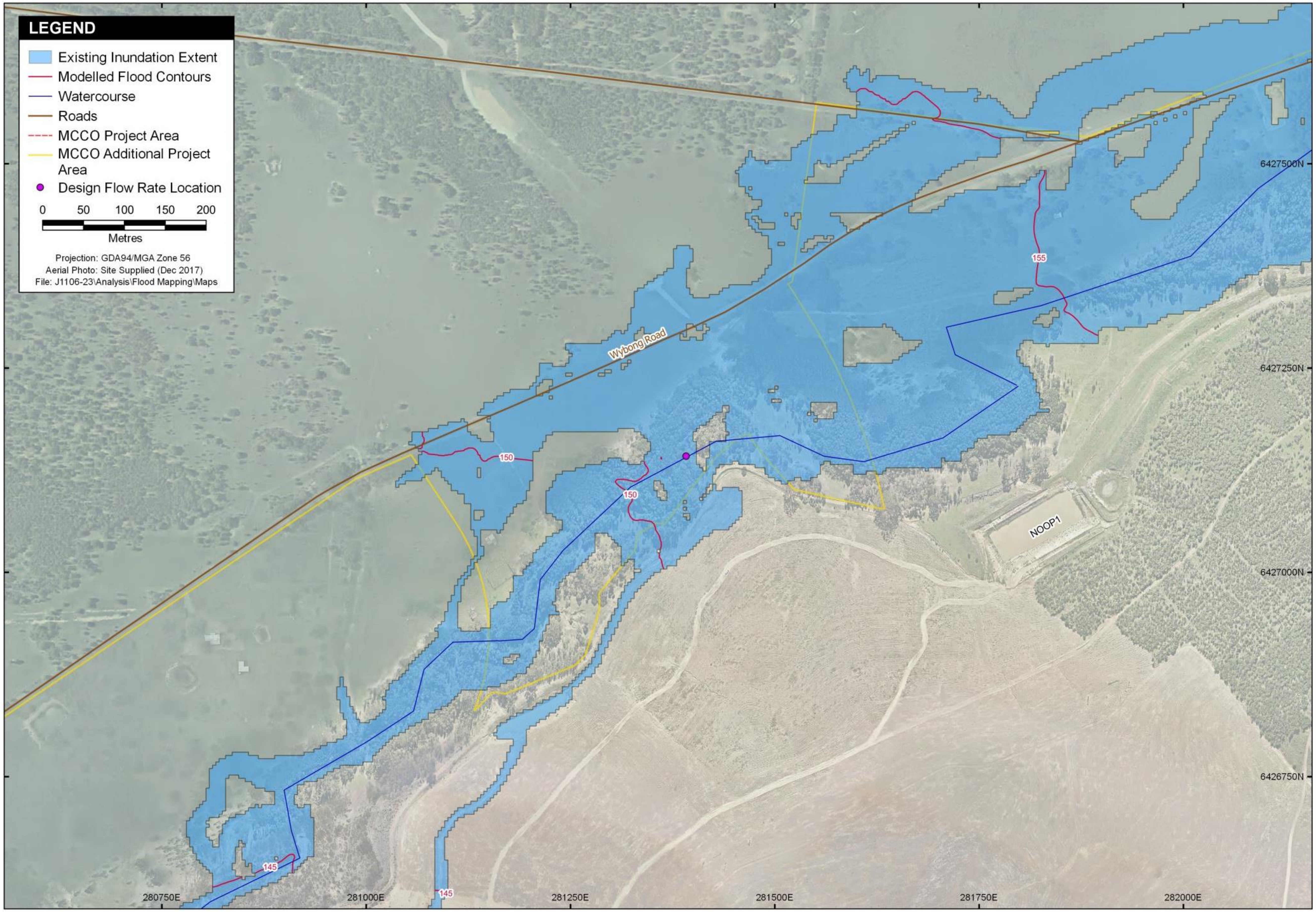
Map A-5 Predicted Existing Flood Levels (mAHD) and Flooding Extent – 1% AEP



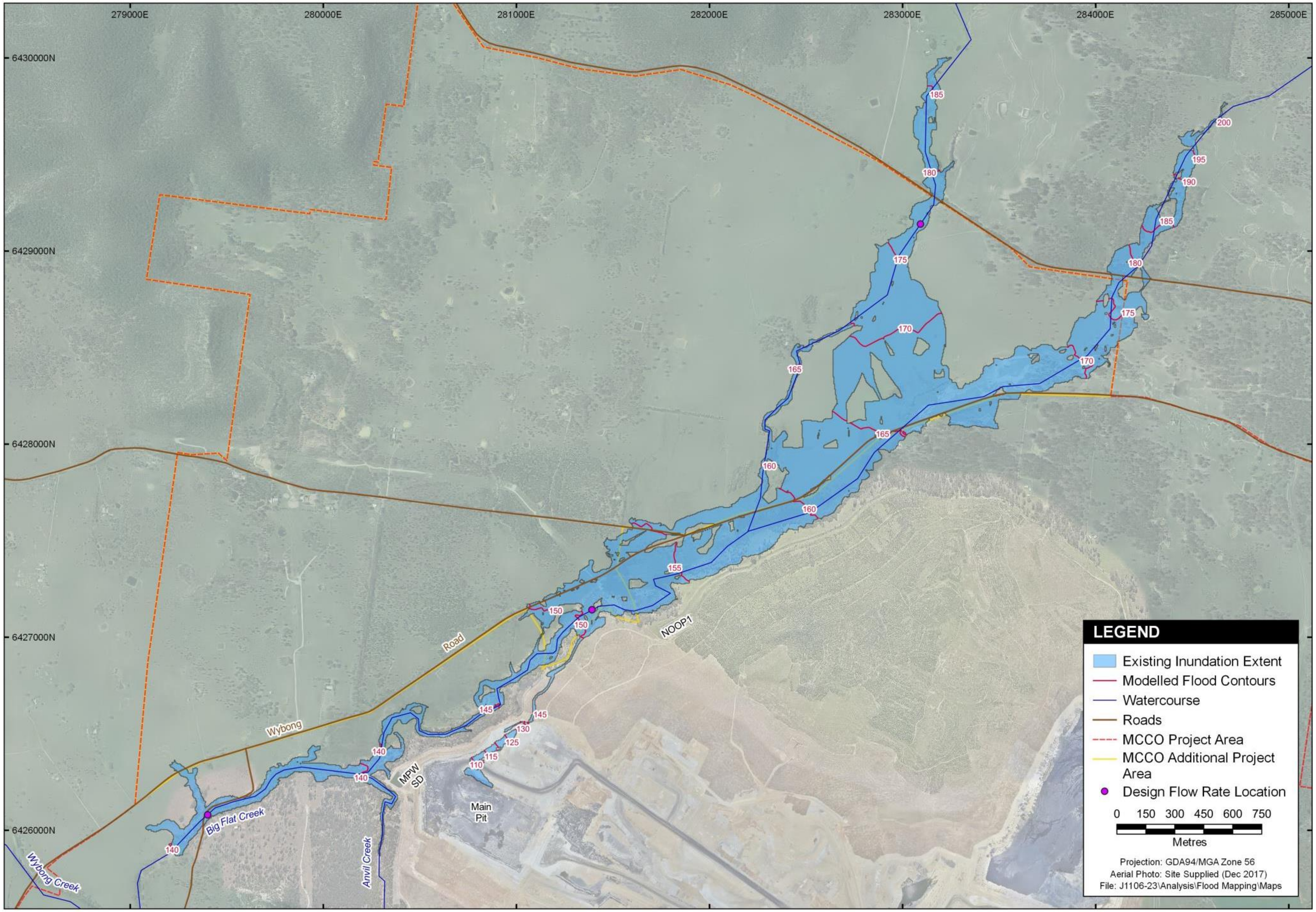
Map A-6 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – 1% AEP



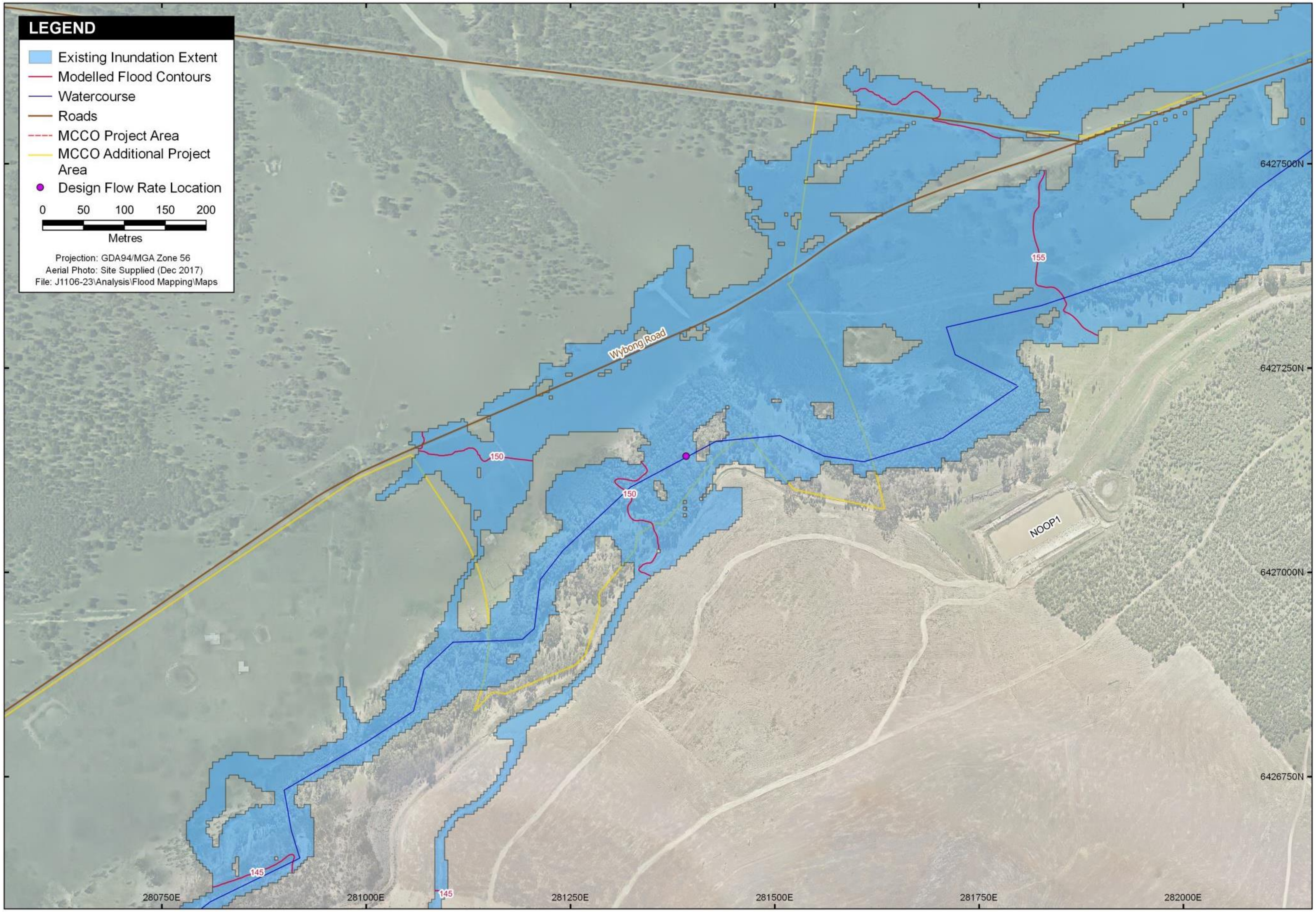
Map A-7 Predicted Existing Flood Levels (mAHD) and Flooding Extent – 0.5% AEP



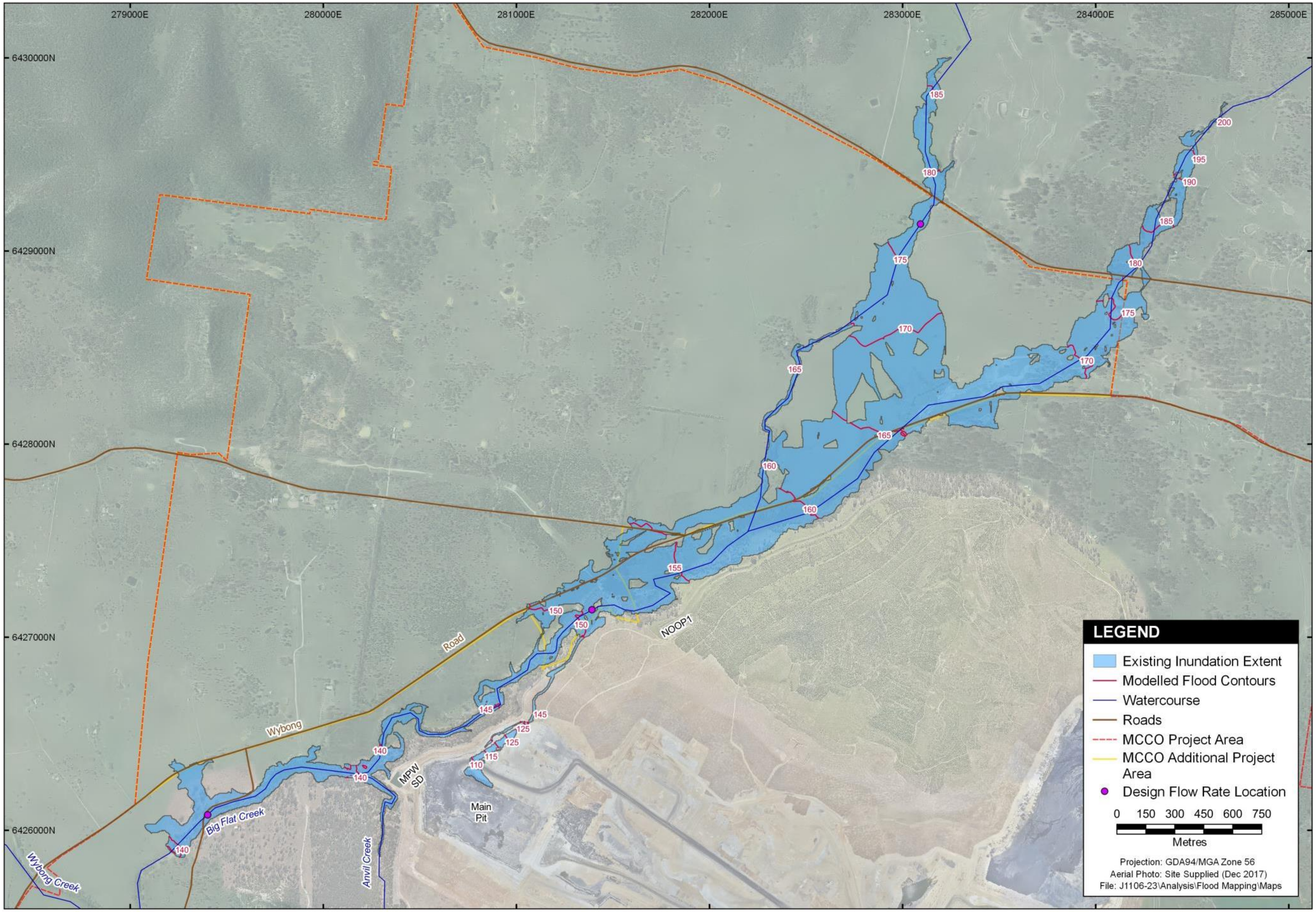
Map A-8 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – 0.5% AEP



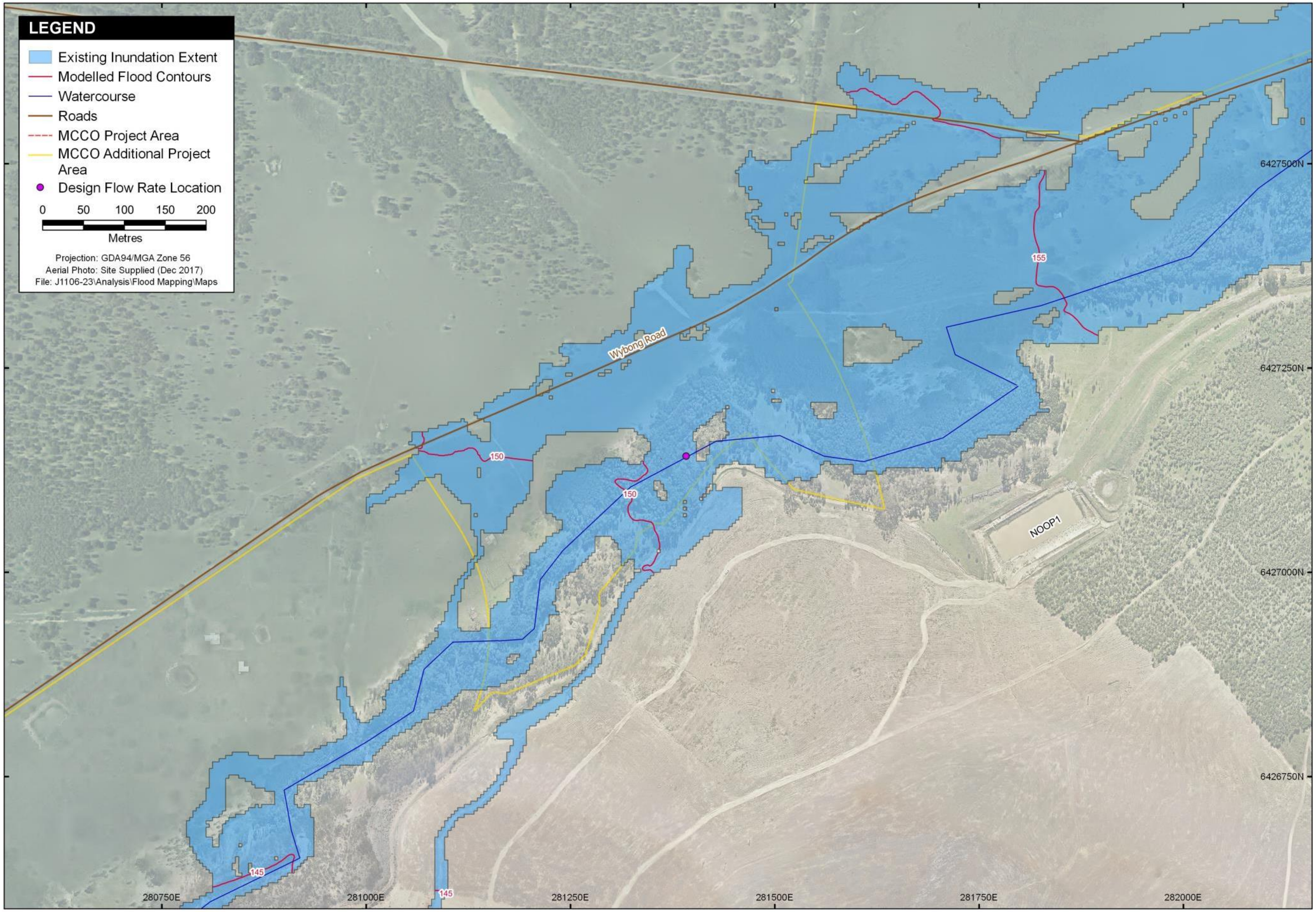
Map A-9 Predicted Existing Flood Levels (mAHD) and Flooding Extent – 0.4% AEP



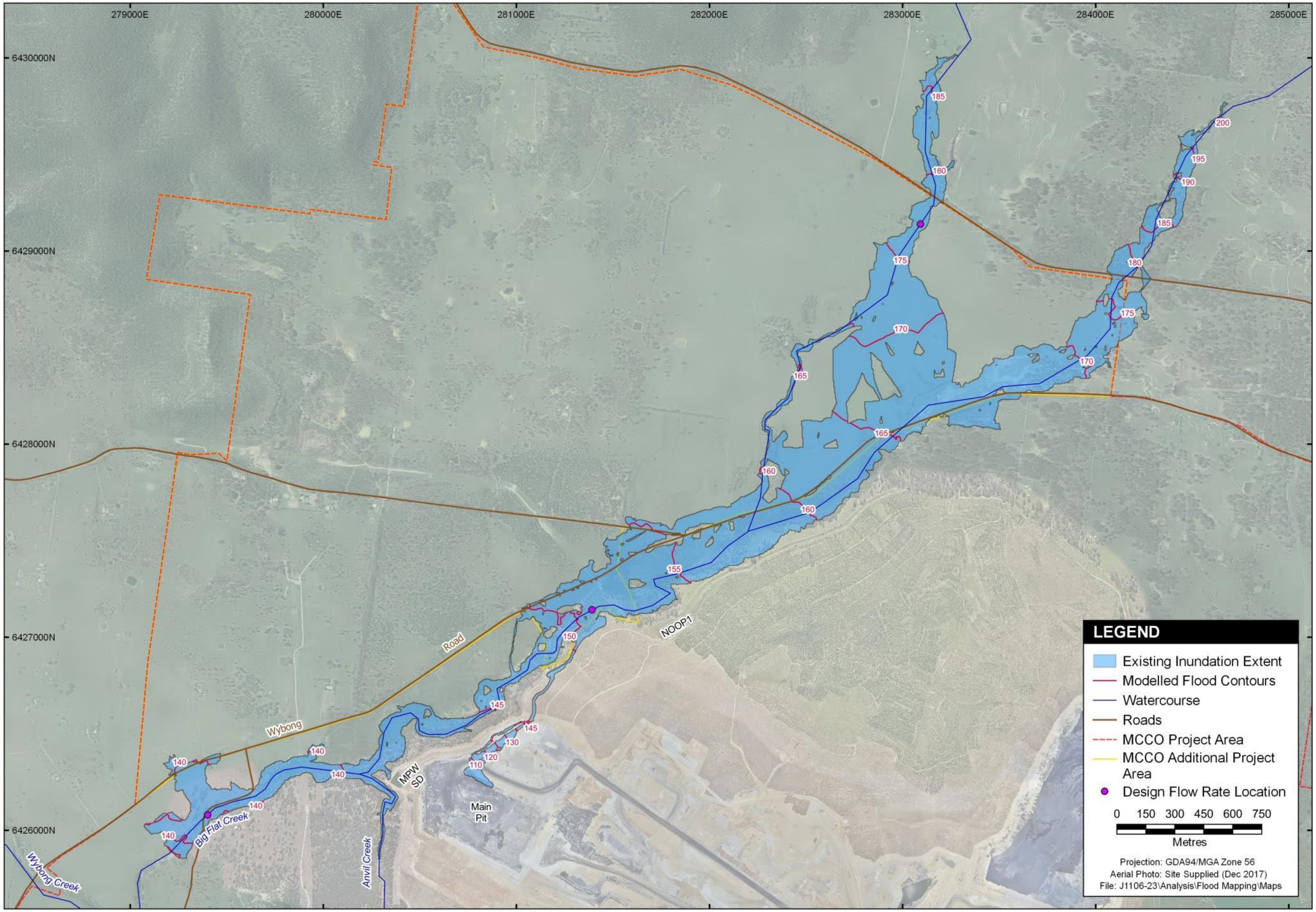
Map A-10 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – 0.4% AEP



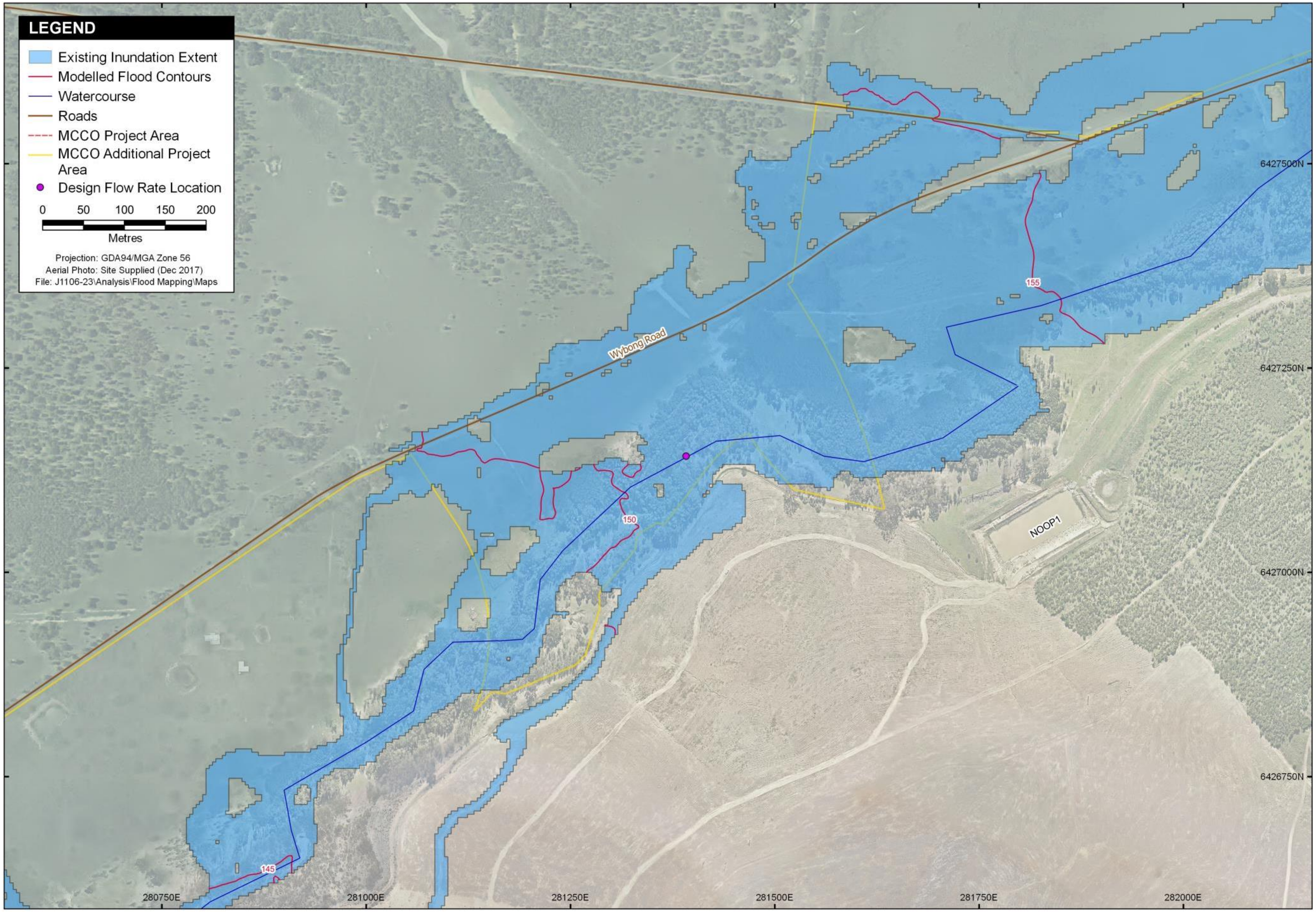
Map A-11 Predicted Existing Flood Levels (mAHD) and Flooding Extent – 0.2% AEP



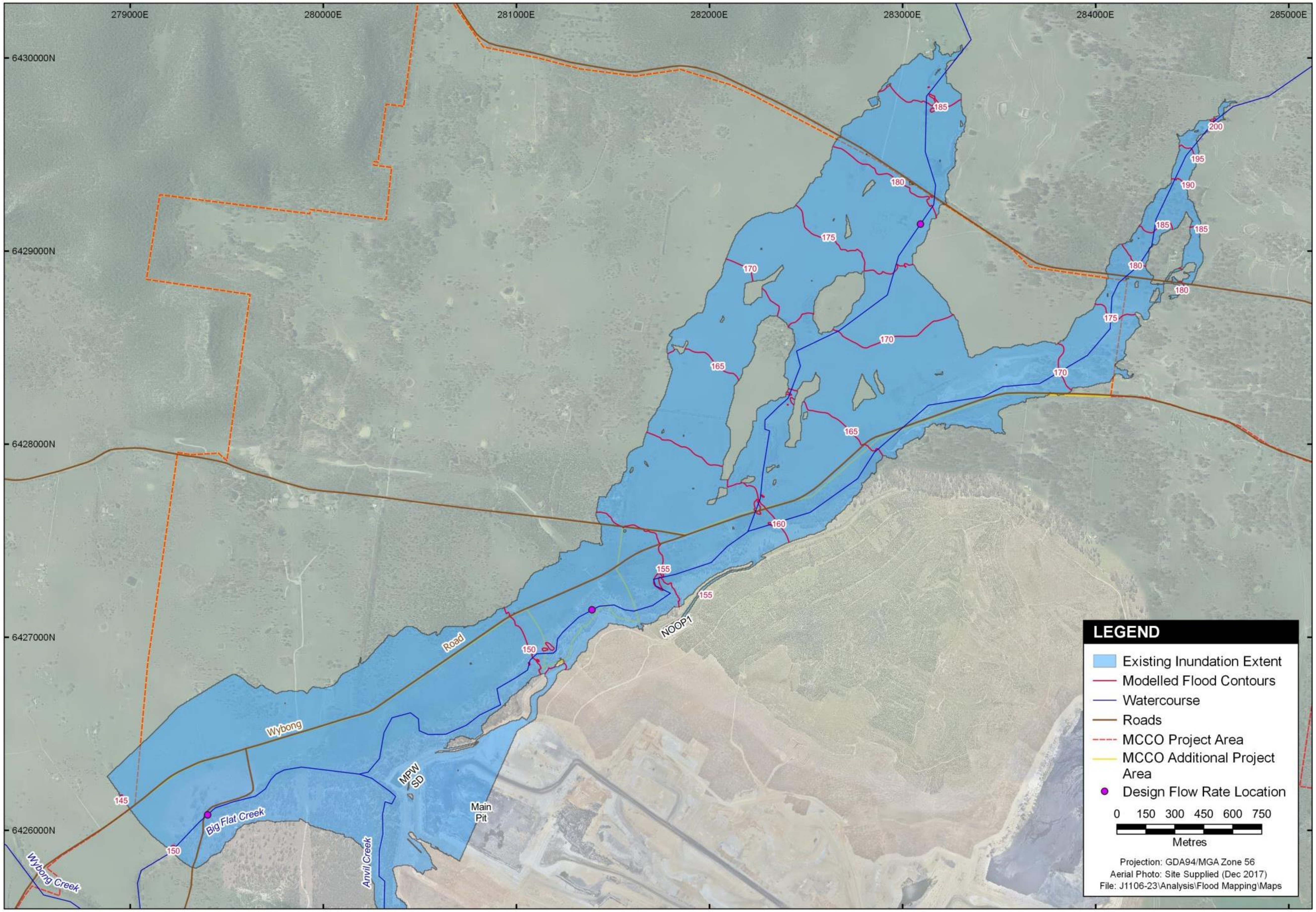
Map A-12 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – 0.2% AEP



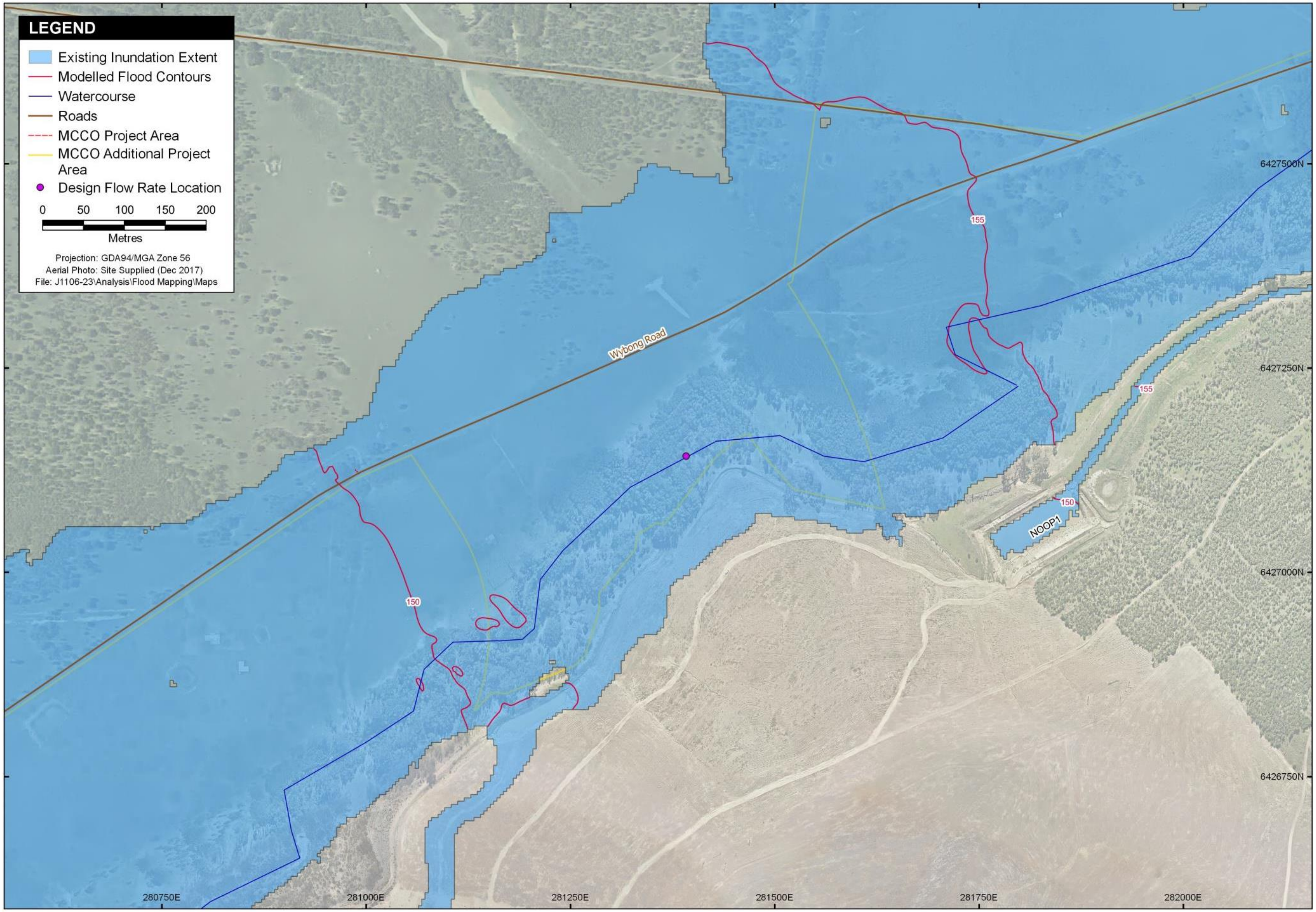
Map A-13 Predicted Existing Flood Levels (mAHD) and Flooding Extent – 0.1% AEP



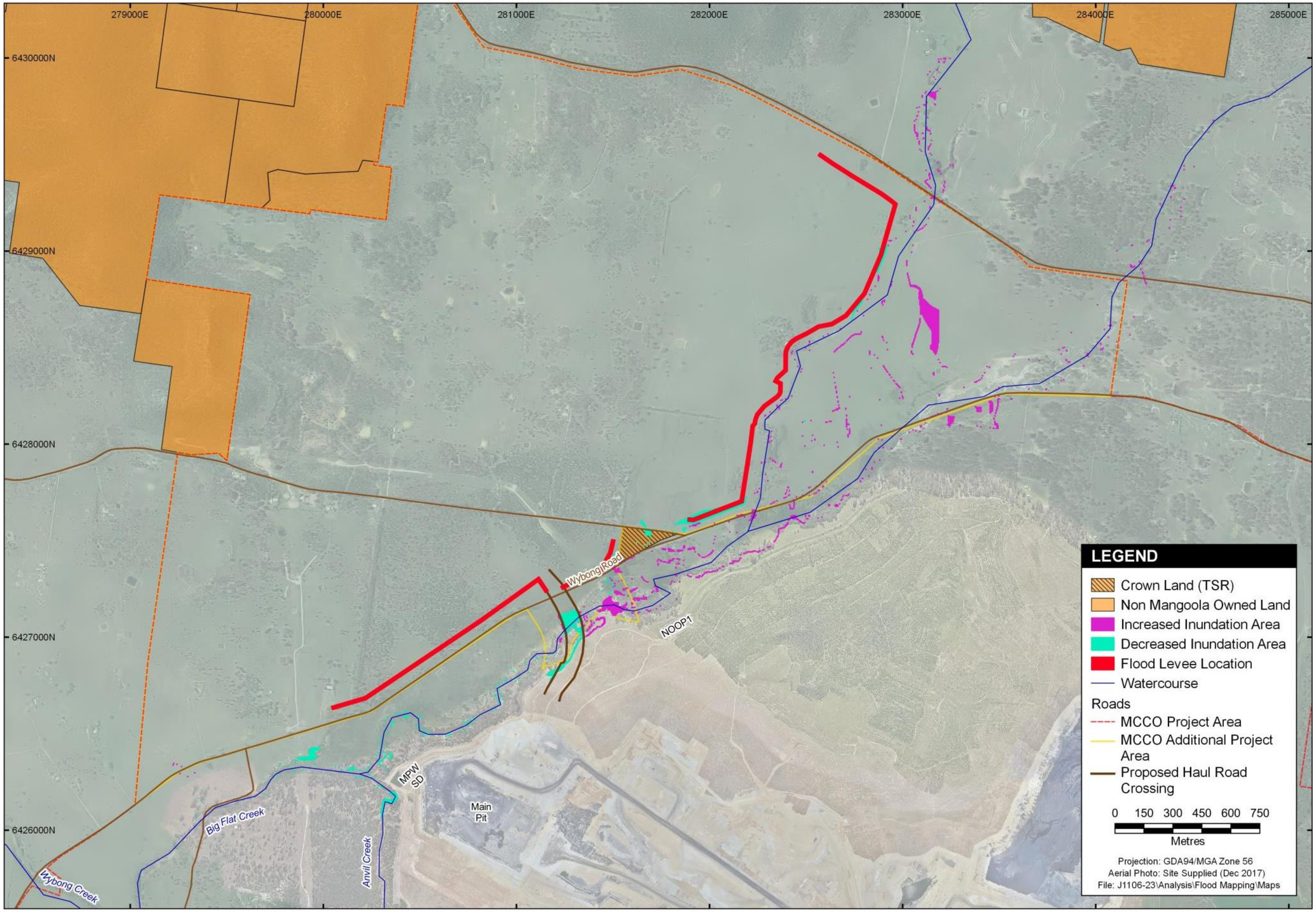
Map A-14 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – 0.1% AEP



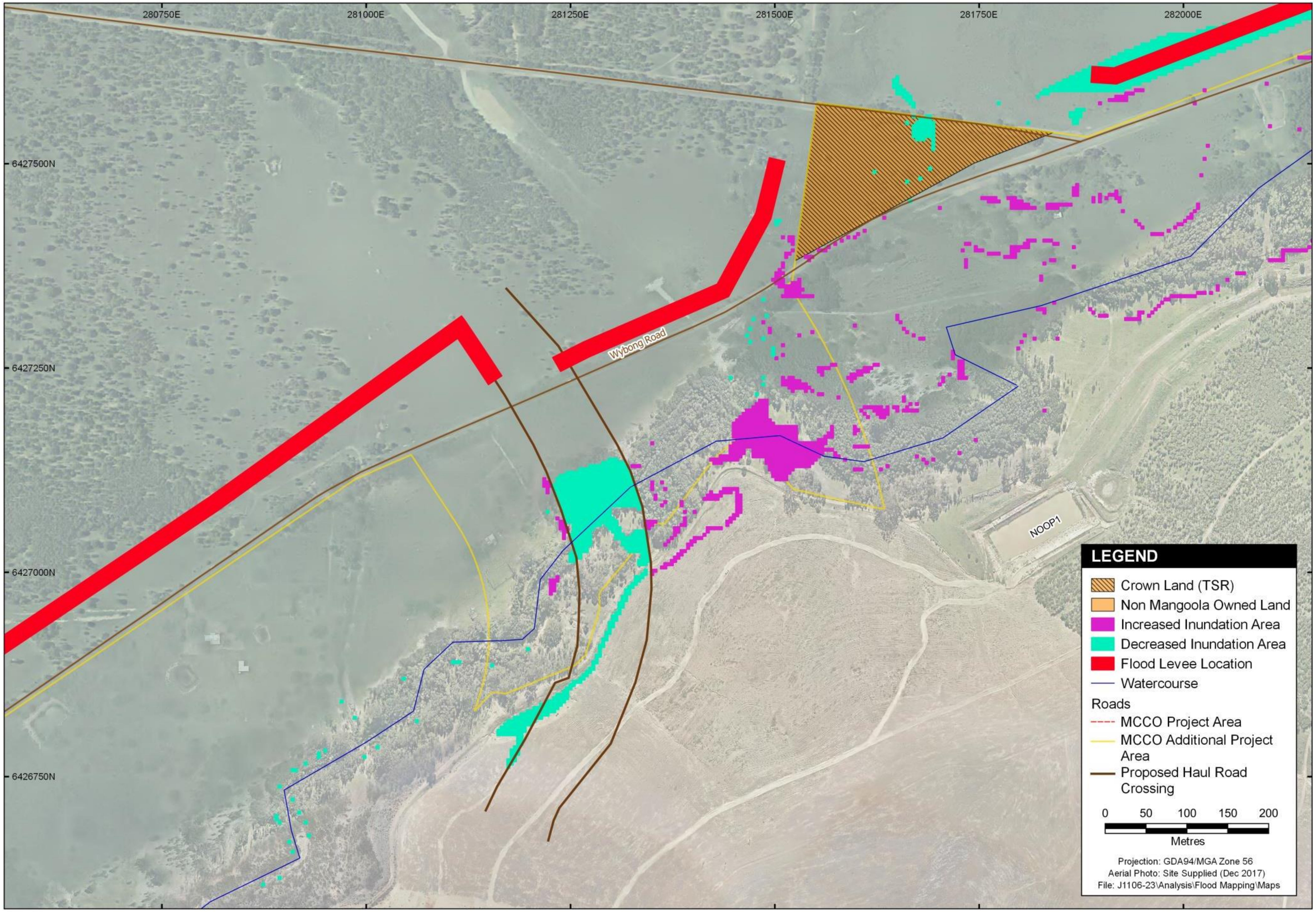
Map A-15 Predicted Existing Flood Levels (mAHD) and Flooding Extent – PMF



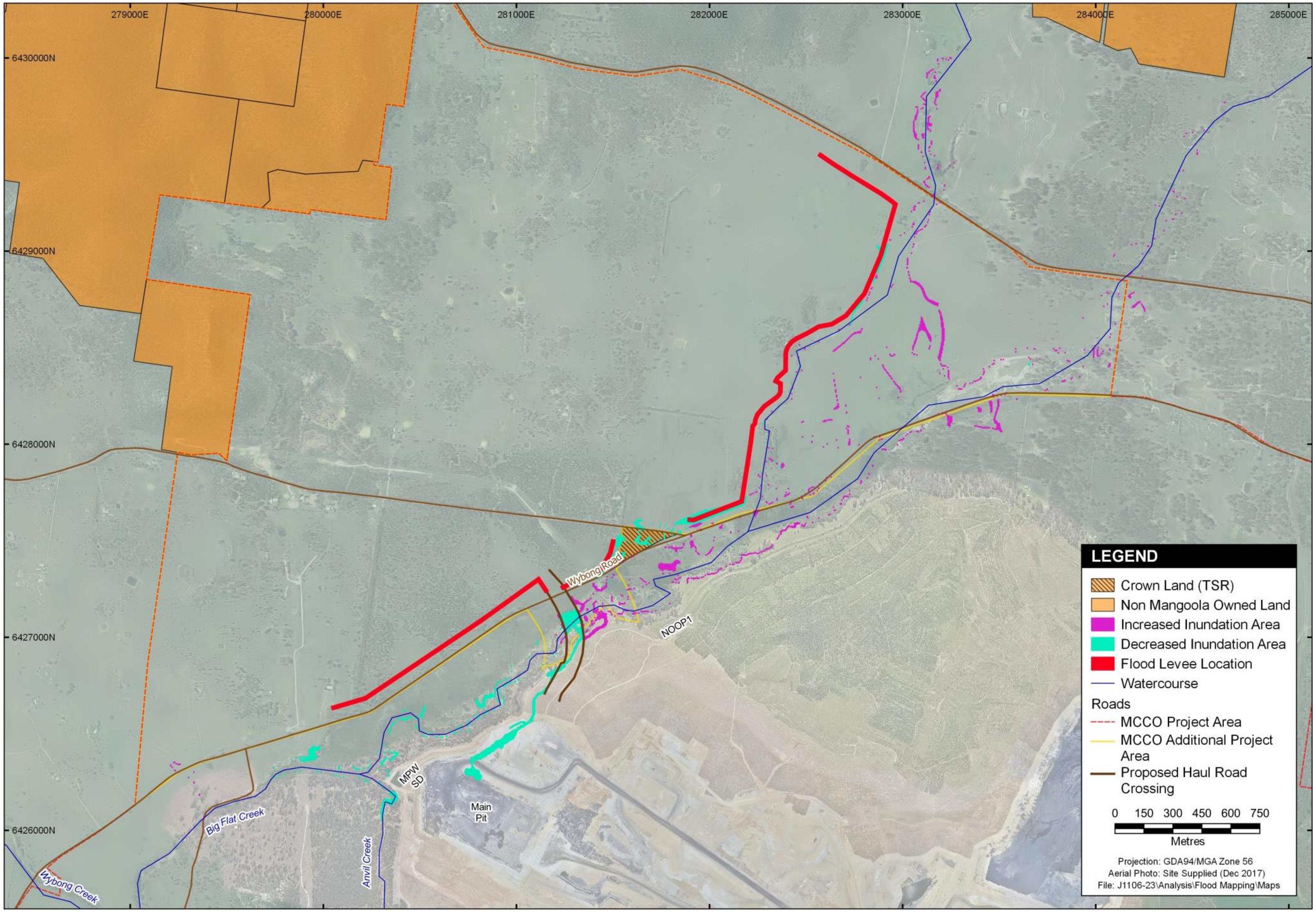
Map A-16 Predicted Existing Flood Levels (mAHD) and Flooding Extent Enlargement – PMF



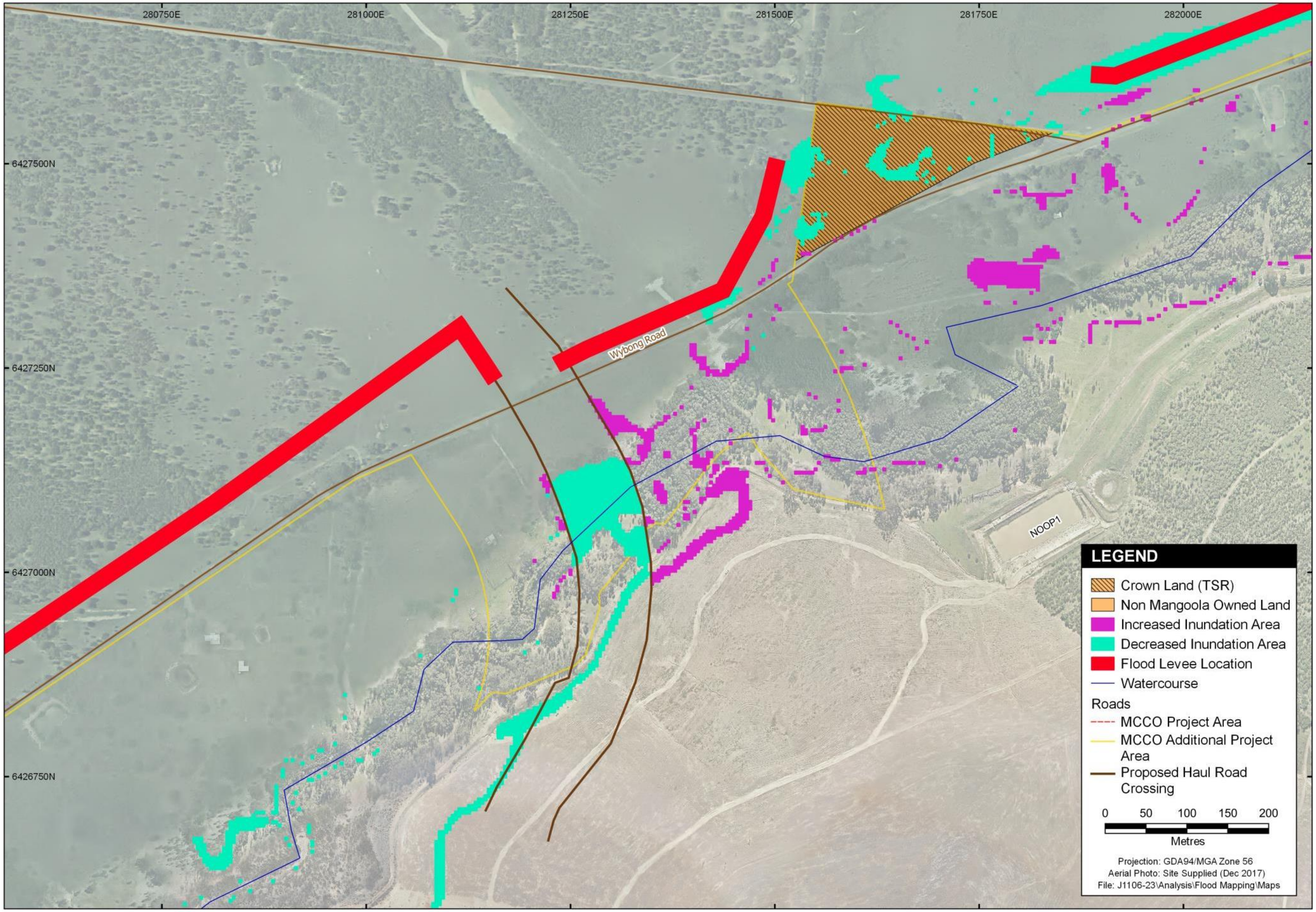
Map A-17 Predicted Changes to Flood Extent – 10% AEP



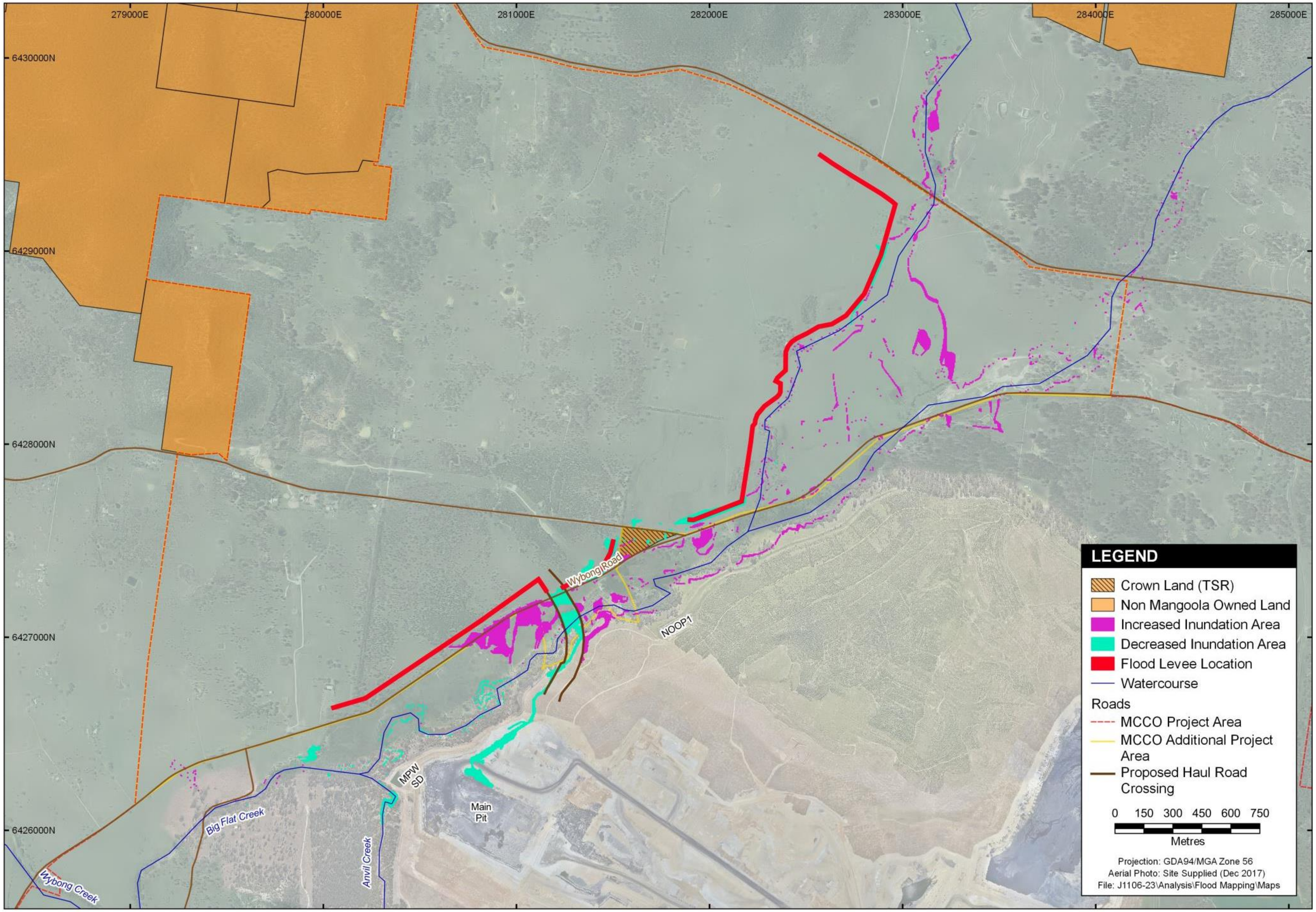
Map A-18 Predicted Changes to Flood Extent Enlargement – 10% AEP



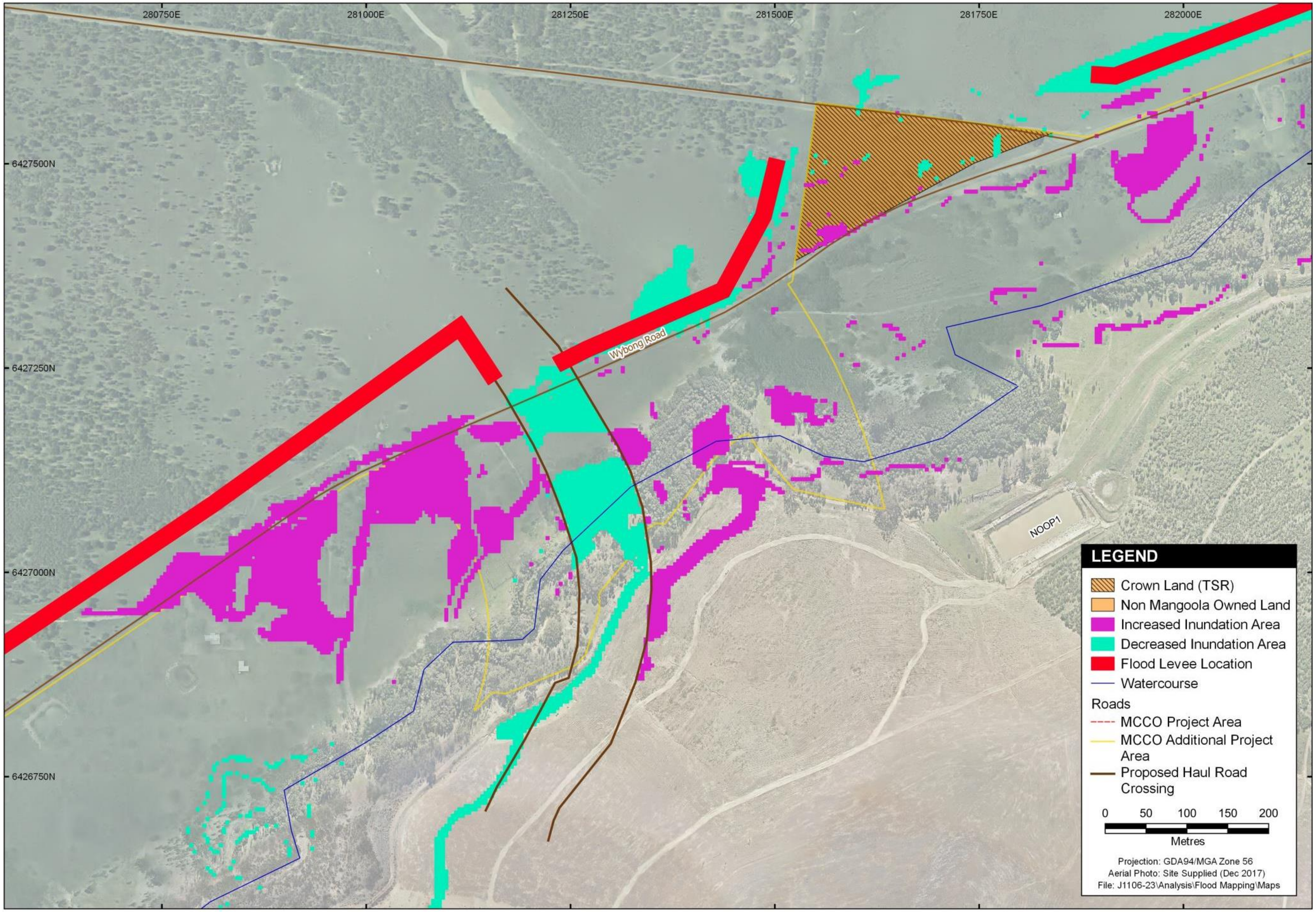
Map A-19 Predicted Changes to Flood Extent – 5% AEP



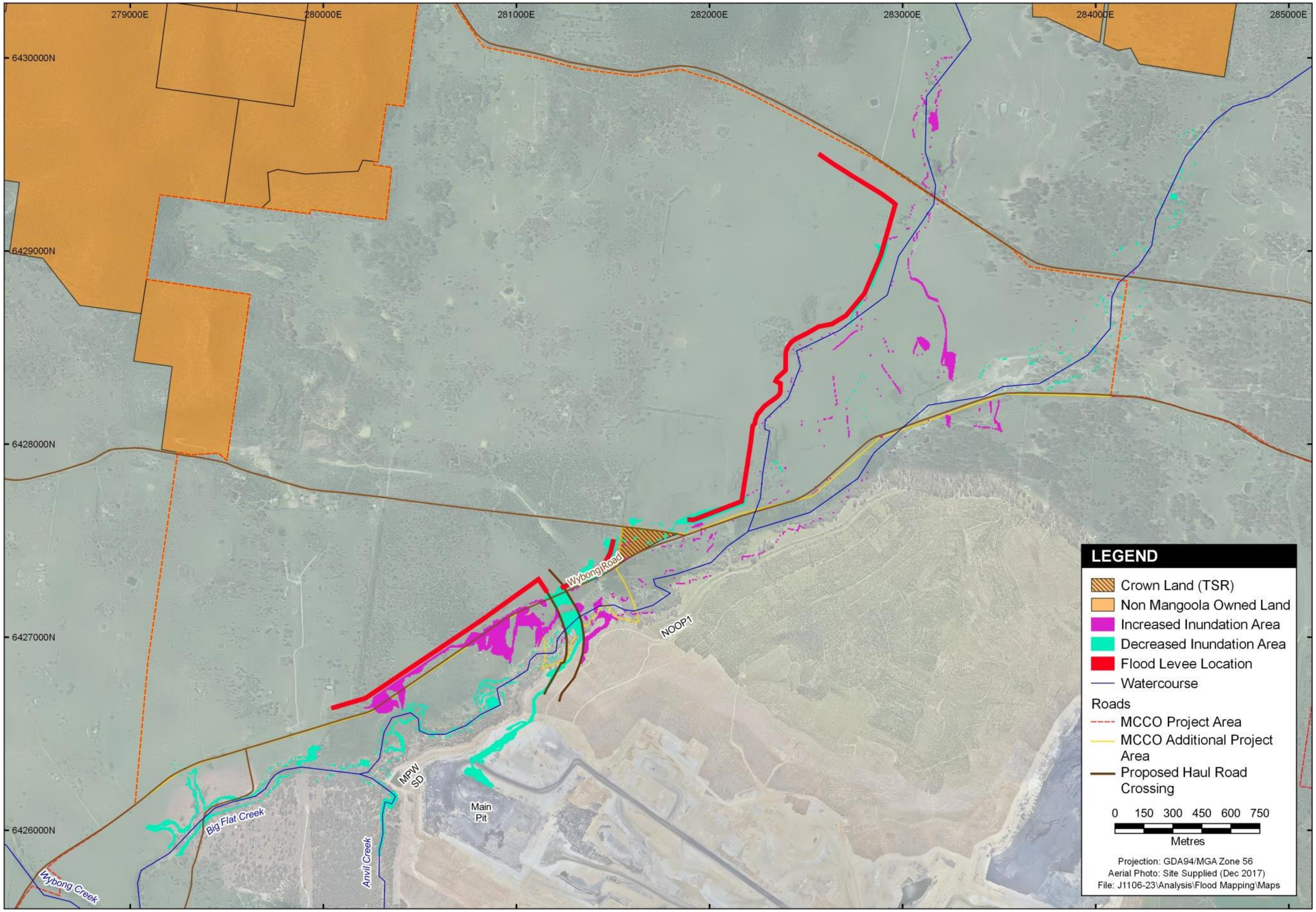
Map A-20 Predicted Changes to Flood Extent Enlargement – 5% AEP



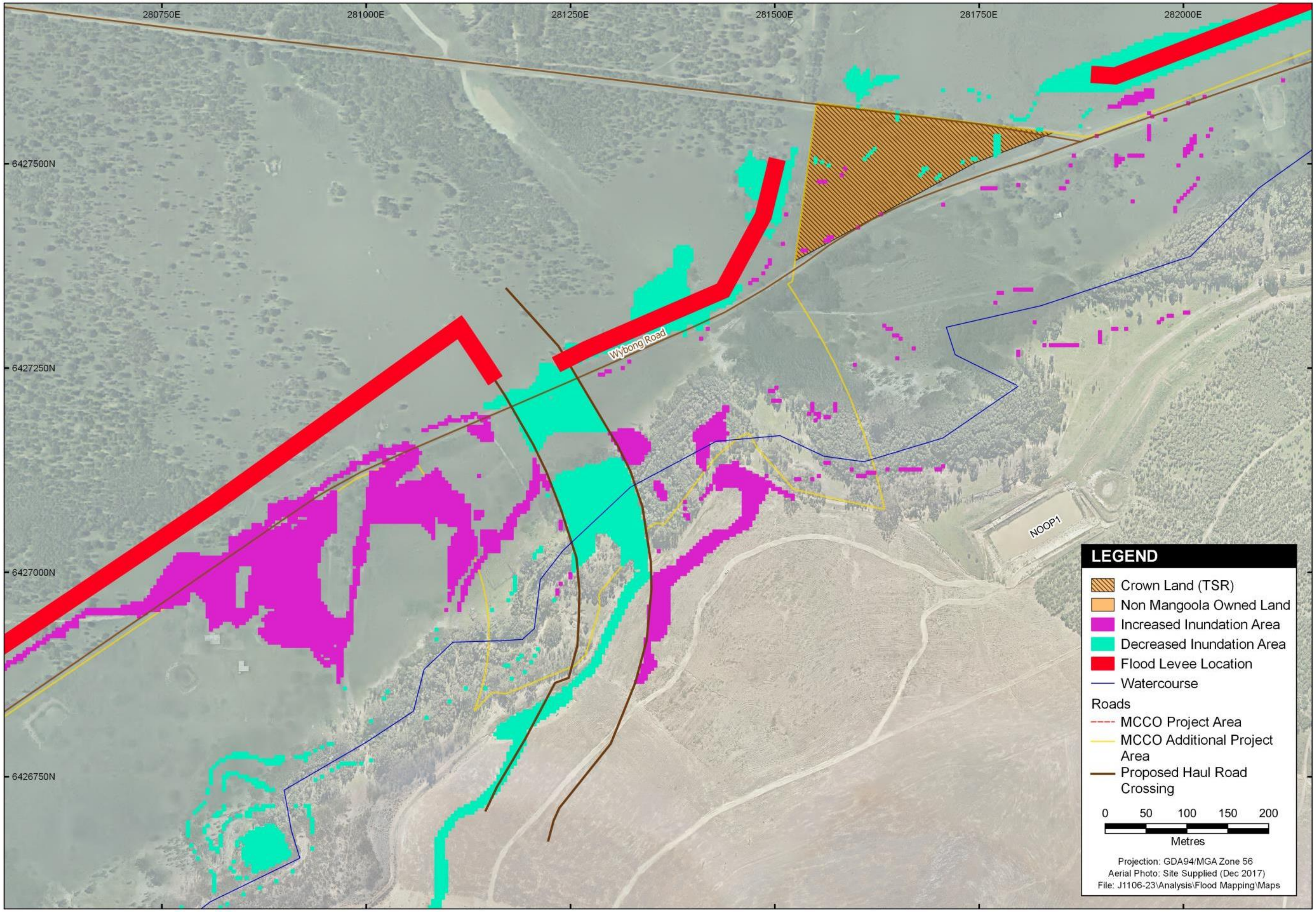
Map A-20 Predicted Changes to Flood Extent – 1% AEP



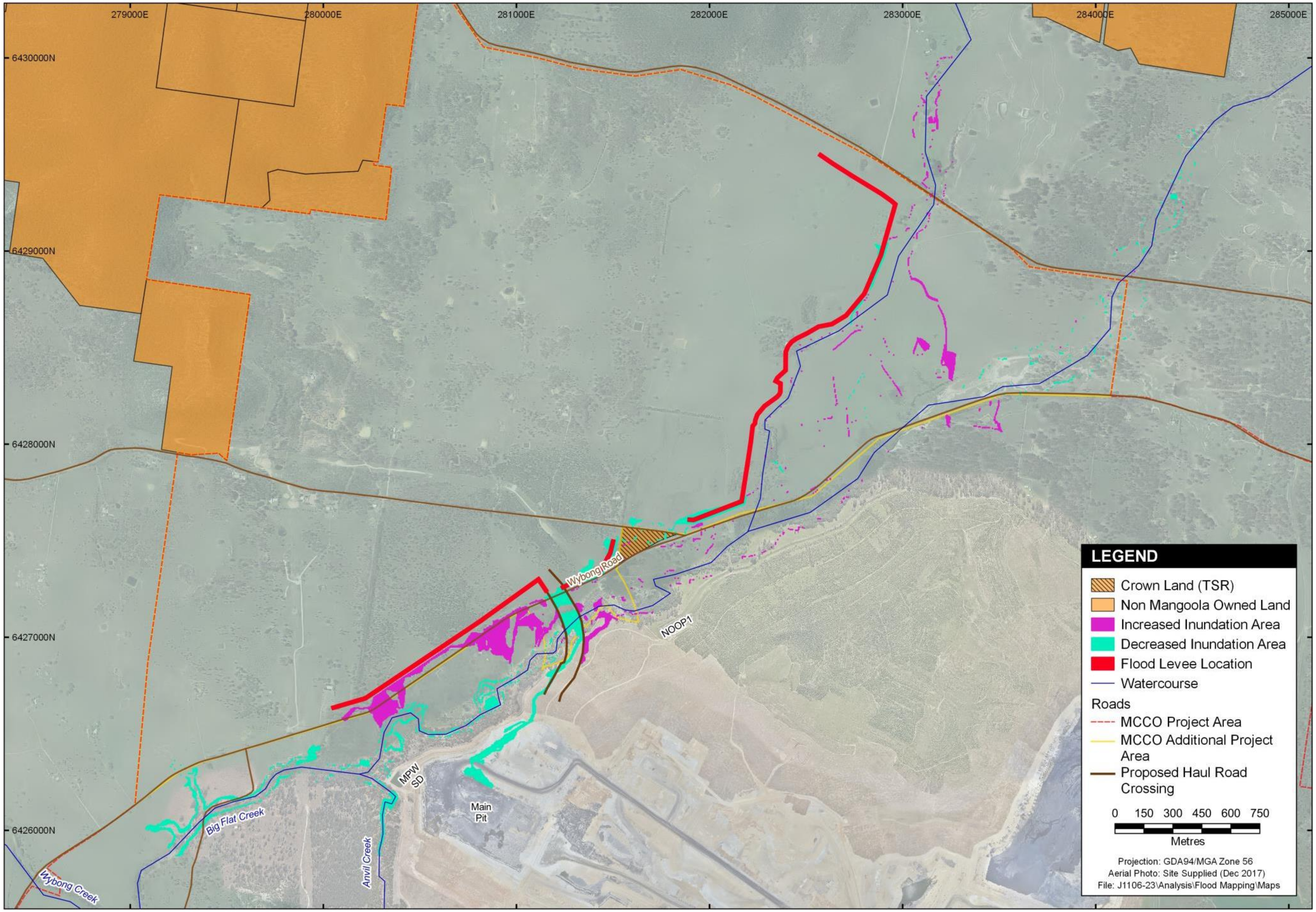
Map A-21 Predicted Changes to Flood Extent Enlargement – 1% AEP



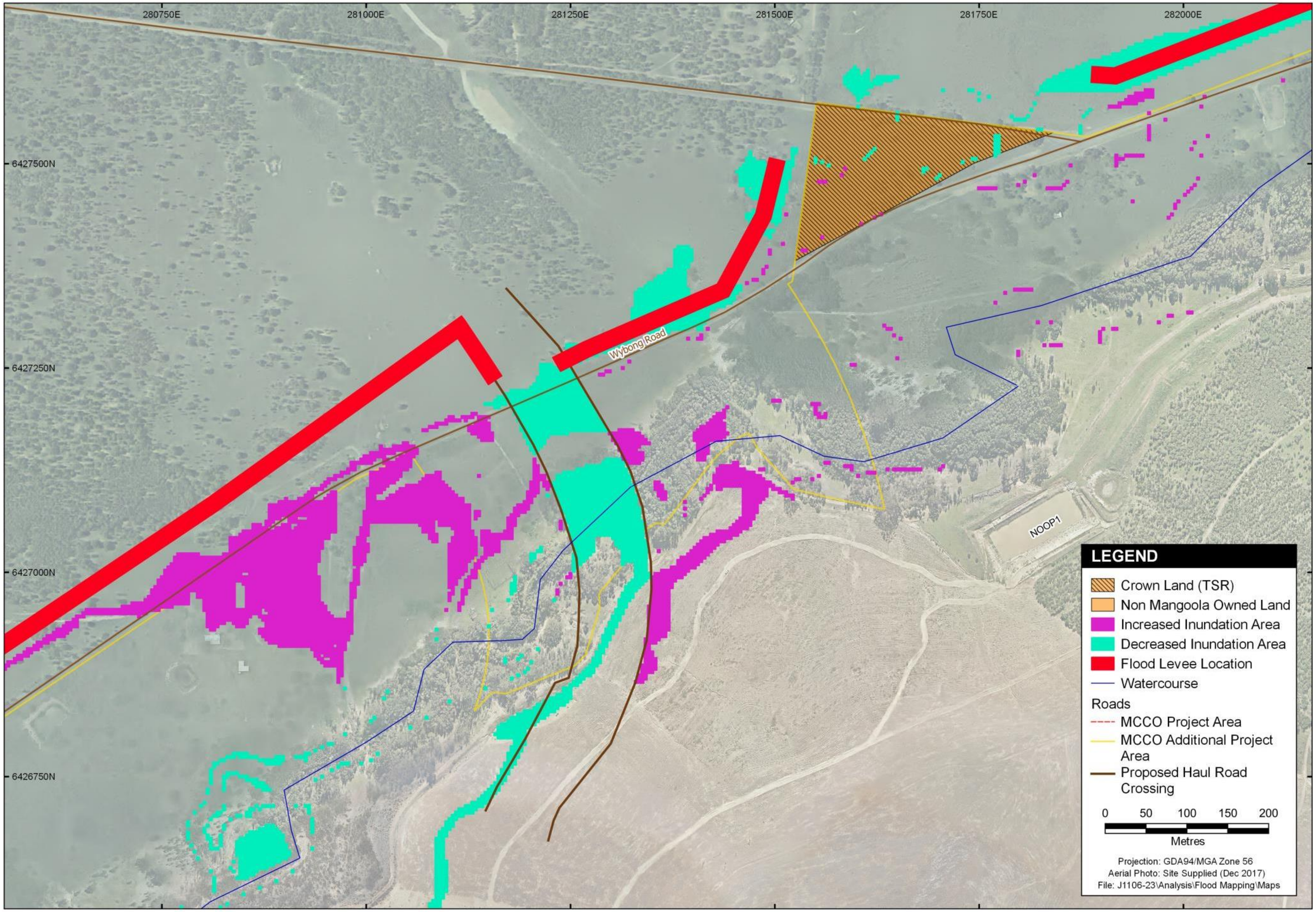
Map A-22 Predicted Changes to Flood Extent – 0.5% AEP



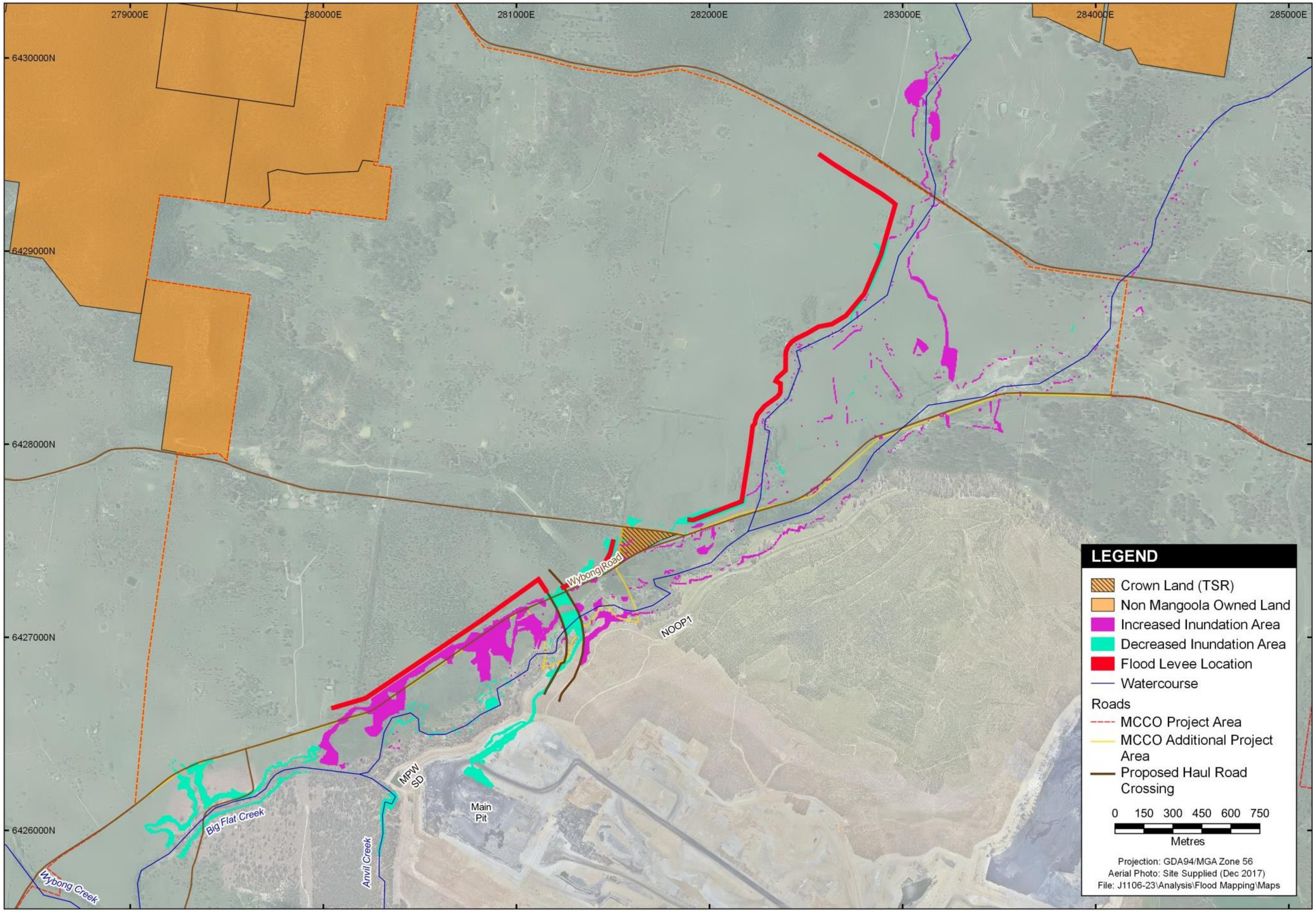
Map A-23 Predicted Changes to Flood Extent Enlargement – 0.5% AEP



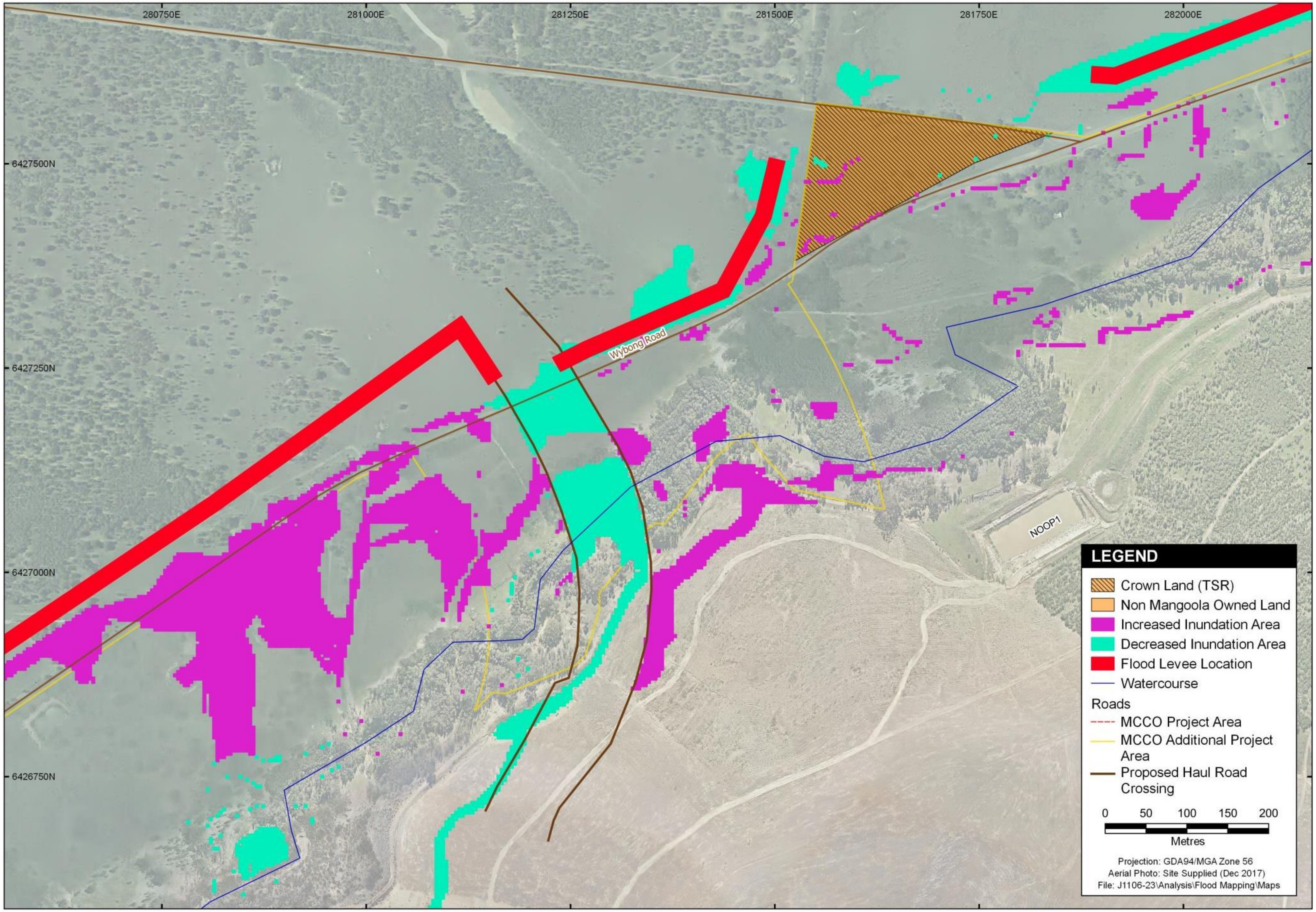
Map A-24 Predicted Changes to Flood Extent – 0.4% AEP



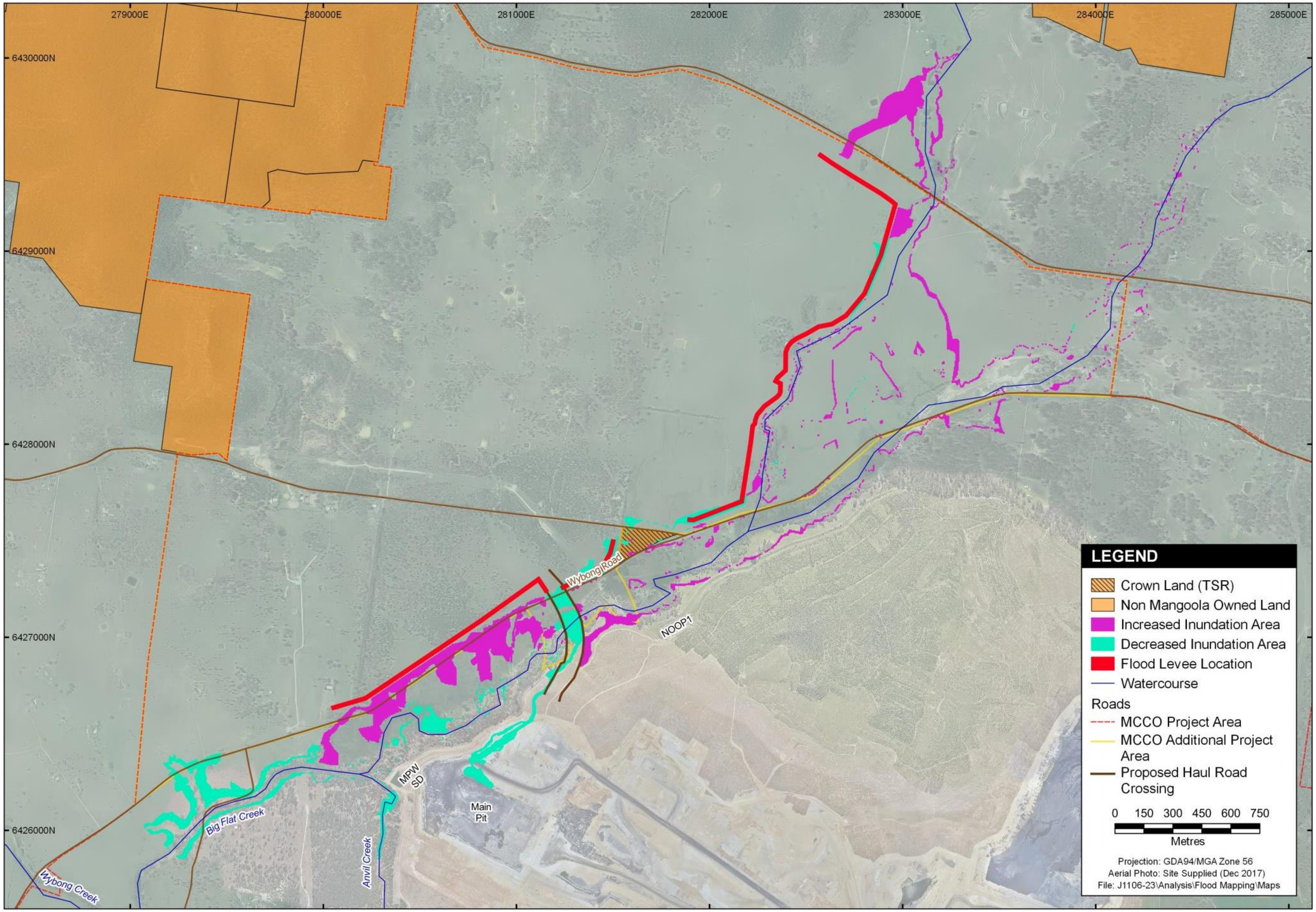
Map A-25 **Predicted Changes to Flood Extent Enlargement – 0.4% AEP**



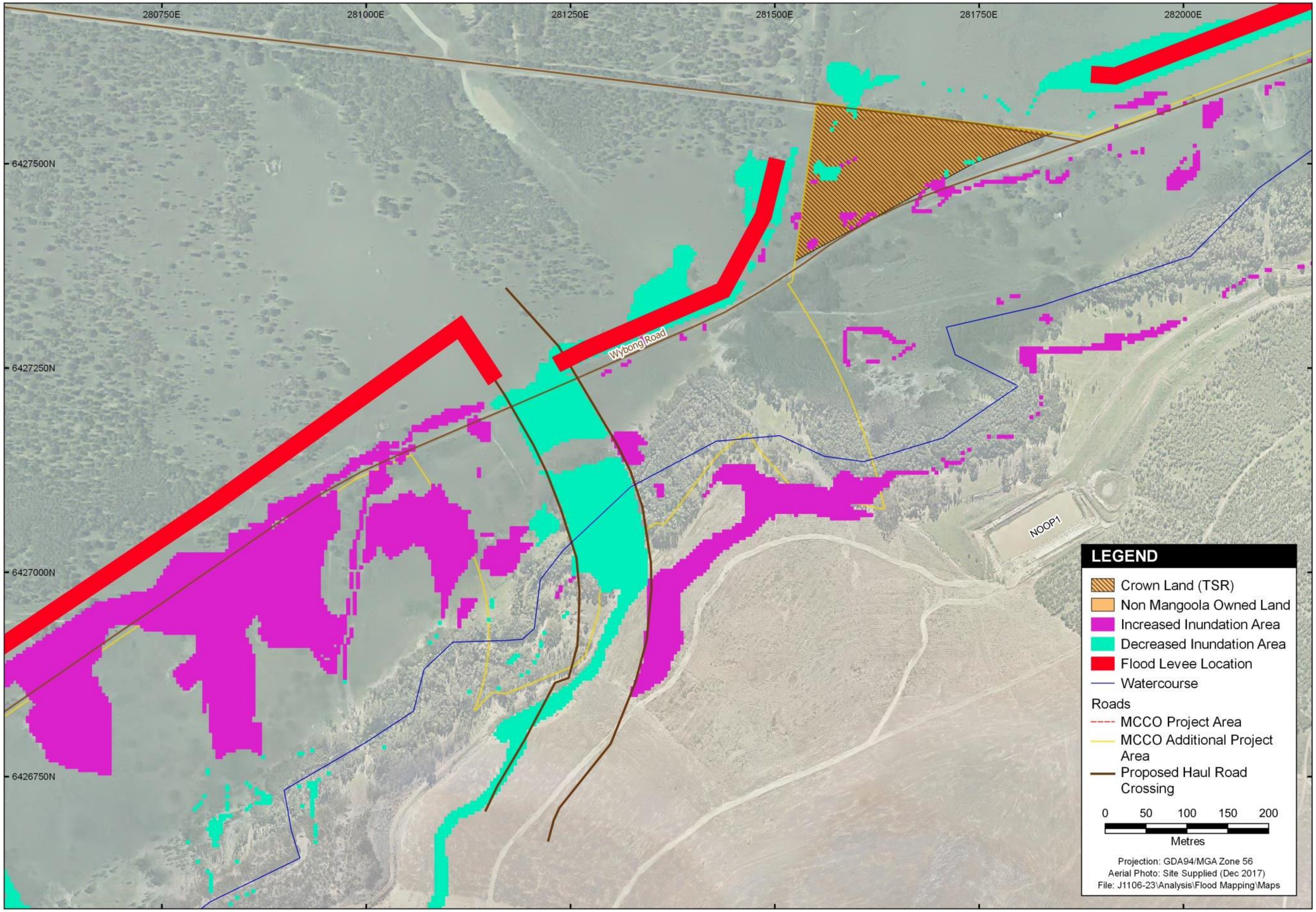
Map A-26 Predicted Changes to Flood Extent – 0.2% AEP



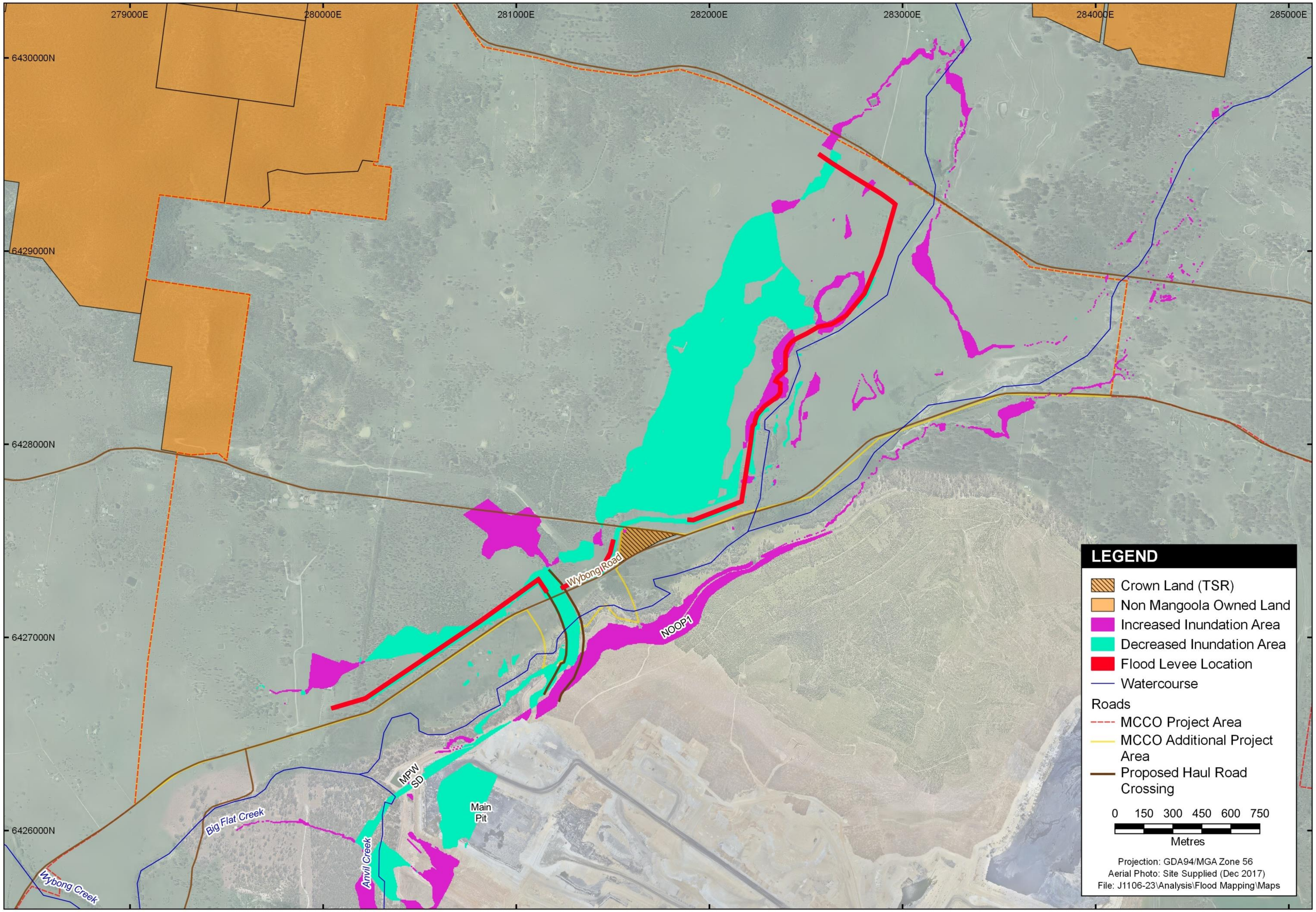
Map A-27 Predicted Changes to Flood Extent Enlargement – 0.2% AEP



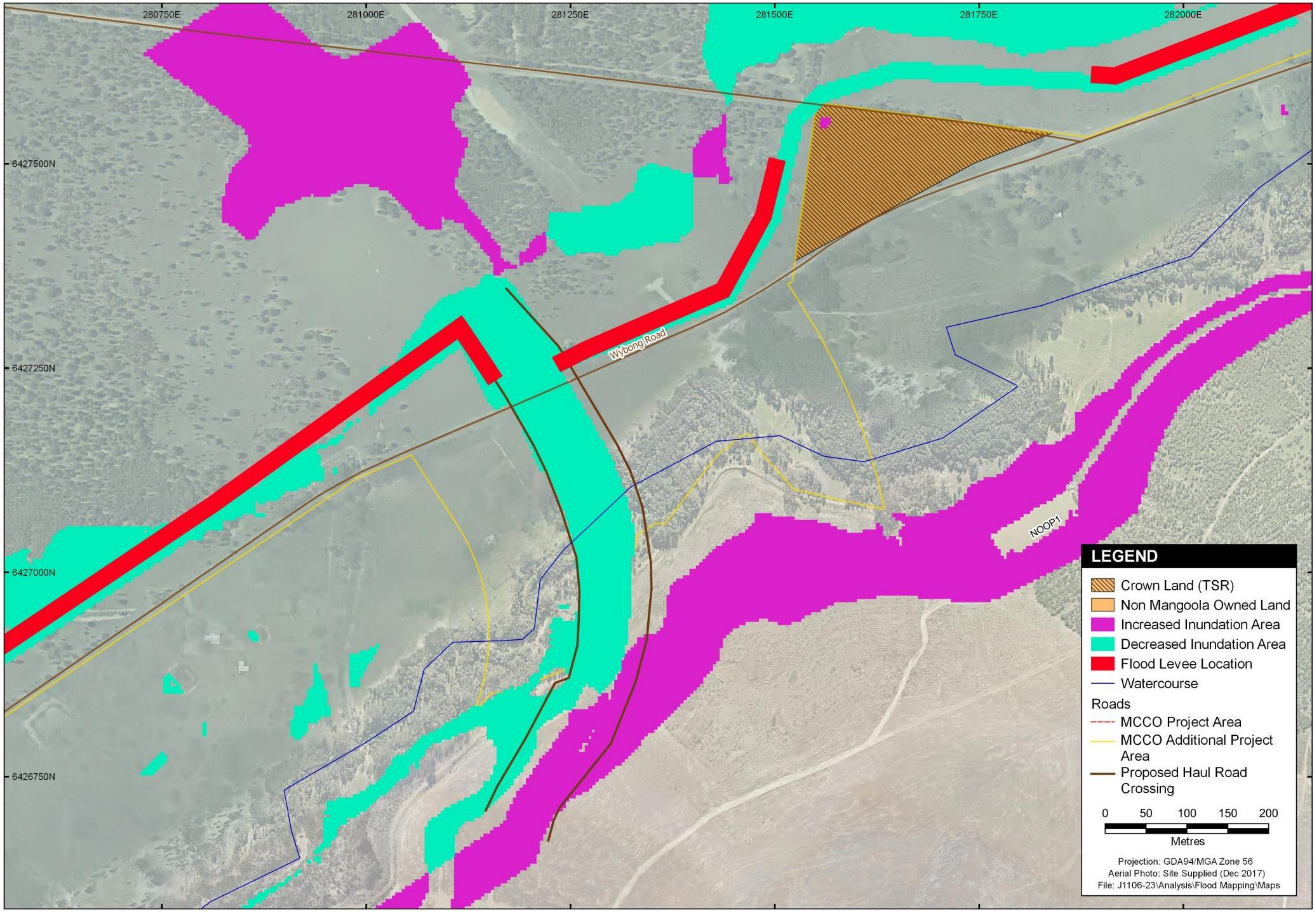
Map A-28 **Predicted Changes to Flood Extent – 0.1% AEP**



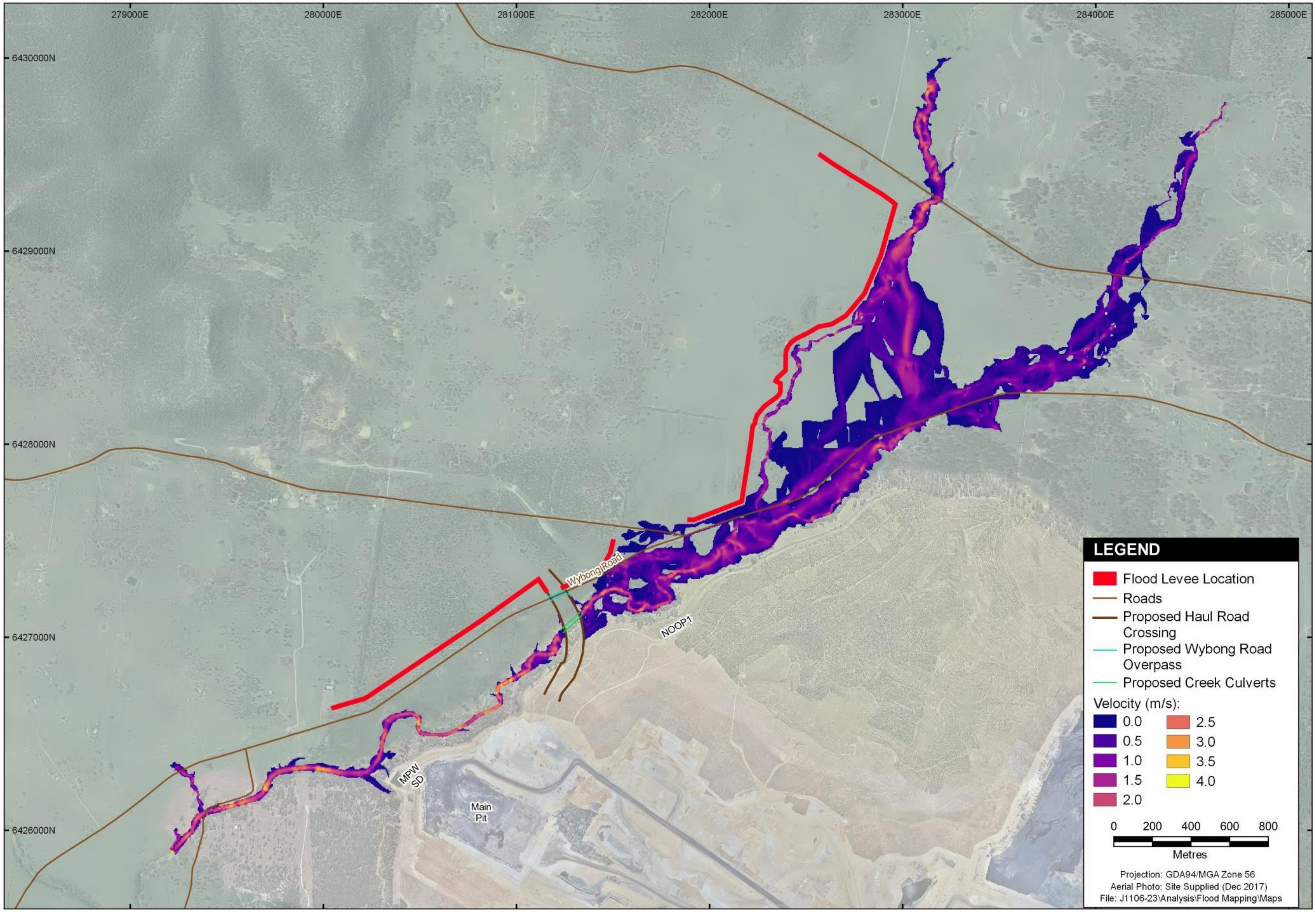
Map A-29 Predicted Changes to Flood Extent Enlargement – 0.1% AEP



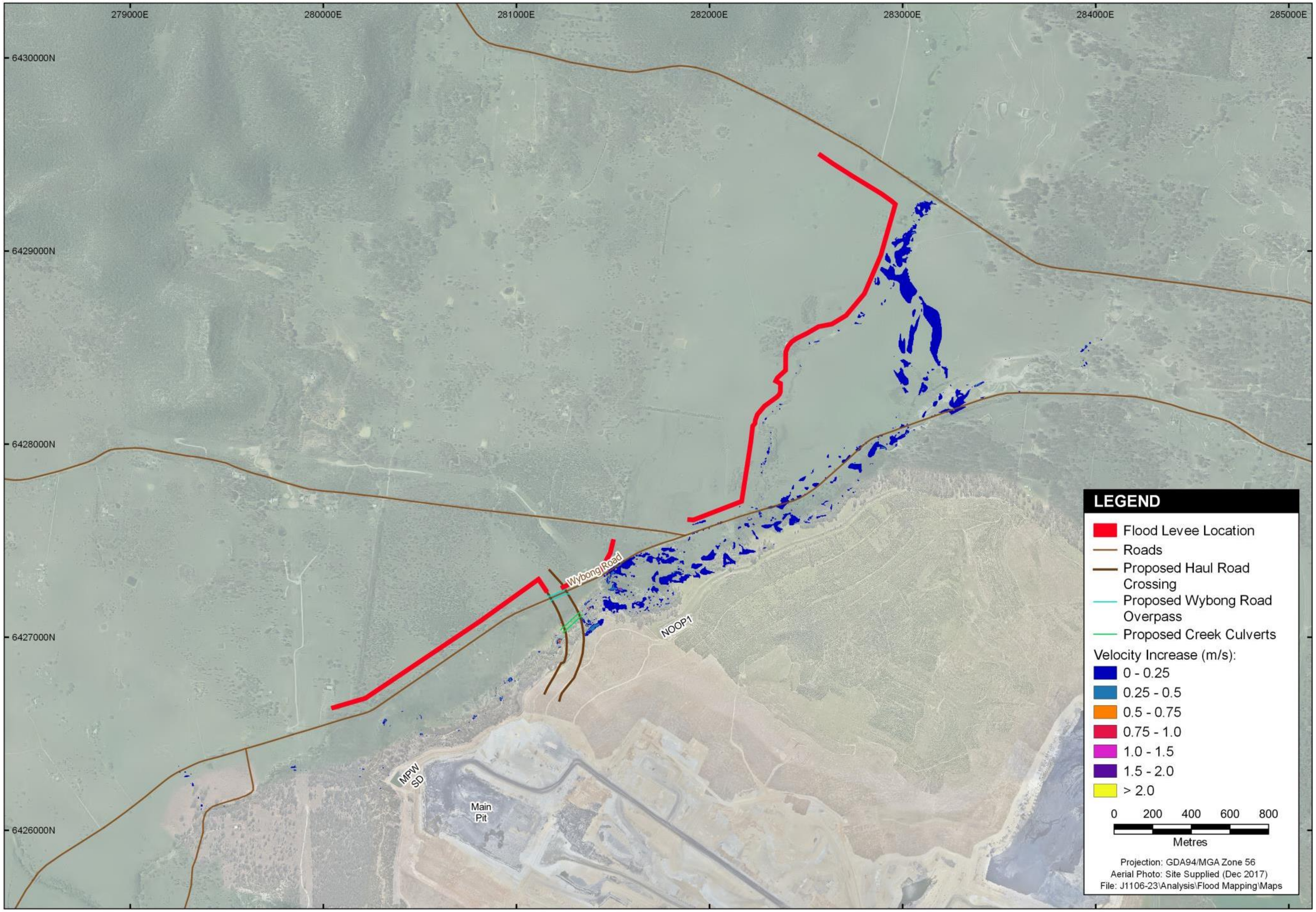
Map A-30 Predicted Changes to Flood Extent – PMF



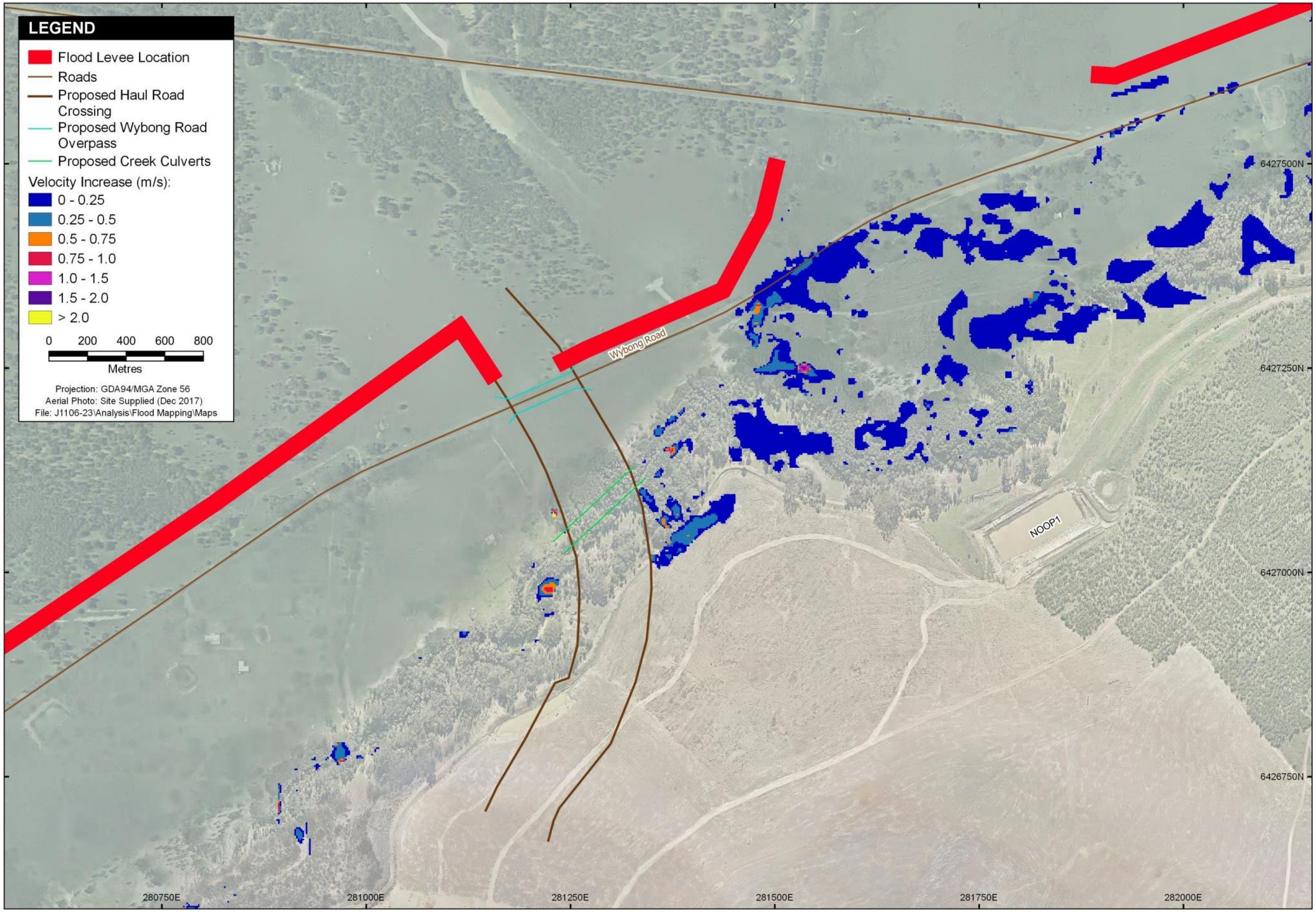
Map A-31 Predicted Changes to Flood Extent Enlargement – PMF



Map A-32 Predicted Peak 5% AEP Flood Flow Velocity Distribution in Big Flat Creek with MCCO Project



Map A-33 Predicted Peak 5% AEP Flood Flow Velocity Increase in Big Flat Creek with MCCO Project



Map A-34 Predicted Peak 5% AEP Flood Flow Velocity Increase in Big Flat Creek with MCCO Project - Enlargement

APPENDIX 5
Flood Model Peer Review

Our Ref: 4828_Flooding_Peer_Review_Final

18 December 2019

Daniel Sullivan
Principal Environmental Consultant
Umwelt Environmental and Social Consultants
75 York Street
Teralba NSW 2284

Dear Daniel

Re: Peer Review of the Mangoola Coal Continued Operations Project Flood Modelling and Reporting

Umwelt (Australia) Pty Limited (Umwelt) was engaged to undertake a peer review of the Mangoola Coal Continued Operations (MCCO) Project Flood Modelling and Reporting prepared by Hydro Engineering and Consulting Pty Ltd (HEC).

The flood modelling results informed the flood impact assessment by HEC that is contained within HEC's Surface Water Assessment (SWA) report. The SWA report title details are:

> *"Mangoola Coal Continued Operations Project – Environmental Impact Statement – Surface Water Assessment*", prepared for Mangoola Coal Pty Ltd, HEC, May 2019 (Final).

This peer review has been undertaken by:

> Mr Glenn Mounser
> Manager Water Group, Umwelt (Australia) Pty Limited
> Principal Water Engineer.

The purpose of the peer review has been to undertake a technical review of the flood modelling and associated flood impact assessment reporting presented as part of the Environmental Impact Statement that accompanied the MCCO Project Development Application.

1. Peer Review Process

A formal (two phase) peer review of the flood modelling and associated flood impact assessment reporting was completed during October and November 2019.

1.1 Peer Review - Phase 1 (interim advice)

During Phase 1 a preliminary review of the hydraulic modelling was completed, involving:

- Review flooding sections in the final SWA report.

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Quality Outcomes

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Umwelt (Australia) Pty Limited
ABN 18 059 519 041

- Initial review of model input / output files and simulation log files.
- Prepare and issue preliminary advice on flood modelling and flood impact assessment matters.

The purpose of this interim advice was to provide a general indication of the suitability of the hydraulic modelling to assess the potential flooding impact of the proposed development and advise on any obvious matters that needed to be addressed by HEC. This process allowed HEC to further progress their work and responses to submissions on the SWA report.

1.2 Peer Review - Phase 2

Phase 2 involved:

- Review of the flooding matters raised in the 05/09/2019 submission by the NSW Department of Planning, Industry and Environment - Biodiversity and Conservation Division (DPIE - BCD).
- A more in-depth review of the hydraulic modelling following the interim advice given in Phase 1.
- Checking key input information used in the hydrologic modelling.
- Review of the flood impact assessment reporting in light of the flood modelling review findings.

1.3 Peer Review Reporting

This letter outlines the results of the peer review process.

Throughout the peer review, findings were collated in a working document that also included recommendations for HEC to address various matters. Ongoing responses by HEC were added to the working document together with follow up peer review comments. The working document changed over time as the review process progressed and HEC responses were considered.

The working document was used to inform preparation of this letter.

2. Flood Modelling - Background and Review Approach

The HEC flood modelling approach employed:

- A RORB hydrological model to produce flood hydrographs at various locations for input to the hydraulic model.
- A two (2) dimensional TUFLOW hydraulic model with a 4 m x 4 m finite difference grid to predict flood levels, velocities and likely flood behaviour changes due to the MCCO Project.

2.1 TUFLOW Hydraulic Model

The peer review initially focussed on assessment of the TUFLOW hydraulic modelling and relevant model files provided by HEC. As the model consists of a vast number of files (many thousands), priority was given to a review of key model setup files and selected output files (including mass balance checks) and selected model check runs, sufficient to establish an informed opinion on the robustness of the TUFLOW hydraulic model and its suitability to achieve the objectives of the flood impact assessment for the MCCO Project.

A review of the TUFLOW hydraulic model setup showed that it comprised:

- Two dimensional (2D) unsteady flow TUFLOW model for Big Flat Creek with a 4 m X 4 m square finite difference grid.
- A digital elevation model (DEM) of the ground surface in the study area to provide the topographic 'backbone' for the hydraulic model.
- Geometric data that is used to define one-dimensional (1D) waterway structures that are dynamically linked to the 2D model. Structures typically include culverts, bridges and roads.
- A proposed flood levee to protect the MCCO Additional Project Area is simulated by setting a model no-flow boundary on the levee alignment.
- The hydrologic modelling (RORB) provided design inflow hydrographs for a series of 'inflow' points at the upstream boundary of the hydraulic model and local inflow points along Big Flat Creek.
- Water level at the downstream boundary of the Big Flat Creek 2D hydraulic model was provided by a separate 2D steady state TUFLOW model simulation for Wybong Creek at the Big Flat Creek confluence.

Three TUFLOW hydraulic modelling scenarios were reviewed, as follows:

- *Wybong Creek 2D steady state model* – steady state simulation of Wybong Creek to establish tailwater conditions for the Big Flat Creek unsteady flow modelling.

  NOTE: Steady flow relates to constant discharge over time, while unsteady flow relates to time varying discharge.

- *2D unsteady flow model of Big Flat Creek* - for the adopted (final) version of the 'Existing Conditions' model.
- *2D unsteady flow model of Big Flat Creek* - for the 'Future Conditions' (i.e. 'With Project') model incorporating the adopted upslope diversion (referred to by HEC as 'Diversion 2' option).

2.2 RORB Hydrology

A RORB hydrologic model provided primary input for the TUFLOW hydraulic modelling in the form of design hydrographs applied at multiple locations within the hydraulic model domain.

The latter part of the peer review also included a check on key input information used in the RORB hydrology. It was not deemed necessary to review RORB model files nor run the RORB model as part of this check on key hydrology input.

The following information provided by HEC was reviewed:

- Catchment maps, including sub-catchment arrangement.
- Catchment/sub-catchment areas (km^2).
- Location of hydrographs to be used as input to the hydraulic model (for 'Existing' and 'With Project').

- Data and calculations for:
  - design rainfalls - range of AEPs and the PMF
  - rainfall losses
  - ensemble temporal patterns
  - aerial reduction factors.
- Calculations for validation to an alternative method.

3. Flood Impact Assessment Reporting - Background and Review Approach

HEC's flooding impact assessment reporting is contained within the SWA report and has been informed by the flood modelling results.

The flood impact assessment reporting includes two main sections with associated flood mapping, being:

- Section 2.7 of the SWA report provides flood modelling results for 'existing conditions' which is stated to include "...... *the existing creek (with the approved Mangoola operations as at 2017) ....".* [Referred to in this peer review report as the 'Existing' scenario.]
- Section 3.2.3 of the SWA report provides flood modelling results for *"...... the fully developed MCCO Project (as at Year 8 - the scheduled end of coal extraction) ......".* [Referred to in this peer review report as the 'With Project' or 'Future' scenario.]

Review of the flood impact assessment reporting included consideration of the Secretary's Environmental Assessment Requirements (SEARs) and other agency EARs relating to flooding. The latter part of the peer review also considered the HEC Response to Agencies Submissions Report as included as Appendix 4 to the RTS.

4. Summary of Peer Review Findings

A range of matters associated with the flood modelling and flood impact assessment reporting were identified during the peer review process that required clarification by HEC. Throughout the peer review HEC provided responses to the identified matters with the additional information included as **Attachment 1** to this report. HEC also addressed numerous matters in their Response to Agencies Submissions Report as included as Appendix 4 to the RTS.

4.1 Flood Modelling and Reporting

Review of the TUFLOW hydraulic modelling for the 'Existing' and 'With Project' scenarios found the following components to be structured appropriately to achieve the objectives of the flood modelling and flood impact assessment:

- Control and event files.
- Database files and GIS supporting files.
- Model geometry (grid, topography).
- Waterway structures, materials roughness and boundary conditions.

A review of the supplied information for the RORB hydrology showed that for both the 'Existing' and 'With Project' scenarios the following key information was structured appropriately to achieve the objectives of the flood modelling and flood impact assessment:

- Catchment / sub-catchment areas (km^2) and sub-catchment discretisation.
- Design rainfalls to ARR2016.

At the culmination of the peer review process there remained a number of key matters requiring final resolution, including:

- Potentially low design discharge predictions (relating primarily to the adopted rainfall losses).
- Procedure for applying areal reduction factors to design rainfalls.
- Procedure for applying ensemble temporal patterns and determining critical storm durations.
- The number and location of hydraulic model inflow hydrographs.
- The similarity between flood extents for design floods of differing magnitudes.
- Flood hazard impacts due to the MCCO Project and the means of mitigating these impacts.
- The representation of 'With Project' flooding conditions (on flood mapping) at the haul road crossing.

Table 1 provides a summary of the key matters requiring final resolution and how they were ultimately addressed by HEC. Peer review close-out comments are also provided in the table.

Also, there remain some minor errors and inconsistencies identified during the peer review. Although these are not material to the flood modelling results nor detrimental to a proper consideration of MCCO Project flooding impacts, they should be clarified in future reporting. They include:

- Inconsistencies in the levee location/extent on various report figures and in report text. The location needs to be confirmed and clearly stated in future reporting.
- Inconsistencies in the location of the Big Flat Creek / Wybong Creek confluence relative to the downstream model boundary and the most downstream disturbance for the MCCO Additional Project Area, as depicted in report figures and in report text. The location needs to be confirmed and clearly stated in future reporting.

Table 1 Key Matters Identified in Peer Review

Key Matter		HEC Response	Peer Review Close-out Comment
No.	Description		
1	Discharge predictions being low (relating primarily to the adopted rainfall losses). *(NOTE: Recent NSW investigations have shown an under-estimation bias when using standard ARR2016 design event methods with default data from the ARR Data Hub. These investigations identified that default continuing losses from the ARR Data Hub over-estimated losses and therefore were not fit for purpose and should only be used where better information was not available. Accordingly for sites in NSW, users need to consider the NSW Specific Tab on the ARR Data Hub for information on losses.* *A check using the Regional Flood Frequency Estimation (RFFE) method for Big Flat Creek at the Wybong Creek confluence, gives a 1% AEP peak discharge of 158 m^3/s with 5% and 95% confidence limits of 65 and 370 m^3/s respectively. The HEC 1% AEP prediction at this location is 114 m^3/s, which is low by comparison. The RFFE is however considered an approximate guide only.)*	"RORB model for the 1% AEP with project case was re-run with probability neutral burst initial losses and a continuing loss of 0.61 mm/hr as per NSW FFA-reconciled losses for Wybong Creek. This results in a peak flow rate increase of approximately 11% at the haul road crossing. The TUFLOW model was re-run for this event [the 1% AEP event and 'With Project' scenario] and results show a maximum depth increase of approximately 17cm on Wybong Road just upstream of the haul road crossing which reduces to 3cm approximately 50m upstream. Maps have been created to show the depth and inundation difference for the updated hydrograph ……"	Using burst initial losses (IL_b) and continuing losses (CL) recommended for NSW practice on the ARR Data Hub, often result in significantly higher discharge predictions relative to standard ARR2016 design event methods with default data from the ARR Data Hub. As a sensitivity test, HEC has re-run the RORB hydrologic model for a 1% AEP event using losses based on recommended NSW practice on the ARR Data Hub. This shows an increase in the 1% AEP peak discharge of 11% at the haul road crossing. It appears that the increase has been limited to 11% due to the rainfall losses adopted by HEC in their original RORB modelling, which HEC considered to be conservative at that time prior to having knowledge of the recent NSW investigations. The investigations have shown an under-estimation bias when using standard ARR2016 design event methods with default data from the ARR Data Hub, and in particular default continuing losses from the ARR Data Hub over-estimate losses and therefore were not fit for purpose. The maximum increase in 1% AEP flood depth is 0.17 m occurring a short distance upstream from the haul road crossing. The additional mapping provided by HEC shows there are a number of areas of increased flood extent upstream and downstream of the haul road crossing with most being quite small. Using the current best practice within NSW is shown to give an increase of 11% in 1% AEP design discharge at the haul road crossing. Using the same procedure, other design event discharge predictions are also likely to change and the difference may be greater or less than 11%. Notwithstanding, the 11% difference for the 1% AEP design event is considered modest and the flood modelling completed to date does provide a reasonable basis for assessing the flooding impact of the MCCO Project relative to 'Existing' conditions. It is recommended that in future detailed design phases (e.g. detailed

Key Matter		HEC Response	Peer Review Close-out Comment
No.	Description		
			design of haul road crossing or design of flood mitigation measures), that associated flood modelling should include the burst initial losses (IL_b) and continuing losses (CL) recommended for NSW practice on the ARR Data Hub. This will result in modified design discharges that produce a small increase to the proposed levee crest heights, and small increases in flood velocities that will better inform the detailed design of energy dissipation and erosion/scour protection. Notwithstanding these future changes to design discharges, the present flood modelling results sufficiently characterise the flooding impact of the MCCO Project for impact assessment purposes.
2	Clarification of Areal Reductions Factors applied to design rainfalls. *(NOTE: A spot check of factored rainfalls supplied by HEC shows unexpected values for some design AEPs in the range 0.5% to 0.05% AEP for some storm durations. These factored rainfalls appear to be high by typically small amounts, up to approximately 5-6%, but this was a spot check only.* *Based on the ARR Data Hub history of changes (referred to as a 'Changelog', it was concluded that ARR2016 design rainfalls downloaded from the ARR Data Hub by HEC in January 2018 are most likely still current and relevant. Hence, it is unclear why*	"My interpretation of your email is that Umwelt are satisfied with the design rainfall depths that were used and that no further clarification on Areal Reduction Factors is needed."	This discrepancy is relatively minor and not detrimental to a proper consideration of MCCO Project flooding impacts. Notwithstanding, it is recommended that the process of determining factored rainfalls be checked for the full range of design AEPs to determine the cause for the discrepancy. This should be resolved prior to any flood modelling to inform future detailed design phases (e.g. design of haul road crossing or design of flood mitigation measures).

Key Matter		HEC Response	Peer Review Close-out Comment
No.	**Description**		
	there is a discrepancy in the factored rainfalls and what the cause may be.		
3	Confirmation of procedure used for ensemble temporal patterns and selection of critical storm durations.	"The attached spreadsheet provides an example of our processing of RORB peak flows to obtain the critical event."	The HEC spreadsheet provides an example of the application of ensemble temporal patterns and selection of the critical storm duration for the 0.1% AEP event under 'Existing' Conditions. The general approach is sound although minor discrepancies were noted in the method for determining the 'average' temporal pattern for each storm duration. This is not considered materially detrimental to the hydrologic predictions. No further action is considered necessary.
4	Confirmation on the sufficiency of inflow hydrographs and associated locations. *(NOTE: This relates to a peer reviewer request to confirm the location of hydrographs generated by the RORB hydrologic model, and advice as to which of these hydrographs were relevant as input to the TUFLOW hydraulic model.)*	"RORB catchment figures updated to show the locations of RORB output locations that weren't used in the TUFLOW model. PDF's will be provided via file transfer."	The additional mapping provided by HEC shows that for 'Existing' conditions there are 15 discrete locations in RORB where hydrographs are generated for input to the hydraulic model. For 'With Project' conditions the mapping shows there are 13 discrete locations in RORB where hydrographs are generated for input to the hydraulic model. The difference in the number of hydrograph locations results from the change in contributing sub-catchments due to MCCO Project final mine void. For both 'Existing' and 'With Project' conditions, there are two further hydrograph locations in RORB that are used only as a check on model results. It is concluded therefore that inflows from the entire contributing catchment, for both the 'Existing' and 'With Project' scenarios, have been accounted for in the flood modelling. No further action is considered necessary.

Key Matter		HEC Response	Peer Review Close-out Comment
No.	**Description**		
5	Similarity between flood extents for design floods of differing magnitudes.	"Depth difference maps have been created for the 10% to 1% and 1% to 0.1% AEP events for the with and without project case. PDF’s will be provided via file transfer."	The additional mapping provided recently by HEC shows that for 'Existing' conditions flood level differences between the 10% and 1% AEP events is typically limited to less than 0.5 m in the upper reaches of Big Flat Creek due mainly to the large areas of overbank / sheet flow, with up to a 1 m difference nearer to the haul road crossing. The difference in flood levels in the lower reaches is more pronounced, being up to 2 m or more due to flow being constrained generally to a single channel or riparian corridor. Under 'Existing' conditions, the additional mapping shows a similar situation for a comparison of the 1% and 0.1% AEP events, except that the difference in flood level is more pronounced in the lower reaches of Big Flat Creek being up to 2.5 m or more. For 'With Project' conditions the additional mapping also shows comparison of the 10% AEP / 1% AEP events and the 1% AEP / 0.1% AEP events. The flood level comparison results are similar to the ‘Existing’ scenario, except that there is a greater difference in the ‘With Project’ flood level comparisons immediately upstream of the haul road crossing, which is to be expected given the flooding impact of the road embankment which is to located on the floodplain. It is concluded that the additional flood mapping results are consistent with the topography and the haul road influence, and provide support for the veracity of the flood mapping generally in HEC’s Flood Impact Assessment. In summary, the additional mapping provided recently by HEC (see **Attachment 1**), as well as the mapping in the HEC Response to Agencies Submission report (see Appendix 4 of the RTS), both of which now include 'zoomed in' views, allow for a better understanding of the similar flood extents for design events of varying magnitudes, particularly in the upper reaches of Big Flat Creek. No further action is considered necessary.

Key Matter		HEC Response	Peer Review Close-out Comment
No.	Description		
6	Flood hazard impacts and the means of mitigating these impacts.	HEC have expanded the relevant section in their Response to Agencies Submission report to read as follows: "The most notable changes evident in Figure 7 are an increase from a H1 hazard classification to either H2 or H3 for approximately 40 m length of road near chainage 2,750 m (just upstream of the proposed overpass) and an increase from a H1 or H2 hazard classification to H5 for approximately 35 m length of road near chainage 3,050 m. There is also an increase of typically 1 classification level for a distance of approximately 60 m near chainage 4,400 m. Taken together, these lengths comprise approximately 6% of the already affected length of road that is predicted to be more affected by floodwaters in a 1% AEP than for the existing situation. A 6% length of road that would be more affected by floodwaters is not considered a significant increase. It should also be noted that the road is predicted in the existing situation to have a hazard classification of H3 to H5 in some areas and therefore would not be trafficable in a 1% AEP event. Therefore the inability of traffic to travel along Wybong Road in a 1% AEP would be unaffected by the Project."	The HEC Response to Agencies Submissions report provides information in Section 10 on 'Wybong Road Trafficability and Flood Hazard'. This involves 3 design flood events (10% AEP, 1% AEP and PMF) and includes hazard vulnerability classifications ranging from H1 to H6. Hazard is based on the product of peak depth and velocity along Wybong Road with the flood modelling results generating the required information. Hazard increases in severity from H1 through to H6. Predicted flood hazard classifications along Wybong Road for the 3 design flood events are plotted over a road length of 5800m. In relation to the PMF, the flood hazard for existing conditions is very high, typically at H5 or H6 for much of the road. Table 3 in the HEC Response to Agencies Submissions report shows there is an increase in 'With Project' flood hazard classification over a total road length of 1,196 m, being 23% of the road length that is flooded. Furthermore, there is a decrease in 'With Project' flood hazard classification over a total road length of 1,199 m, also being 23% of the road length that is flooded. This decrease is due to the presence of the haul road crossing and overtopping of the levee, with subsequent entry of flood flows into the MCCO Additional Project area. The increase in flood hazard classification is generally limited to 1 classification level in most areas of increased hazard. However, near CH3400-3500 m the increase appears to be 4 hazard classification levels (H2 to H6). The PMF is a very rare event and the probability of such an event occurring over the relatively short life of the mining operation is extremely low. Given this very low probability, and very high hazard under existing conditions (meaning there is an extremely low likelihood of people or vehicles using Wybong Road at such a time), the 'With Project' PMF flood hazard increase is not considered meaningful in a practical sense. The 10% AEP and 1% AEP events are considered to be more meaningful

Key Matter		HEC Response	Peer Review Close-out Comment
No.	Description		
			events to assess flood hazard and the impact of the Project. In the 1% AEP event, notable 'With Project' increases in flood hazard classification levels occur at CH2750 (H1 to H2 and H3), CH3050 (H1 and H2 to H5), CH4400 (H4 to H5), CH4700 (H2 to H4). Table 3 in the HEC Response to Agencies Submissions report shows there is an increase in flood hazard classification over a total road length of 352 m, being 15% of the road length that is flooded (2,390 m). It is relevant that in the 1% AEP event 2,390 m of the 5,800 m road length is inundated under 'Existing' conditions, and the flood hazard is already at the H5 level at 4 locations. Further, the H5 level is not exceeded under 'With Project' conditions. It can be concluded there is a very low likelihood that people or vehicles will be using Wybong Road during such an event. The 10% AEP event provides a more realistic gauge of flood hazard impacts in an event where there is a reasonable likelihood that people or vehicles may be using Wybong Road. In the 10% AEP event 1,436 m of the 5,800 m road length is inundated under 'Existing' conditions, and the flood hazard reaches the H2 level at 4 locations. The H2 level is not exceeded under 'With Project' conditions, except at CH4700 where there is an increase in 3 classification levels (H2 to H5). This is at the southern tributary creek crossing of Wybong Road, and HEC state this occurs because the 2.0 m/s velocity threshold is just exceeded - there is a 2.5% velocity increase (1.97 to 2.02 m/s) and a depth increase of 0.03 m, so in practical terms there is minimal increase in flood hazard. Table 3 shows there is an increase in flood hazard classification over a total road length of 69 m, being 5% of the road length that is flooded (1,436 m). It is a moot point as to whether the increase in 'With Project' flood hazard requires the provision of mitigation measures. On the one hand the increase in flood hazard is very minor for the smaller 10% AEP design event but becomes increasingly significant for the rarer design events in which there is a very much reduced likelihood that people or vehicles

Key Matter		HEC Response	Peer Review Close-out Comment
No.	Description		
			would in any case be using Wybong Road. The need (or otherwise) for flood mitigation measures to minimise 'With Project' flood hazard increases can be addressed in future detailed design phases, which would entail further flood modelling to inform the process and to prepare a design for mitigation measures should this be deemed necessary. Any future consideration of increased 'With Project" flood hazard and associated mitigation measures would also need to address emergency management.
7	Providing appropriate representation (on flood mapping) of changed flooding conditions at the haul road crossing.	"Inundation maps have been updated to remove "decreased inundation extent" on Wybong road under the overpass. PDF's will be provided via file transfer."	This matter relates to the proposed haul road crossing of Big Flat Creek and Wybong Road as well as the proposed levee, whereby major flood flows will be directed towards and then "channelled" through the road opening below the haul road crossing. It is expected therefore, that the flood mapping would show an increase in flood depth for Wybong Road where it passes under the haul road embankment. The additional mapping provided recently by HEC shows areas of 'Decreased Inundation Area' (i.e. reduced flood extent) within the footprint of the haul road embankment. This is because areas that were flooded under 'Existing' conditions are no longer flooded with the haul road embankment in place. Where the haul road passes over Wybong Road, the additional flood mapping shows no change in 'Inundation Area' (i.e. flood extent). This is because for the smaller design events (10%, 5% AEP) Wybong Road at this location is not flooded under 'Existing' conditions, and this remains the case under 'With Project' conditions. For the larger design events (1%, 0.5%, 0.4%, 0.2%, 0.1%, PMF), there is no change in 'Inundation Area' where Wybong Road passes under the haul road because this strip of road is flooded under 'Existing' conditions and continues to be flooded under 'With Project' conditions, albeit at greater depths due to increased

Key Matter		HEC Response	Peer Review Close-out Comment
No.	Description		
			flood flows being "channelled" along this section of road. As the available flood mapping shows flood extent but not flood depth, the magnitude of flood depth changes are not reflected in the flood mapping. Hence the flood mapping, including the additional mapping recently provided by HEC, should be read in conjunction with information provided in the HEC Response to Agencies Submissions Report as included as Appendix 4 to the RTS. Figure 4 in this report shows a 'With Project' 0.54 m increase in 1% AEP flow depth on Wybong Road upstream of the haul road crossing. Further, Figure 3 shows a 'With Project' 1% AEP flood depth over Wybong Road where it passes under the haul road crossing of approximately 0.55 m at the road centreline and approximately 0.75 m at the road edge. In summary, by referring to the additional mapping provided and the HEC Response to Agencies Submissions report there is sufficient information to assess changed flooding conditions at the haul road crossing. No further action is considered necessary.

Table 1 above outlines further action that is considered necessary in relation to the key matters listed. Another matter identified in the peer review that although not critical to a determination of the project, should be addressed in the future as outlined below:

- 'With Project' design flood velocities will be high in some locations, particularly in the riparian corridor, and notably in the vicinity of the haul road crossing. There are also locations where the ‘With Project’ velocities, although not as high, represent a significant increase relative to 'Existing' conditions. Future detailed design should cater not only for the provision of erosion and scour protection in areas of high ‘With Project’ flood velocities (e.g. rock armouring) but also consider areas where there are significant increases in ‘With Project’ velocities. Importantly, a suitable erosion and scour monitoring and maintenance program should be implemented.

4.2 Summary Comments

A peer review of the flood modelling has been undertaken. This included a review of the hydraulic model, key input to the hydrologic model, flood assessment reporting and associated flood mapping. This was conducted as a staged process to allow questions and requests for further information to be addressed by HEC. Following assessment of the responses and additional information provided by HEC (refer **Attachment 1**), the final findings of the peer review have been documented in this peer review report.

Following consideration of the additional assessment undertaken by HEC, including the HEC Response to Agencies Submissions report (refer Appendix 4 of the RTS), the peer review found that while some issues had been identified and future work recommended to improve the overall accuracy of the modelling, with the additional information to be provided by HEC, the present flood modelling sufficiently characterises the flooding impact of the MCCO Project for impact assessment purposes.

Recommendations have been made for updates to flood modelling (refer to **Table 1**) as part of the future detailed design phase for the MCCO Project (e.g. detailed design of the haul road crossing or design of flood mitigation measures).

Yours sincerely

Glenn Mounser
Manager Water Group, Umwelt (Australia) Pty Limited
Principal Water Engineer.

Attachment 1 – Additional Information Provided by HEC

4 December 2019

Manager Water Group
Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284
via Email
Attention: Glenn Mounser

Glenn,

Re: Mangoola Coal Continued Operations Project (SSD 8642) – Surface Water Assessment Flood Modelling and Reporting Peer Review

Further to our recent correspondence, the following provides additional information and data relating to key issues raised during the peer review.

1. *Discharge predictions being low (relates primarily to the adopted design rainfalls and rainfall losses).*

The RORB hydrologic model for the 1% AEP “with Project” case was re-run with probability neutral burst initial losses and a continuing loss of 0.61 mm/hr as per NSW FFA-reconciled losses for Wybong Creek. This results in a peak flow rate increase of approximately 11% at the proposed haul road crossing of Big Flat Creek. The TUFLOW hydraulic model was also re-run for this event using the increased peak flow rate and results show a maximum depth increase of approximately 17 cm on Wybong Road just upstream of the proposed haul road crossing, which reduces to 3 cm approximately 50 m further upstream. Maps have been created to show the depth and inundation difference for the updated hydrograph which are provided in Attachment A. If it is considered that the increase is significant enough to warrant re-modelling of all AEPs, we could undertake this work in January.

2. *Clarification of Areal Reductions Factors (ARFs) applied to design rainfalls.*

We have previously supplied design rainfall depth data for the Project site with ARFs applied. Our interpretation of your subsequent email is that you are satisfied with the design rainfall depths that were used and that no further clarification on ARFs is needed.

3. *Confirmation of procedure used for ensemble temporal patterns and selection of critical storm durations.*

A spreadsheet has been provided via email as an example of our processing of RORB peak flows to obtain the critical event. We trust that this clarifies this matter.

4. *Confirmation on the sufficiency of inflow hydrographs and associated locations.*

The RORB catchment figures have been updated to show the locations of RORB output locations that weren’t used in the TUFLOW model. These figures are provided as Attachment B.

5. *Flood extent mapping that is very similar/same for floods of different magnitude (appears to relate to flood level predictions in hydraulic model results files being the same or very similar for different design flood events).*

Peak depth difference maps have been created to compare the 10% to 1% and 1% to 0.1% AEP events for the “with” and “without Project” cases. These are provided as Attachment C.

6. *Flood hazard impacts and the means of mitigating these impacts.*

The relevant section in the RTS report has been amended to read as follows:

"The most notable changes evident in Figure 7 are an increase from a H1 hazard classification to either H2 or H3 for approximately 40 m length of road near chainage 2,750 m (just upstream of the proposed overpass) and an increase from a H1 or H2 hazard classification to H5 for approximately 35 m length of road near chainage 3,050 m. There is also an increase of typically 1 classification level for a distance of approximately 60 m near chainage 4,400 m. Taken together, these lengths comprise approximately 6% of the already affected length of road that is predicted to be more affected by floodwaters in a 1% AEP than for the existing situation. A 6% length of road that would be more affected by floodwaters is not considered a significant increase. It should also be noted that the road is predicted in the existing situation to have a hazard classification of H3 to H5 in some areas and therefore would not be trafficable in a 1% AEP event. Therefore the inability of traffic to travel along Wybong Road in a 1% AEP would be unaffected by the Project."

As discussed, it is suggested that the issue of mitigating potential road flooding impacts is obviated by the last statement.

7. Providing appropriate representation (on flood mapping) of changed flooding conditions at the haul road crossing.

Inundation maps have been updated to remove "decreased inundation extent" on Wybong Road within the overpass. These maps are included as Attachment D.

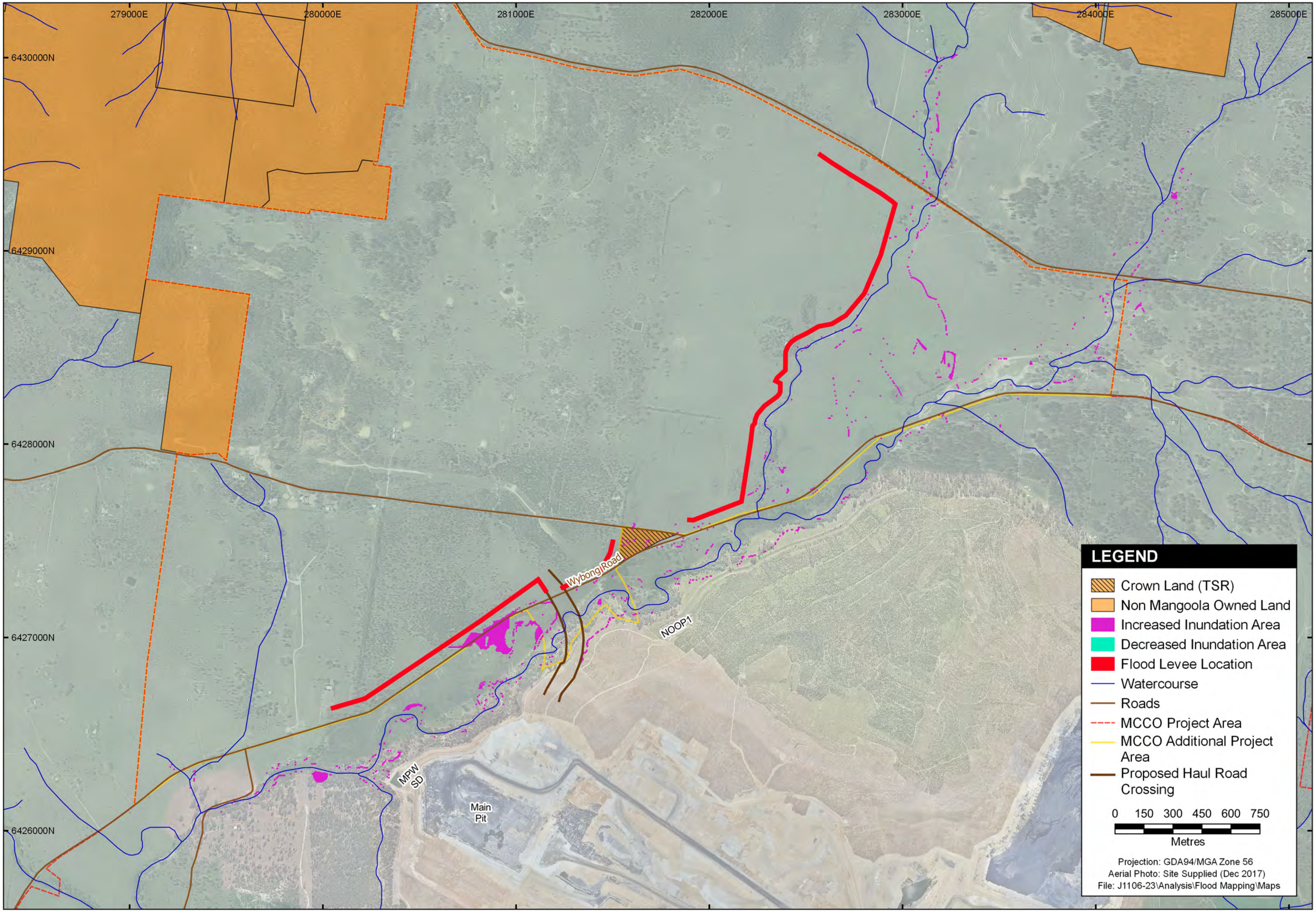
Please contact the undersigned if you have any queries.

Yours faithfully,

Tony Marszalek
Director

Attachment A

Depth and Inundation Difference Maps for 1% AEP Peak Flow "With Project" and with NSW FFA-reconciled losses for Wybong Creek



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NOOP1
MPW SD
Main Pit
LEGEND
Crown Land (TSR)
Non Mangoola Owned Land
Increased Inundation Area
Decreased Inundation Area
Flood Levee Location
Watercourse
Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
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Metres
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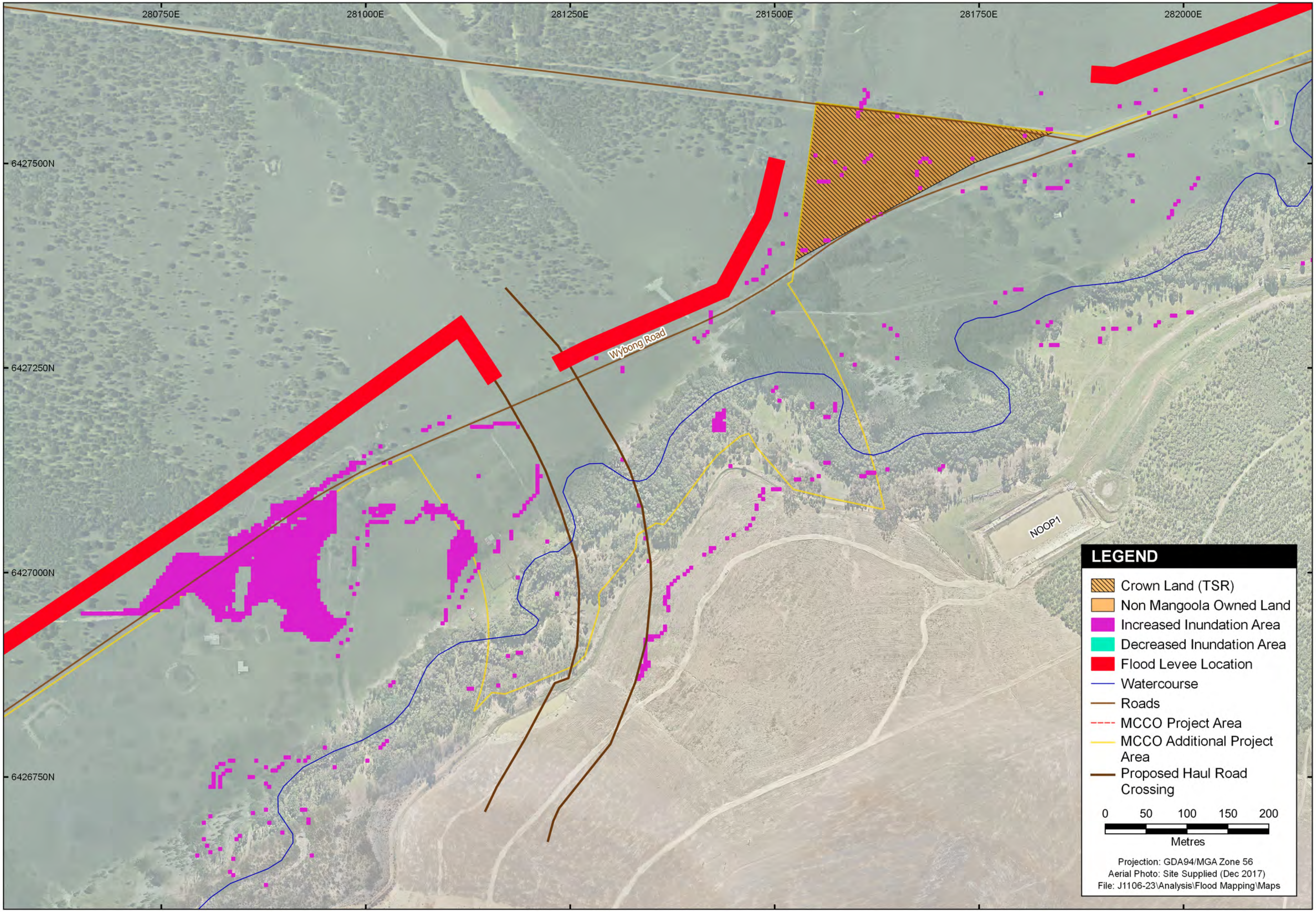
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps



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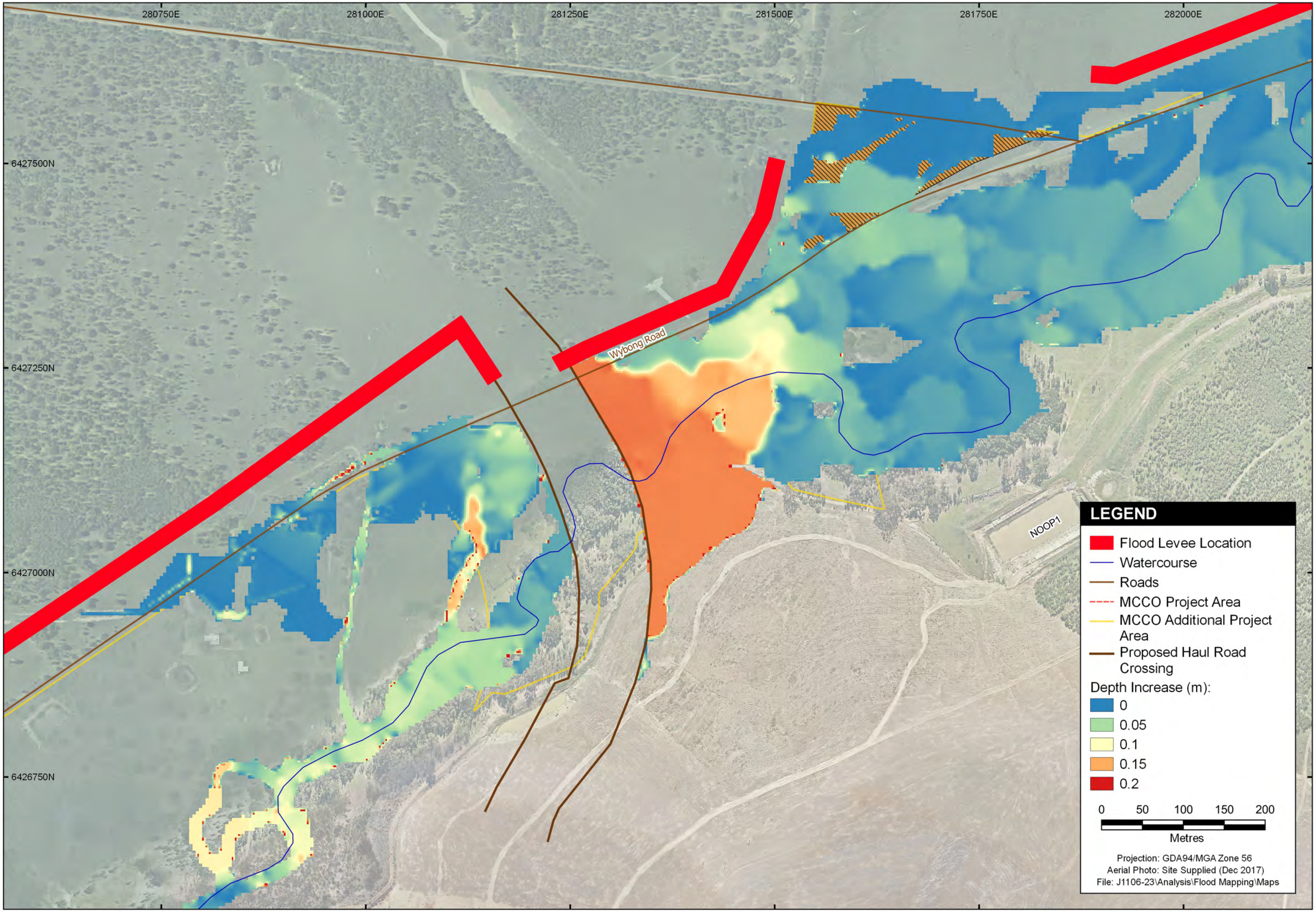
6427500N
6427250N
6427000N
6426750N
Wybong Road
NOOP1
LEGEND
Crown Land (TSR)
Non Mangoola Owned Land
Increased Inundation Area
Decreased Inundation Area
Flood Levee Location
Watercourse
Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
0 50 100 150 200
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps



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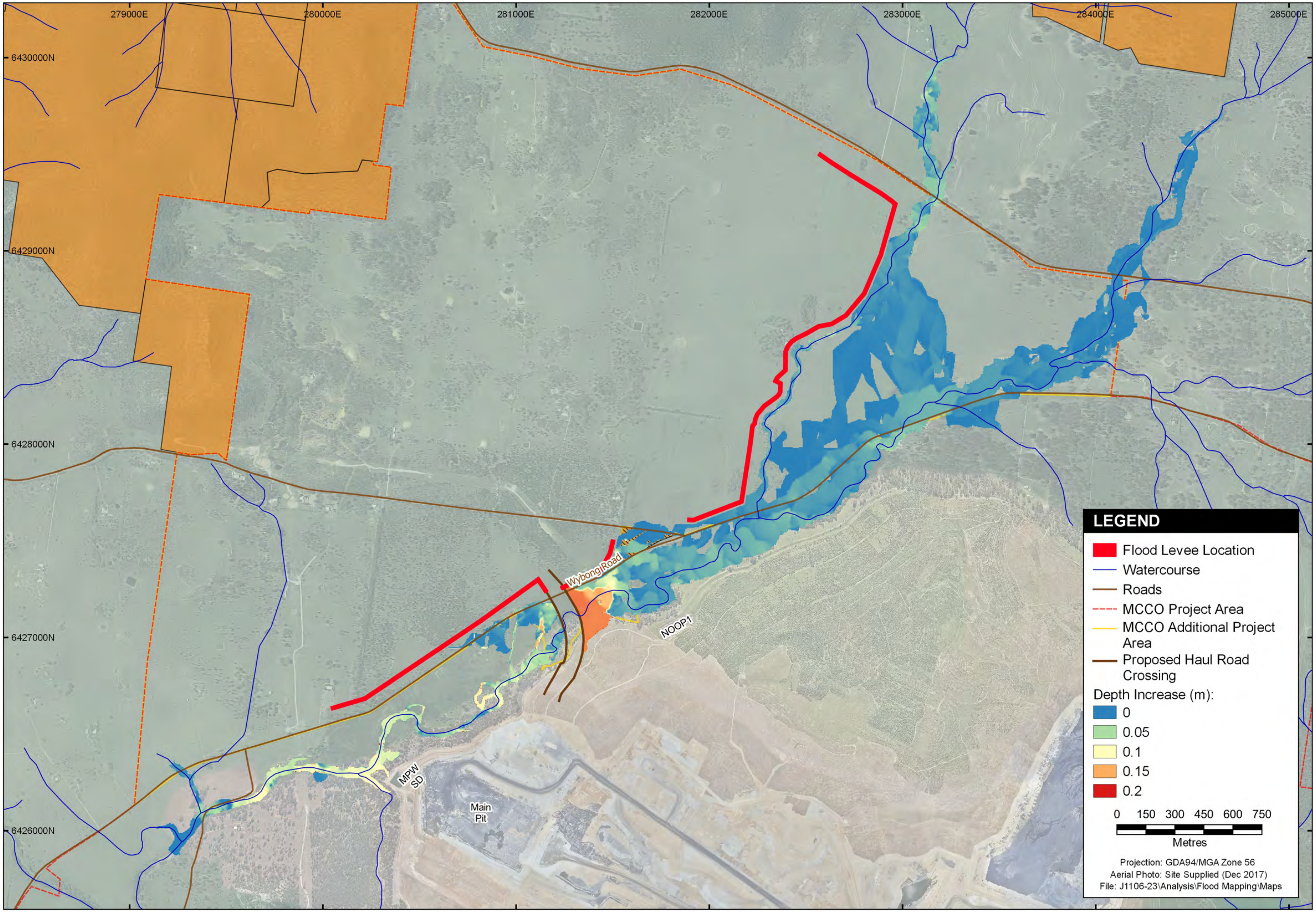
6426750N
Wybong Road
NOOP1
LEGEND
Flood Levee Location
Watercourse
Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
Depth Increase (m):
0
0.05
0.1
0.15
0.2
0 50 100 150 200
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps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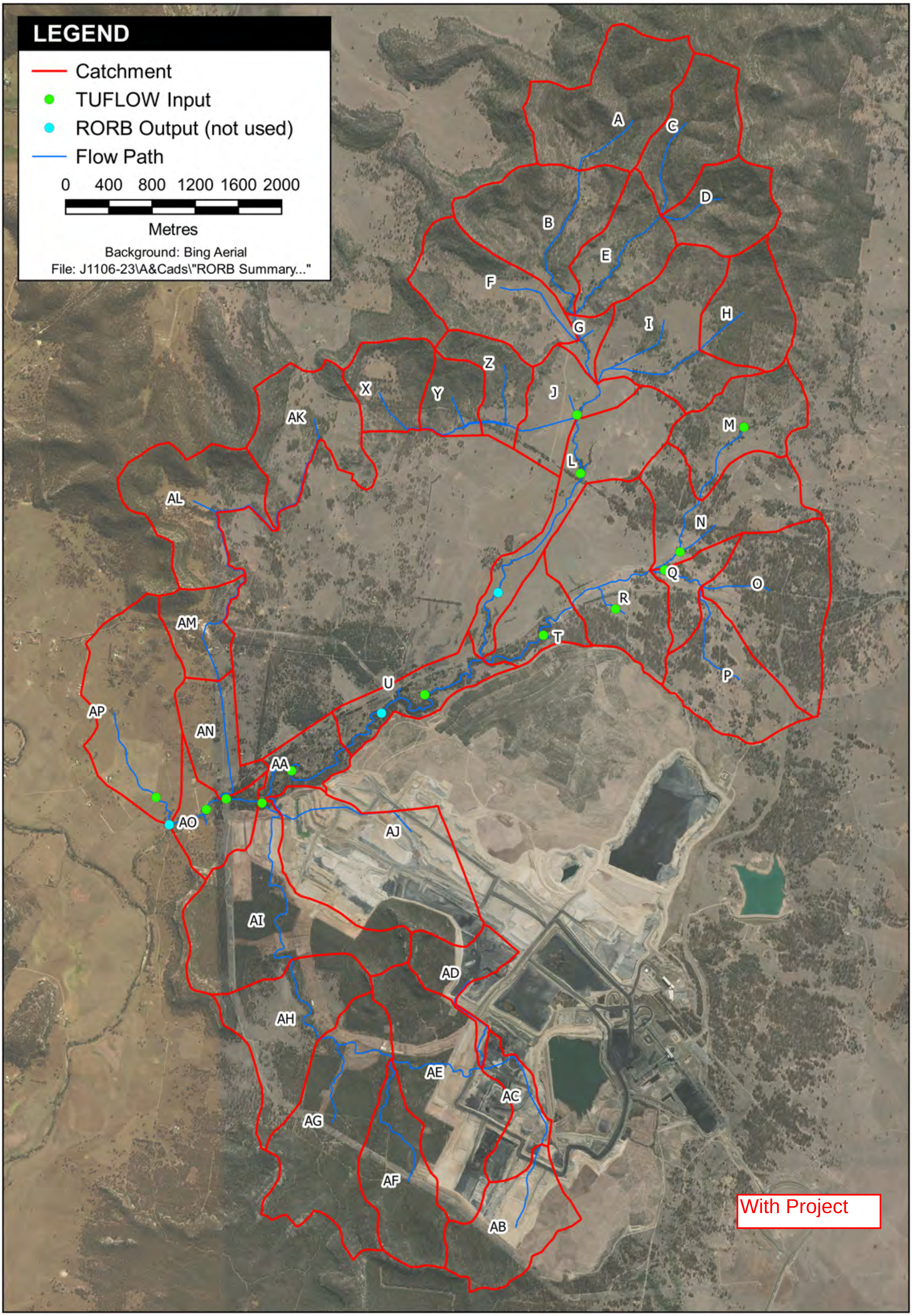
Wybong Road
NOOP1
MPW SD
Main Pit
LEGEND
Flood Levee Location
Watercourse
Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
Depth Increase (m):
0
0.05
0.1
0.15
0.2
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps

Attachment B

Updated RORB Catchment Figures


LEGEND
Catchment
TUFLOW Input
RORB Output (not used)
Flow Path
0 400 800 1200 1600 2000
Metres
Background: Bing Aerial
File: J1106-23\A&Cads\"RORB Summary..."
A
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AN
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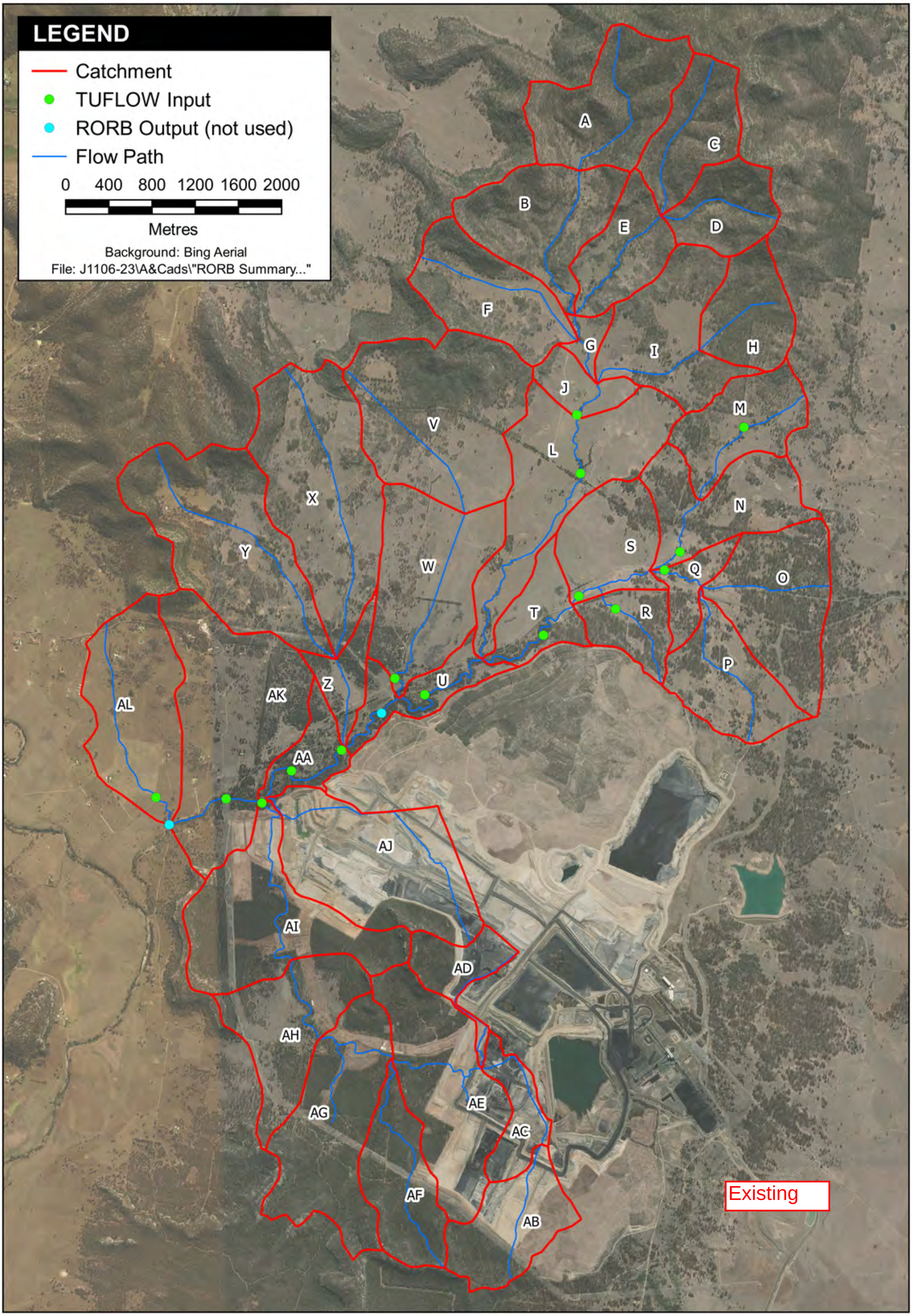
AP
With Project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Catchment
TUFLOW Input
RORB Output (not used)
Flow Path
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Metres
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V
W
X
Y
Z
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AF
AG
AH
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AJ
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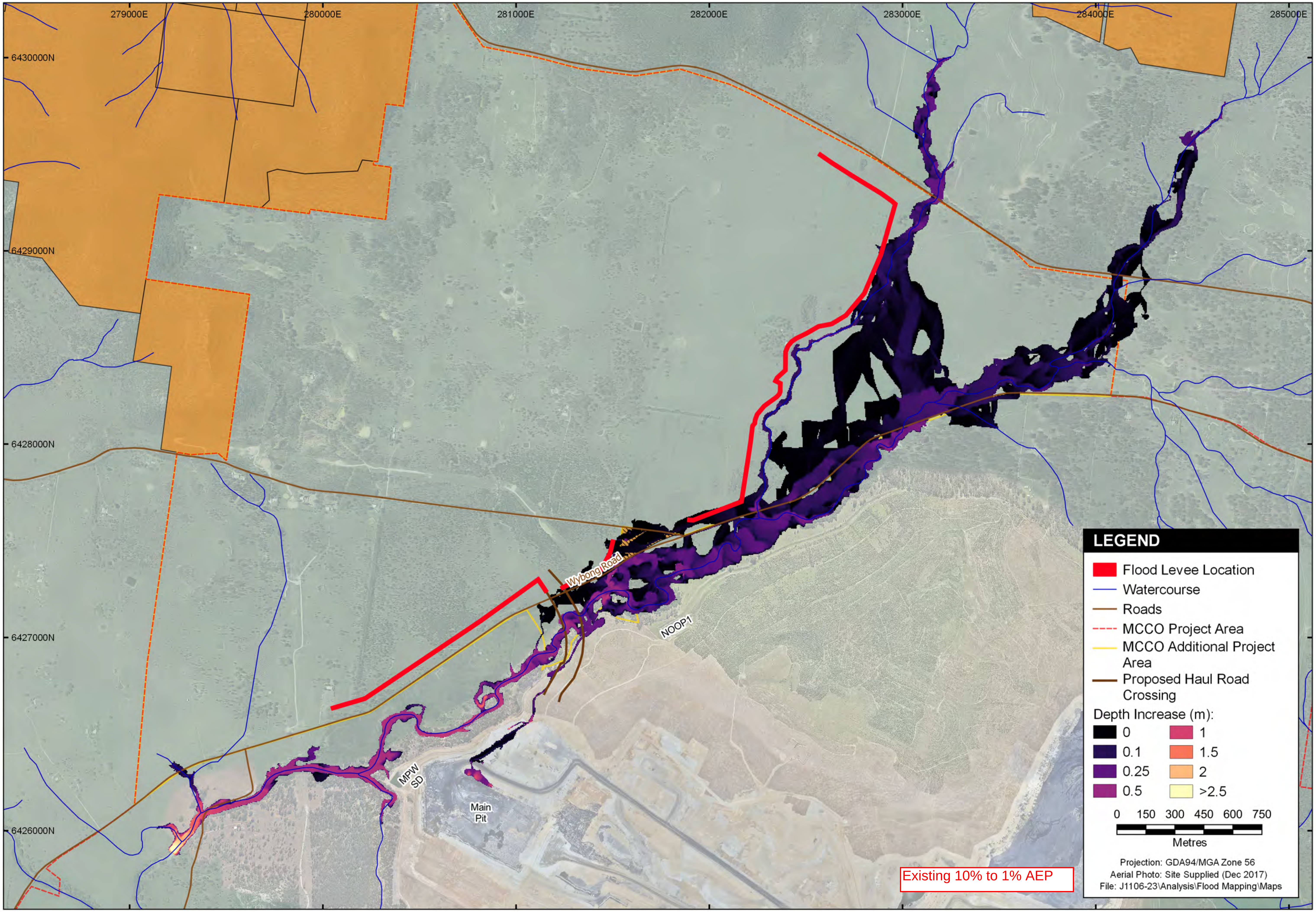
AL
Existing

Attachment C

Peak Depth Difference Maps Comparing 10% to 1% and 1% to 0.1% AEP Events for the "With" and "Without Project" Case



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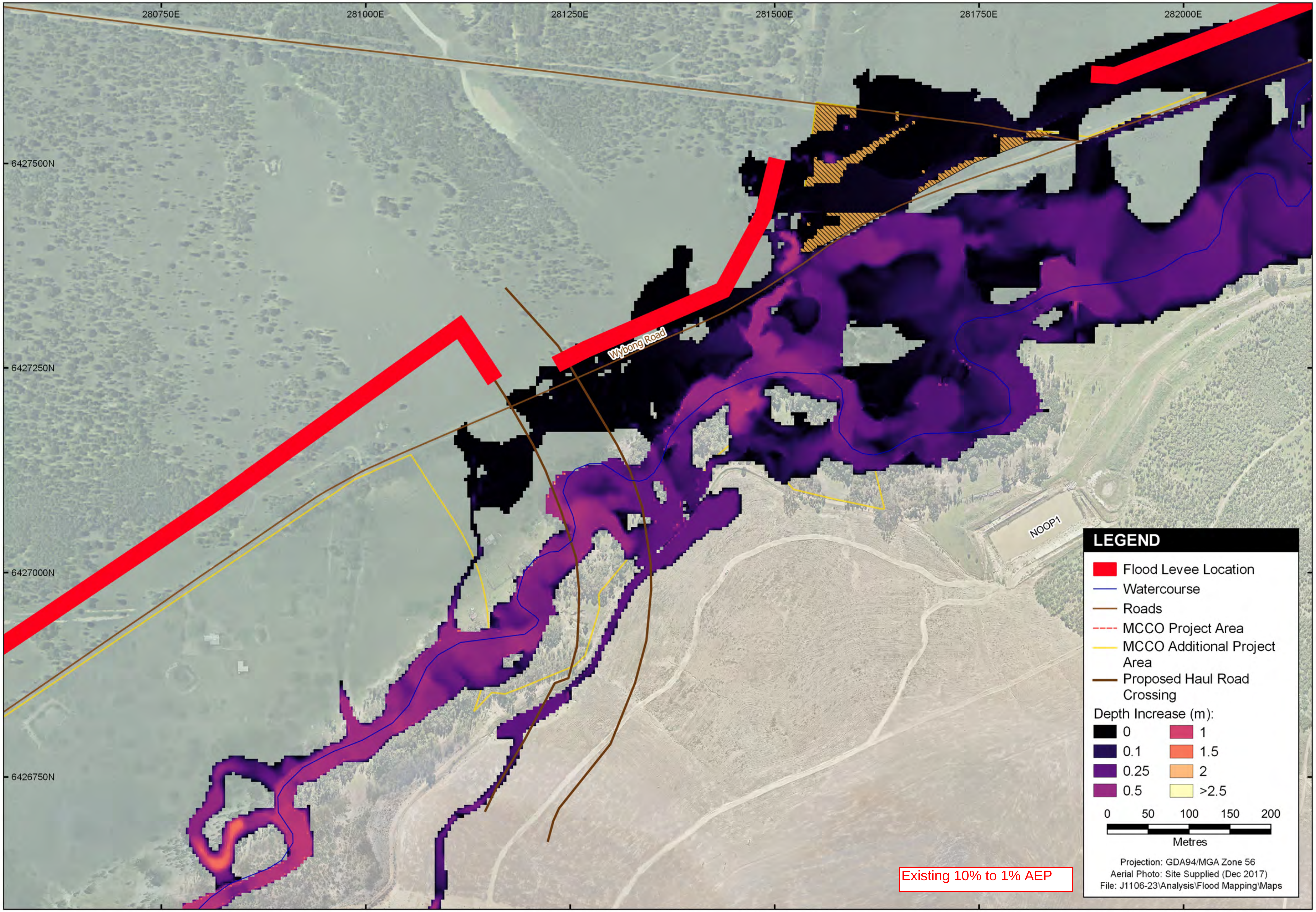
Wybong Road
NOOP1
MPW SD
Main Pit
LEGEND
Flood Levee Location
Watercourse
Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
Depth Increase (m):
0
0.1
0.25
0.5
1
1.5
2
>2.5
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
Existing 10% to 1% AEP



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6427500N
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6426750N
Wybong Road
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Watercourse
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MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
Depth Increase (m):
0
0.1
0.25
0.5
1
1.5
2
>2.5
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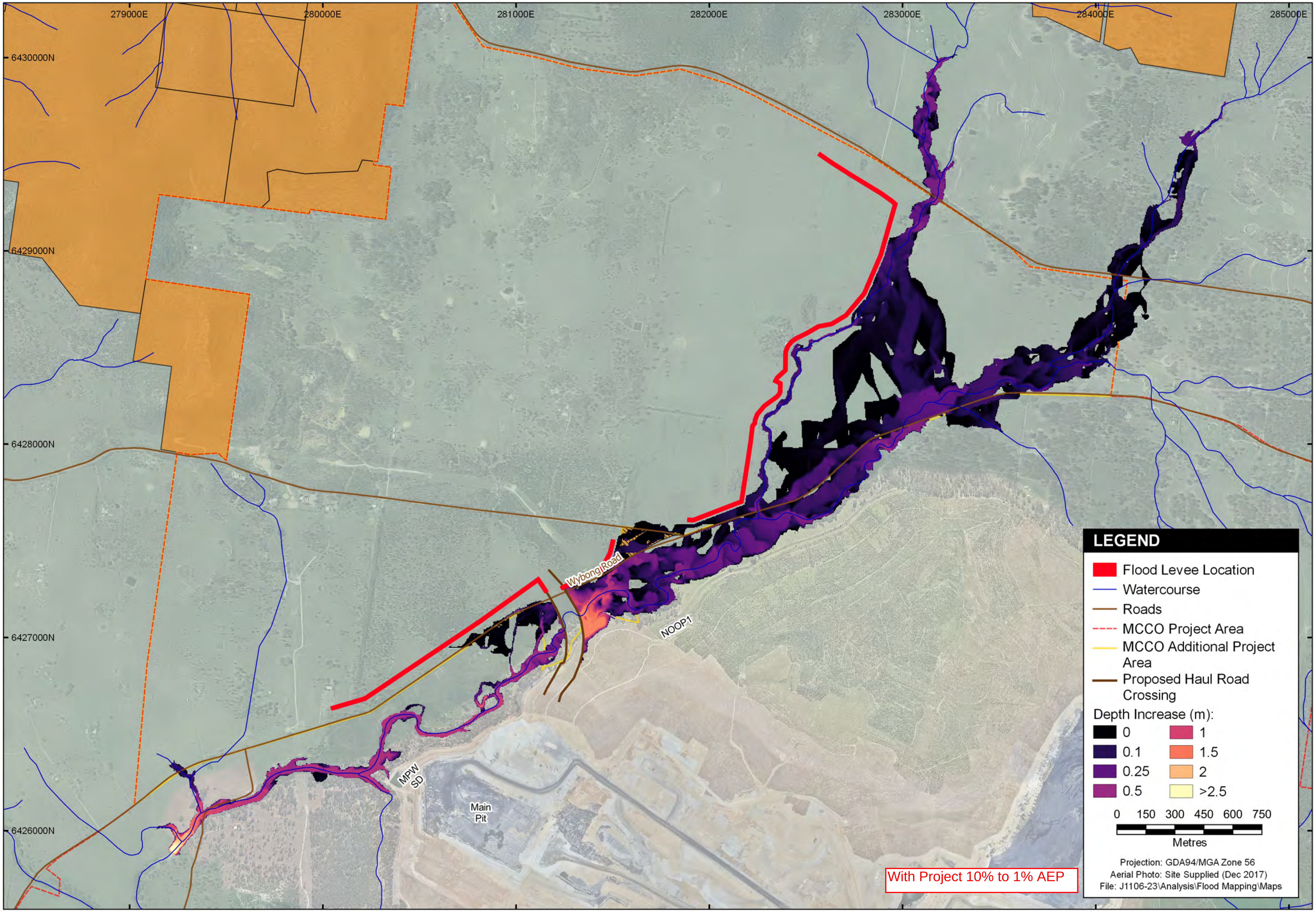
50
100
150
200
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
Existing 10% to 1% AEP



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Wybong Road
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MCCO Additional Project Area
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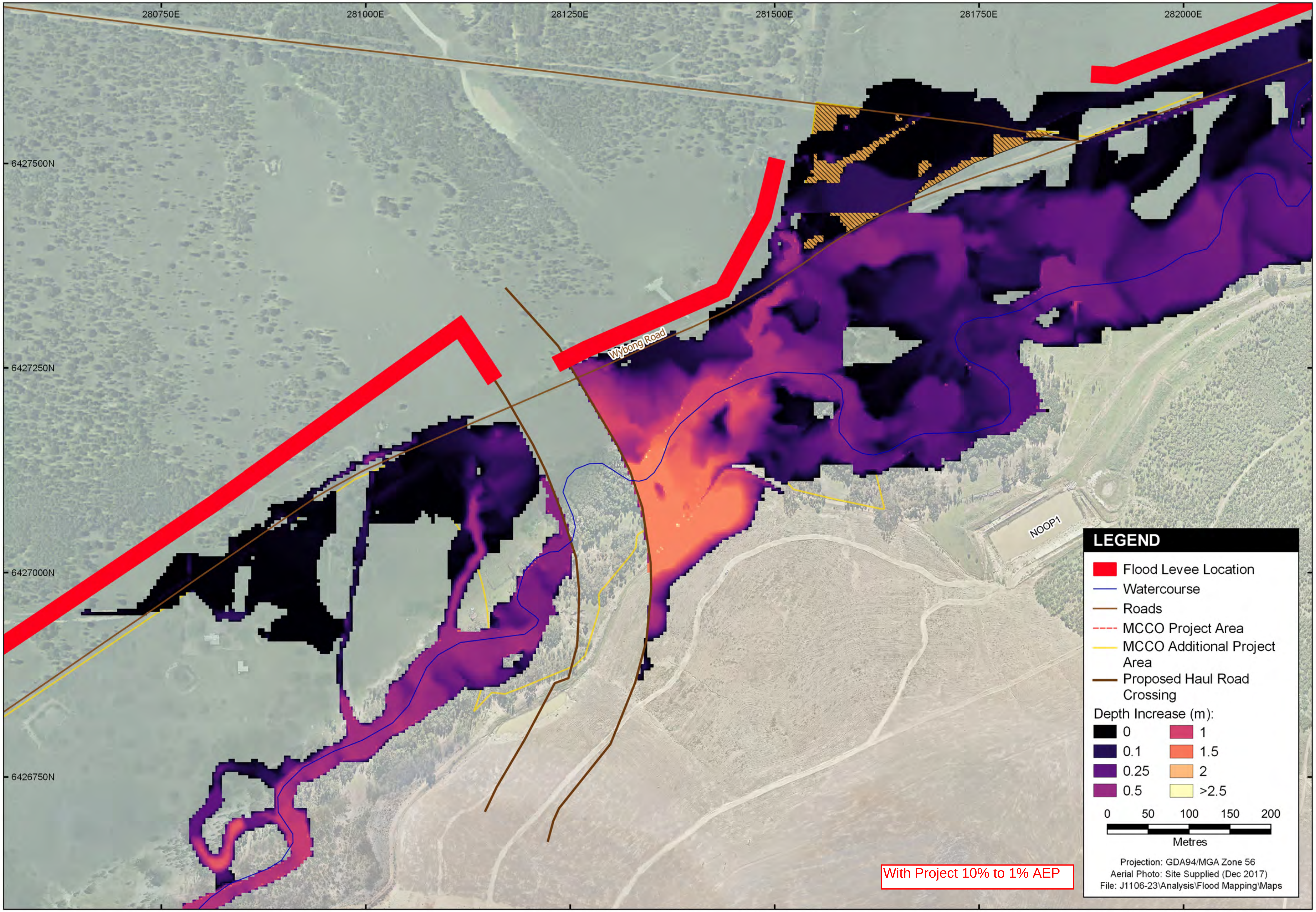
>2.5
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
With Project 10% to 1% AEP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Wybong Road
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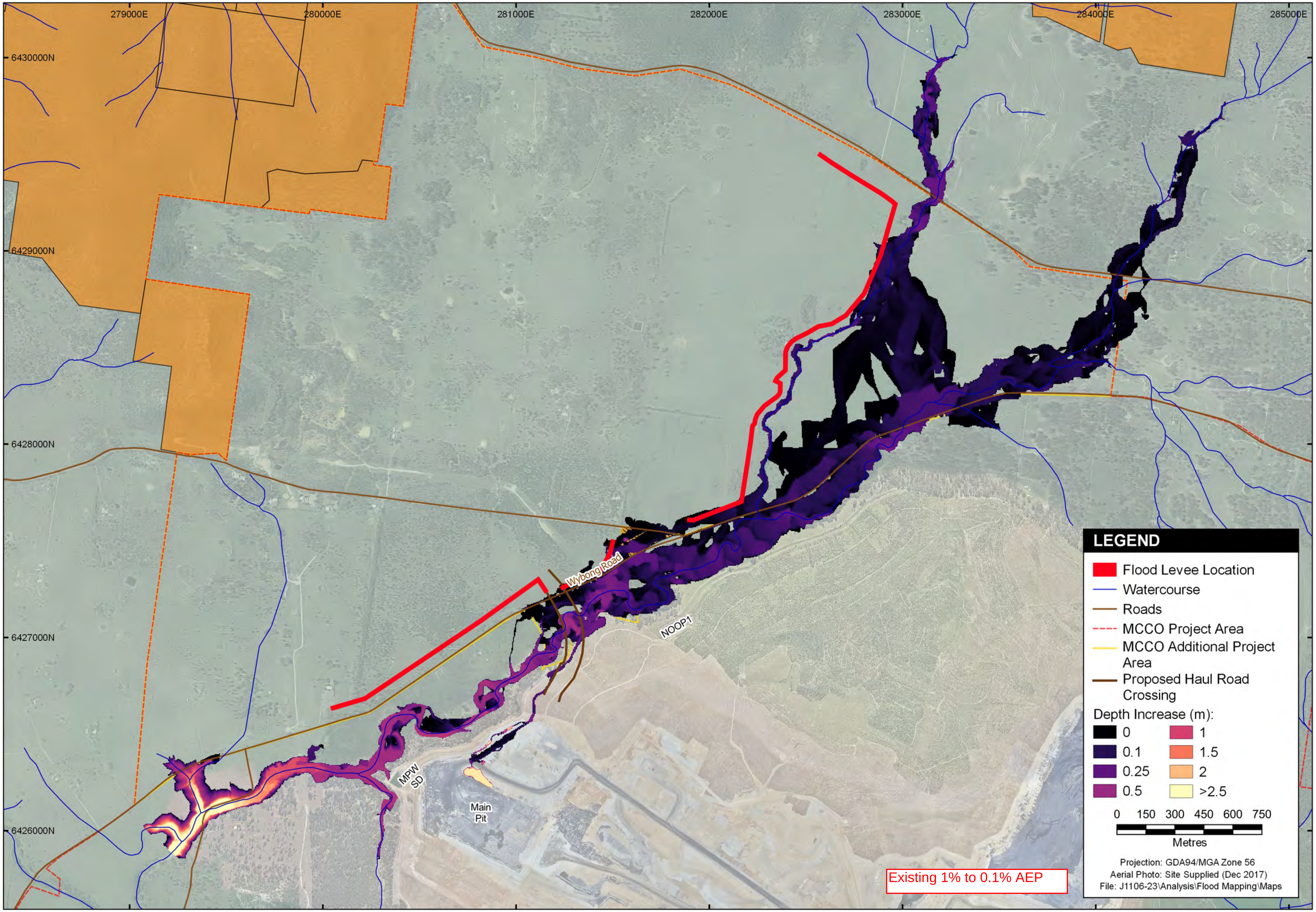
0 50 100 150 200
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
With Project 10% to 1% AEP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>2.5
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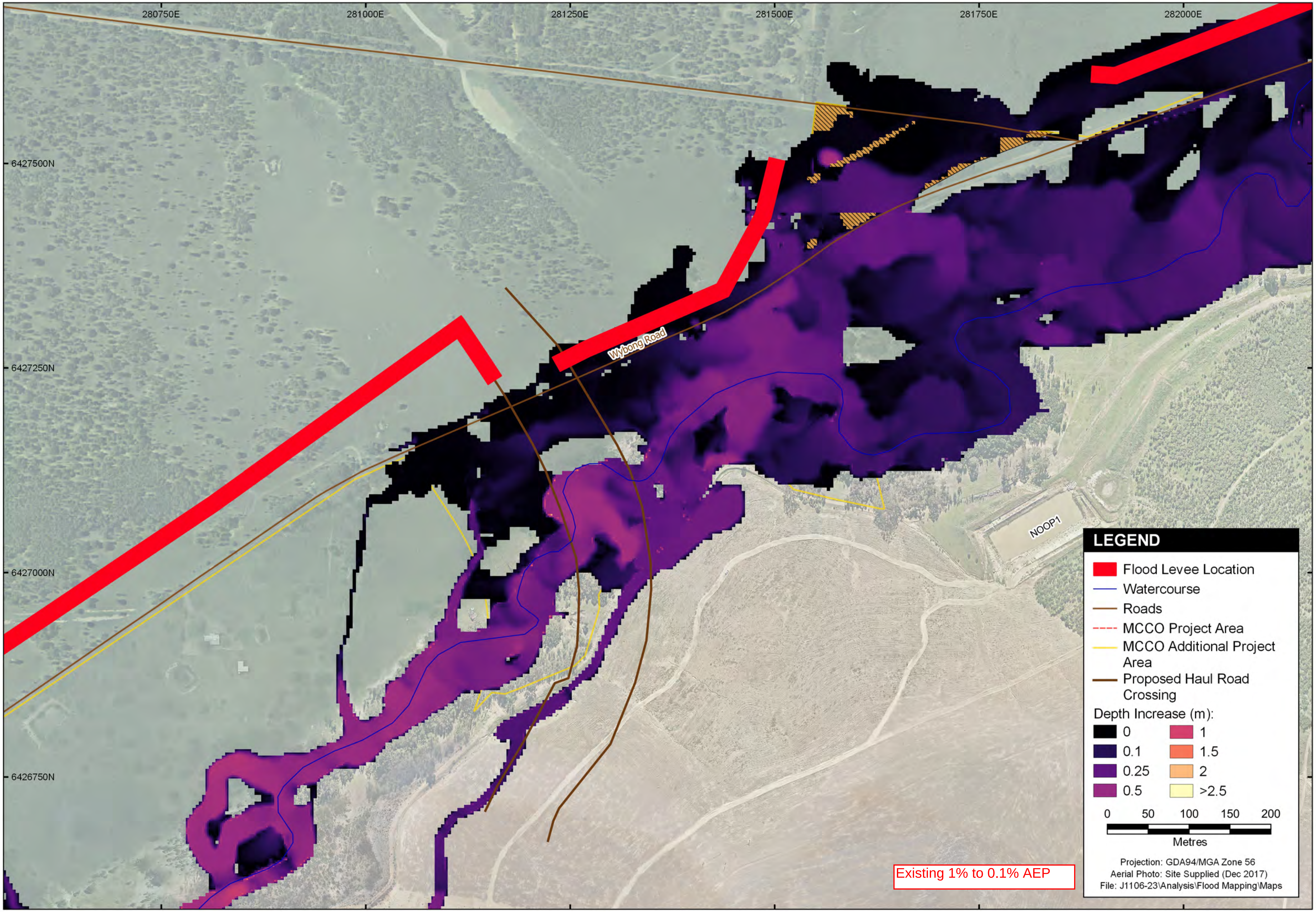
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
Existing 1% to 0.1% AEP



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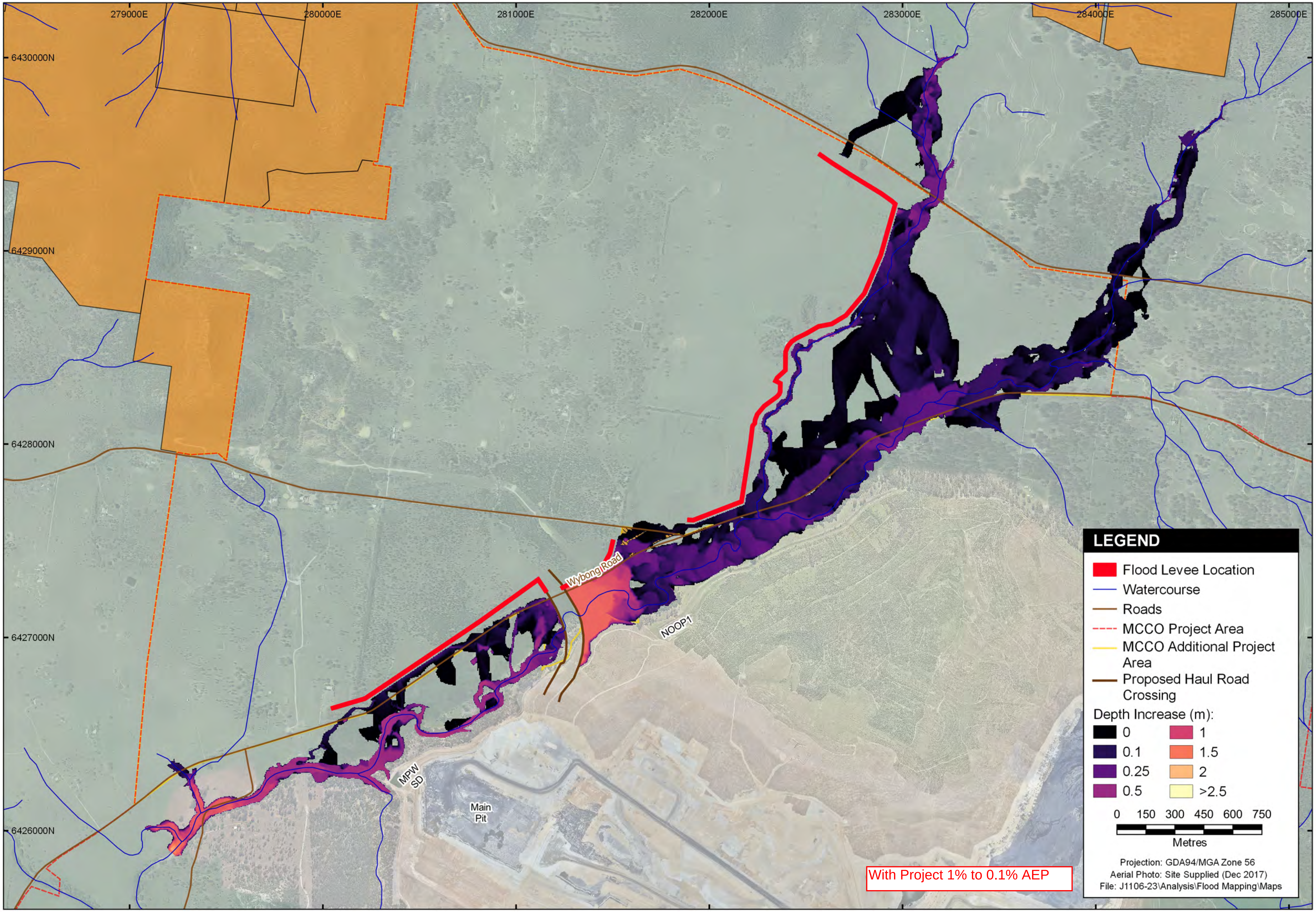
Existing 1% to 0.1% AEP



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0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
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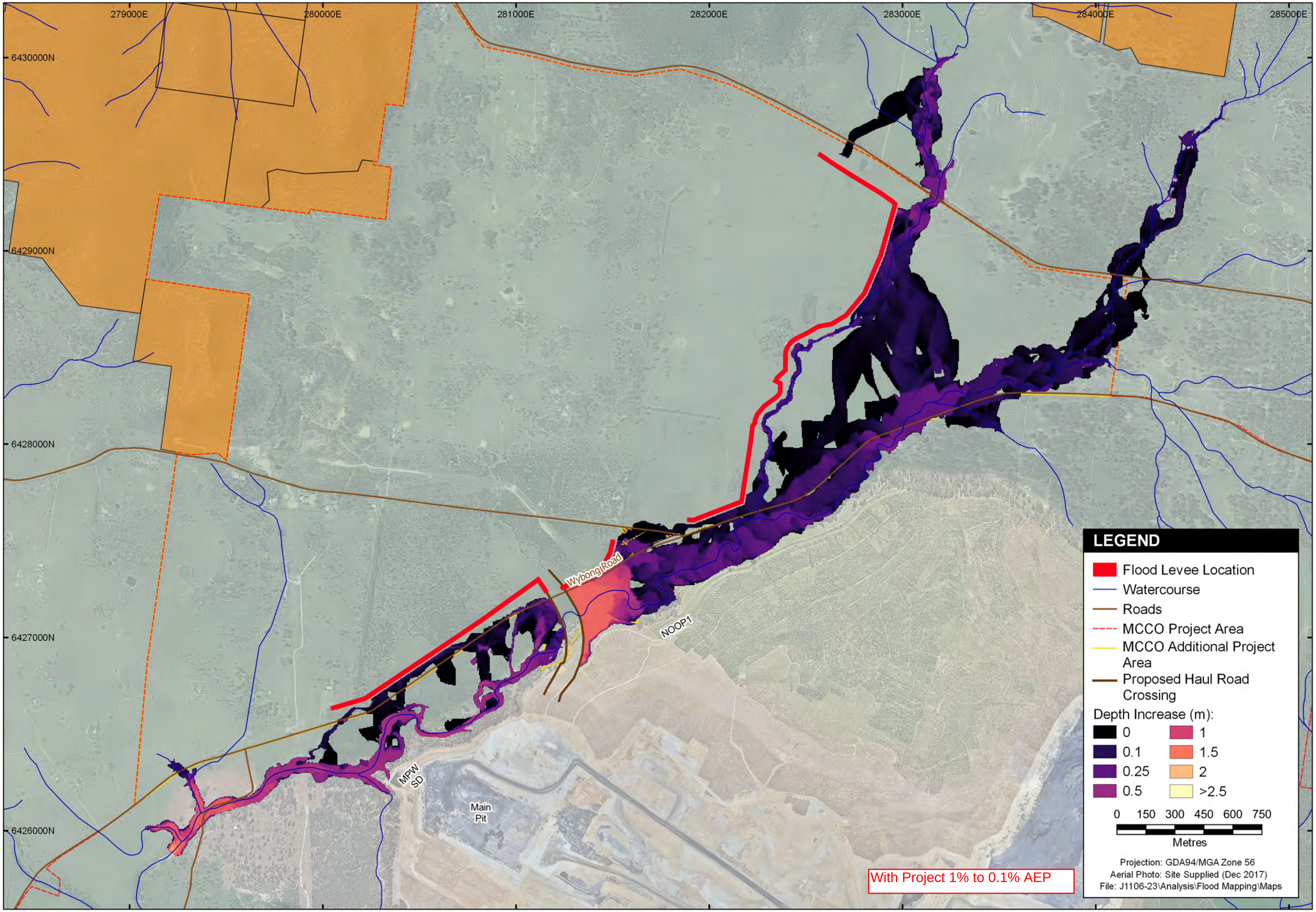
With Project 1% to 0.1% AEP



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Wybong Road
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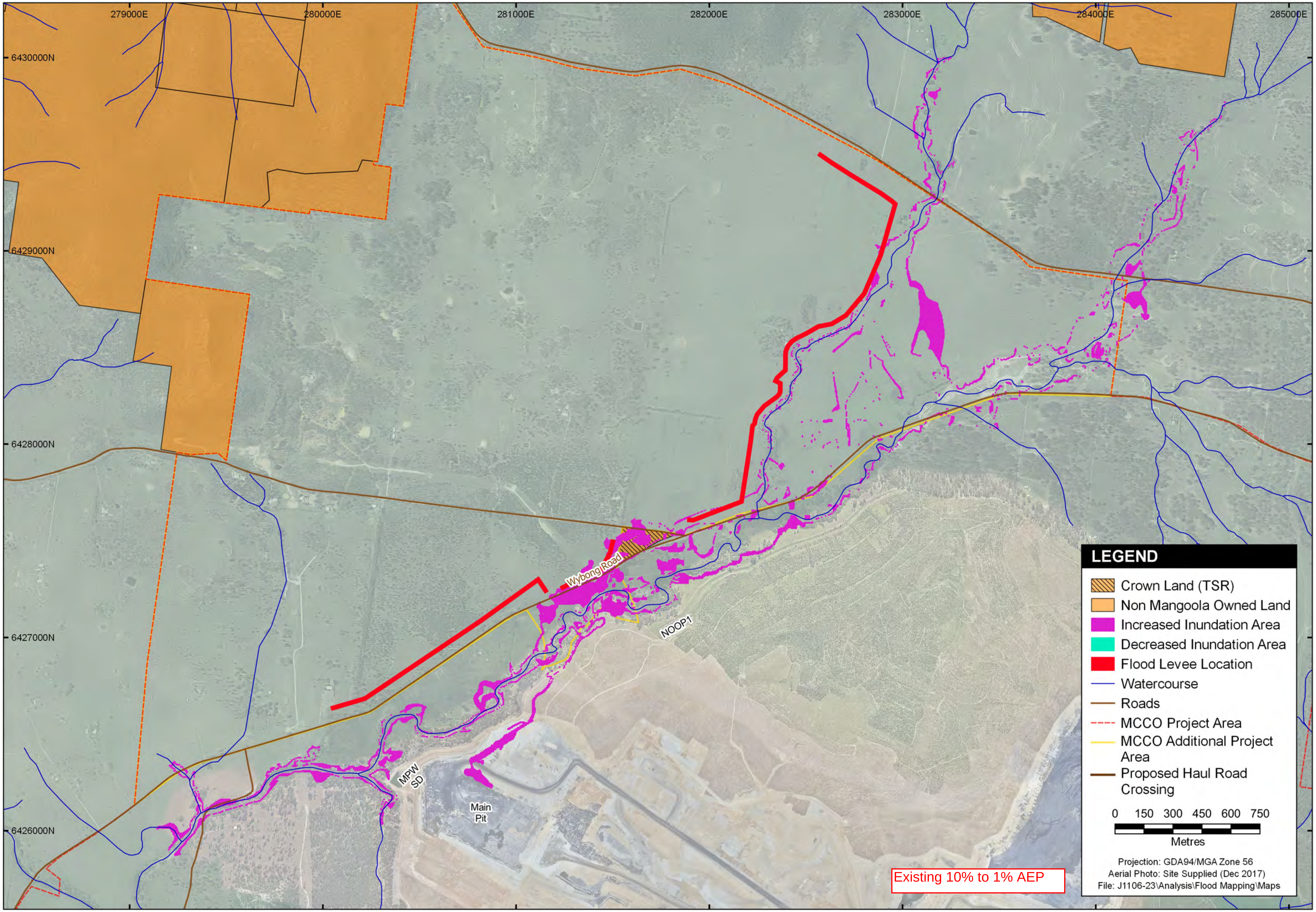
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
With Project 1% to 0.1% AEP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Wybong Road
NOOP1
MPW SD
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LEGEND
Crown Land (TSR)
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Increased Inundation Area
Decreased Inundation Area
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Roads
MCCO Project Area
MCCO Additional Project Area
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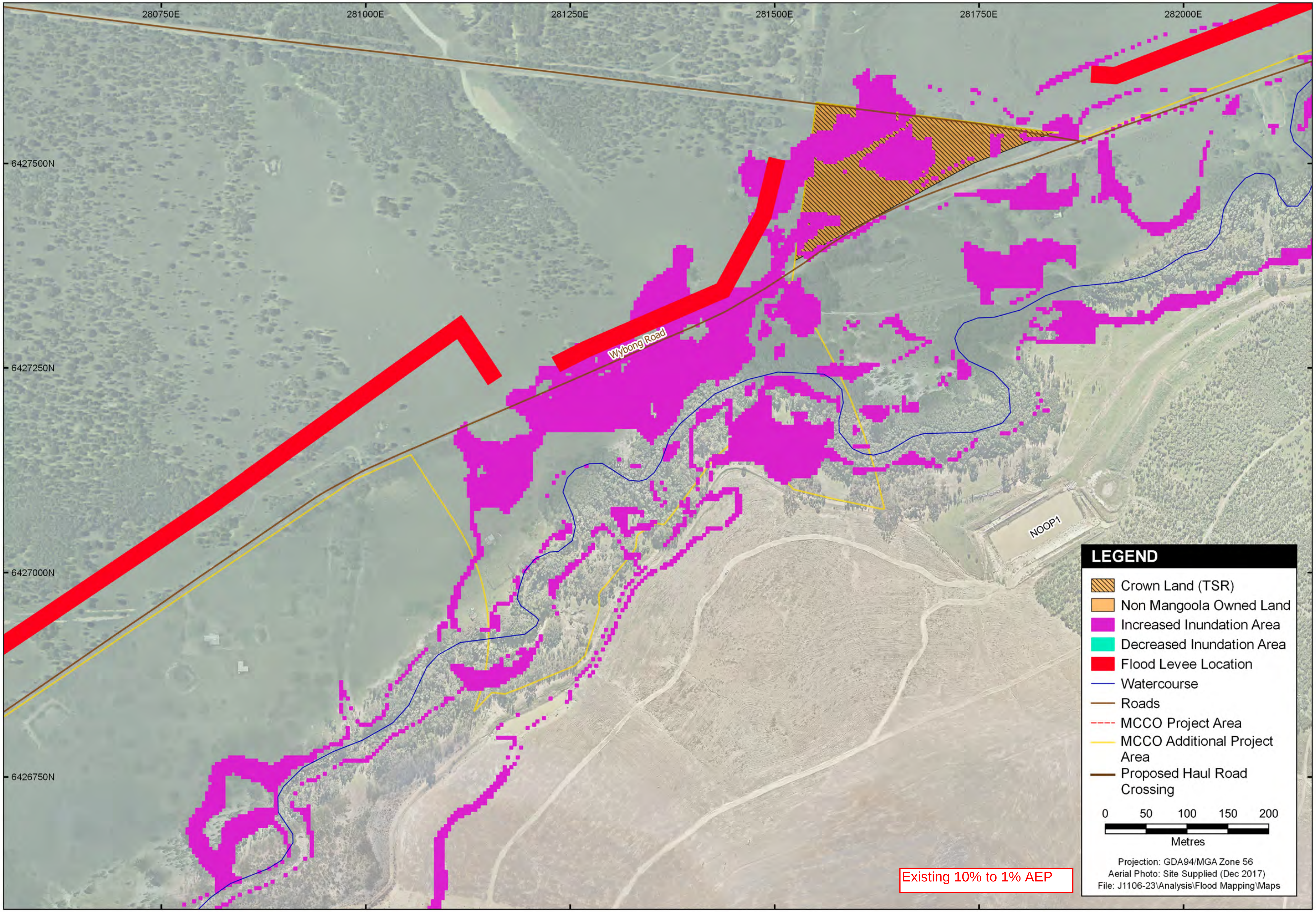
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
Existing 10% to 1% AEP



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Wybong Road
NOOP1
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Decreased Inundation Area
Flood Levee Location
Watercourse
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MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
0 50 100 150 200
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
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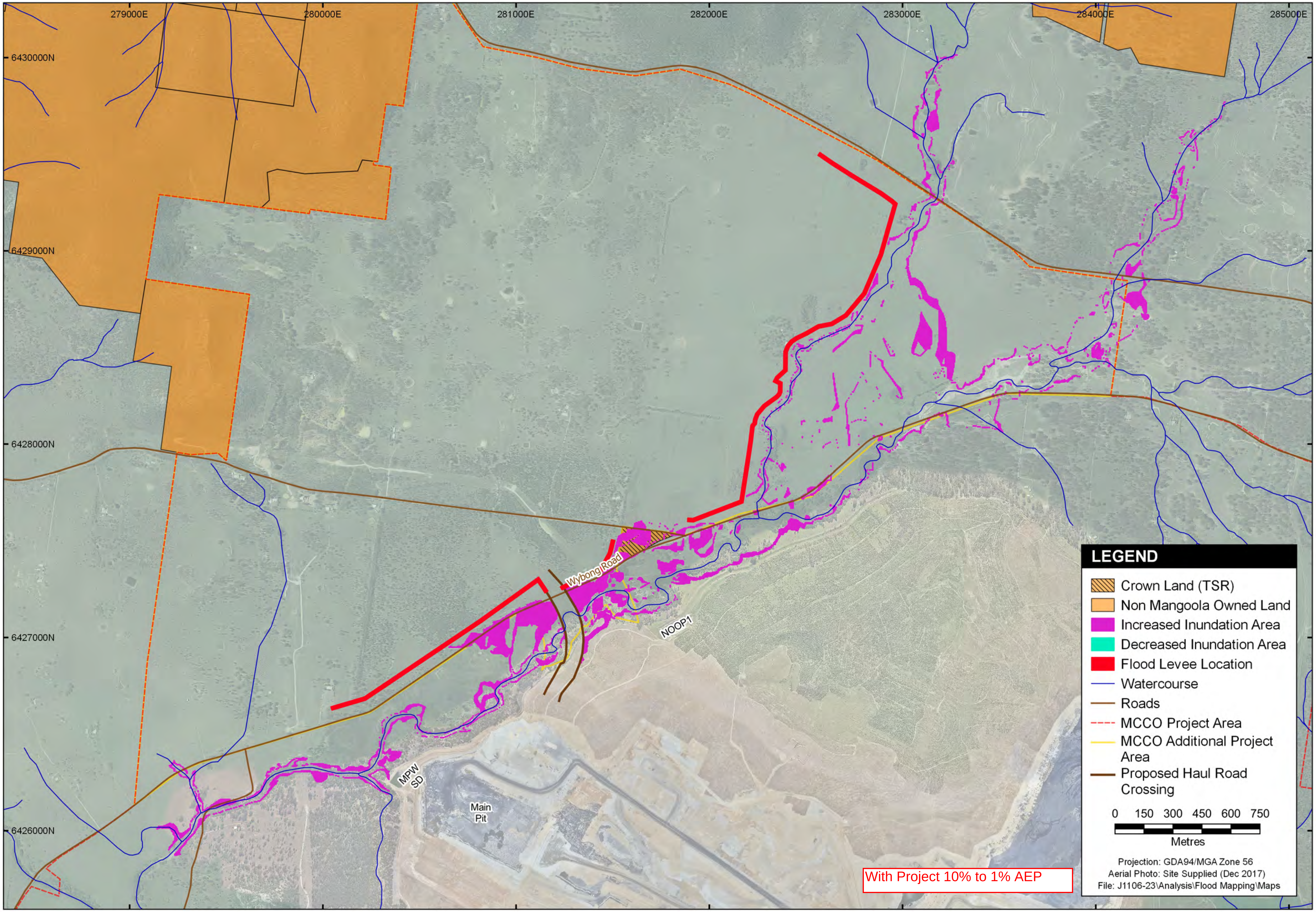
Existing 10% to 1% AEP



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NOOP1
MPW SD
Main Pit
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Non Mangoola Owned Land
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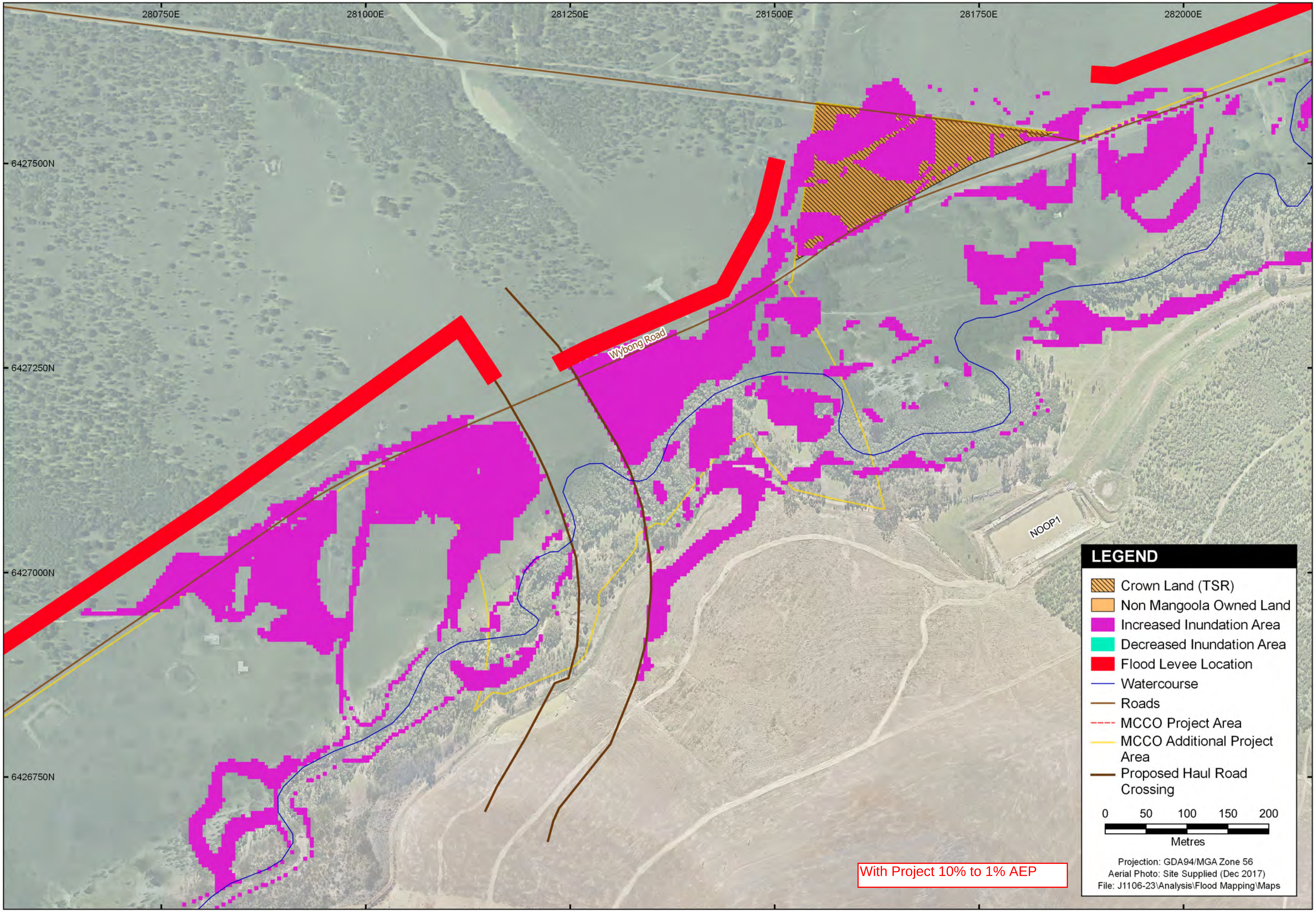
Decreased Inundation Area
Flood Levee Location
Watercourse
Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
With Project 10% to 1% AEP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NOOP1
LEGEND
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Decreased Inundation Area
Flood Levee Location
Watercourse
Roads
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MCCO Additional Project Area
Proposed Haul Road Crossing
0 50 100 150 200
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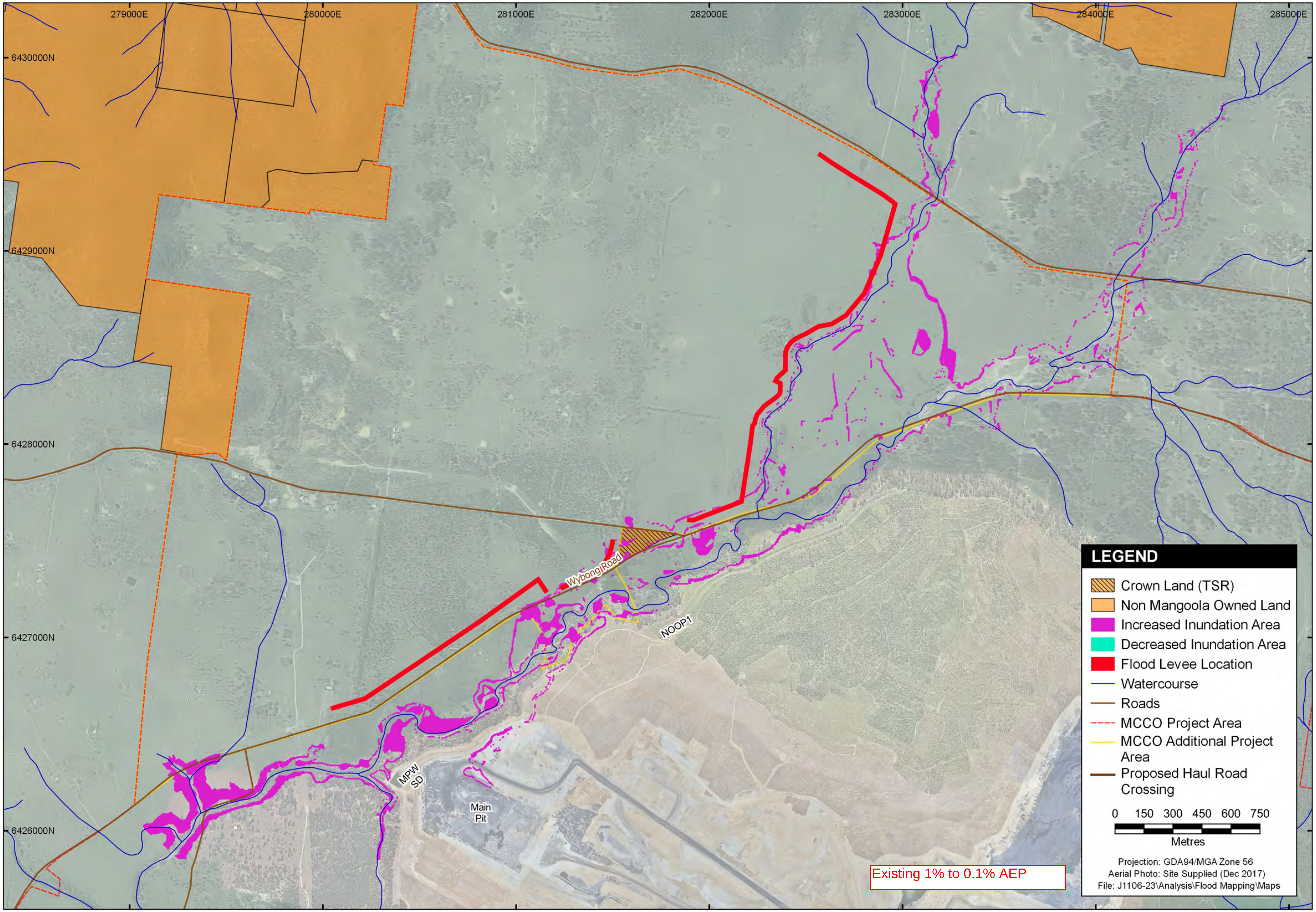
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
With Project 10% to 1% AEP



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Wybong Road
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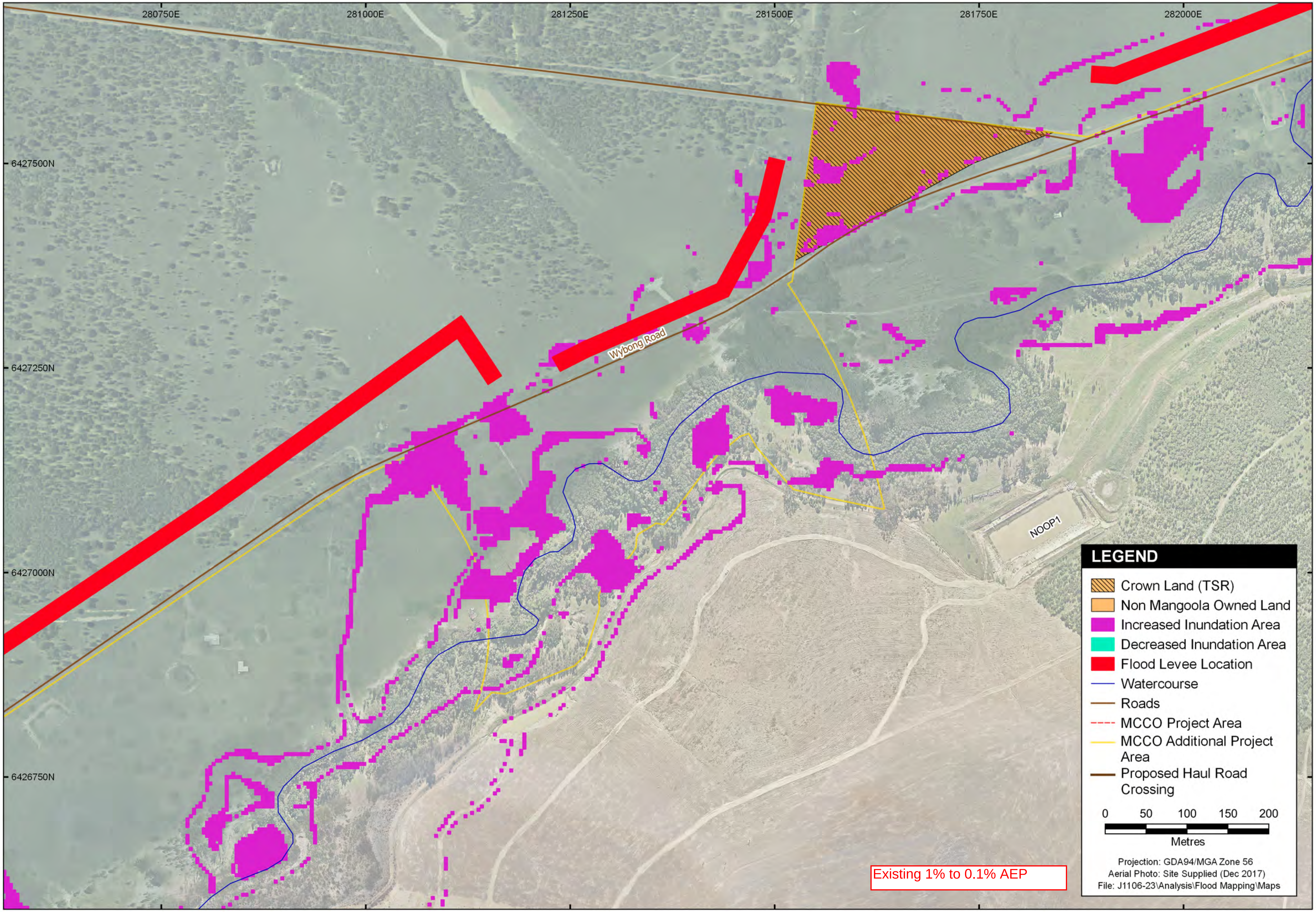
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
Existing 1% to 0.1% AEP



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Wybong Road
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Watercourse
Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
0 50 100 150 200
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
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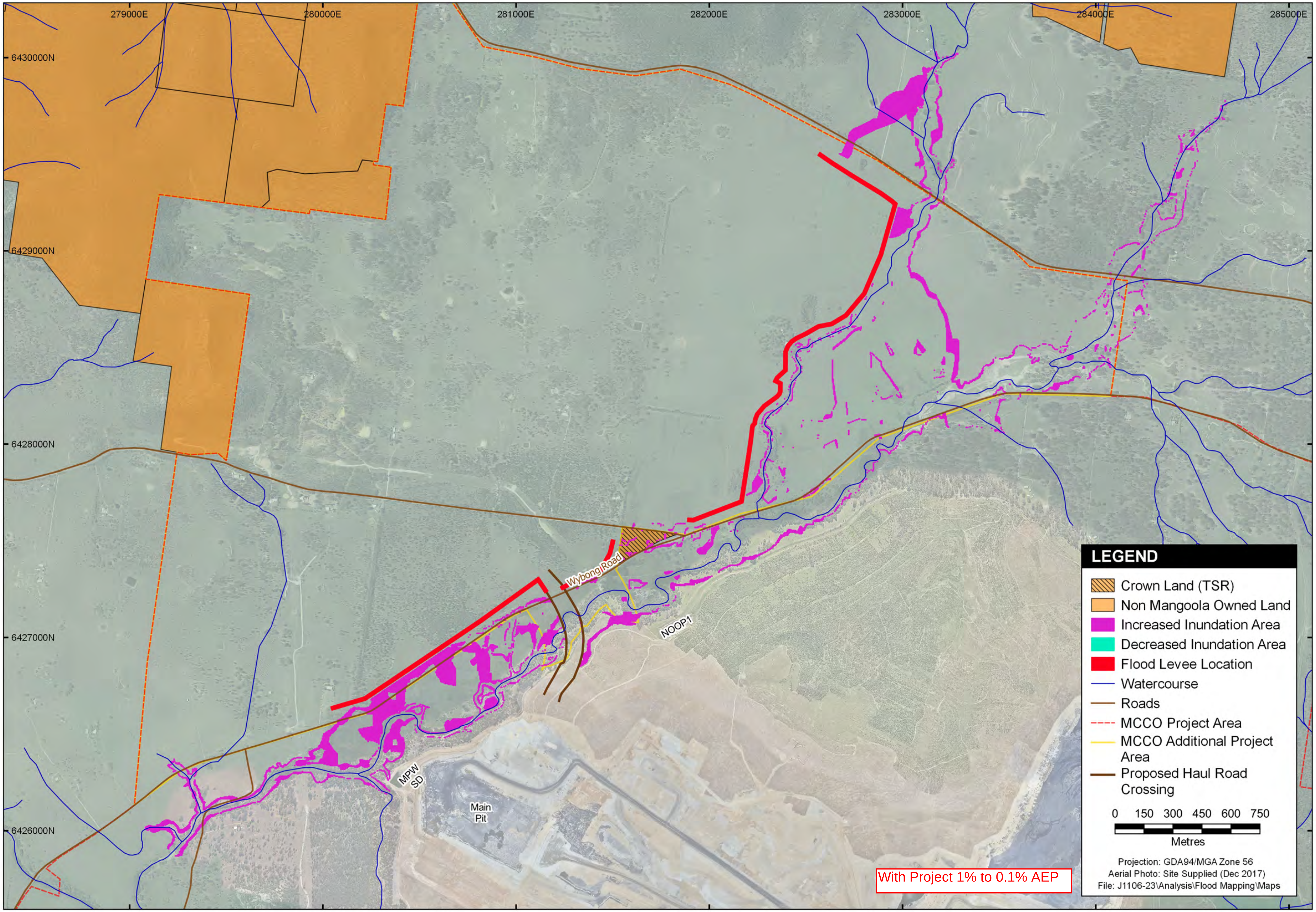
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Wybong Road
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Main Pit
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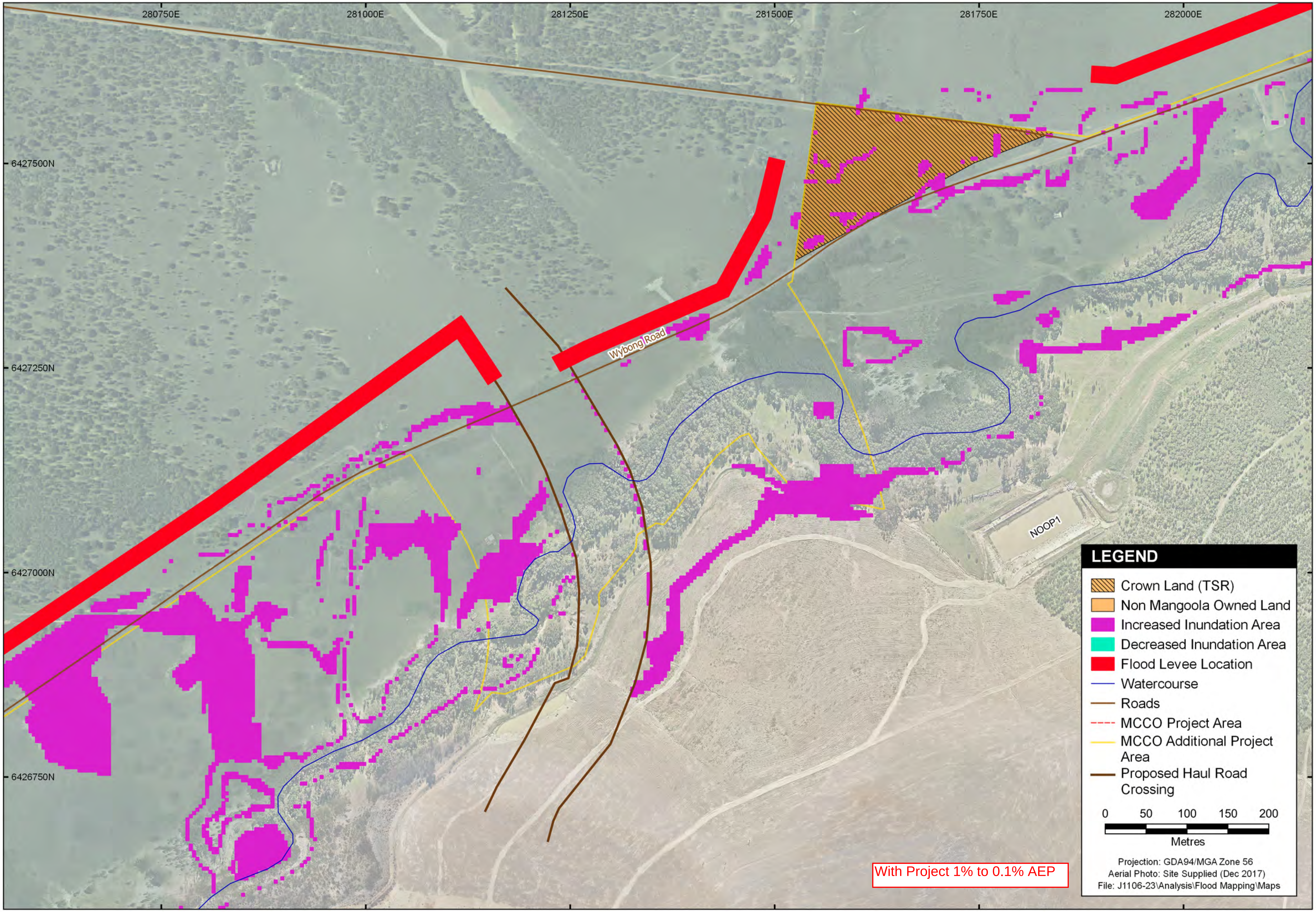
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
With Project 1% to 0.1% AEP



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Wybong Road
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Roads
MCCO Project Area
MCCO Additional Project Area
Proposed Haul Road Crossing
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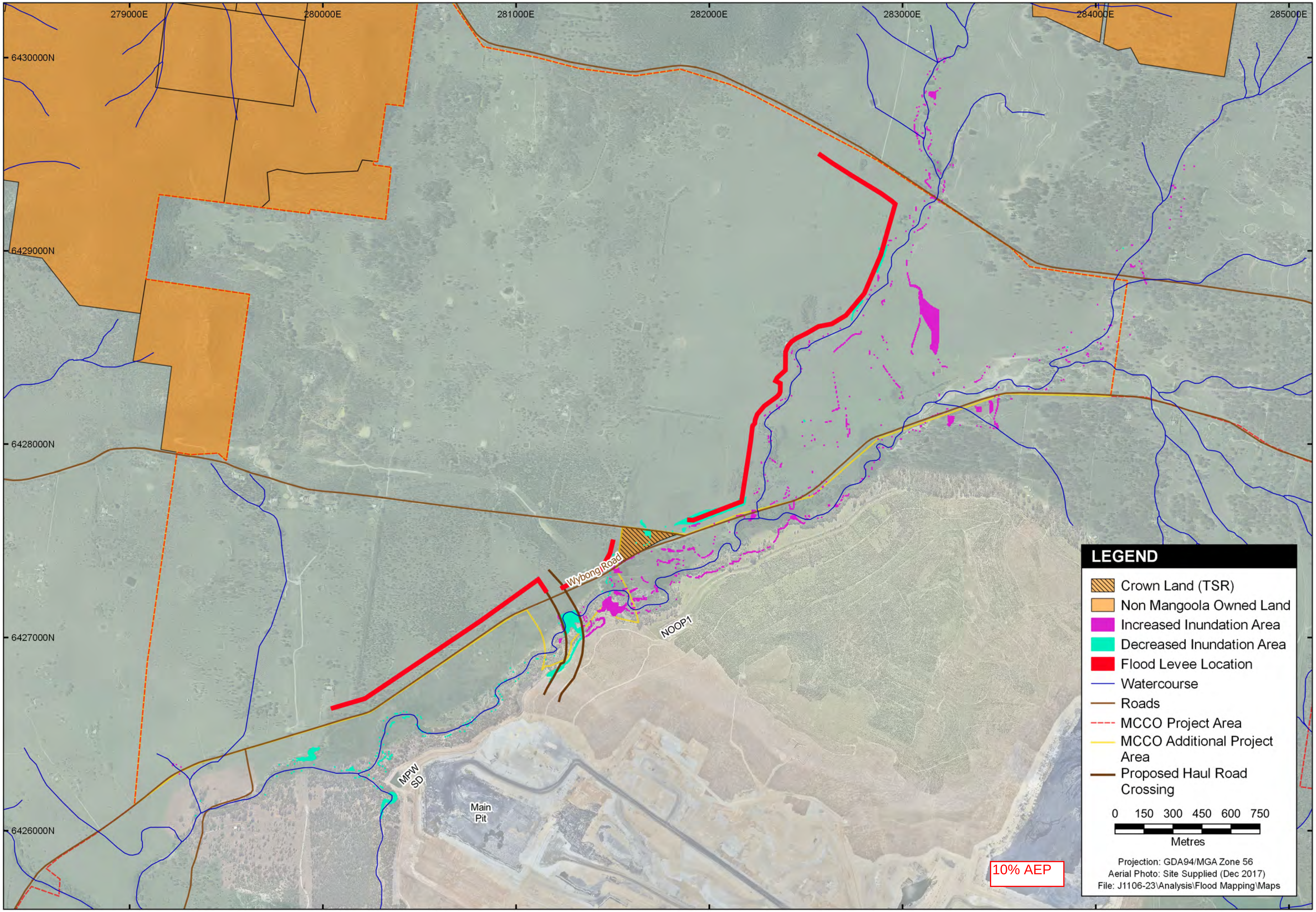
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
With Project 1% to 0.1% AEP

Attachment D

Updated Inundation Maps



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0 150 300 450 600 750
Metres
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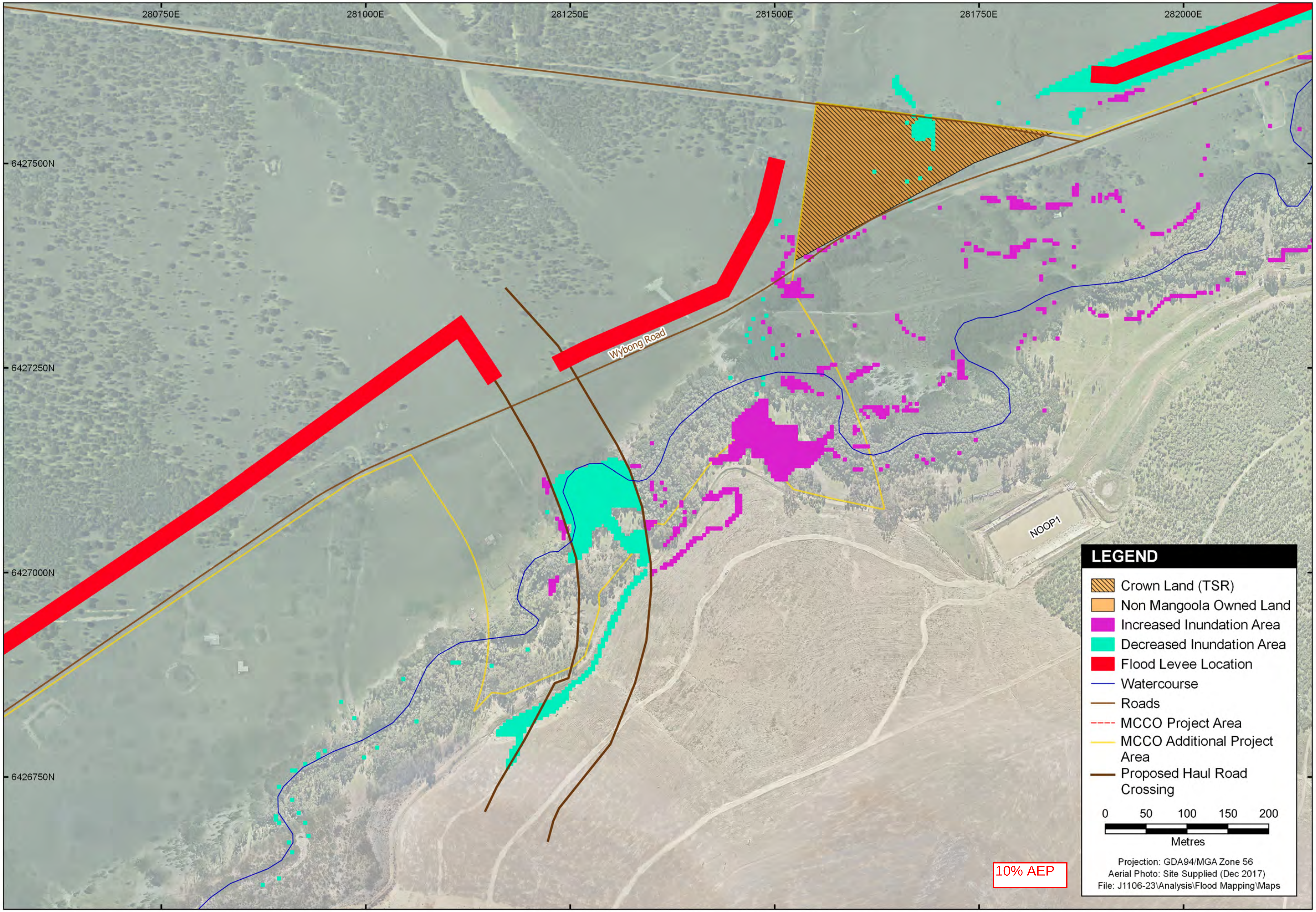
File: J1106-23\Analysis\Flood Mapping\Maps
10% AEP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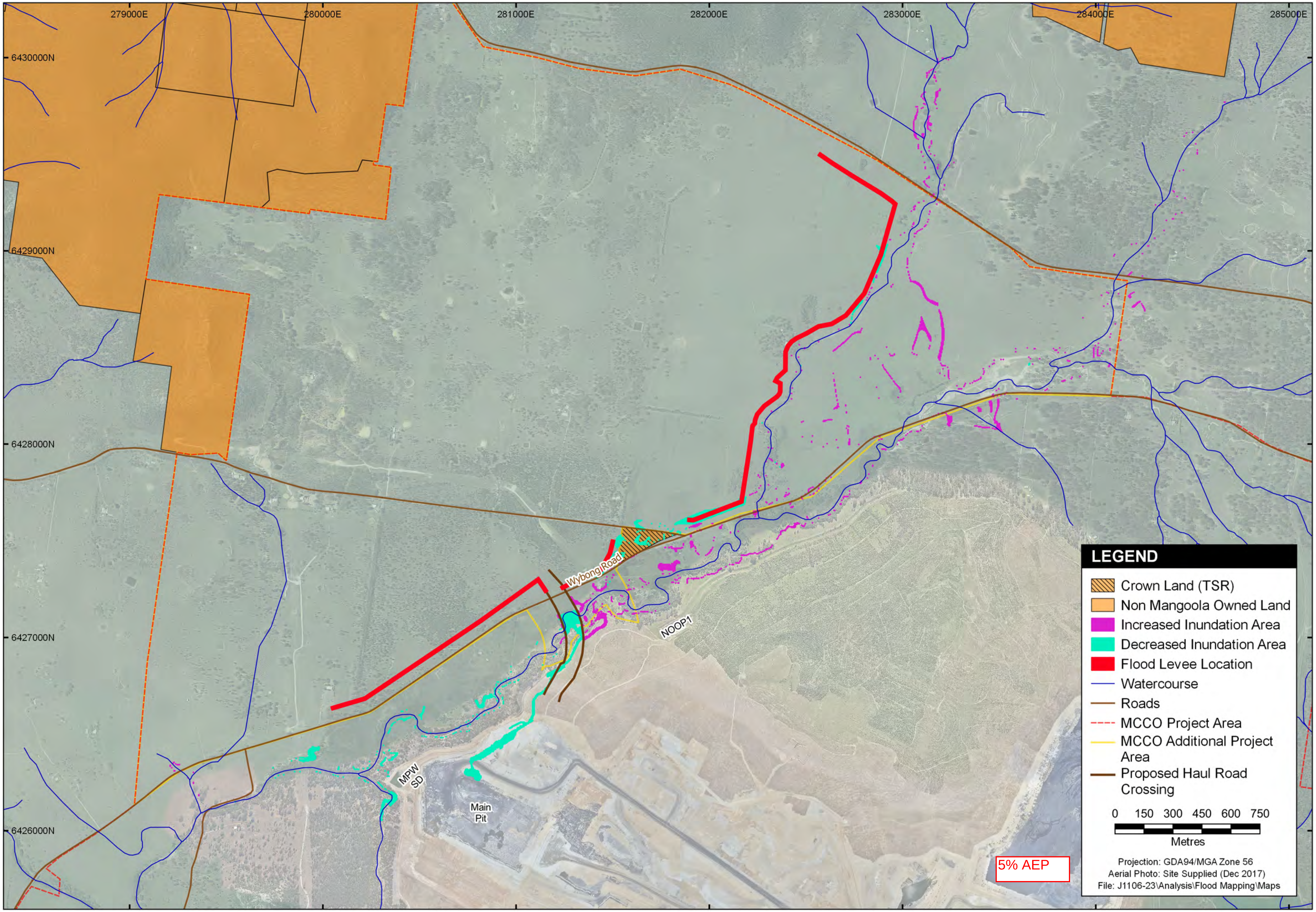
10% AEP



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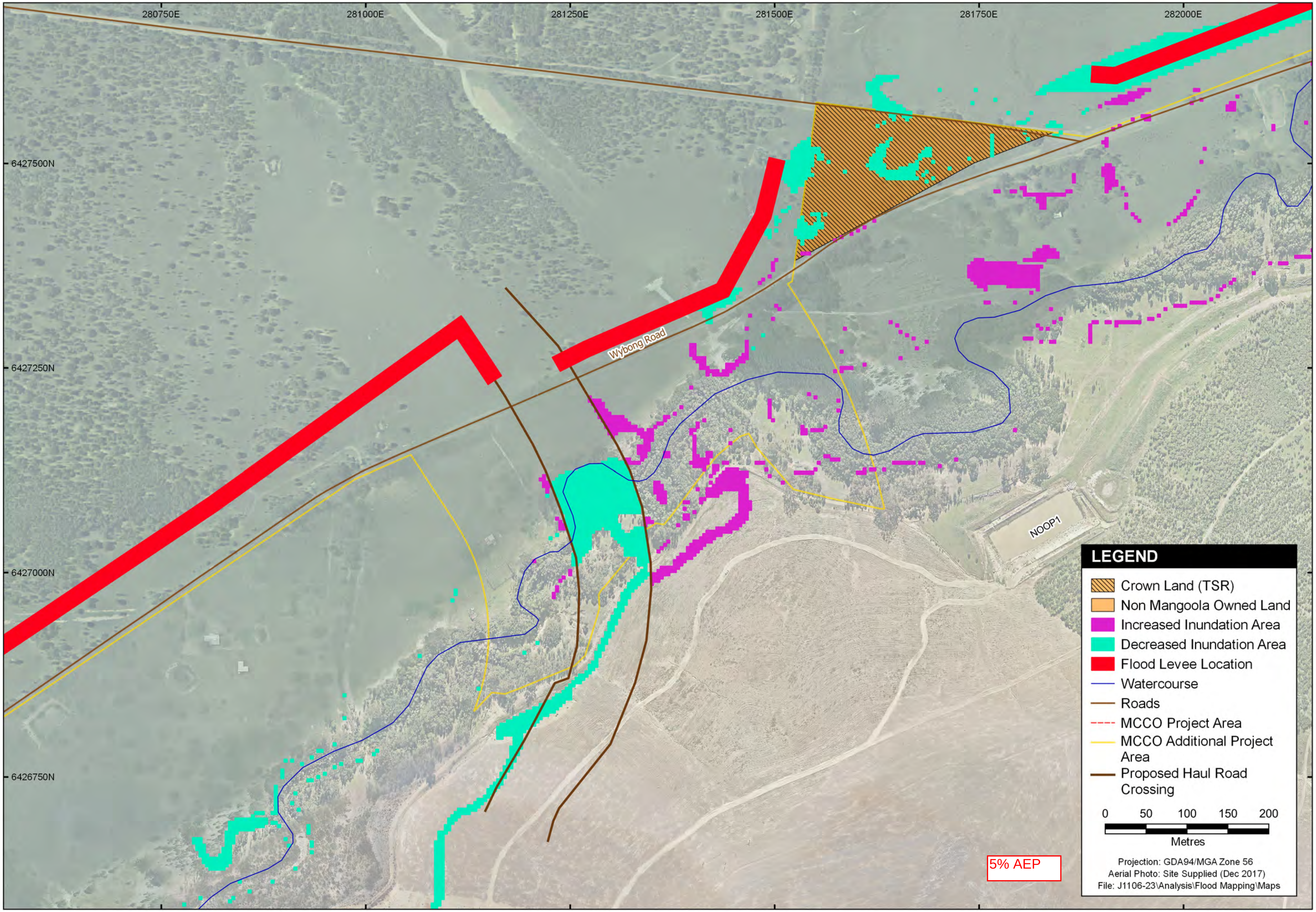
0 150 300 450 600 750
Metres
Projection: GDA94/MGA Zone 56
Aerial Photo: Site Supplied (Dec 2017)
File: J1106-23\Analysis\Flood Mapping\Maps
5% AEP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Wybong Road
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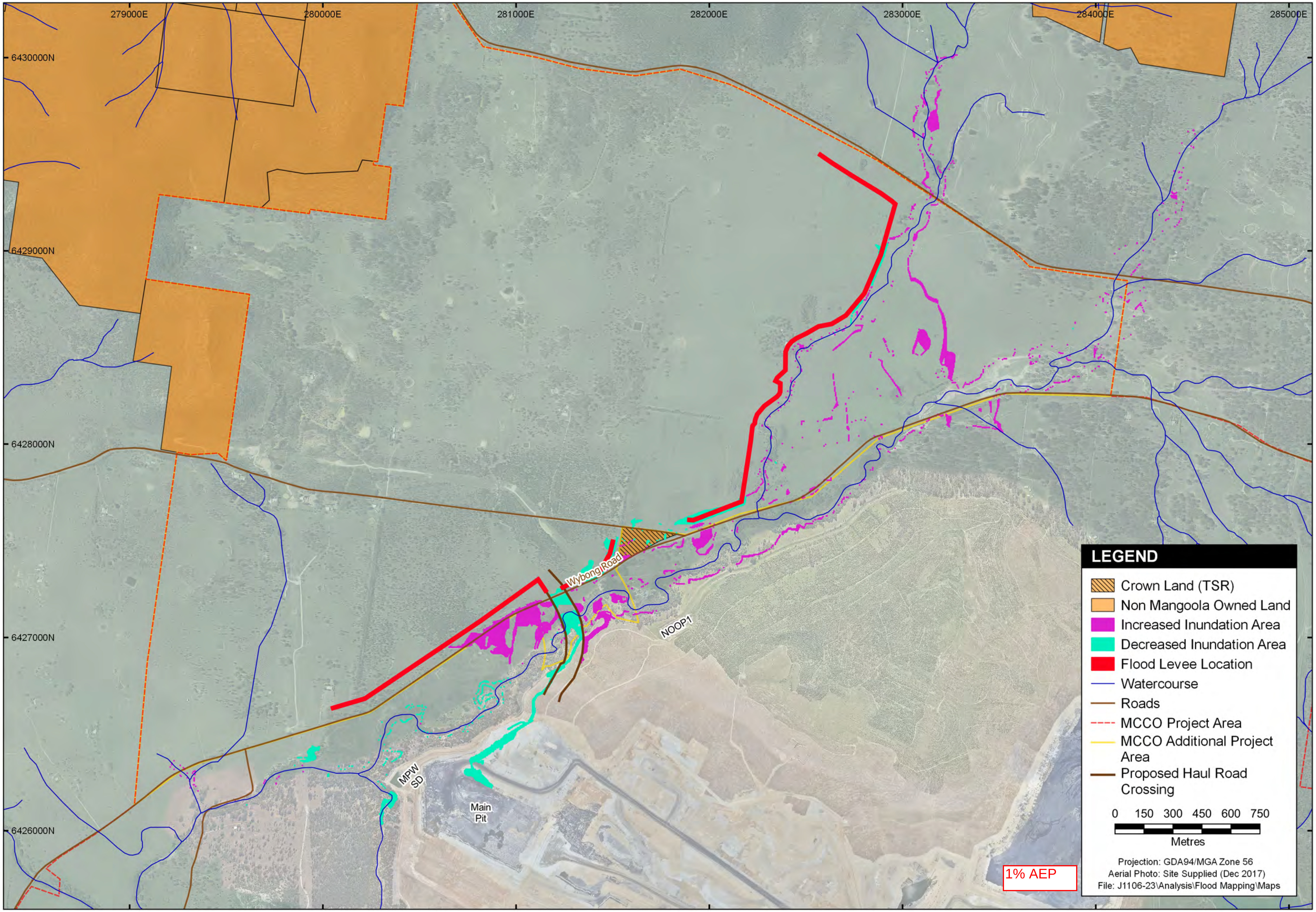
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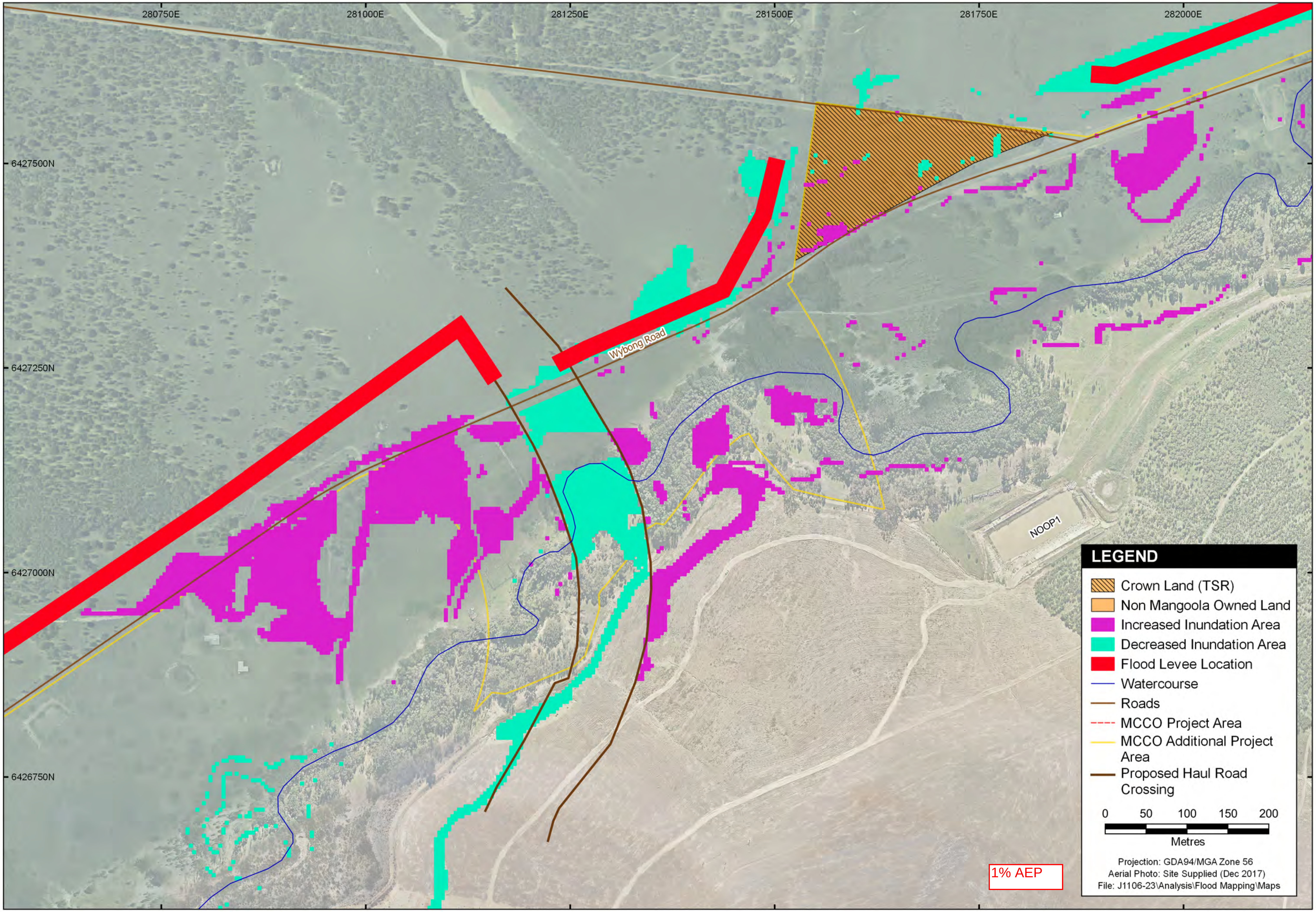
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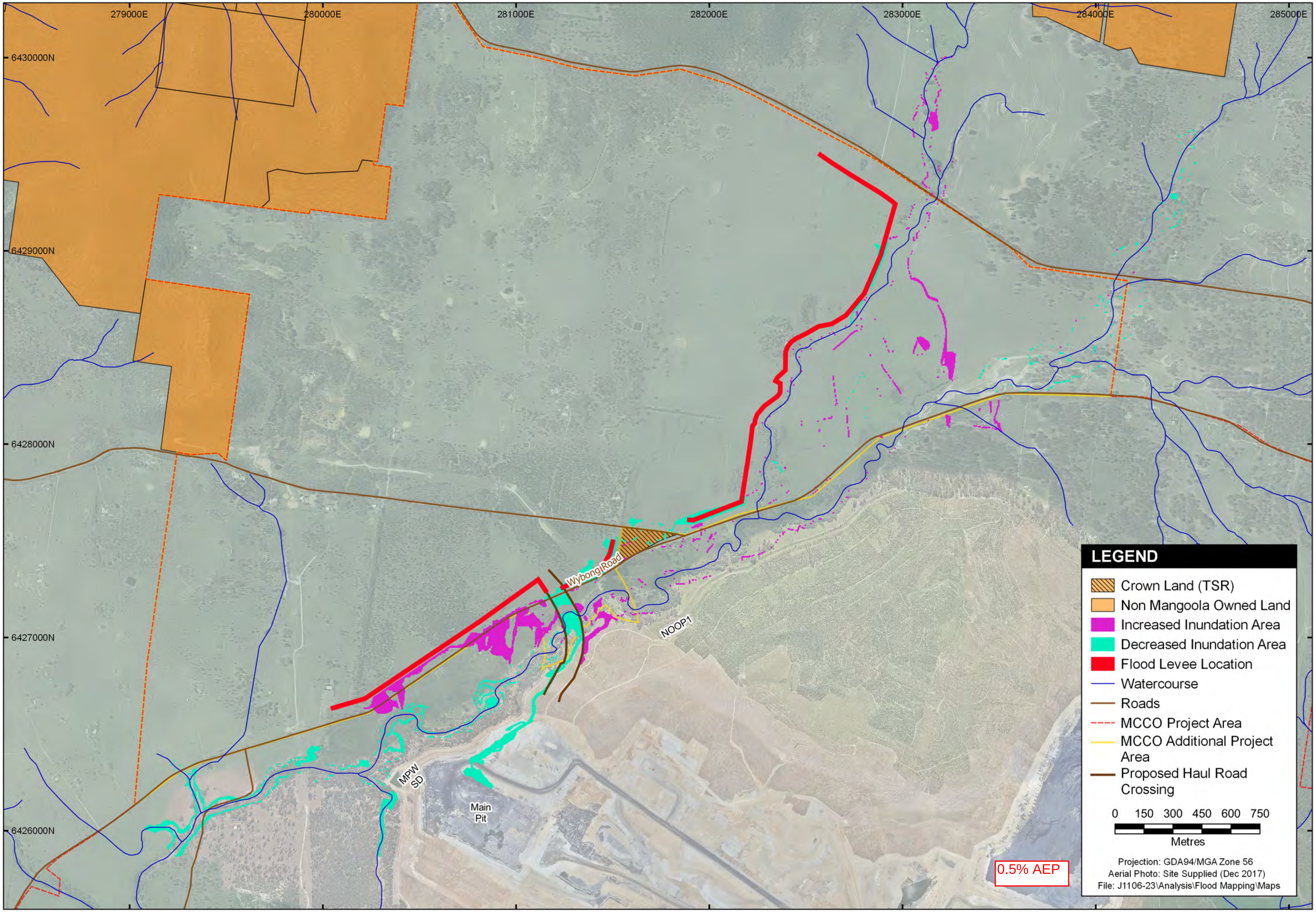

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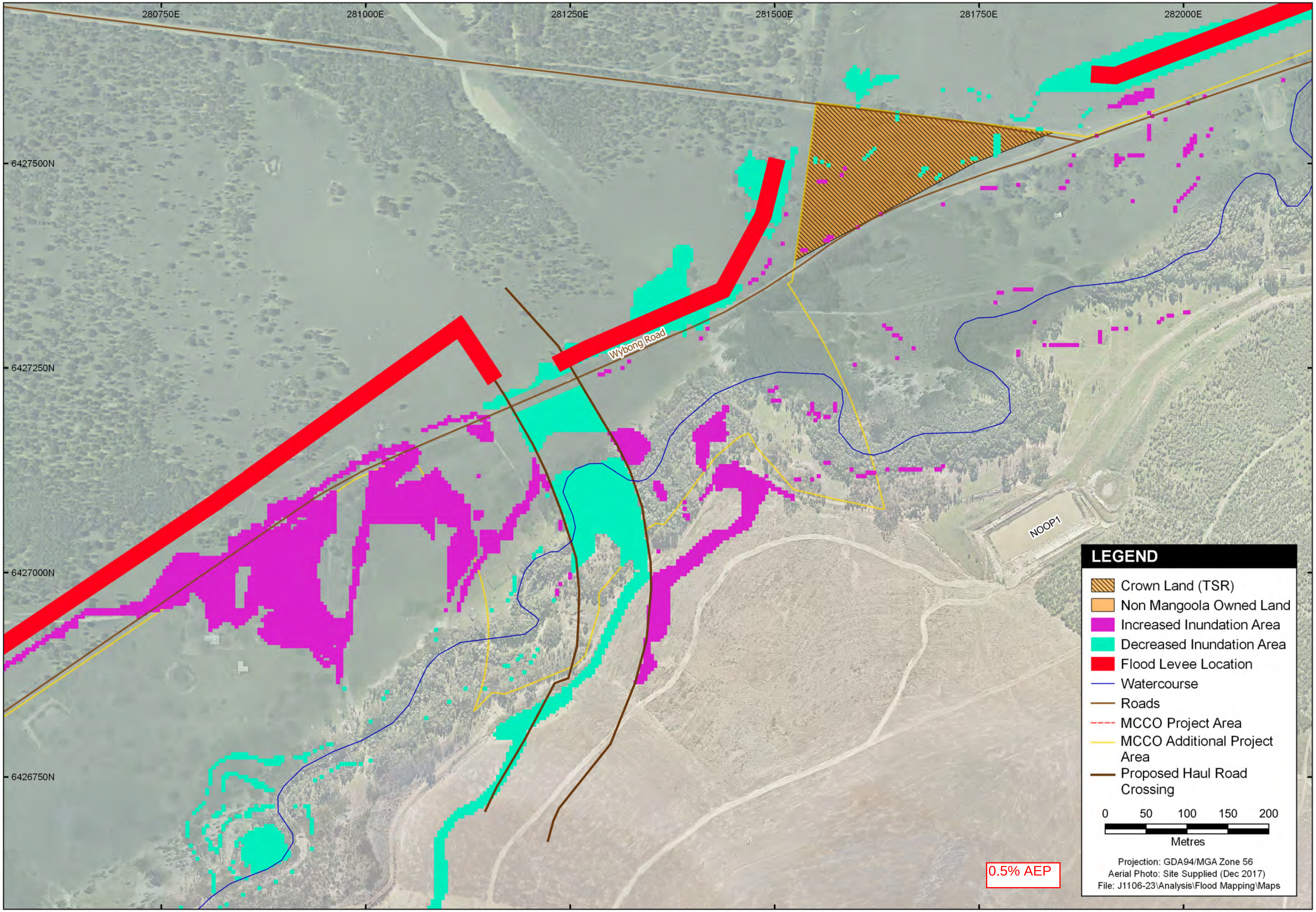
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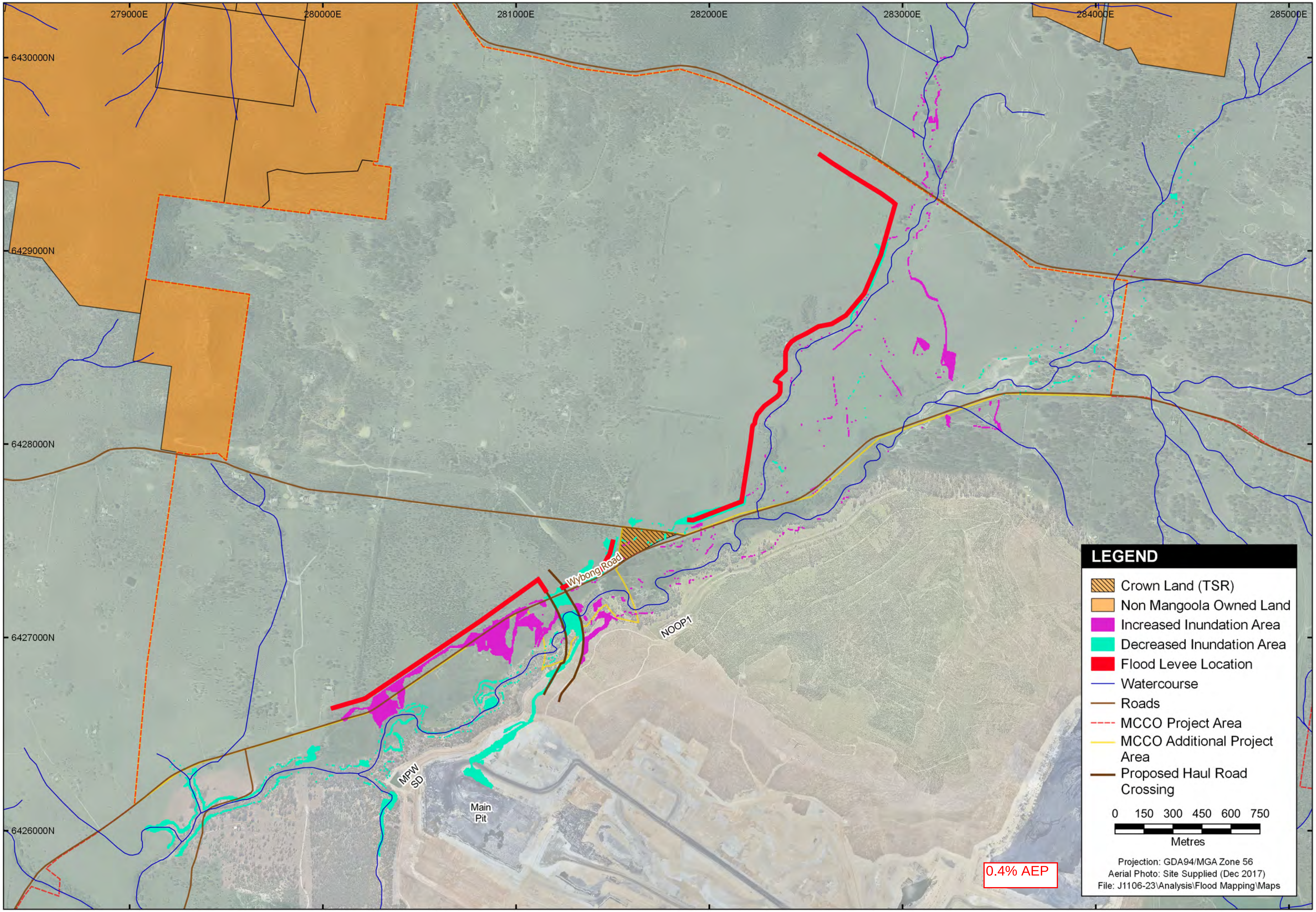

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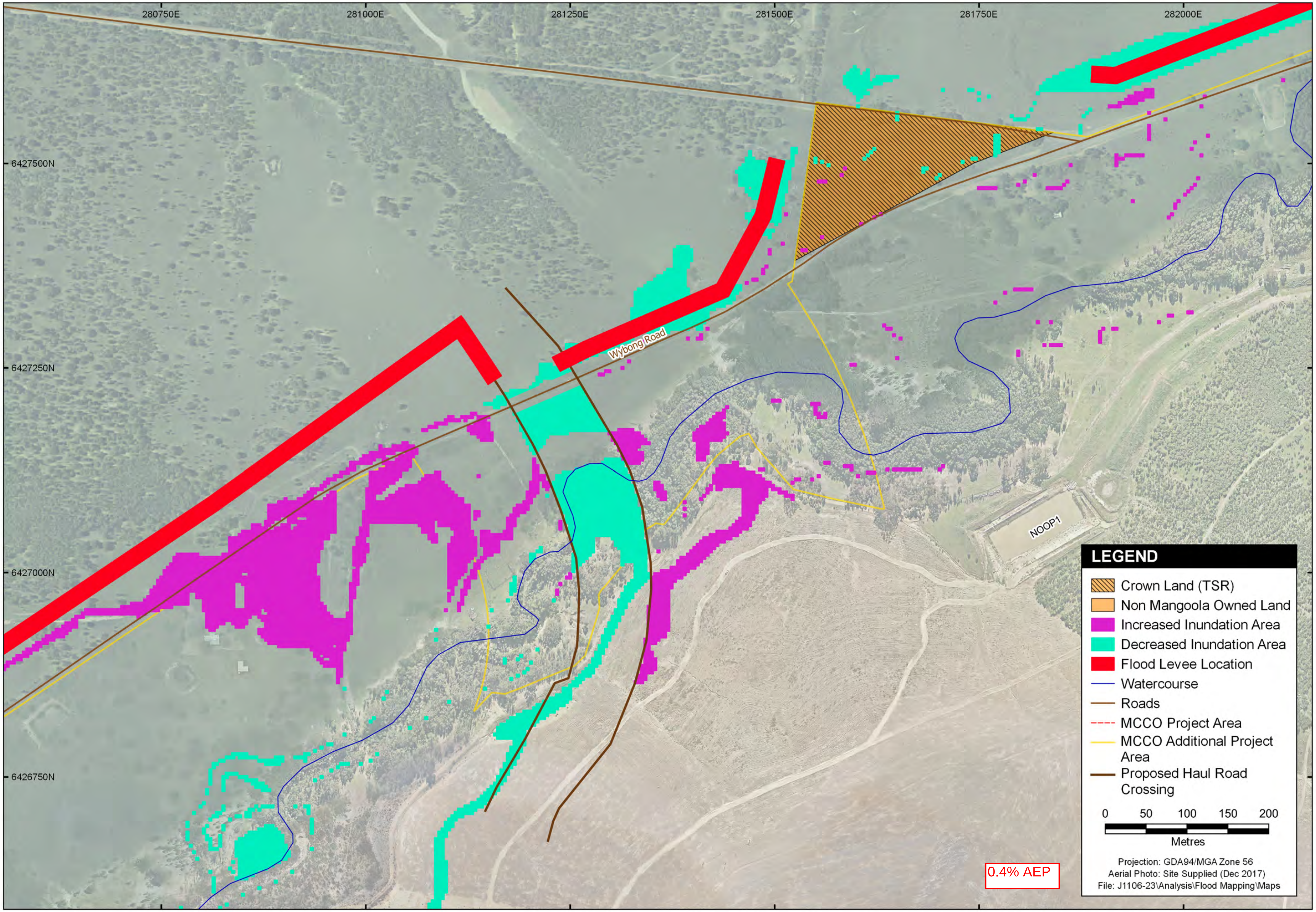
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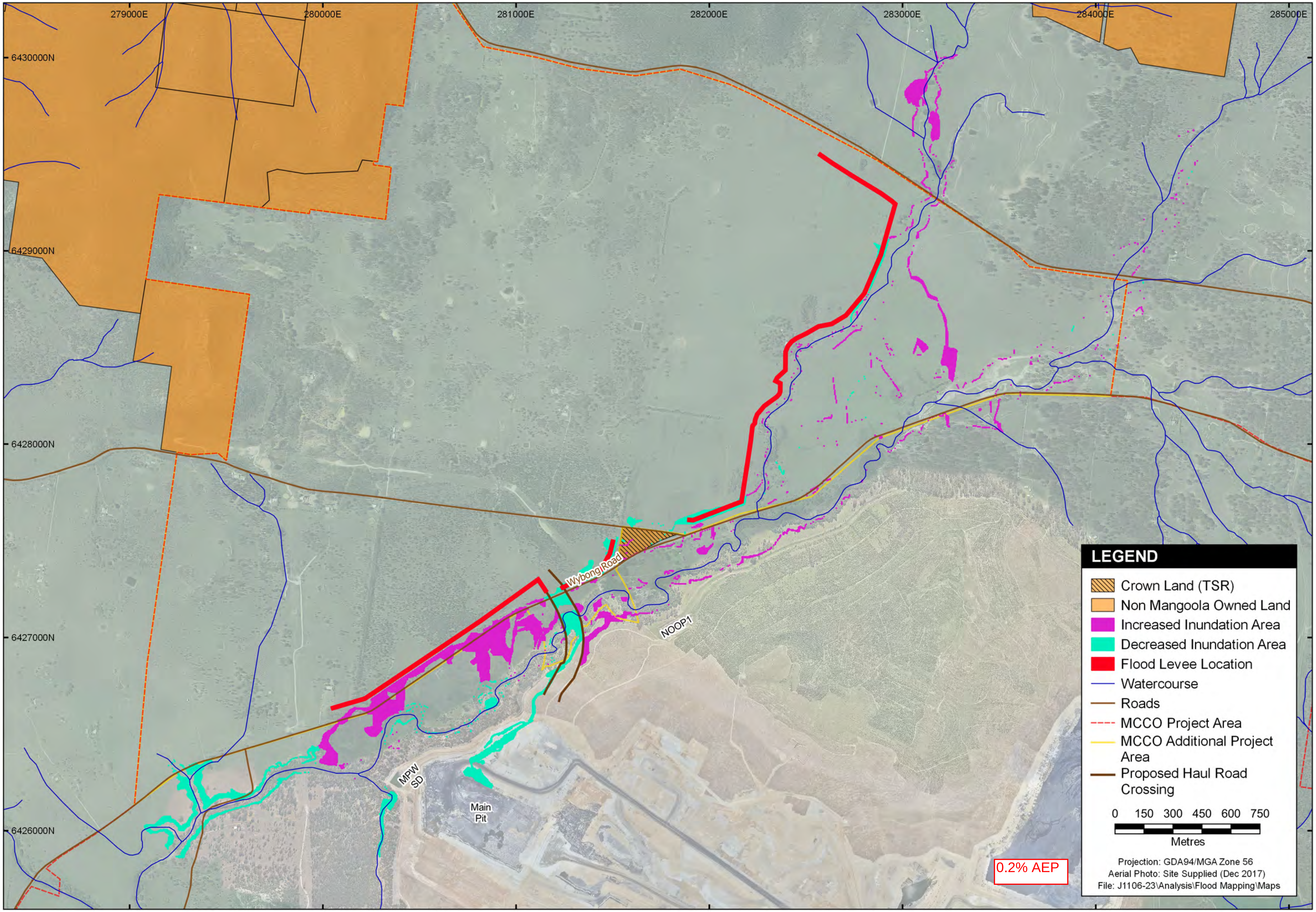

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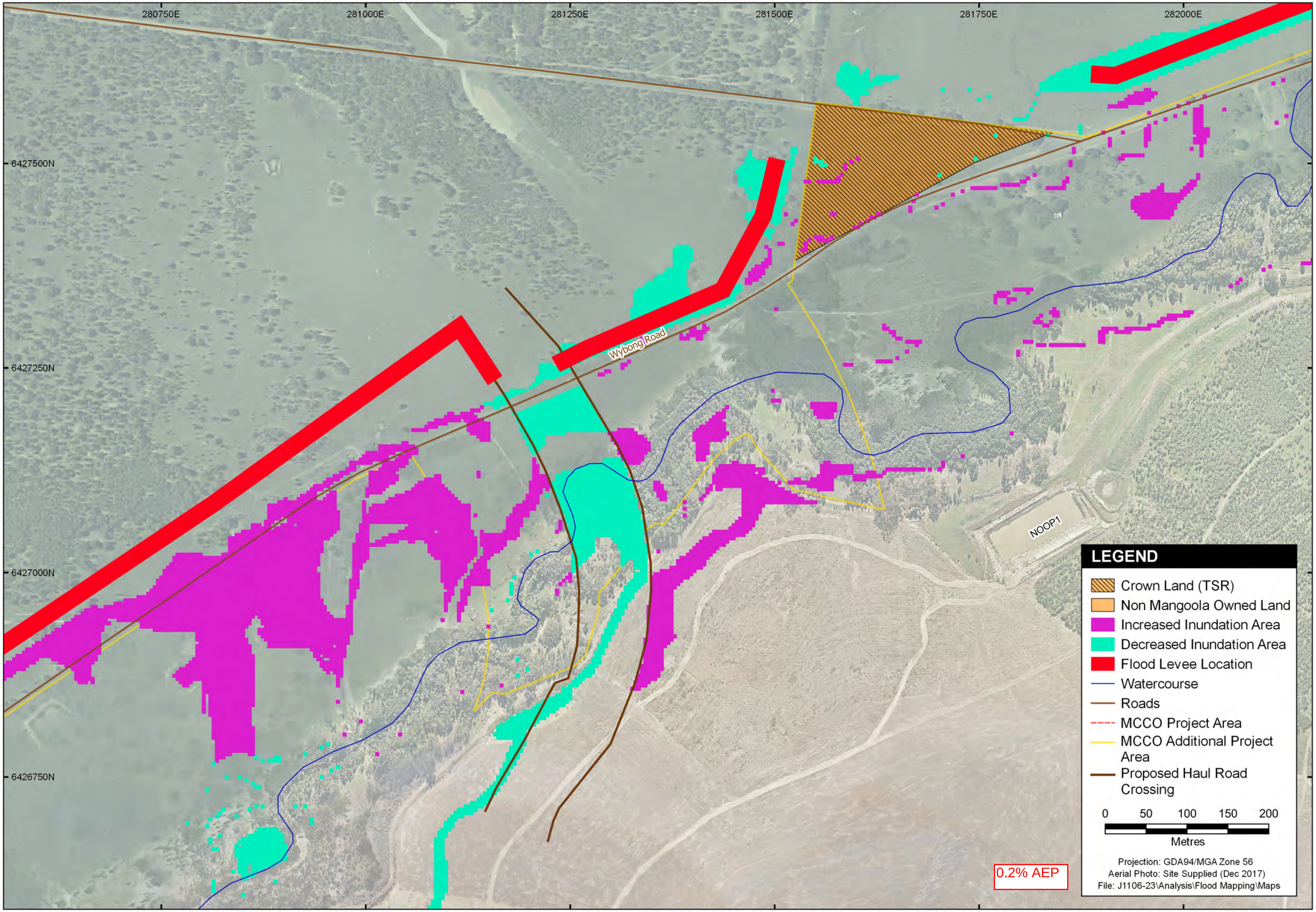
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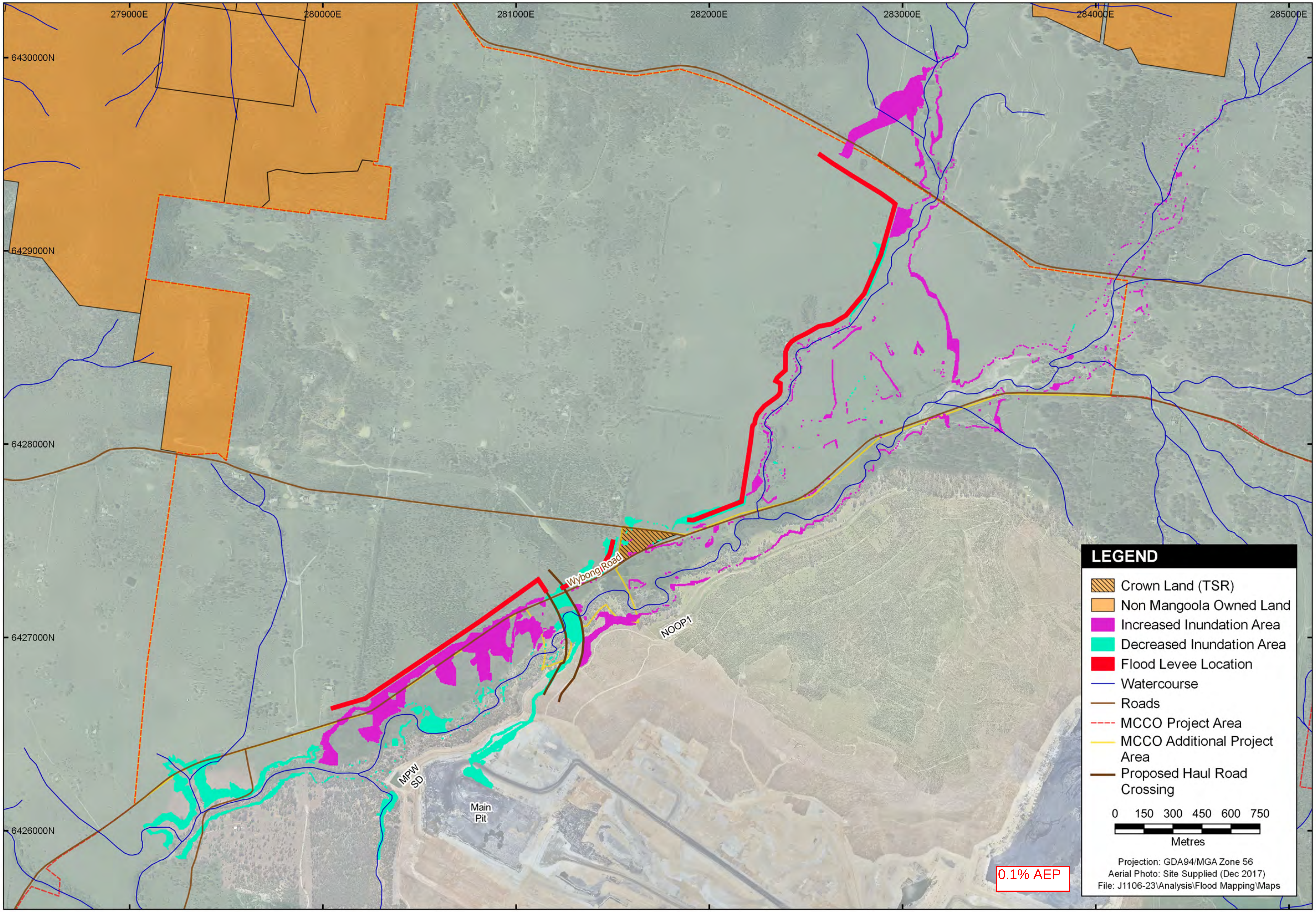

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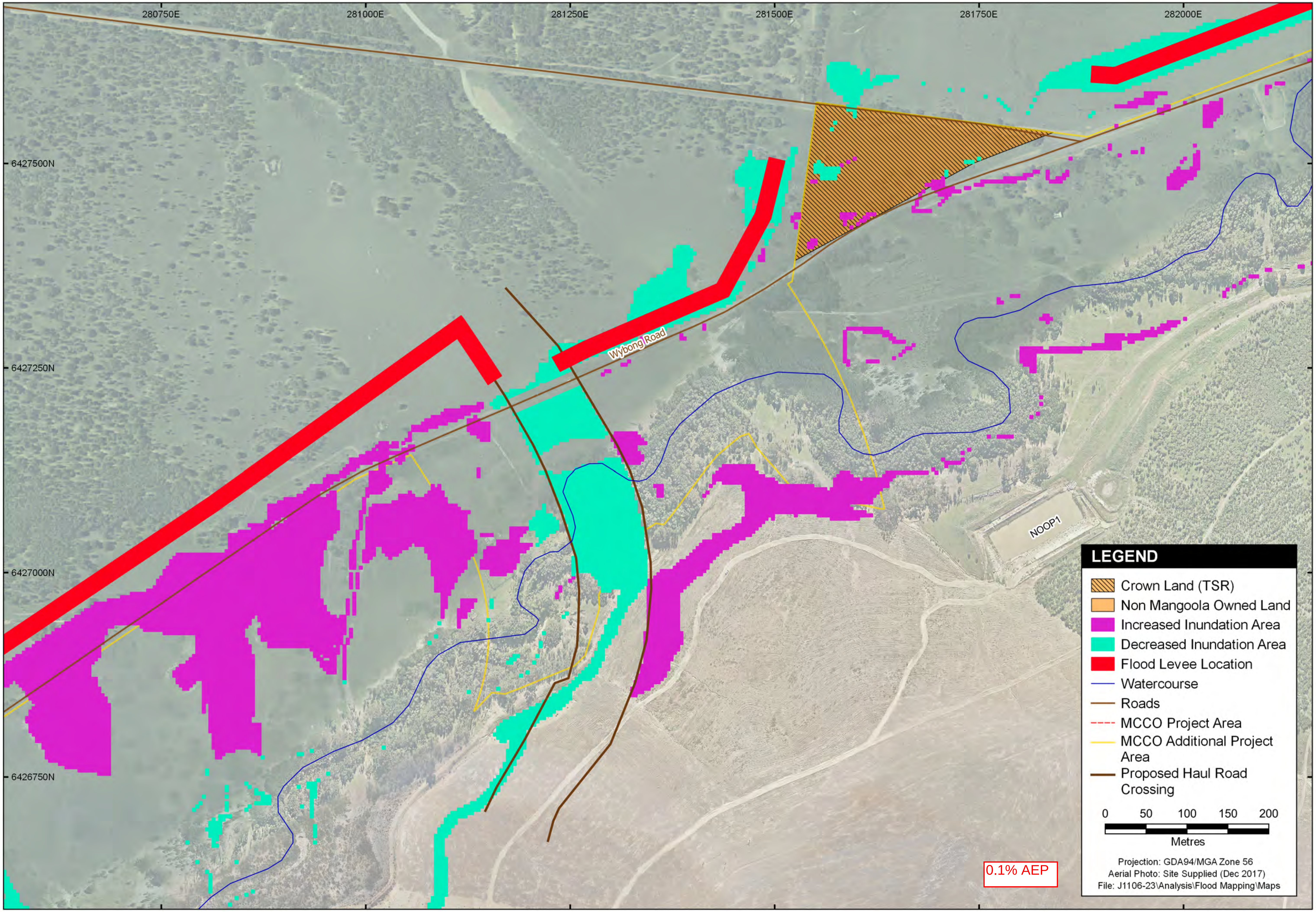

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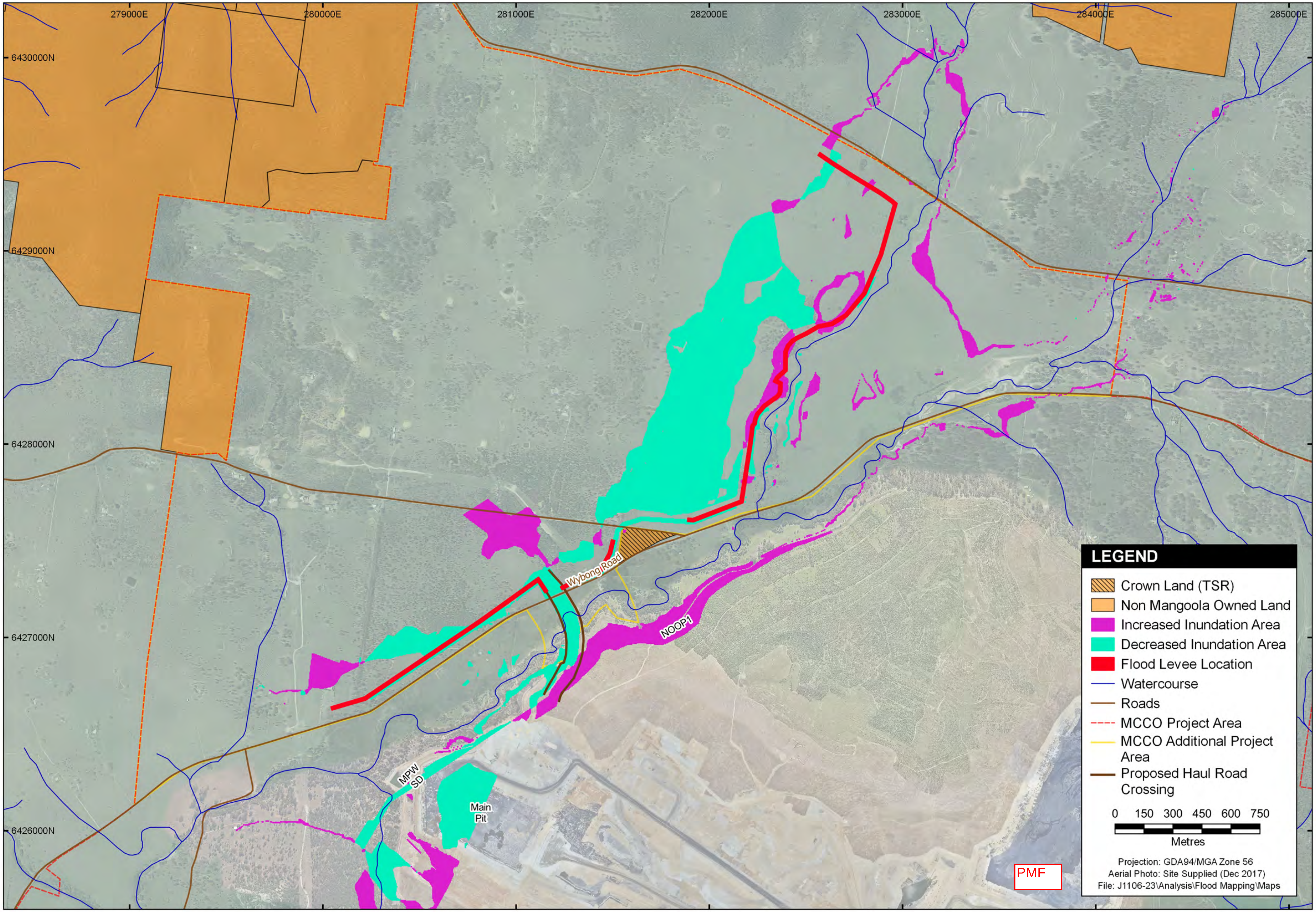
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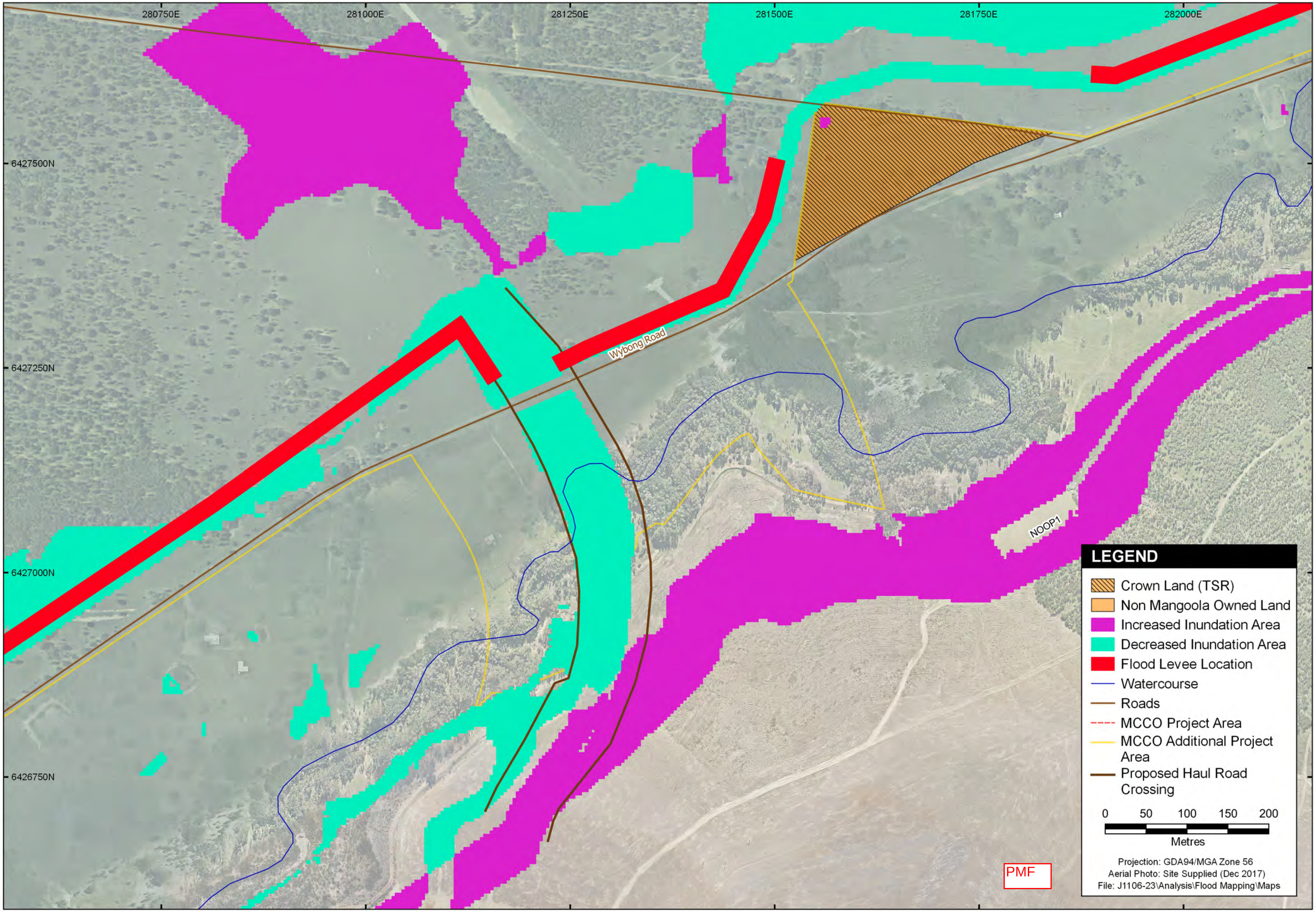

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APPENDIX 6

Independent Peer Review
Final Landform

Independent review of the final landform proposed for the Mangoola Coal Continued Operations Project.

www.iema.com.au

IEMA Ref: UWT02-001
Version No: -Final
03/12/2019

Prepared by:

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DOCUMENT CONTROL

Reference	Date	Prepared	Authorised
Draft Report V1	28/11/2019	Andrew Hutton	Andrew Hutton
Final Report	3/12/2019	Andrew Hutton	Chris Cooper

DISCLAIMER

This report has been prepared by Integrated Environmental Management Australia (IEMA) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from IEMA.

IEMA disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

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APPENDICES

1. INTRODUCTION

1. On 18 October 2019, Andrew Hutton of Integrated Environmental Management Australia (**IEMA**) received a commission from Umwelt (**the Client**) to undertake an independent review of the proposed landform for the proposed Mangoola Coal Continued Operations (**MCCO**) Project.

2. Andrew has 25 years of experience in the mining industry, including experience in both operational roles and consulting roles. Andrew has worked on many projects within the mining, coal seam gas and agricultural sectors both here in Australia and overseas. In addition, he is an experienced Environmental Auditor (No. #120689) with certification covering the scopes of Environmental Audit, EMS, Environmental Report verification and Compliance auditing. He has significant experience undertaking audits, including numerous transactional due diligence audits for mining and industrial clients. A copy of Andrews CV is attached as **Appendix A**.

3. The Division of Resource & Geoscience (DRG) provided a submission on the MCCO project following the public exhibition period. In their submission dated 21 August 2019, the DRG requested that an independent expert examination of the proposed final landform be undertaken, focusing on whether the final landform case selected by the Proponent is the best option. A copy of their submission is attached as **Appendix B**.

4. In addition to the scope of work for IEMA, Mangoola Coal Operations Pty Limited (Mangoola) engaged Xenith to provide an opinion from a mining engineering expert on the preferred options proposed final landforms suitability, practicality (of execution) and overall viability. This work by Xenith has been considered by IEMA during this review (see **Section 4.2**).

5. The review and analysis of options was undertaken based on desktop review of documents as well as a site inspection. The inspection was used to better understand the final landform options proposed for the MCCO Project, including inspecting the existing areas of rehabilitation that have been completed using the natural landform principles. A summary of the documents considered during the review by IEMA are summarised in **Section 4.3**

6. The site inspection was undertaken on 28 October 2019 by Andrew Hutton and Lauren Byrne of IEMA. Key project personnel from Mangoola and Umwelt also attended the site inspection.

1.1. Site and locality

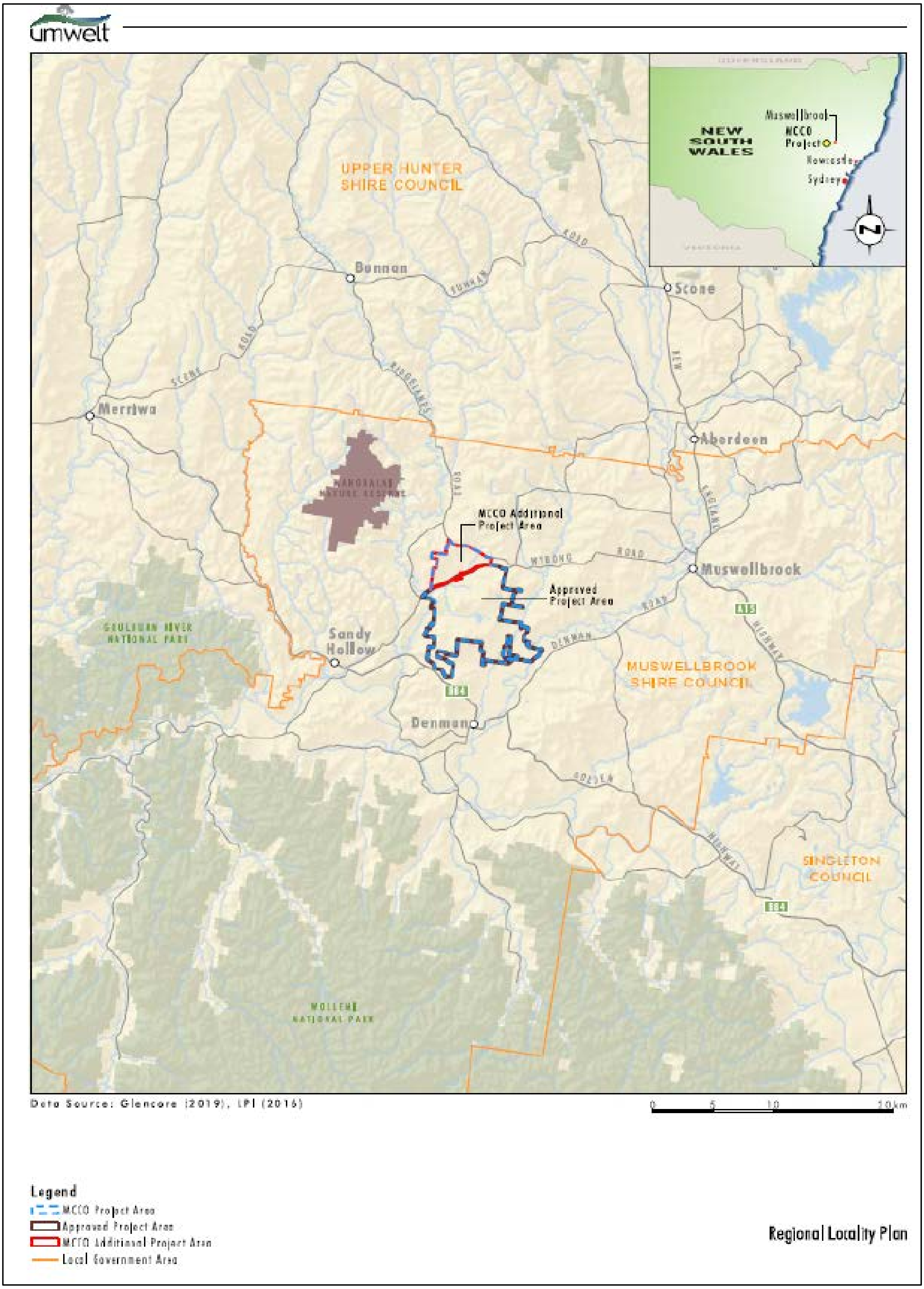
7. Mangoola Coal Mine is an existing open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW. Mangoola Coal Operations Pty Limited (**Mangoola**) has operated the Mangoola Coal Mine in accordance with NSW Project Approval (PA) 06_0014 since mining commenced at the site in September 2010. **Figure 1** shows the location of the MCCO Project in relation to Muswellbrook.

1.2. Summary of the project being reviewed

8. The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The Project is classed as State Significant Development (SSD 8642) and requires approval under the *NSW Environmental Planning and Assessment Act 1979 (EP&A Act).*

9. In July 2019, Mangoola presented the MCCO Project Environmental Impact Statement (EIS) to the NSW Department of Planning, Industry and Environment (NSW DPIE). If approved, the MCCO Project will provide access to an additional approximately 52 Million tonnes (ROM) of reserves. As stated in the MCCO Project EIS, based on the current proposed mine scheduling, this resource would enable continuation of mining operations within the MCCO Additional Mining Area for approximately eight years with equipment and operations transitioning from the existing approved mining area from approximately late 2022 through to approximately 2026, where it is anticipated that the existing approved coal mining operation would be complete. Mining will then continue until the end of mine life in the MCCO Additional Mining Area until approximately 2030.

10. The Mine Plan Options Report (June 2019; Appendix 2 EIS) discusses the proposed mine design and includes a final void study that was undertaken for the MCCO Project and forms part of an EIS to accompany an application for development consent under Division 4.1 and 4.7 of Part 4 of the EP&A Act for the MCCO Project.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WALES
Muswellbrook
MCCO
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Sydney
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Merriwa
Aberdeen
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Project Area
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11. It is noted by IEMA that the preferred MCCO Project Mine plan included in the EIS has been determined following consideration of several different mine plan options which were examined in the Mine Plan Options Report. A total of seven potential operating scenarios and final landform options were considered in order to select the go forward MCCO Project Case as presented in the EIS.

12. IEMA has thoroughly reviewed the Mine Plan Options Report with it being the basis of this Independent Review.

3. APPROACH TO TECHNICAL REVIEW

13. The following section outlines the key tasks completed during this Independent Review.

3.1. Request for Information

14. Prior to the site Inspection, IEMA reviewed preliminary information provided by Umwelt. This included the EIS, the Mine Plan Options Report and the scope of works provided to Xenith. Following this review a Request for Information (RFI) was submitted to Umwelt. **Section 3.3** includes a list of the documents reviewed.

3.2. Site Inspection & Meetings

15. On the 28th October, Andrew Hutton of IEMA undertook a site visit with representatives of the MCCO project team. The meeting and site inspection was attended by:

- Andrew Hutton (IEMA)
- Lauren Byrne (IEMA)
- Imogen Krause (Umwelt)
- Brian Pease (MCCO Project Manager)
- Jason Martin (MCCO Approvals Manager) (meeting only)
- Damien Ryba (Mangoola Environment and Community Coordinator)

16. Following the site meeting at Mangoola, Andrew and Lauren met separately with Matt Esdaile, who was previously employed at Mangoola as the Long Term Planning Engineer and was assigned to the MCCO Project as the Mining Engineer responsible for the mine planning, providing experience to the integration of the existing and proposed mining areas. He was a key contributor to the initial mining options review which formed the basis of the base case considered in the Mine Plan Options Report.

17. The purpose of the site inspection and related meetings was to meet with the key MCCO Project technical representatives to have them present on the various options that they proposed for the project. It was also an opportunity for IEMA to ask relevant questions about the various inputs, assumptions and approach adopted for selecting the preferred options. In addition, it was an opportunity for IEMA to inspect existing areas of the active mine and rehabilitation, particularly where there were similarities between what has been completed within the active operation and what is proposed as part of the MCCO project.

18. During the site visit the following areas were inspected:

- Tailings Dam 4 area;
- Areas of the backfilled landform that had recently been reshaped, ripped and seeded;
- A permanent site lookout that had a views over the active working pit;
- A viewpoint that provided a panoramic view of the completed rehabilitation areas;
- A vantage point internal to the existing mine site that enabled a panoramic views across the proposed MCCO Project area and surround areas; and
- Various sections of the established rehabilitation (various ages).

19. In addition, IEMA drove along Wybong Road and looked back at the proposed MCCO Project area and surrounding landscape.

20. The following includes some selected photos taken during the site inspection.

Plate 1: Areas of the existing Mangoola mine that have been reshaped, topsoiled and seeded.

Plate 2: Areas reshaped, topsoiled and seeded with logs and larger sticks placed across the landform as habitat features (standing trees in background).

Plate 3: Areas reshaped, topsoiled and seeded with logs and sticks placed across the landform as habitat features (standing trees in background).

Plate 4: Areas reshaped, topsoiled and seeded in the foreground with the active mining pit and Anvil Hill in the background.

Plate 5: Constructed frog ponds established within the reshaped landform

Plate 6: Rehabilitated areas with a mixture of tree and shrub species established. Some secondary plant establishment is evident.

Plate 7: More mature rehabilitation in an area that was some of the earlier areas of rehabilitation completed at Mangoola. Some of the landforms pre-date the formal use of natural landform principles.

Plate 8: Further examples of some of the earlier rehabilitation completed at Mangoola.

3.3. Documents Reviewed

21. In undertaking this Independent review, IEMA has carefully considered the following Project related material (**Table 1**).

Table 1: Documents reviewed by IEMA as part of the Independent Review.

Document Name	Document Date	Document Author
Mangoola Coal Operations - Final Landform - Independent Expert Examination Report	Nov-19	Xenith
Mangoola North Schedule 13.5MT Geo Option 3 Basis spreadsheet	24-Sep-18	Mangoola
Mangoola Coal 2014 Annual Review	Mar-15	SLR
Mangoola Open Cut 2015 Annual Review	Mar-16	SLR
Mangoola Open Cut 2016 Annual Review	Mar-17	SLR
Mangoola Open Cut 2017 Annual Review	Mar-18	SLR
Mangoola Open Cut 2018 Annual Review	Mar-19	SLR
Mangoola Coal Mine Independent Environmental Audit Report	Oct-19	Hansen Bailey
11.17 Mine Closure Planning Protocol	Dec-16	Glencore
11.17 Mine Void Closure Policy	Dec-16	Glencore
11.16 Rehabilitation Management Protocol	Mar-17	Glencore
Tailings Storage Facilities Protocol	Nov-18	Glencore
Mangoola Coal Environment and Community 2019 Annual Plan	Jan-19	Mangoola
Shaped and Topsoiled' figure (DWG format)	Sep-19	Mangoola
Disturbance and Rehab Plan (PDF format)	Sep-19	Mangoola
Mangoola Coal MOP Jan 2016 - Dec 2019	Sep-18	Mangoola
Mangoola Coal Continued Operations Project EIS	Jul-18	Umwelt
SEARs for Mangoola Coal Continued Operations Project (SSD 8642)	Feb-19	DPE
Mangoola Coal Continued Operations Project - Groundwater Impact Assessment	May-19	AGE
Mangoola Coal Continued Operations Project - Surface Water Assessment	May-19	HEC
Mangoola Coal Continued Operations Project - Economic Impact Assessment	Jun-19	Cadence Economics
Mangoola Coal Continued Operations Project (SSD-8642) Resource and Economic Assessment	Aug-19	DPIE
Mangoola Coal Continued Operations Project - Mine Plan Options Report	Jun-19	Mangoola

4. TECHNICAL REVIEW CONSIDERATIONS

4.1. Preferred Mine Design, Landforms and Final Voids

22. The preferred MCCO mine schedule and development strategy has been outlined in the Mine Plan Options Report. It is presented a preferred mine plan (**Case 3**).

23. IEMA notes that the mine design process has been iterative since the commencement of the MCCO Project pre-feasibility phase exploration program in early 2014. In addition, IEMA notes that the proposed mining area has been altered throughout the project development and impact assessment in response to both physical constraints (e.g. powerlines, creeks, existing roads, biodiversity, topographical constraints etc) along with operations constraints such as safety, geology, haul distance, reducing final voids, noise, air quality and visual impacts associated with the project.

24. IEMA notes that the mine design iterations also considered a range of improvement opportunities relating to the currently approved Mangoola Coal Mine. These included;

- Improving the geometry of the currently approved final void;

- Improving the backfilled landform to ensure that the requirement to re-establish the Anvil Hill Creek could be meet;
- Improving the closure outcomes of the Tailings Decant Dam and Tailings Dam 4 (e.g. material available for capping). IEMA understands that TD4 is the life of mine (LoM) Tailings disposal option for the MCCO Project; and
- Enabling the establishment of more landforms using natural landform design principles and revegetation techniques that are currently used at Mangoola Mine.

25. A detailed description of the mine design iterations are outlined in the Mine Plan Options Report (Sections 2 & 3) and shown graphically in Figure 5. They have not been reproduced in this report. It is therefore expected that a reader of this report has also read the Mine Plan Options Report.

26. Following the completion of the MCCO Project Additional Mining Area base case mine plan, the next phase of the options assessment undertaken by Mangoola was to review the resulting landforms with a view of further reducing the potential for final voids to occur as well as reducing the size and improving the final geometry of any voids that were proposed to remain following mining.

27. IEMA understands that this process utilised the same mining shell (i.e. no change to the disturbance footprint), equipment and mining schedule however varied the sequence, location and/or timing for overburden material emplacement by considering seven (7) different options in order to ascertain the preferred option to be taken forward into the EIS for the MCCO Project.

28. A summary of the seven cases is outlined in the Mine Plan Options Report (Section 4.4). It is therefore expected that a reader of this report has also read the Mine Plan Options Report.

29. Table 1 in the Mine Options Plans includes a summary description of each of the seven cases. The following includes a summary of options as understood by IEMA and therefore the subject of this independent review.

- **Case 1:** All overburden placed entirely within the MCCO Additional Mining Area (most cost-effective mining option);
- **Case 2:** Haulage of approximately 50Mbcm from MCCO to the existing approved Mangoola mining area for the purpose of establishing an improved landform including and improved post-closure void geometry (particularly the slopes of the low wall);
- **Case 3:** Haulage of approximately 50Mbcm from MCCO to the existing approved Mangoola mining area (as above for Case 2) as well as rehandling 5Mbcm at the completion of mining in the MCCO mining area to also improve the overall geometry of the MCCO final void;
- **Case 4:** No post mining void in the existing approved Mangoola Mining area by hauling an additional 33Mbcm from the MCCO mining area. One final void remains at the completion of operations, being the void in the MCCO Additional Mining Area;
- **Case 5:** No voids in either the Mangoola Mining area or the MCCO Additional mining area by removing approximately 100Mbcm at the completion of coal extraction from the existing rehabilitated mining areas of the existing approved Mangoola Coal Mine to fill the MCCO Additional Mining Area void.
- **Case 6:** Partially filling of both the voids in the Mangoola Mining area and MCCO Additional mining area by hauling approximately 56Mbcm from MCCO to the existing approved Mangoola mining area and rehandling approximately 8Mbcm of overburden from the MCCO Additional Mining Area overburden emplacement dumps, post mining completion, to partially fill the MCCO Additional mining area void; and
- **Case 7:** The MCCO Project does not proceed.

30. As part of assessing the Mine Plan options, Mangoola has completed a review of the seven options from an engineering and economic feasibility standpoint. The outcomes of this review has been summarised in the Mine Plan Options Report and included as **Table 2** of this report as the basis for the selection of **Case 3** as the preferred option by Mangoola to be taken forward into the EIS.

Table 2: Summary of the review of the various options considered by Mangoola (source: Mine Plan Options Report)

Description	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Case Description	Business Baseline Case – All Overburden emplaced in the MCCO Additional Mining Area	Initial Integrated Project Case	MCCO Project Case (as included in the EIS)	Non preferred case – One Void in the North	Non preferred case – No Voids	Non preferred case – Partial fill of Final Voids	Non preferred case – No MCCO Project Case
Overburden Emplacement Strategy	Overburden is hauled to additional, larger and higher overburden dumps in the MCCO Additional Project Area of up to approximately RL220	Haul approximately 50Mbcm of overburden from the MCCO Additional Mining Area to the existing approved mining area	As per Case 2 along with additional 5Mbcm rehandle to improve the overall shape and size of the void in the MCCO Additional Mining Area	As per Case 2 along with additional 33Mbcm of overburden from the MCCO Additional Mining Area to the existing approved mining area to fill the existing approved mining area void to approximately RL150 - RL160	As per Case 4 however at the completion of coal extraction, remove approximately 100Mbcm (394 ha) of established rehabilitation to fill the MCCO Additional Mining Area void.	As per Case 2 with an additional 6Mbcm from the MCCO Additional Mining Area to the existing approved mining area and rehandle approximately 8Mbcm of overburden from the MCCO Additional Mining Area	Mining continues as per current approved operations
Volume of Rehandle (Estimated Mbcm)	Nil	Nil	5	Nil	100	8	N/A
Number of Voids at completion of mining	2	2	2	1	0	2	1
Additional Time to complete	Nil	Nil	6 months	Nil	4.5 years	9 months	N/A
Indicative Total Cost (compared to baseline)	Baseline Costs	\$53M	\$75M	\$114M	\$526M	\$95M	Economic benefits of the Project are lost

31. A summary of the final void options that have been included in the Mine Plan Options Report is presented in **Table 3** over the page.

Table 3: Summary of the review of the final void options, with preferred case (source: Mine Plan Options Report)

Case Identification	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Void Options	All Overburden emplaced in the MCCO Additional Mining Area	Initial Integrated Project Case	MCCO Project Case (as included in the EIS)	One Void in the North No void in the existing mining area	No Final Voids	Partial fill of Final Voids	No MCCO Project Case
Reasonable & Feasible Mine Design?	Yes	Yes	Yes	Yes	No	Yes	-
Reasonable & Feasible Engineering Design?	Yes	Yes	Yes	Yes	No	Yes	-
Economically Feasible?	Yes	Yes	Yes	Possibly feasible	No	Feasible	No as the economic benefits of Project will be lost
Proposed	No	No	Yes	No	No	No	No
Comments	Most economical case however not proposed due to larger and higher emplacement areas in the MCCO Additional Mining Area, associated environmental impacts	Less costly than Case 3 however would result in a larger final void in the MCCO Additional Mining Area	The proposed final landform seeks to strike the balance between mine planning, economic, environmental and social outcomes	Unbalanced outcome	No perceived benefit	Not proposed as the total area of void doesn't reduce in line with the significant costs	Would result in the early closure of Mangoola Mine

4.2. Xenith Report - Expert Mining Engineering Review.

32. Xenith Consulting has been asked to act as an expert by Mangoola Coal to examine the proposed MCCO Project conceptual final landform. The Xenith review report provided an opinion on the proposed final landforms suitability in terms of practicality (of execution) and overall viability. Xenith prepared the report with the aim of examining the final landform case selected by Mangoola to determine if it is the best option and, where possible, to make recommendations for improvement.

33. An analysis requested of Xenith by Mangoola was to determine if the preferred MCCO Project mine plan was reasonable in the approach to the following areas:

- Out of pit overburden emplacement;
- Overburden rehandling;
- The final pit void size and shape;
- Whether the mine plan and final landform was appropriate when considering all constraints in the MCCO Project area (e.g. mining leases, roads, biodiversity, creeks, surface water, noise, air quality, existing infrastructure, topography, etc); and
- The integration of the existing operation, equipment and facilities.

34. In addition, the report prepared by Xenith also needed to provide a commentary on the findings from the MCCO Project EIS in relation to:

- Surface Water management;

- Groundwater;
- Visual Amenity;
- Land Resources and Land Use; and
- Rehabilitation and Mine Closure.

35. Lastly, Xenith was required to comment on whether the final landform for both the mining operations is practically achievable.

36. Where applicable, IEMA has considered the Xenith report (November 2019) with the relevant findings from this expert review including the following:

- Xenith has examined the overall Volumetric balance on a total basis, and a staged basis using the current Life of Mine (LOM) schedule supplied from site, which includes the integration of the MCCO Project. They determined that the factors used for the allowance of material swell, reject emplacement and overburden material handling were considered appropriate.
- Xenith noted that as a result of the improved pit sequencing developed in the LOM schedule analysis, the rehandle volume in the MCCO Project Area could be reduced from 5Mbcm to 3.5Mbcm and could potentially be further reduced with detailed engineering.
- Xenith concluded that there is an excess capacity of 5.1Mlcm being available and that this confirms Mangoola have enough room to accommodate the spoils from the active pit areas and achieve the landform objectives stated in the EIS for Case 3.
- Xenith concluded that overall the staging volumes presented for the EIS option (Case 3) appear correct and balanced.
- Xenith has confirmed the MCCO spoils balance over the life of the MCCO Project with sufficient spoil room available in the main pit and the MCCO dump designs with a small residual volume of 3.5Mbcm at the end of the mine life indicating that the EIS landform is achievable with surplus material available for use to further improve the conceptual final landform. This residual volume represents 1.0% of the total overburden movement over the LOM and is considered within acceptable margins of error for the calculation of spoil balances, given the propensity for material to exhibit some swell variation over time.
- Xenith stated that it understands the 17% swell factor used for the EIS includes the provision for reject emplacement in the overburden dumps. They went on to say that Mangoola differs from other Hunter Valley operations regarding the higher proportion of coarse spiral sands, separated during coal washing, that are sent to tailing dams rather than the overburden dumps. Xenith considers that enough allowances have been made in the development of the landform surfaces to accommodate the coarse rejects.
- Xenith concluded that the proposed MCCO Project out of pit dump (OOPD) is designed for a storage volume of 8.4Mlcm with a final slope angle of 10º or less and that the proximity of Big Flat Creek directly to the south of this dump has necessitated a standoff from the OOPD toe.
- Xenith found that the outer slopes of the MCCO overburden emplacement would be 10º or less. The EIS states all exterior MCCO final landform slopes will be 10º or less and overburden emplacements shall not exceed 240mAHD. Xenith has confirmed these design criteria have been adhered to in the go forward case proposed in the EIS.
- Xenith has calculated the overall plan area for the final void for the MCCO additional mining area is approximately 121 ha and for the existing Approved Project Area 100 ha based on the supplied final landform. This differs from the areas quoted in the EIS of 82 ha and 48 ha respectively, however that when considering the definition of a final void outlined in the Mine Plan Options Report, took a view that based on that definition of the void the areas were determined to be commensurate with the Mangoola EIS.

> "…'*final void' to be "the area within the crest of the final highwall circumnavigating the predicted long-term water recovery level of the pit lake and excluding the low wall/end walls. The low walls/end walls have been excluded from the definition of a final void due to the reduced slopes compared to mining conditions, combined with the ability for rehabilitation opportunities as described within the report. It is important to note that not all*

areas defined as a final void render the land unusable..."

- Xenith identified that some areas of the Mangoola Approved Project Area are steeper than 10^{o}, these steeper areas occur on both the low-wall (natural surface) and the final highwall.
- Xenith concluded that overall, the Approved Project Area and the MCCO Additional Mining Area landforms have been designed to incorporate natural micro-relief and natural drainage lines. Xenith understand the final highwall, in both pits, may be selectively blasted down to an appropriate overall angle and buttressed by the emplacement of spoils, adjacent to the final highwall, subject to future detailed geotechnical assessments. Xenith examined the widths of emplaced buttress material to allow haul trucks access and is of the opinion the work is practically achievable.
- Xenith noted that it is predicted that both the Approved Project Area and the MCCO Additional Mining Area voids will partially fill with water over time and the benefits of natural landform development, which is presented for the whole low wall to the pit floor, may not be forthcoming. They recommended that:

> *"... future work should potentially consider the expected water recovery level and focus on the stability of natural landform above this level as part of the ongoing life of mine planning and mine closure plans..."*

- Xenith stated that by keeping all the spoils generated by the MCCO Project within the confines of the MCCO Additional Project Area it would result in final dump elevations greater than 190mAHD, approximately 10-15m higher in places than the proposed landform under Case 3 (which has 50Mbcm of material being returned to the Approved Mining Area).
- With this considered, Xenith found that the proposed conceptual final landform in the MCCO Additional Mining Area would be approximately up to 30m higher than the surrounding [pre-mining] original landform.
- Xenith has examined the proposed pre mining and post mining drainage lines and considers the designs appropriate and achievable. Xenith was of the opinion that the proposed conceptual final landform is well aligned to the original surface for in terms of drainage density [Pre = 9.9; Post = 10.1] *(Xenith note that drainage density is an arbitrary ratio determined by the division of the total of the drain line lengths (m) by the total catchment area in (ha), the output being the average catchment per unit area of channel).*
- Xenith attempted to assess the slope profiles in terms of compliance to accepted design principles by examining the profiles of the main drainage channels proposed in the final landform and that the results confirm the slopes adhere to the concave profile that is inherently more stable from an erosional perspective.
- Xenith notes various catchment and water control dams, levee banks have also been proposed in the final landform to separate a variety of water types. Xenith confirmed that in their opinion the location of the water control dams relative to the MCCO final landform surface contours and the location of the proposed drainage lines is suitable and should be sufficient to control dirty water egress into Big Flat Creek and surrounding waterways.
- Finally, Xenith concluded that:

> *"...The conceptual final landform presented in the Mine Plan Options Report and the go forward case for the EIS is considered to be best option of the 6 cases considered in this report* [Case 3]*. The final landform presented honours the constraints provided by the Proponent and presents the appropriate balance of mine planning, economic, social, and environmental objectives..."*; and
>
> *"...As a result of the investigations in this report, Xenith is of the opinion the proposed conceptual final landform for the MCCO Project, as presented in the EIS, conforms with the objectives of delivering a safe, non-polluting, low maintenance, low risk of erosion surface. Xenith also considers the final landform for the MCCO area to be well suited to reestablishment of native vegetation, in line with the principles currently applied at Mangoola..." .*

4.3. Relevant Considerations

37. This section of the report outlines the relevant considerations made by IEMA during this review.

38. IEMA notes that the Mine Plan Options Report only completed detailed planning and assessment on the preferred case for the MCCO Project (Case 3). The alternative mine plan options contained within the report were conceptual in nature and have been used as a guide in order to arrive at the preferred case and are for landform and indicative comparison purposes only. See Section 1.3 of the Mine Plan Options Report for further detail around the assumptions and limitations.

39. On this basis, IEMA has taken the approach to testing and validating the assumptions and conclusions drawn by Mangoola regarding the selection of Case 3 scenario as the go forward case, with a high-level review of the other options for comparison.

4.3.1. Current Project Approval

40. The current Project Approval 06_0014 (Mod 8) approves a void to be left subject to the following rehabilitation objectives.

41. IEMA has reviewed the existing approval for relevance to the proposed final void within the currently approved mining area and is satisfied that the preferred case [Case 3] under the MCCO Project is in accordance with the current rehabilitation objectives for the site.

Table 12: Rehabilitation Objectives

Feature	Objective
Mine site (as a whole)	• Safe, stable and non-polluting • Final landforms designed to incorporate natural micro-relief and natural drainage lines • Restore self-sustaining ecosystems, including establishing: o appropriate native woodland species; and o at least 700 hectares of native grassland, in the final rehabilitated landscape.
Final voids	• Designed as long term groundwater sinks and to maximise groundwater flows across back-filled pits to the final void • Minimise to the greatest extent practicable: o the size and depth of final voids o the drainage catchment of final voids o any high wall instability risk o risk of flood interaction for all flood events up to and including the Probable Maximum Flood.
Anvil Creek realignment	• Restore self-sustaining ecological and hydrological function of the creek.

4.3.2. SEARs

42. IEMA has reviewed the SEARs issued by the DPIE on the 15 February 2019 and is satisfied that the preferred option [Case 3] addresses the General Requirements as well as the Key Issues outlined in the SEARs relating to Rehabilitation and Final Landform.

4.3.3. Mining Operations Plan (MOP)

43. IEMA has reviewed the current approved Mining Operations Plan (MOP) and is satisfied that the preferred case [Case 3] meets the general objectives of the MOP relating to the proposed final void within the current Approved Mining area. Given the MOP only addresses the current mining area, IEMA did not consider the proposed final void in the MCCO Project Area.

44. IEMA notes that Section 6.17.2 of the EIS includes information relating to the treatment of highwalls and the installation of a safety berm which is consistent with the commitments in the current MOP.

45. Plan 4 of the MOP Conceptual Final Rehabilitation and Post Mining Land Use at the end of the mine life 2029 includes a secondary domain called Final Void. IEMA is satisfied that the void in the current mining area will be in the same general location. It was noted that the geometry of the proposed void is less than the MOP with the additional backfill enabling more space to re-establish Anvil Creek.

4.3.4. Mine Closure Planning Protocol

46. Glencore Coal Assets Australia (GCAA) has in place the Mine Closure Planning Protocol (11.17). The purpose of the protocol is to ensure that closure planning is a process that is undertaken throughout the business life cycle and designed to leave a positive legacy. One of the key issues that are required to be reviewed as part of the Mine Closure Planning process is considering opportunities to minimise final void liability and overall disturbance footprint through a review of mine design and dumping strategies at strategic intervals e.g. as part of new approvals, approval modifications, operational reviews.

47. IEMA is satisfied that the preferred case [Case 3] has been part of an internal review process and meets the objectives of the Mine Closure Planning Protocol.

4.3.5. Mine Void Closure Policy

48. As part of the GCAA Mine Closure Planning Protocol (11.17) there is a policy document that relates to Mine Voids. It applies to all GCAA sites. Section 5 of the Mine Voids Policy refers to the factors to be considered when making decisions on Final Voids. These factors include:

- Operational constraints and consideration of the Life of Mine (LoM) material balance;
- Reducing the size of the voids by backfilling with overburden material, coal tailings (coarse and fine);
- Potential for offsite impacts (i.e. aquifers); geotechnical risks in terms of proximity to important built or natural features; and land ownership and tenure constraints;
- Mining is a dynamic business and mine plans can change in response to several factors (both external in internal); and
- Voids can have a range of economic benefits post mining (e.g. recreation; waste management, tourism, etc).

49. IEMA is satisfied that the preferred case [Case 3] meets the objectives of the Mine Void Policy.

4.3.6. Final Voids

50. IEMA notes that once the conceptual mine plan for the MCCO Project was determined, further assessment was undertaken by Mangoola of final landform options, specifically related to final voids, balancing the design inputs and expectations surrounding the establishment of a final landform. These inputs and expectations include:

- Maximising resource recovery and financial viability;
- Ability to minimise void size during the mining process;
- Available material post mining completion for use in rehabilitation activities;
- Surrounding constraints such as topography and boundaries;
- Long term stability, safety and non-polluting landform establishment;
- Visual considerations; and
- Long-term environmental sustainability and minimisation of impacts associated with the final landform.

51. IEMA notes that the existing approved final landform for Mangoola Coal Mine has one final void.

52. The MCCO Project Case 3 has retained this void to be generally as currently approved, however has improved the final void geometry due to the application of a revised natural landform design and shallower slopes on the low wall by hauling 50Mbcm of overburden from the MCCO Project Area. The approximate area of the void has been estimated at 48ha (See 36 dot point 8).

53. IEMA notes that the additional material from the MCCO Project area also has the added benefit of providing additional space in the backfill to better enable the reinstatement of Anvil Creek which is a key commitment under the existing Approval.

54. One additional void is planned for the MCCO Additional Project Area at an estimated area of approximately 82ha (See 36 dot point 8).

55. IEMA notes that under Case 3, two final voids would remain under the MCCO Project, with the distribution of overburden for emplacement in both voids partially reducing their size and improving the shape of the void in the currently approved mining area.

56. When comparing the options, IEMA notes that Case 5 considered the complete backfilling of voids; whilst Case 6 was an option that moved 8Mbcm of additional material to further rehandle material and partially fill both voids.

57. IEMA notes that the project has committed to developing a Final Void Management Plan incorporating the outcomes of specific final void groundwater assessments and identifying potential use options for the final voids. It is noted that the Final Void Management Plan will be developed and included in the Final Closure Plan which will be prepared in accordance with the requirements of the Mine Closure Planning Protocol (See 4.3.3 above).

58. IEMA notes that Table 6.3.4 of the EIS has provided a high-level analysis of potential post mining landforms for the Mangoola mine, including the final voids. Whilst there has not been a specific commitment to a post mining land use of the voids, IEMA notes that a range of alternatives where considered including:

- Water bodies in a conservation landscape;
- Aquaculture;
- Pumped Storage Hydro Power;
- Recreation / extreme sports; and
- Waste Recycling and reuse.

4.3.7. Landform and Rehabilitation

59. During the site inspection, IEMA inspected a range of different rehabilitation areas, including some of the earlier box-cut slopes that were rehabilitated prior to the adoption of the natural landform principles at the site

60. IEMA has also reviewed a series of the Annual Review Reports between 2014- 2018.

61. IEMA noted that in September 2018, a walkthrough rehabilitation inspection audit was completed by a specialist consultant to provide a snapshot of the condition of mine rehabilitation and highlight areas where remedial (maintenance) action is required. The report concluded that:

- Overall the rehabilitation works to date remain highly successful and are generally progressing towards the completion criteria listed in the MOP;
- Native diversity across both rehabilitation areas was considered generally high;
- Most areas exhibited appropriate species for the target vegetation community in all layers';
- Adaptive management was evident across Mangoola's rehabilitation areas. This included improvements in plant densities between older and newer areas of rehabilitation, improved ground cover diversity and the implementation of recommendations from previous monitoring events such as thinning of mid layer species;
- The report noted that the Mangoola rehabilitation areas contained some mild erosion sites however overall erosion control was generally successful. The establishment of vegetation and stabilisation of previous erosion gullies was noted as a promising sign; and
- The report also noted that while the structure and diversity of vegetation across the site was generally good, improvements could be made in the mid story by increasing the number of longer-lived shrub species; and on the ground layer by increasing the cover and diversity of species and growth forms.

62. IEMA notes that landforms established at Mangoola Coal Mine are completed using natural landform design principles and revegetation techniques that are widely recognised as industry leading practice. The aim of this approach to natural landform is to be consistent with the surrounding landscape and has been integrated into the business since the early phases of operations.

63. It is noted by IEMA that the current natural landform design principles and revegetation techniques currently used are intended to be applied in the MCCO Project Area.

64. IEMA understands that Mangoola has successfully rehabilitated approximately 532 ha (to the end of 2018) of disturbed land of the Approved Mangoola Coal Mine Disturbance Area in accordance with conditions of Project Approval 06_0014 and the Mangoola Mining Operations Plan (MOP). Much of this rehabilitation was completed using natural landform design principles.

65. During the site inspection IEMA requested additional information from the Mangoola Project team on the site-based processes applied during mine planning to ensure that the principles noted above are followed. The following is a summary of the information provided:

- Software (currently Geofluv) is used by the Technical Services Department to model on site dump parameters and soil types utilising comparisons to the surrounding natural land surface. The software provides a theoretically stable landform based on fluvial geomorphic landform design methods.
- The digital outcomes of this software are used by the Technical Services Department to develop appropriate dumps and ramps to produce a landform which is as close to the plan as practicable.
- The detailed design of the natural landform implemented at the Mangoola Coal Mine has been developed progressively as part of the detailed mine planning process and is included in the staged rehabilitation plans in the MOP.
- The final landform is designed as a self-draining structure. Consultants have also been engaged to develop conceptual plans for drainage designs from the landforms created through the mining process to manage runoff to the realigned creeks. These conceptual designs will be utilised where practicable and integrated into the final landform design which will be developed by the Technical Services Department.

66. The key documents in guiding the Rehabilitation at Mangoola Coal Mine is the MOP (which includes the Rehabilitation Management Plan requirements under the existing Planning Approval) and the Annual Rehabilitation and Closure Management Plan. From these documents, IEMA understands that the approach generally adopted for the implementation of the approved final landform includes:

- The final ‘Geofluv’ surface of the landform is generated with assistance from an external specialist in line with anticipated progression of the MOP;
- An internal review of the final landform is undertaken with overburden emplacement design and access planned to achieve the final surface;
- Material is placed in varying lifts from 5m to 20m in the upper portion of the final surface to achieve the correct waste balance with material close to final location i.e. limiting push lengths to <100m;
- If necessary localised block tipping is undertaken to obtain finer detailed relief of the final landform;
- An overall push plan is created utilising 3D mine design software and uploaded to final landform shaping equipment (typically D11 with high precision GPS control systems) specifically tasked with the final natural landform establishment;
- The high precision technology is used to guide the shaping of the final Geofluv surface. This process usually involves bulk shaping followed by a final trim to +/- 1m of the required surface; and
- Surface preparation activities for rehabilitated areas are then conducted as soon as practicable following completion of the bulk shaping activities.

67. In addition to external compliance monitoring and reporting, as part of the internal Annual

Rehabilitation and Closure Management Plan, a detailed review of the current rehabilitation status, according to the rehabilitation progress towards relinquishment and also the programmed works for the following year, is completed (See 61 above).

68. Based on the review of these stated processes and observations during the site inspection on the 28th October 2019, IEMA is satisfied that Mangoola has a good track record for committing to and completing the post mining natural landforms. This demonstrates to IEMA that there is a high likelihood that the same rehabilitation outcomes can be achieved in the MCCO Project area where the same landform design and rehabilitation techniques are proposed.

5. CONCLUSION

69. IEMA has completed a site inspection and meetings with the Project team on the 28th October 2019 as well as reviewing the information provided by Mangoola as summarised in **Table 1** above.

70. IEMA has concluded that **Case 3,** as presented in the Mine Plan Options Report, represents an appropriate outcome which demonstrates that Mangoola has considered the balance between delivering an economic mine plan whilst giving proper regard to leaving beneficial post mining land uses and minimising final voids.

71. The reasons for this are summarised below:

- The proposed final void in the Active Mining Area is consistent with the existing project Approval, noting however that if approved the new void configuration would supersede the current. IEMA has considered this aspect relevant as it demonstrates that what is proposed under the preferred Case 3 is not materially different to what is already approved;
- The proposed post mining landform relating to the currently approved void is an improvement on what is currently approved. In addition, the extra material will enable a better opportunity to re-establish Anvil Creek (a requirement in the current Project Approval);
- The review and options analysis undertaken by Mangoola as part of the EIS preparation addresses the requirements of the SEARs relating to Landform and Rehabilitation;
- The proposed final void in the Active Mining Area is generally consistent with what is currently approved in the MOP;
- The work undertaken as part of the Mine Plan Options Report meets the expectations of both the GCAA Mine Closure Planning Protocol (11.17) and the Mine Voids Policy. Whilst not necessarily a regulatory requirement, it represents compliance with the wider GCAA policies that have been developed in consultation with key stakeholders;
- Mangoola has demonstrated through the rehabilitation already completed at the mine that they have been able to successfully design and construct the natural landforms along with the revegetation techniques that are proposed in the MCCO Project Area EIS;
- As part of the MCCO Project EIS, Mangoola has included a commitment to rehandle 5Mbcm of material in order to improve the geometry on the proposed Void in the MCCO Project Area. It is noted by IEMA that Xenith have identified opportunities in future mine plan iterations to review the rehandling requirements to achieve a better final void outcome;
- Mangoola have given regard to potential beneficial post mining land use options for the final voids. Whilst they have not made any commitments in the EIS it is acknowledged that the EIS has included the options for ongoing review as the mine nears mine closure; and
- Xenith have undertaken a review of the Mine Planning aspects and concluded in their review that the final landform presented under Case 3;

  "...honours the constraints provided by the Proponent, achieves a volumetric balance over the LOM and presents an appropriate balance of mine planning and economic considerations..."

72. Whilst at this time, the preferred option Case 3 has been determined a balanced outcome between mine planning an acceptable outcome for the proposed MCCO Project Area, IEMA notes that there are a number of proposed Government policy reforms relating to final voids. In addition, there is significant interest from a range of stakeholders in relation to final voids in the Hunter Valley, and there is a genuine desire from these stakeholders for mining companies to demonstrate robust and considered mine plans that reduce or eliminate final voids.

73. In the future, the expectations around final voids may be very different and as such the outcomes of this review should only be relevant to this Application at this point in time.

Yours Sincerely
Integrated Environmental Management Australia

ANDREW HUTTON
Managing Director/Principal Consultant

INTEGRATED ENVIRONMENTAL MANAGEMENT AUSTRALIA

Appendix A

Andrew Hutton - CV

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ANDREW HUTTON

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QUALIFICATIONS

- Bachelor's Degree in Natural Resources (B.Nat Res) - from the University of New England, Armidale, (1995).
- Masters Degree in Business and Environmental Management (M.Bus.Mgt) from the University of Newcastle, (2004).
- Diploma of Management, (2011), Australia Education and Training Services (AETS).
- Certificate IV – Training and Assessors qualifications.
- Exemplar Global – Principal Environmental Auditor (#120689)

AFFILIATIONS / REGISTRATIONS

Member of the Australian Institute of Company Directors (MAICD)

Past Member Australian Institute of Mining and Metallurgy (AUSIMM) stood down due to perceived conflicts with the IPCN

Elected AUSIMM Community & Environment Committee Society Executive (Treasurer)

Member of the Hunter Coal Environment Group (HCEG)

EXPERTISE

- Project Management and Project Direction
- Mine Closure & Life of Mine Planning
- Risk Assessment
- Environmental Compliance and Transactional Due Diligence
- Stakeholder Engagement and Consultation
- Environmental Approvals and Management Advisory
- Environmental Management Systems, Workforce Training, Auditing and Reporting

CAREER SUMMARY

Andrew is the Managing Director and founder of IEMA Pty Ltd who are a specialist Environmental Management Advisory consultancy based in the Hunter Valley, NSW.

Prior to this current position Andrew was a Technical Director with SLR Consulting Australia Pty Ltd as well as being an Executive member of the Asia Pacific Regional Management team (RMT) and the Asia Pacific Regional Sector Leader for Mining and Minerals.

Andrew has 23 years of experience in the mining, agriculture and extractive industry sectors, including experience working in both operational and consulting roles in NSW and Qld working with BHP at the Saraji and Norwich Park open cut Mines. Andrew also worked in the Hunter Valley working at the Donaldson open cut coal mine as Environmental Manager. In these roles, Andrew managed all facets of the environmental management, operational and community stakeholder engagement functions.

Andrew was previously the Principal Consultant and General Manager of GSS Environmental (GSSE) taking the consulting business from start-up in 2003 and building the firm into a multi-disciplinary environmental and engineering consultancy of 50 people based in Newcastle, Mackay and in Sydney. GSSE was acquired by SLR in 2012.

Andrew is an experienced Environmental Auditor (No. #120689) with certification covering the scopes of Environmental Audit, EMS, Environmental Report verification and Compliance auditing. He has significant experience undertaking audits, including numerous transactional due diligence audits for mining and industrial clients.

Andrew is currently Commissioner with the NSW Independent Planning Commission NSW (IPCN). The IPCN is a statutory body established under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) being appointed as a Commissioner by the Minister of Planning in 2015 and was the subsequently reappointed for a further 3 years in 2018.

The EP&A Act details the key functions of the Commission including the determination of development applications when those matters are delegated to it by the Minister, and the provision of independent expert advice to the Minister on a range of planning and development matters.

.... environmental management professional with Executive experience as a member of an Asia Pacific Regional Management team (RMT) as well as the APAC Regional Sector Leader for the Mining and Minerals sector......

KNOWLEDGE AND EXPERTISE

The following section summarises Andrew's project and technical experience including a list of his key skills and the key clients with whom he has worked. Further specific project details can be provided on request.

Environmental Planning and Approvals – Project Management / Direction

Andrew has been involved on numerous Environmental Impact Assessments (EIA) across a range of projects and jurisdictions. Andrew's involvement has been both as Technical Director providing strategic input and peer review as well Project Manager as preparing and contributing to technical reports.

Andrew has also been involved in the preparation of all aspects of post approval documentation from management plans to operational plans and risk assessment. Andrew is currently a Commissioner on the NSW Independent Planning Commission (IPC) having worked across several projects within the built environment, mining, renewable energy and extractive industries

Summary of Skills:

- Project Director on major project approvals
- Project Management of major project approvals
- Project scoping and definition
- Project Risk Assessment
- Approval strategy and pathway
- Management of subject matter experts and contributors
- Stakeholder identification and engagement
- Technical Peer Review
- Preparation of post approval operational management plans
- Environmental permits and licences

Key Clients

- Glencore Coal Assets Australia (multiple sites)
- Centennial Coal (multiple sites)
- ProTen – major poultry producer
- Reach Energy – Solar Farm
- Hunter Quarries
- Karuah East Quarry
- Allworth Quarry
- Warnervale Waste Recycling

Decommissioning and Mine Closure Planning

Andrew is a leader in the development of Mine Closure Plans from concept plans through to detailed plans having project managed and directed several detailed closure planning projects including the delivery of all supporting technical studies and the cost estimates. Andrew also has experience in policy and standard development particularly around corporate mine closure standards. Andrew has worked for various government jurisdictions having delivered Rehabilitation Cost Estimation (RCE) tools for the NSW, Victorian and Queensland governments

Summary of Skills:

- Conceptual mine closure plans
- Detailed mine closure plans
- Corporate Closure Standards
- Closure constraints and opportunities
- Post Mining Land Use Analysis
- LoM Planning
- Rehabilitation strategies
- Mining operations plans
- Closure Risk Assessment

- Management of subject matter experts and contributors
- Stakeholder identification and engagement
- Regulator engagement and consultation
- Technical Peer Review.

Key Clients

- Bathurst Resources (NZ)
- Glencore Coal (multiple sites)
- Whitehaven Coal
- Centennial Coal (Multiple sites)
- Hunter Quarries
- Idemitsu Australia Resources – Muswellbrook Coal
- BHP
- Donaldson Coal
- Xstrata
- Peabody Coal
- Rio Tinto
- Port Waratah
- NSW Minerals Council
- Mt Isa Mine
- Tampakan Copper-Gold Project in Mindanao, Philippines.

Financial Assurance & Cost Estimation

Summary of Skills:

- Development of Rehabilitation Cost Estimates (RCE)
- Engagement and review of Accounting Standards/auditors
- Due Diligence review (M&A transactions)
- Review of closure cost assumptions and rates
- Development of a Security Bond Calculator/tools for Governments for mining and oil/gas sectors
- Preparation of "Close Now" and "Planned Closure" cost estimates for rehabilitation and closure
- Project Director for the preparation of engineering-based Bill of Quantity (BoQ) estimate for detailed mine closure plan.

Key Clients

- Glencore Coal (multiple sites)
- Glencore Copper - Tampakan Copper-Gold Mine (Philippines)
- NSW Department of Mineral Resources (DMR)
- Qld Department of Environment and Heritage (DEHP)
- Victorian Environmental Protection Agency (EPA)
- Centennial Coal (Multiple sites)
- Whitehaven Mining
- Donaldson Coal
- Russell Vale and Wongawilli Underground Coal Mines
- Fernvale Gravel Quarries
- Hunter Quarries
- Abbott Point Coal Terminal

Risk Assessment

Andrew has extensive experience in risk management holding formal qualifications in MNCG1002A - Risk Management & Facilitation "Implement and Apply Risk Management Processes (G2 Course)". Andrew's has contributed to and lead numerous risk management workshops for a range of clients across various disciplines.

Summary of Skills:

- Emergency response and preparedness
- Business Risk
- Project pre-feasibility and feasibility risk assessment;
- Life of Mine (LoM) Planning risk assessment;
- Mine Closure;
- Operational expansion and improvement risk assessments;
- Subsidence Management Plans (SMP)
- Environment and Community
- Stakeholders
- Change management

Key Clients

- Glencore Coal (multiple sites)
- Bathurst Resources
- BT Mining
- Centennial Coal (multiple sites)
- Rio Tinto
- Yancoal
- Peabody
- Peak Gold Mines
- Donaldson Coal
- Xstrata
- Tampakan Copper-Gold Project in Mindanao, Philippines
- Hunter Quarries
- Allworth Quarry
- Karuah East Quarry

Environmental Compliance, transactional due diligence and auditing

Andrew is a certified Principal Auditor having led environmental compliance audits across a range of industry sectors. In addition, Andrew has been a member of Transactional Due Diligence teams supporting firms by providing input into key environmental aspects such as estimated closure and rehabilitation costs, regulatory constraints and timeframes and permits and approval matters.

Summary of Skills:

- Lead Auditor on environmental compliance audits
- Subject matter expert on transactional due diligence audits (closure, approvals, rehab, environmental aspects, etc)
- Exploration Permits
- Compliance with Development Consent conditions
- Compliance with approved operational Management Plans
- Environmental Due Diligence
- Government appointed independent Environmental Auditor
- EMS compliance

Key Clients

- Bathurst Resources
- BT Mining

- Glencore Coal
- Centennial Coal
- Whitehaven
- J T Boyd
- CSA Global
- ProTen
- Yancoal
- Cullen Valley / Invincible colliery
- Wambo
- URS

Stakeholder Engagement and Consultation

Andrew has significant experience in development of Stakeholder Engagement Plans and undertaking the Consultation having led the process for a number of Mining, Extractive industry and renewable energy projects. In addition, Andrew can assist with engagement and consultation with the key Regulators to ensure projects are delivered to meet all stakeholder expectations

Summary of Skills:

- Stakeholder mapping
- Stakeholder identification and engagement strategies
- Community Consultative Committees (CCC)
- Regulator engagement
- Aboriginal & Native Title Stakeholder Consultation

Key Clients

- Glencore Coal
- Donaldson Coal
- Rio Tinto
- Whitehaven
- Reach Solar Farms
- ProTen
- Bathurst Resources
- BT Mining
- Wild Quarries
- Hunter Quarries
- Allworth Quarry
- Karuah East Quarry

Environmental Management Systems, training, auditing and reporting

Andrew has significant experience in the development, application and compliance with Environmental Management Systems (EMS) - ISO 14001. In addition, Andrew has led Environmental Business Improvement and Environmental Awareness training packages for clients across all levels of the business from production to senior management. Andrew can delivery training in partnership with an RTO so that participants received formally recognised qualifications.

Summary of Skills:

- Development and implementation of ISO 14001 Environmental Management Systems (EMS)
- Compliance and legal obligations registers
- Environmental Policy
- Operational Management Plans
- Aspects and Impacts Assessment
- Compliance and pre-certification audits
- Workforce Training
- Environmental Awareness
- Sustainable Project Management

- Development of Compliance Management System

Key Clients

- Donaldson Coal
- Baiada
- ProTen
- Dynamic Learning Services
- Glencore
- Centennial Coal
- Hunter Quarries
- Allworth Quarry
- Karuah East Quarry

PROFESSIONAL HISTORY

2018 – Current –	Managing Director and founder of Integrated Environmental Management Australia (IEMA) Pty Ltd.
2015 – 2018 -	SLR Consulting, Regional Sector Leader – Mining & Minerals, Asia Pacific and Executive Member of the Regional Management team.
2013 – 2015 -	SLR Consulting, Executive – Environmental Management Planning Approvals (EMPA) and Ecology, Asia Pacific Business Sector Leader – Mining.
2012 – 2013:	SLR Consulting, Technical Director, Business Sector -Coordinator – Mining Environmental Services.
2003 – 2012-	GSSE, Principal Environmental Consultant/General Manager, NSW
2000 – 2003-	Environmental & Community Manager, Donaldson Coal Mine, NSW
1999 – 2000-	IESA Pty Ltd, Environmental Projects/Field Operations Manager,
1997 – 1999-	BHP Coal Pty Ltd, Saraji, Environmental Officer, Qld
1996 – 1997-	BHP Coal Pty Ltd, Norwich Park Mine, Graduate Environmental Officer,
Oct 1996 – Dec 1996-	Peabody Resources, Ravensworth Mine, Student Environmental Officer, NSW.
Oct 1995 – Feb 1996-	Shell Coal Pty Ltd, Callide/Boundary Hill Mines, Student Environmental Officer, Qld.

TRAINING

- Company Director Course, Australian Institute and Company Directors (2018)
- Implement and Apply Risk Management Process (G2) – Risk Facilitation
- Certificate IV – Training and Assessors qualifications
- BHP Minerals Environmental Management Systems (EMS) Auditor Training
- ETRS Lead Auditor Certificate in Environmental Management Systems (EMS).
- Mine Officials Statutory Training
- Rio Tinto Coal Australia (Coal & Allied) – Job Co-ordinators, NSW.
- Short course on Environmental Testing & Monitoring for the Mining Industry

PUBLICATIONS / PAPERS

- *Planning for temporary or permanent mine closure – what you might consider and what is it going to cost?* Presentation to the Darwin Branch of AusIMM, 2015.
- *"A review mine closure liability estimates using case studies of the real costs associated with the demolition and removal of infrastructure in mine closure"* (expansion and update on the paper below given at the International Mine Closure Conference) – proceedings for the 2012 AUSIMM Life of Mine Conference, Brisbane
- *The "smoking gun" of detailed mine closure cost over-run – a review using case studies of the real costs associated with the demolition and removal of infrastructure in mine closure*. Proceedings from the 2011 International Mine Closure Conference, Lake Louise, Canada.
- *"The Smoking Gun of detailed Mine closure costs over-runs – A review using case studies".* NSW Minerals Council Conference, 2010, Wollongong, NSW
- *New Regulatory Approaches in Rehabilitation Cost Estimation – how successful have they been.* Proceedings form the 2009 International Mine Closure Conference, Perth, WA.
- *Calculating a Realistic Security Bond and Assessing True Mine Closure Liabilities.* Proceedings from the 2006 International Mine Closure Conference 2006, Perth, WA.

INTEGRATED ENVIRONMENTAL MANAGEMENT AUSTRALIA

Appendix B

Letter from DGR requiring the Independent Review

www.iema.com.au

Planning, Industry & Environment

DOC19/604703

DIVISION OF RESOURCES & GEOSCIENCE ADVICE RESPONSE

Genevieve Seed
Energy and Resources – Planning and Assessment Division
Department of Planning, Industry & Environment
GPO Box 39
SYDNEY NSW 2001

genevieve.seed@planning.nsw.gov.au

Dear Genevieve

Project: Mangoola Coal Continued Operations Project
Stage: Review Environmental Impact Statement and complete Resource & Economic Assessment
Development Application: SSD-8642

I refer to your correspondence dated 15 July 2019 inviting the Division of Resources & Geoscience (Division) to provide comments on the *Mangoola Coal Continued Operations Project* (Project or Proposal) Environmental Impact Statement (EIS). The EIS was submitted by Mangoola Coal Operations Pty Limited which is owned by Glencore Coal Pty Ltd (Glencore or the Proponent).

The relevant units of the Division have been consulted in generating this advice. The Department of Planning, Industry and Environment – Planning and Assessment Division and the Proponent should be aware that matters pertaining to rehabilitation, environmental impacts of final landform design, mine operator and safety are not assessed by the Division. Reference should be made to the response from the Resources Regulator on these matters.

Advice overview

The Division has determined that the Proposal will:

- ensure continued operations at Mangoola until 2030.
- provide certainty and ongoing employment opportunities for the existing Mangoola mine personnel as the mine would cease operations in 2026 if the Project was not approved.
- safeguard sustained production, employment and royalties from 2023 onwards from the existing operation.
- improve resource recovery and be an efficient use of resources.
- generate total revenue (value of coal produced) of $3.3 billion (current dollars)
- ensure an appropriate return to the state with $258 million royalties (current dollars).
- involve employment for 330 of the workforce at the existing Mangoola mine until 2030.

NSW Department of Planning, Industry and Environment
Division of Resources & Geoscience – Resource Operations – Assessment Coordination Unit
516 High St Maitland NSW 2320 PO | Box 344 Hunter Region Mail Centre NSW 2310
Tel: (02) 4063 6500 Fax: (02) 4063 6974 Email: assessment.coordination@planning.nsw.gov.au
www.resourcesandgeoscience.nsw.gov.au
ABN 38 755 709 681

Resource and Economic Assessment

The Division has examined the final landform for the Project outlined by the Proponent. Seven different scenarios were developed and assessed by Glencore and ranked according to mine design, engineering feasibility, economic feasibility, including consideration of environmental and social outcomes. The preferred case chosen by Glencore and included in the Project's EIS is estimated to take six months more and additional costs compared with the baseline case of $75 million.

The Division recommends that an independent expert examination of the proposed final landform be undertaken, focusing on whether the final landform case selected by the Proponent is the best option.

In view of the constraints outlined in the Proponent's EIS, the Division considers the Project satisfies section 3A objects of the *Mining Act 1992* (NSW) (the Act) and the requirements of cl 15 of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007.

The Project represents an efficient development and utilisation of coal resources which will foster significant social and economic benefits. The Division is satisfied the proposed mine design and mining method submissions adequately recover coal resources and will provide an appropriate return to the state.

The resource utilisation and economic benefits assessment undertaken by the Division is addressed in Attachment A.

Application of section 380AA of the *Mining Act 1992* – restrictions on planning applications for coal mining and titles required to undertake mining

Coal is a prescribed mineral under the Act and the Proponent is required to hold appropriate mining titles from the Division to undertake mining.

Section 380AA states:

> *(1) An application for development consent, or for the modification of a development consent, to mine for coal cannot be made or determined unless (at the time it is made or determined) the applicant is the holder of an authority that is in force in respect of coal and the land where mining for coal is proposed to be carried out, or the applicant has the written consent of the holder of such an authority to make the application.*
>
> *(2) For that purpose, an authority in respect of coal need not be in force in respect of the whole of the land to which the application for development consent relates but must be in force for the land where mining for coal is proposed.*

Based on current title information the Division advises that the Proponent holds the appropriate titles as required for planning applications for coal as relating to the Project and satisfies the requirements of section 380AA.

The requirement for a mining authorisation and royalty liability

Coal is a prescribed mineral under the Act and the Proponent must obtain the appropriate mining title(s), such as a mining lease, from the Division to undertake mining.

The Division notes that the EIS makes reference to the requirement to lodge an application for a mining lease over the Project area. The area is currently covered by Assessment Lease 9 (Act 1992) held by the Proponent (see Attachment B), which allows for an application for a mining lease to be made (refer to section 51 of the Act).

Furthermore, the holder of a mining lease is also liable to pay royalty for both publicly and privately-owned minerals (refer to section 282-285 of the Act).

Application of section 65 of the *Mining Act 1992* – development consents under the Environmental Planning and Assessment Act 1979

A development application under the *Environmental Planning and Assessment Act 1979* must be approved before a mining lease can be granted. A mining lease will only be granted for activities specified in the development consent.

Section 65 states:

> *The Minister must not grant a mining lease over land if development consent is required for activities to be carried out under the lease unless an appropriate development consent is in force in respect of the carrying out of those activities on the land.*

Biodiversity offset assessment

The Division notes that biodiversity impacts of the proposed Project are currently being assessed, managed and offset under the Framework for Biodiversity Assessment and the NSW Biodiversity Offset Policy for Major Projects.

Continued consultation should be undertaken with:

- The holders of Assessment Lease 19 (Act 1992), held by Muswellbrook Coal Company Ltd, and Exploration Licence 8064 (Act 1992), held by Ridgelands Coal Resources Pty Limited, regarding the small portion of the proposed *Mangoola Offset Area* that appears to encroach into the title areas.
- The holders of Petroleum Exploration Licence 456 (Act 1991), held by Hunter Gas Pty Ltd & Santos QNT Pty Ltd, regarding the small portion of the title that overlaps the *Highfields Offset Area*.
- The neighbouring mines such as Mt Pleasant and Mt Arthur regarding the potential for cumulative impacts associated with the Project.

The Division requests that the Proponent consider potential resource sterilisation in relation to any amendments to proposed biodiversity offsets areas. The Division requests that both the Geological Survey of NSW – Land Use Assessment team and holders of existing mining and exploration authorities that could be potentially affected by planned biodiversity offsets be consulted. This will ensure there is no consequent reduction in access to prospective land for mineral exploration or potential for the sterilisation of mineral and extractive resources.

Summary of review

The Division has determined that should the project be approved; efficient and optimised resource outcomes can be achieved, and any identified risks or opportunities can be effectively regulated through the conditions of mining authorities issued under the *Mining Act 1992*.

For enquiries regarding this matter, contact Adam Banister, Senior Advisor Assessment Coordination on 02 4063 6534 or assessment.coordination@planning.nsw.gov.au.

Yours sincerely

Dr David Blackmore
A/Executive Director Resource Operations
Division of Resources & Geoscience
21 August 2019

Encl.
Attachment A - Mangoola Continued Operations Project (SSD 8642) - Resource & Economic Assessment (DOC19/604749)
Attachment B - Mangoola Continued Operations Project (SSD8642) - Diagram (DOC19/693679)

APPENDIX 7
Xenith Report

Xenith

Mangoola Coal Operations

Final Landform - Expert Examination Report

NOVEMBER 2019

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DOCUMENT ISSUE APPROVAL

Project & Document No:	Date:
2075GLEN	14/11/2019
Title	**Revision No:**
Final Landform - Expert Examination Report	4
Client:	**Status:**
Glencore – Mangoola Coal Operations	Final

	Name	Position	Signature	Date
Prepared by:	Ben Smedley	Lead Mining Engineer		14/11/2019
Reviewed by:	Mark Perquin	Manager - Brisbane		14/11/2019

DISTRIBUTION

Organisation	Attention	No of hard copies	No of electronic copies	Actioned
Glencore - Mangoola Coal Operations	Brian Pease	0	1	BS

1 EXECUTIVE SUMMARY

Xenith Consulting has been asked by Mangoola Coal (the Proponent) to conduct an expert review of the Mangoola Coal Continued Operations Project (MCCO Project) conceptual final landform. Xenith is to provide an opinion on the proposed final landforms suitability, practicality (of execution) and overall viability. Xenith has prepared the following expert report with the aim of examining the final landform case selected by Mangoola and presented in the MCCO Project Environmental Impact Statement (EIS) (Umwelt 2019) to determine if it is the best option and, where possible, to make recommendations for improvement.

The conceptual final landform presented in the Mine Plan Options Report (Mangoola Coal Operations, 2019) and the go forward case for the EIS, is considered to be the best option from a mine planning perspective in terms of the proposed final landforms volumetric balance, practicality (of execution) and overall engineering viability, of the 6 cases considered in this report. The final landform presented honours the constraints provided by the Proponent and presents the appropriate balance of mine planning and economic considerations.

Xenith has examined the overall Volumetric balance on a total basis, and a staged basis using the current LOM schedule supplied from site, which includes the integration of the MCCO Project. The factors used for the allowance of material swell, reject emplacement and overburden material handling are considered appropriate.

The final landform review has considered the spoil balance between the existing and proposed mining operations both at the time of the EIS and using the current LOM schedule. Xenith has confirmed the waste spoils generated by the MCCO operation do fit within the supplied EIS final landform envelopes on a staged and total volume basis with the overall spoil balance being within acceptable tolerances.

Xenith has undertaken a final slope assessment for the proposed final landform and a high-level drainage/water management assessment that confirms the landform proposed adheres to correct design principles to ensure longer term slope stability with minimal likelihood of excessive erosion taking place over time. Xenith has not acted as an environmental consultant and does not make representations or comment on matters of approvals, rehabilitation, re-vegetation, or other social aspects of the project.
As a result of the investigations in this report, Xenith is of the opinion the proposed conceptual final landform for the MCCO Project, as provided in the EIS, conforms with the objectives of delivering a safe, non-polluting, low maintenance, low risk of erosion surface.

2 INTRODUCTION

Mangoola Coal Mine is an existing open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of New South Wales (NSW). Mangoola Coal Operations Pty Limited (Mangoola) has operated the Mangoola Coal Mine under Project Approval (PA) 06_0014 since mining commenced at the site in September 2010. Glencore Coal (GC) Pty Ltd owns the Mangoola Coal Mine.

Mangoola recovers coal from the Newcastle coal measures and produces thermal coal for both domestic and export markets. Mining operations are currently concentrated in two open cut areas, namely West Pit and South Pit. Mining south of Wybong Road in the current pits overlaps the commencement of mining north of Wybong Road. The existing operation is likely to complete south of Wybong Road in 2025.

In July 2019, Mangoola presented the MCCO project EIS to the NSW Department of Planning, Industry and Environment (NSW DPIE). The MCCO Project, to the north of the existing mining operations, would provide access to an additional approximately 52Million tonnes (ROM) of reserves in the MCCO Additional Mining Area. As stated in the MCCO Project EIS based on the current proposed mine scheduling, this resource would enable continuation of mining operations within the MCCO Additional Mining Area for approximately eight years with equipment and operations transitioning from the existing approved mining area from approximately late 2022 through to approximately 2026, where it is anticipated that the existing approved coal mining operation would be complete. Mining will then continue until the end of mine life in the MCCO Additional Mining Area until approximately 2030 (subject to the timing of commencement of the Project following approval and construction) (Umwelt 2019).

The MCCO Project Mine plan proposed in the EIS has been determined following consideration of several different mine plan options examined in the “Mine Plan Options Report”, prepared by Mangoola in June 2019. A total of 7 potential operating scenarios and final landform options were considered in order to select the go forward MCCO Project Case as presented in the EIS.

The NSW DPIE, Division of Resources and Geoscience (DRG) have provided a submission in support for the MCCO Project with a request that an independent expert examination of the proposed final landform be undertaken. The extracted DRG submission statement is reproduced as:

> *“The Division has examined the final landform for the project outlined by the Proponent. Seven different scenarios were developed and assessed by Glencore and ranked according to the mine design, engineering feasibility, economic feasibility, including consideration of environmental and social outcomes. The preferred case chosen by Glencore and included in the Project’s EIS is estimated to take six months more and additional costs compared with the baseline case of $75 million.*
>
> *The Division recommends that an independent expert examination of the proposed final landform be undertaken, focusing on whether the final landform case selected by the Proponent is the best option.”*

Xenith Consulting has been engaged by Mangoola to act as an expert and examine the proposed MCCO final landform in the context of the aforementioned outcomes and form an opinion on the proposed final landforms suitability, practicality (of execution) and overall viability. Xenith has been asked to provide a report on whether the final landform case selected by Mangoola in the EIS is the best option and, where possible, to make recommendations for improvement.

3 SCOPE OF WORK

In October 2019, Mangoola Coal Operations sought the services of a qualified consultant to provide expert advice on the MCCO Project mine plan, Life of Mine (LOM) schedule and conceptual final landform aspects of the MCCO Additional Mining Area. An analysis was requested by Mangoola to assist the DRG in determining if the MCCO Project mine plan was reasonable in the approach to the following areas:

- Out of pit overburden emplacement
- Overburden rehandling
- The final pit void size and shape
- The mine plan and final landform considering all constraints (see below)
- The integration of the existing operation, equipment and facilities

The examination of the final landform is to be at a high standard with the aim of providing the DRG with information suffice to establish whether the mine has honoured its stated final landform objectives in the MCCO Project EIS. Xenith has also been asked to comment on whether the final landform for the MCCO Project is practically achievable.

The report prepared by the consultant also needs to consider and provide commentary on the findings from the MCCO Project EIS in relation to:

- Final Landform design
- Material handling
- Volumetric Balance over the LOM
- Slope stability/compliance

4 DATA & CONSTRAINTS

The analysis was conducted using data provided by Mangoola and was comprised of:

- Pit Limits – pit shells of proposed mining areas
- Approved disturbance boundary
- MCCO proposed disturbance footprint
- Approved project boundary
- AL9 Boundary
- Land ownership
- Coal titles
- Local roads
- Existing 500k Transmission lines
- Mangoola cadastral data
- Topsoil stockpile locations
- Final surface – approved final landform
- MCCO Project EIS Stage Plans and conceptual final landform
- Haulage – haulage strings and corresponding hauled volumes
- LOM Schedule
- Structural geological model – coal structure grids, ply and working sections
- Plan data corresponding to Mine Plans Options Report for the additional mining area
- Topography surfaces – includes current surveyed surface, original topography, mined out surfaces
- Swell factor for waste in emplacement areas – 17%

Reports referenced are summarised in Appendix A .

The EIS and Mine Plan Options Report discusses constraints considered in the mine planning phase which ultimately influences the mine plan and the therefore the final landform. The following constraints were supplied for consideration in the report.

- The existing mining lease and tenement boundaries
- The existing mining operation south of Wybong Road
- The existing biodiversity offset areas to the east
- Big Flat Creek located between the existing mining operation and the MCCO Additional Project Area
- The Big Flat Creek conservation area located between the existing operation and the MCCO
- Additional Project Area and which generally aligns with a significant portion of Big Flat Creek
- Wybong Road located between the existing mining operation and the MCCO Additional Project Area
- The location of known threatened flora species including Acacia pendula, Diuris tricolor and Prasophyllum petilum
- Potential implications to environmental impacts that may arise including air quality, noise, visual and surface water
- Wybong Post Office Road located in the central portion of the MCCO Additional Project Area
- Ridgeland's Road located north of the MCCO Additional Project Area
- The rising topography to the north/northwest
- The existing 500kV TransGrid power lines located to the west
- ROM coal and product coal, strip ratios
- Overburden dumping constraints, including limiting out-of-mine overburden emplacement, avoiding disturbance of the existing mine rehabilitation areas
- Wybong Creek to the west

5 STUDY APPROACH

The conceptual final landform for the MCCO Project should be a roadmap for the company and its external stakeholders that integrates staged dump development with mine rehabilitation and closure throughout the life of mine. The strategy and the process of its development must instil confidence and trust in those external stakeholders that the company has a rigorous and timely understanding of its risks and opportunities. It must also provide assurance that the company is systematically working toward the reduction of uncertainty and creation of value during mining in order to create the best final landforms for long terms stability, revegetation and potential post-mining uses.

The proposed MCCO development strategy outlined in the Mine Plan Options Report and proposed as the go forward scenario in the EIS is referred to as Case 3. Table ES1 from the Mine Plan Options Report is reproduced below in Figure 5.1.

Figure 5.1 – Mine Plan Options Report – MCCO Cases Considered

Description	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Case Description	Business Baseline Case – All Overburden emplaced in the MCCO Additional Project Area	Initial Integrated Project Case	MCCO Project Case (as included in the EIS)	Non preferred case – One Void in the North	Non preferred case – No Voids	Non preferred case – Partial fill of Final Voids	Non preferred case – No MCCO Project Case
Overburden Emplacement Strategy	Overburden is hauled to additional, larger and higher overburden dumps in the MCCO Additional Project Area of up to approximately RL220	Haul approximately 50Mbcm of overburden from the MCCO Additional Mining Area to the existing approved mining area	As per Case 2 along with additional 5Mbcm rehandle to improve the overall shape and size of the void in the MCCO Additional Mining Area	As per Case 2 along with additional 33Mbcm of overburden from the MCCO Additional Mining Area to the existing approved mining area to fill the existing approved mining area void to approximately RL150 - RL160	As per Case 4 however at the completion of coal mining, remove approximately 100Mbcm (394 ha) of established rehabilitation to fill the MCCO Additional Mining Area void.	As per Case 2 with an additional 6Mbcm from the MCCO Additional Mining Area to the existing approved mining area and rehandle approximately 8Mbcm of overburden from the MCCO Additional Mining Area	Mining continues as per current approved operations
Volume of Rehandle (Estimated Mbcm)	Nil	Nil	5	Nil	100	8	N/A
Number of Voids at completion of mining	2	2	2	1	0	2	1
Additional Time to complete	Nil	Nil	6 months	Nil	4.5 years	9 months	N/A
Indicative Total Cost (compared to baseline)	Baseline Costs	$53M	$75M	$114M	$526M	$95M	Economic benefits of the MCCO Project are lost

Xenith has taken the following approach to testing and validating the assumptions and conclusions drawn by the Proponent regarding the selection of Case 3 scenario as the go forward case, areas of consideration are summarised in Table 5.1

Table 5.1 – Technical Review Approach for Case 3

Area of Investigation
Mangoola Resource verification
Volumetric Balance based on EIS supplied Surfaces Total Basis/Staged Basis
Volumetric Analysis based on current LOM schedule
Haulage Analysis – impact of MCCO rehandle on cycle time, fleet size to achieve objectives
Slope assessment

6 ALTERNATIVE CASES

Xenith has also undertaken a high-level assessment of the other 5 options which were not progressed, in order to test the veracity and reasons for the exclusion of each particular case.

Xenith has not undertaken as assessment of Case7, whereby the MCCO Project does not progress as this option requires a more detailed understanding of the MCCO Project economics and is considered outside the scope of this report.

Xenith has examined the key issues for each case using the same criteria as outlined in the mine plan options report but has not undertaken a detailed financial assessment for each case.

Table 6.1 – Cases Examined – Mine Plan Expert Review

Description	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Case Summary	All Overburden into MCCO Area	Initial Project Case	MCCO Project Case (EIS). Approximately 58Mlcm to existing mine	One large void in MCCO	No Voids.	Additional (Partial) fill of the MCCO and existing mine voids
Overburden Emplacement Strategy	Would result in a larger and higher overburden dump in the MCCO area	Haul 50Mbcm from MCCO to existing mine void.	Improved final landform slopes and appearance for both voids without compromising project economics excessively	Requires an additional 33Mbcm to be hauled from MCCO to the existing pit Adverse effect on project economics due to high cycle times and haulage costs.	Rehandle 100Mbcm to fill both voids. Large volume of rehandle for both areas. Costs would likely prohibit feasibility of development	Case 2 but requiring 6Mbcm more from the MCCO area to the main pit and rehandling an additional 8Mbcm into the MCCO. Cost impacts on project economics
Volume of Rehandle	None	None	3.5Mbcm (MCCO only)	None	100Mbcm	8Mbcm
Number of voids	2	2	2	1	0	2
Expert Review Comment	Xenith calculates the dump requirements for this scenario would be 216Mlcm and result in larger and higher dumps with associated visual amenity issues and poorer outcomes for the main pit landform	Solves the issue of the spoil balance for the MCCO and improves the existing mine landform but does not address the MCCO final void. Leaves a large open void in the MCCO area with angular and potentially unstable pit corners that would deteriorate over time. Visual amenity and post mining usages limited. Safety considerations	Xenith considers this the best option. As a result of the improved pit sequencing developed in LOM schedule analysis, the rehandle volume has been reduced from 5Mbcm to 3.5Mbcm and could potentially be further reduced with detailed engineering.	Noise and dust impacts associated with additional haulage back across. Same issues with the potential for an angular and potentially unstable MCCO final void as Case2.	Xenith has not undertaken a detailed financial assessment but considers the project would no longer be economically feasible due to the cost/bcm to rehandle such a large volume of spoil material.	Reduced final void overall volumes, but at a higher cost. Xenith believes pit sequencing in the final years of both open cuts may be able to deliver similar benefits without the large rehandle considerations.

7 LOM VOLUMETRIC BALANCE

Xenith undertook a series of volumetric calculations in order to determine whether the swollen waste material extracted as part of the MCCO Project would fit within the supplied final landforms supplied by the Proponent. These calculations were undertaken on a total basis, a staged basis and using the sites current LOM schedule. Insitu Resources were reported to determine and validate the total waste and coal volumes present within the supplied MCCO pit shell and main Mangoola pits. The Insitu resource calculation is based on a survey surface at the 4th October 2019, which in the case of the MCCO area is the original unmined topography.

7.1 MCCO Insitu Resources Calculation

A grid calculation of the total resources for the MCCO project was undertaken to validate the waste and coal quantities quoted in the EIS. The original topography was used as upper starting surface, with the total pit-shell from the MCCO options report as the basal limiting surface. The Mangoola18_07 geological model supplied by site was used for the calculation of each seams Insitu quantities.

Table 7.1 – MCCO Resource Calculation

Seam	Waste (Mbcm)	Coal (Mbcm)	Xenith coal (Mt)	Client coal (Mt)
WAL	113.0	1.0	1.6	1.8
GN	54.0	8.0	12.5	12.3
GNX	0.0	1.5	0.0	
FSU	11.3	1.5	2.3	2.7
FSL	0.7	13.7	21.4	20.1
FFX	0.0	5.5	8.5	8.9
UPA	4.8	1.0	1.6	0.9
UPAB	0.7	3.2	5.0	5.1
UPB	0.0	0.3	0.5	0.6
TOTAL	**184.6**	**34.3**	**53.4**	**52.3**

Xenith understands the 52.3Mt coal tonnage figure quoted in the EIS was on a Run of Mine (ROM) basis, whereas the 53.4Mt figure Xenith has calculated above was determined on an Insitu basis. The resulting difference is due to mine-site adjustments for loss and dilution, seam aggregation into working sections, coal wasting, and coal recovery adjustments being included in the EIS figure.

Figure 7.1 – Supplied Pit Shell

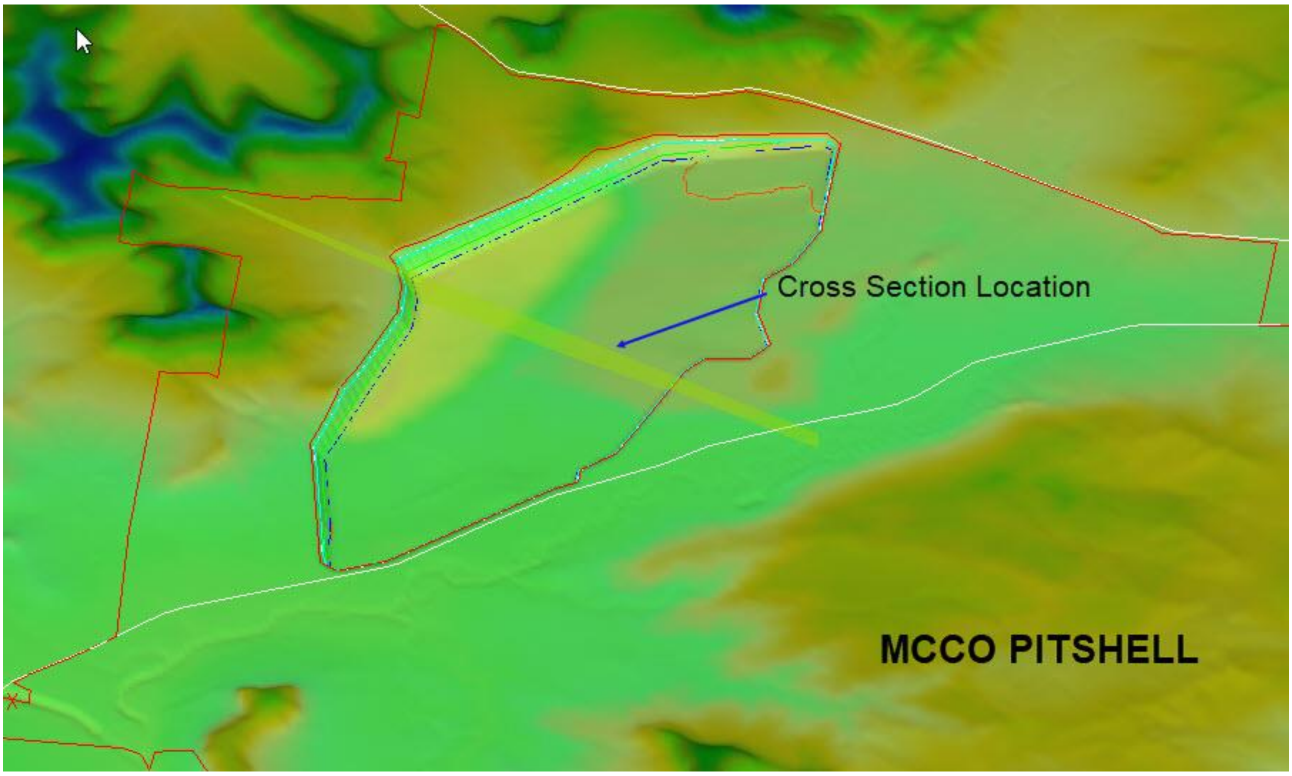
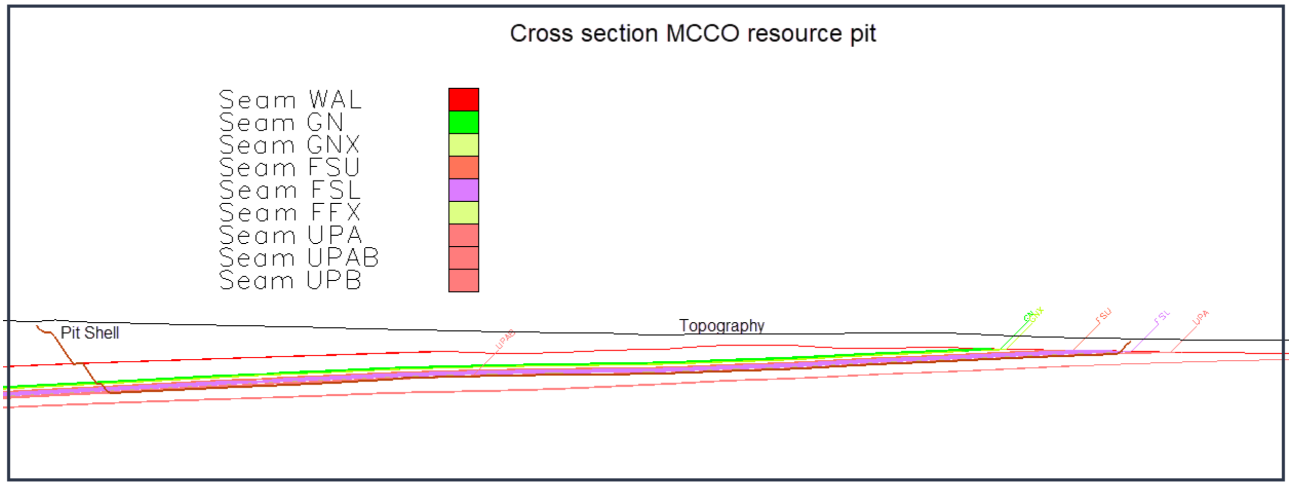


Figure 7.2 – Cross Section of Grid Model



7.2 MCCO Resources – Emplacement Calculations

The total volume available between the proposed conceptual final surface and the topography combined with the pit shell shows that 57Mlcm of waste will need to be transported away from the MCCO Additional Mining Area (to the existing mine) for a balance of waste to the proposed MCCO final landform surface.

A swell factor is applied to convert material from Bank Cubic Metres (bcm) to Loose Cubic Metres (lcm) in recognition of the volume increase of the material due to voids (air pockets) added to the material post excavation. The historically measured swell factor of 17% is applied to resource waste volumes for calculation of emplacement volumes shown in Table 7.2.

As stated in the Mine Plan Options Report, the MCCO Project includes the haulage of approximately 50Mbcm from the MCCO Additional Mining Area for emplacement in the existing approved mining area (see Figure 5.1). With consideration of swell, (17%) the 57.9Mlcm quoted in this report aligns closely with the volume stated in the MCCO report within acceptable tolerances for volumetric variation.

Table 7.2 – Total Emplacement volume MCCOP

Volume	Units	Description
158.3	Mlcm	Volume available to dump from proposed final landform to MCCO pit floor/topography
184.8	Mbcm	Volume of waste generated from North pit.
216.2	Mlcm	Swelled volume (assume 17%)
57.9	Mlcm	Volumetric difference required to be stored in existing mine (West/South pits)

Figure 7.3 – MCCO Emplacement Area

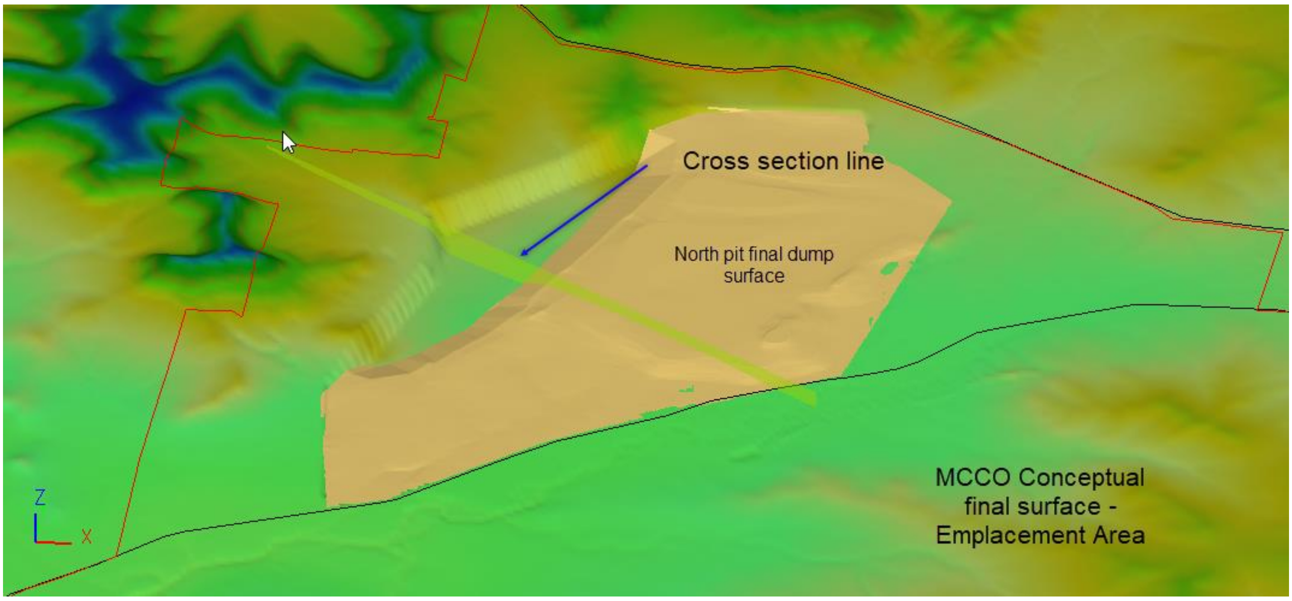
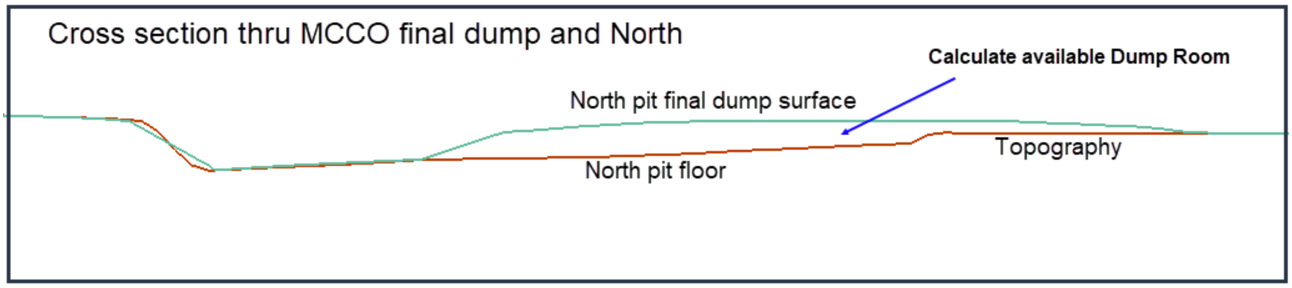


Figure 7.4 – Cross section of Emplacement Area



7.3 Mangoola Open Cut – Emplacement room to Proposed Final Landform

An exercise was undertaken to calculate the volume available for waste emplacement in the existing Mangoola mining operation. The upper surface used was the conceptual final land form supplied by the Proponent and used in the EIS. For this assessment the basal surface was developed as a composite of the sites current surveyed topography at the 4th October 2019, combined with the LOM pit shell.

Insitu Resources were calculated using the supplied surfaces and are summarised in Table 7.3. It is noted that the coal identified in Table 7.3 forms part of the existing approved operation and is not 'additional' coal as proposed by the MCCO Project.

Table 7.3 – Mangoola Open Cut – Resource Calculation

Seam	Waste (Mbcm)	Coal (Mt)
WAL	64.7	1.6
GN	61.9	14.4
3	0.1	3.3
FA	14.0	4.2
FB	7.8	2.0
FSL	0.3	21.5
FFX	0.0	2.7
UPA	4.3	6.0
UPAB	0.3	1.1
UPB	5.7	3.3
TOTAL	**159.3**	**60.2**

The results are summarised in Table 7.4 and show an excess capacity of 5.1Mlcm being available. This confirms Mangoola have enough room to accommodate the spoils from the active pit areas and achieve the landform objectives stated in the EIS for Case3 associated with the existing approved mining area.

Table 7.4 – Existing Approved Mining Area (West/South Pits) - Total Emplacement Volume

Volume	Units	Description
249.4	Mlcm	Volume available for emplacement in existing Main pit area
159.3	Mbcm	Waste Volume remaining to mine in existing Main pit (approved operations)
186.4	Mlcm	Volume remaining to mine Main Pit swell 17%
63.0	Mlcm	Surplus volume using Main pit waste only
57.9	Mlcm	Volume to be brought back into existing Main pit from MCCO pit
5.1	Mlcm	Volume residual

The 5.1Mlcm (4.4Mbcm) difference on a total basis represents approximately 1.3% of the total material movement over the life of the project, (September 2019 – 2030) and is considered by Xenith to be within the margin of error for surface based volumetric calculations over the whole mine.

The detailed LOM schedule and volumetric assessment considered in this report has included a period based volumetric balance and shows small surplus of material (3.5Mbcm) in the northern operation, with no excess capacity in the West/South pits at the cessation of operations. These volumes effectively balance within the acceptable margins of error. It is anticipated additional future design work around the conceptual final landform will provide an opportunity for the adjustment of these small volumetric imbalances.

Figure 7.5 and Figure 7.6 show the supplied surfaces used in the mass balance calculation.

Figure 7.5 – Basal Surface for Existing Pit Emplacement Calculation

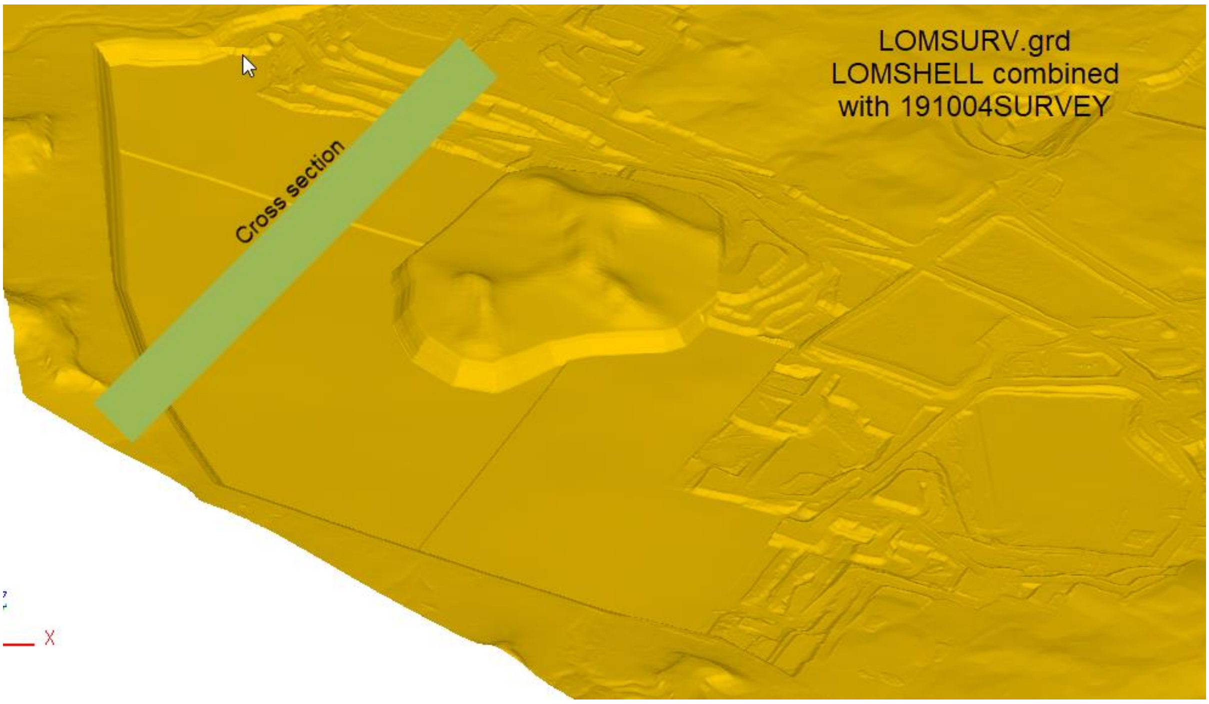


Figure 7.6 – Top Surface for Existing Pit Emplacement Calculation

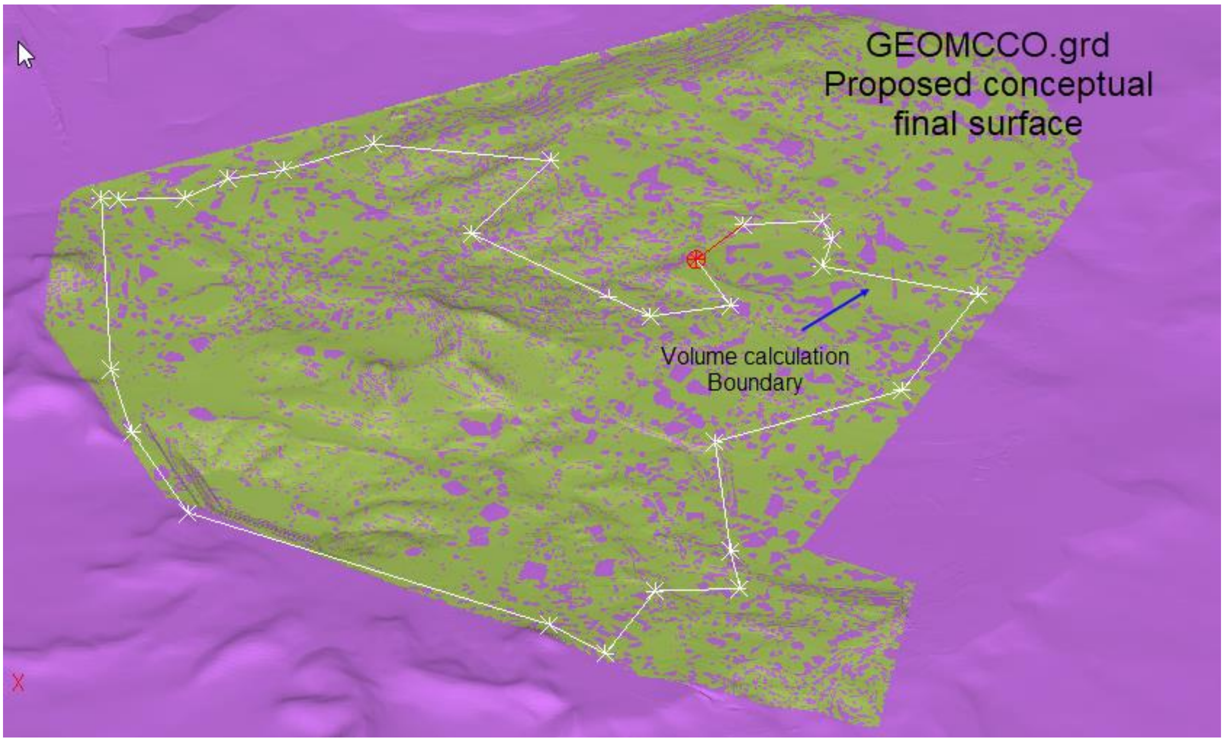
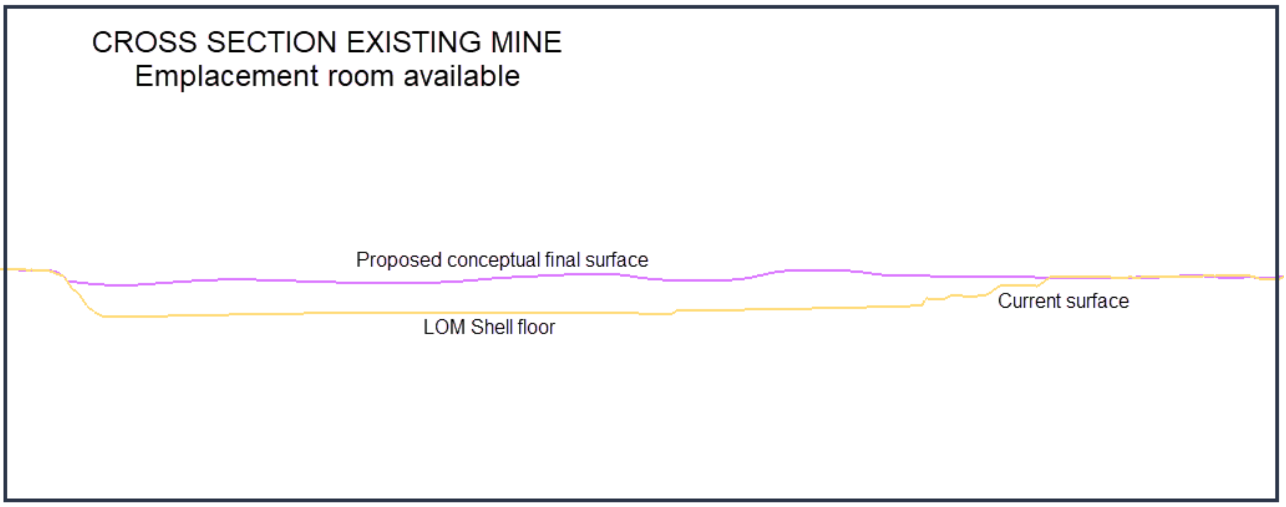


Figure 7.7 shows a cross section through the landforms.

Figure 7.7 – Cross Section Existing Mine Showing Emplacement Area



8 ANNUAL VOLUME BALANCE

Stage plans and spreadsheet calculations used in the EIS were supplied by Mangoola Coal, for each year from 1st Jan 2023, (noting that this date was an arbitrary start date for mine planning purposes) and examined for volume balance between the supplied surfaces. Xenith was not supplied surfaces prior to the 1st Jan 2023 making reconciliation with the present surface difficult. Overall the staging volumes appear correct and balanced for Case 3 in the EIS when considered from 1st January 2023.

9 MCCO PIT SEQUENCING CONSIDERATIONS

Xenith has confirmed the MCCO spoils balance over the life of the MCCO Project with enough spoil room available in the main pit and the MCCO dump designs, with a small residual volume of 3.5Mbcm at the end of the mine life indicating that the EIS landform is achievable with surplus material available for use to further improve the conceptual final landform. This residual volume represents 1.0% of the total overburden movement over the LOM and is considered within acceptable margins of error for the calculation of spoil balances, given the propensity for material to exhibit some swell variation over time.

Table 9.1 summarises the MCCO material emplacement volumes over time.

Table 9.1 – MCCO Annual volumetric Balance

Year	Prime Quantity (Mbcm)	Dumped Quantity (Mbcm)	Percentage Dumped
2022	0.9	0.9	100.0%
2023	18.5	18.5	100.0%
2024	23.3	23.3	100.0%
2025	23.3	23.3	100.0%
2026	25.0	25.0	100.0%
2027	25.3	25.3	100.0%
2028	25.1	25.1	100.0%
2029	25.5	25.5	100.0%
2030	17.8	14.3	80.3%
Final Landform		3.5	100%
Total	**184.8**	**184.8**	**100%**

10 MCCO HAULAGE REQUIREMENT ANALYSIS

10.1 Haulage Requirements

Xenith undertook a high level haulage assessment to understand the additonal trucking requirement to move material from the MCCO Additional Mining Area back to the Approved Project Area void for final emplacement, using the 1712 mining schedule supplied by site. MCCO mining operations currently commence in October 2022. Xenith has focused the analysis on the larger 230t payload class of trucks employed by Mangoola (Cat793s), primarily employed in overburden movement and emplacement. Haulage fleet calculations have been based on an average of 5270 truck operating hours per annum, this figure being supplied by site.

Mangoola currently operates a fleet of sixteen (16) Cat 793 trucks and eleven (11) Cat789 units. Figure 10.1 through Figure 10.2 show the total Cat793 truck fleet size and average haulage cycle times over the LOM. Peak truck demand climbs to twenty (20) Cat793 trucks in 2024, however haulage optimisation work is expected to keep the maximum truck fleet size around 20 trucks by smoothing out the truck demand over time. Steady state inpit dumping in the MCCO Additional Mining Area occurs late in 2027. The retirement of two excavators, as proposed by Mangoola, reduces the size of the truck fleet requirement.

It is anticipated the average additional truck fleet requirement will be four Cat793 trucks through the years 2023 – 2025, however there is potential for some of the Cat789 fleet on coal & partings to be able to assist with overburden haulage if latent capacity exists.

Xentih recommends further refinment of the haulage requirements over time with a view to optimising material handling and placement and minimising the operating requirements and hire duration for the additional trucks. There exists the potential for significant cost reduction if pit sequencing can reduce both the rehandle requirements, minimise truck cycle times and the duration for the additional truck fleet.

Figure 10.1 – Total Cat 793 Fleet Requirements showing current fleet (16)

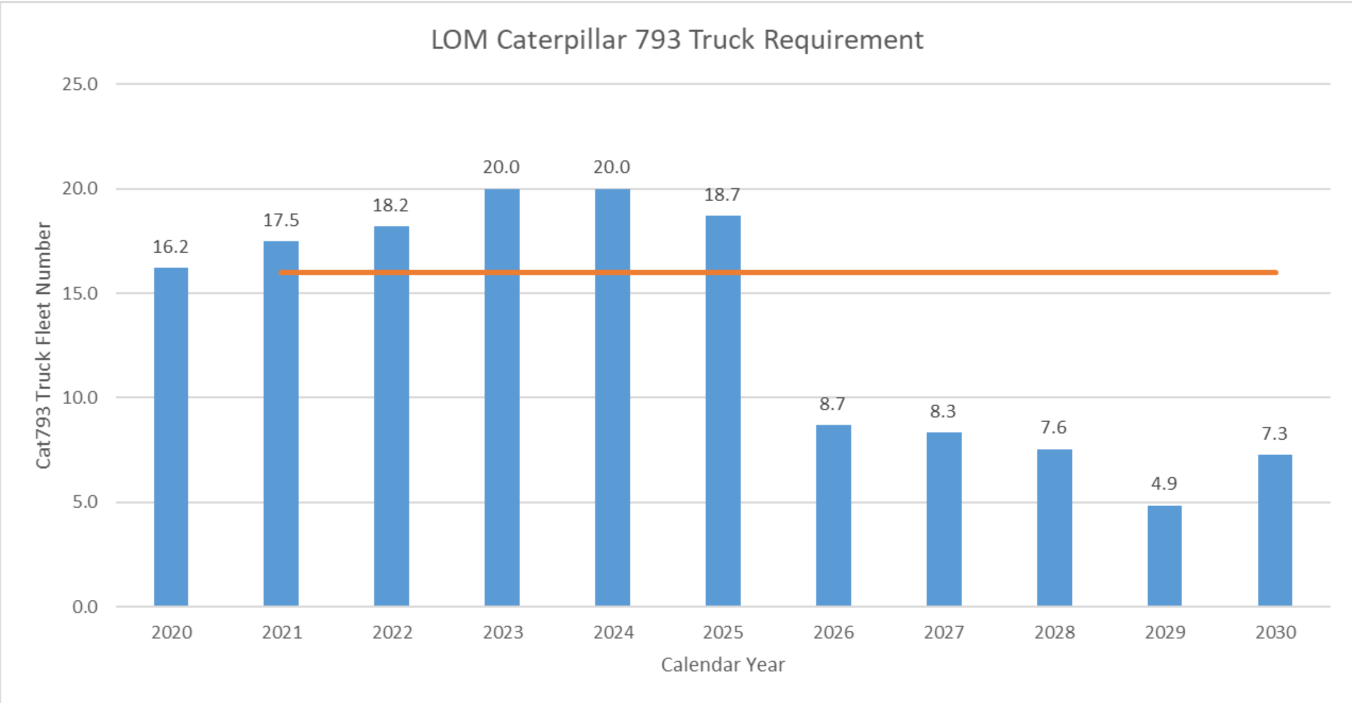
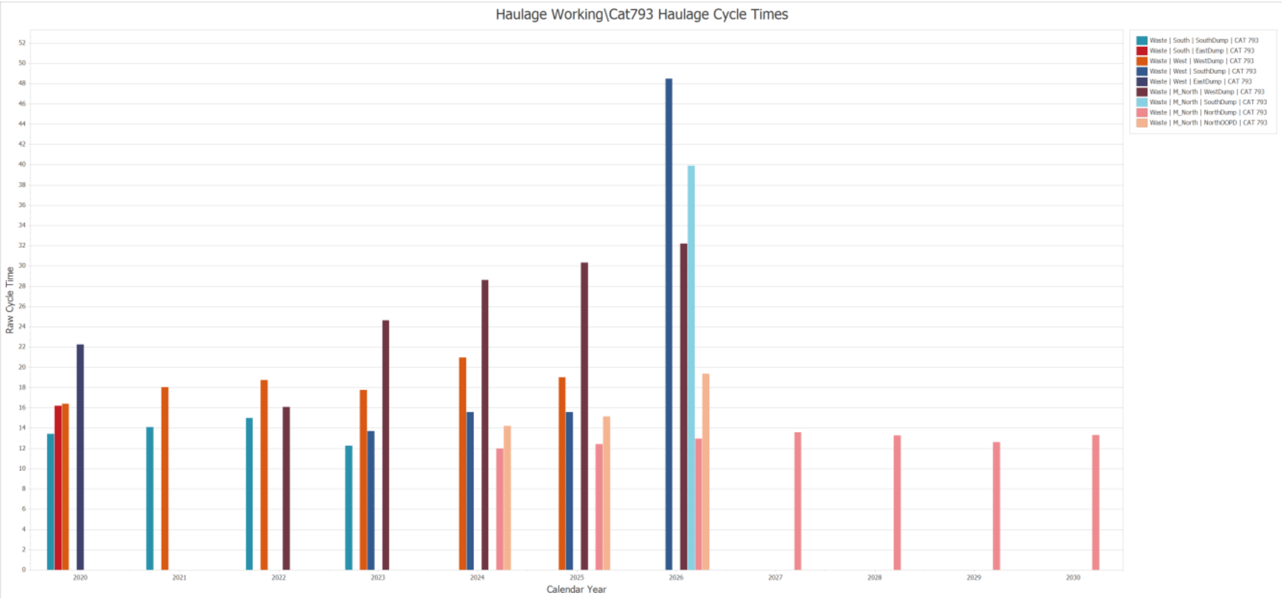


Figure 10.2 – Cat 793 Haulage Cycle Times



10.2 Coal Reject Allowance

Xenith understands the 17% swell factor used for the EIS includes the provision for reject emplacement in the overburden dumps. Mangoola differs from other Hunter Valley operations regarding the higher proportion of coarse spiral sands, separated during coal washing, that are sent to tailing dams rather than the overburden dumps. Xenith considers sufficient allowances have been made in the development of the landform surfaces to accommodate the coarse rejects. All reject haulage is considered to be undertaken by the Cat789 truck fleet and has not been considered in this report.

11 REHABILITATION – FINAL SURFACE AUDIT

11.1 Final Landform – Slopes and Voids

Xenith has examined the final landforms proposed by Mangoola, for both pit areas, and considered how the final void slopes will be backfilled, highwalls blasted and revegetated. Xenith has also investigated whether the final landforms will be geotechnically stable, non-polluting and minimise the areas of unusable land post mine closure.

The current out of pit dump (OOPD) is designed for a storage volume of 8.4Mlcm with a final slope angle of 10 degrees or less. The proximity of Big flat creek directly to the south of this dump has necessitated a standoff from the OOPD toe

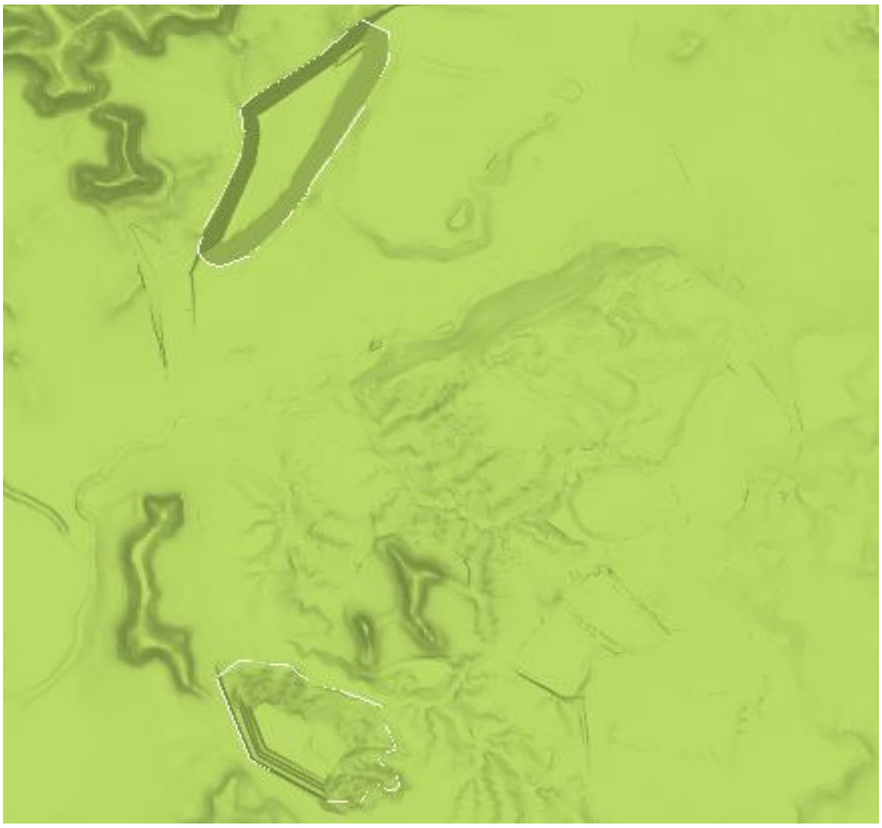
The outer slopes of the MCCO overburden emplacement are also 10degrees or less. The EIS states all exterior MCCO final landform slopes will be 10 degrees or less and overburden emplacements shall not exceed 240mAHD. Xenith has confirmed these design criteria have been adhered to in the go forward case proposed in the EIS. Xenith notes in the EIS (Page 349), Mangoola's intention to examine the potential to implement a natural landform design for MCCO area, similar to what is proposed in the EIS for the main Mangoola open cut under the Case 3 option. Mangoola Coal has a good track record for committing to, and completing the post mining natural landforms, giving a degree of confidence the MCCO work will be undertaken.

Xenith has calculated the overall plan area for the final void for the MCCO additional mining area is approximately 121ha and for the existing Approved Project Area as 100Ha based on the supplied final landform. This differs from the areas quoted in the EIS of 82 ha and 48 ha respectively. Figure 11.1 shows the polygonal limits used for the final void area calculations.

The Mine Plan Options Report defines the 'final void' to be "*the area within the crest of the final highwall circumnavigating the predicted long-term water recovery level of the pit lake and excluding the low wall/end walls. The low walls/end walls have been excluded from the definition of a final void due to the reduced slopes compared to mining conditions, combined with the ability for rehabilitation opportunities as described within the report. It is important to note that not all areas defined as a final void render the land unusable and further, final voids may have future value beyond the scope of this report*."

Based on the definition in the Mine Plan Options Report the void areas were determined to be commensurate with the Mangoola plans.

Figure 11.1 – Final Void Area Calculations



The following two slides show the proposed and existing landform slopes colour shaded in final slope degrees, as per the legend in Figure 11.2 . The proposed MCCO project surface is only slightly steeper in small areas when compared with the original topography as shown in Figure 11.3.

Figure 11.2 – Proposed Final Conceptual Landform Slopes

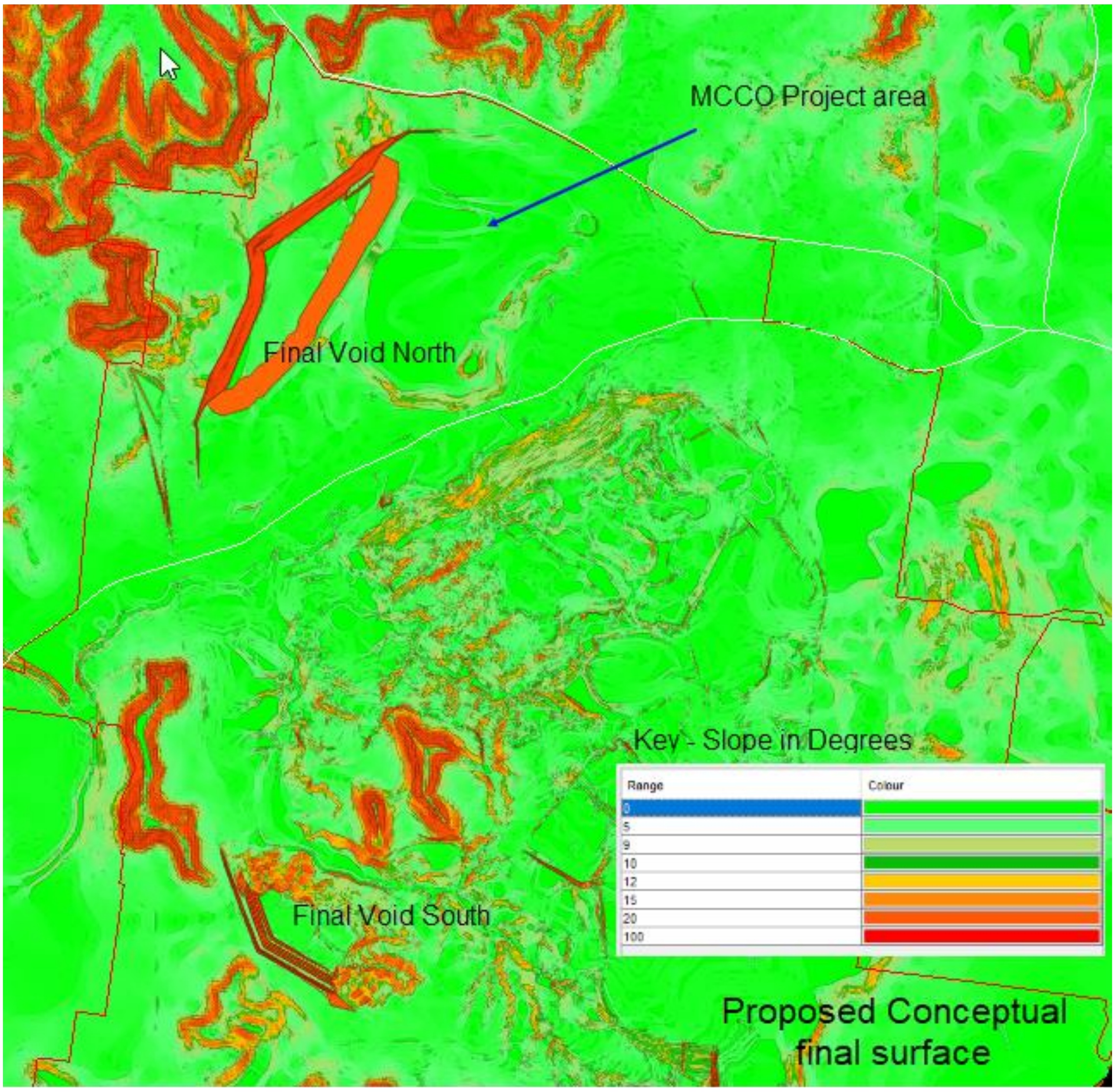
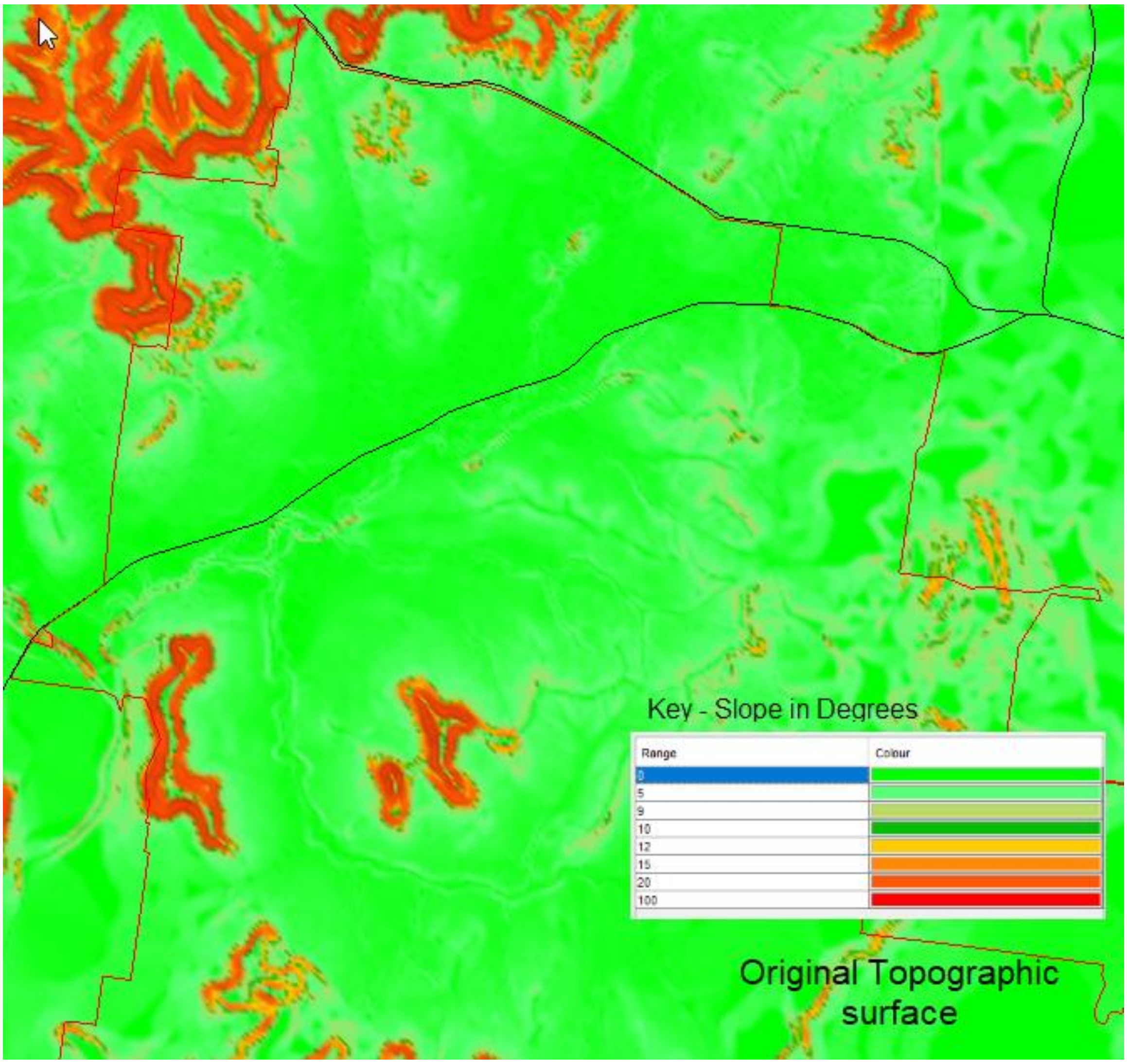


Figure 11.3 – Existing topographic Surface



Some areas of the Approved Project Area are steeper than 10degrees, these steeper areas occur on both the low-wall (natural surface) and the final highwall. Overall, the Approved Project Area and the MCCO Additional Mining Area landforms have been designed to incorporate natural micro-relief and natural drainage lines. Xenith understand the final highwall, in both pits, may be selectively blasted down to an appropriate overall angle and buttressed by the emplacement of spoils, adjacent to the final highwall, subject to future detailed geotechnical assessments. Xenith examined the widths of emplaced buttress material to allow haul trucks access and is of the opinion the work is practically achievable.

It is predicted that both the Approved Project Area and the MCCO Additional Mining Area voids will partially fill with water over time and the benefits of natural landform development, which is presented for the whole low-wall to the pit floor, may not be forthcoming. Future work should potentially consider the expected water recovery level and focus on the stability of natural landform above this level as part of the ongoing life of mine planning and mine closure plans.

Xenith considers the post mining landforms for both the Approved Project Area and the MCCO Additional Mining Area to provide the best outcome in terms of visual amenity. Keeping all the spoils generated by the MCCO Project within the confines of the MCCO Additional Project Area would result in final dump elevations greater than 190mAHD, approximately 10-15m higher in places than the proposed landform. The proposed conceptual final landform in the MCCO Additional Mining Area is approximately up to 30m higher than the surrounding original landform which would generally be considered quite a low final dump height by Hunter Valley standards.

11.2 MCCO - Post Mining Drainage

Xenith has examined the proposed pre mining and post mining drainage lines and considers the designs appropriate and achievable. Figure 11.4 show the existing drainage lines prior to mining. Figure 11.5 shows the post mining landform drainage lines.

Figure 11.4 – Existing Drainage Lines

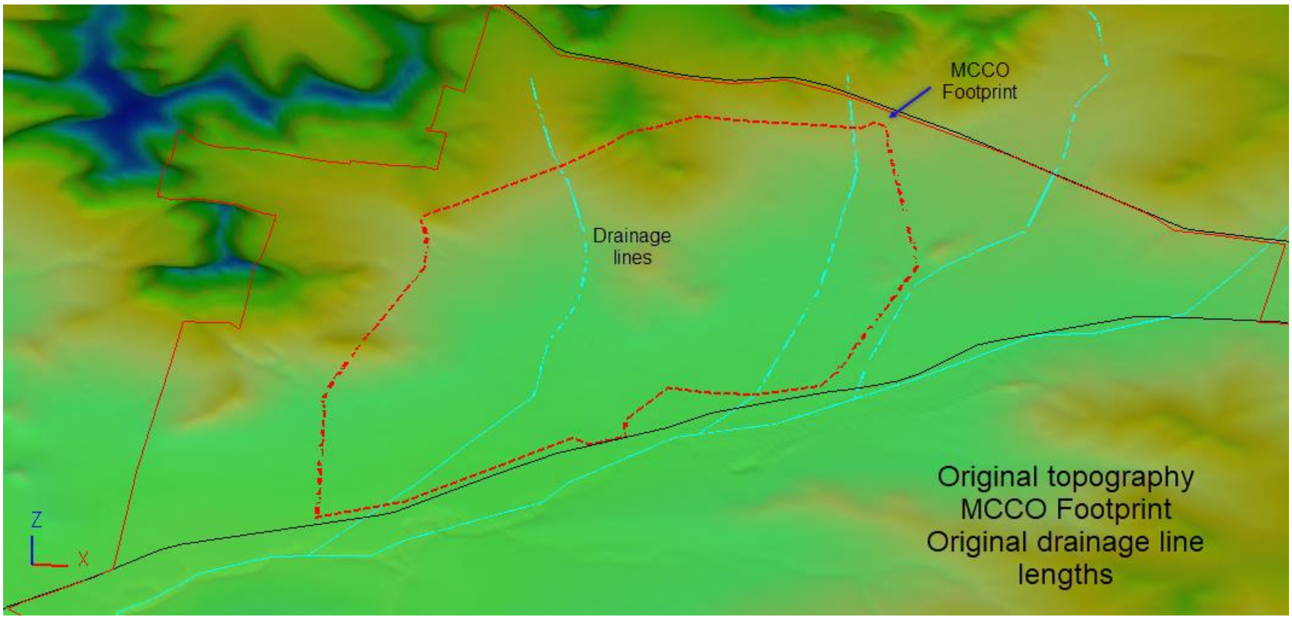
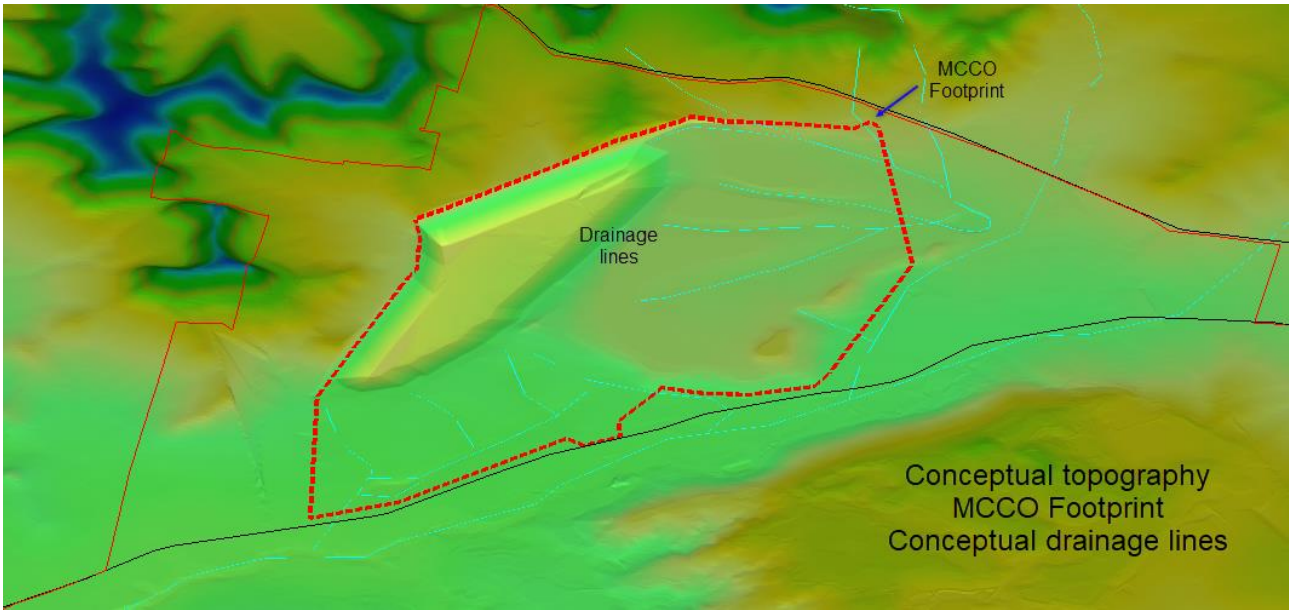


Figure 11.5 – Proposed Drainage Lines



11.3 MCCO Drainage density

Xenith has examined the drainage density for the proposed landform. Low maintenance post mining landforms are considered to have low drainage density resulting in more manageable erosion profiles over time. The drainage density is an arbitrary ratio determined by the division of the total of the drain line lengths (m) by the total catchment area in (ha), the output being the average catchment per unit area of channel.

The proposed conceptual final landform is well aligned to the original surface for in terms of drainage density as summarised in Table 11.1.

Table 11.1 – Drainage Density Calculation

	(ha)	(m)
MCCO Footprint area	485.4	
Original creek lengths		2,780
		2,039
Total drainage line length		4,819
Original Drainage Density Ratio		**9.9**
Proposed Post Mining creek lengths		625
		315
		1,350
		927
		750
		740
		192
Total drainage line length		4,899
Proposed Drainage Density		**10.1**

For a post mining landform to be at a low risk of surface erosion and excessive siltation of drainage channels and waterways over time, the final surface needs to adhere to certain slope design profiles. The preferred slope profile to minimise erosional degradation is shown in Figure 11.6.

Figure 11.6 – Typical Slope Profiles (Hannan, 1995)

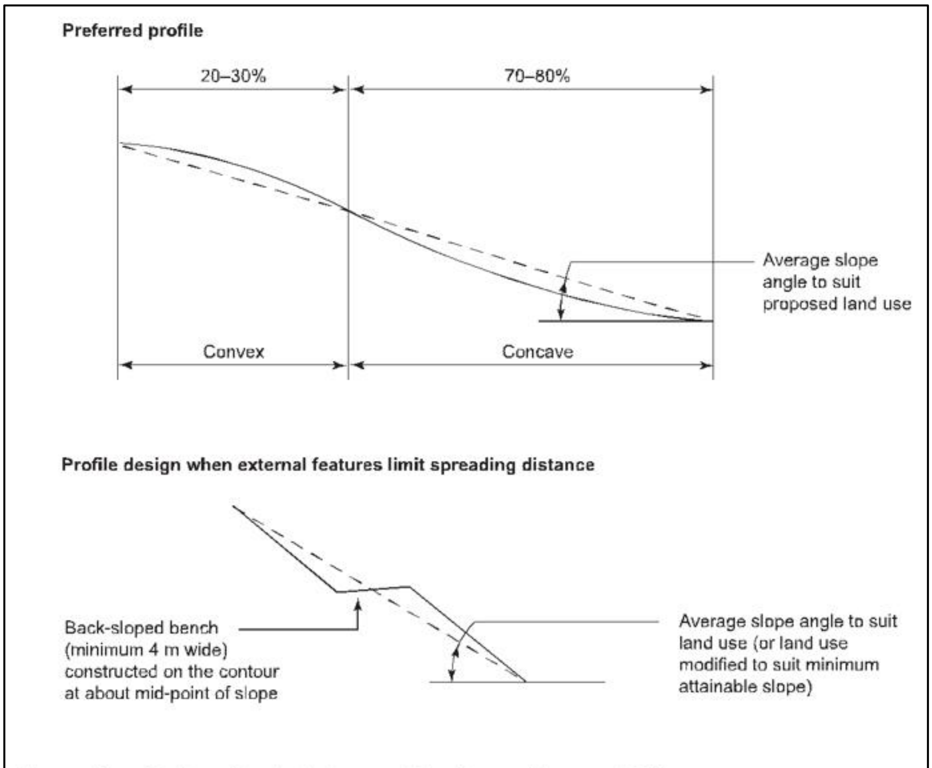
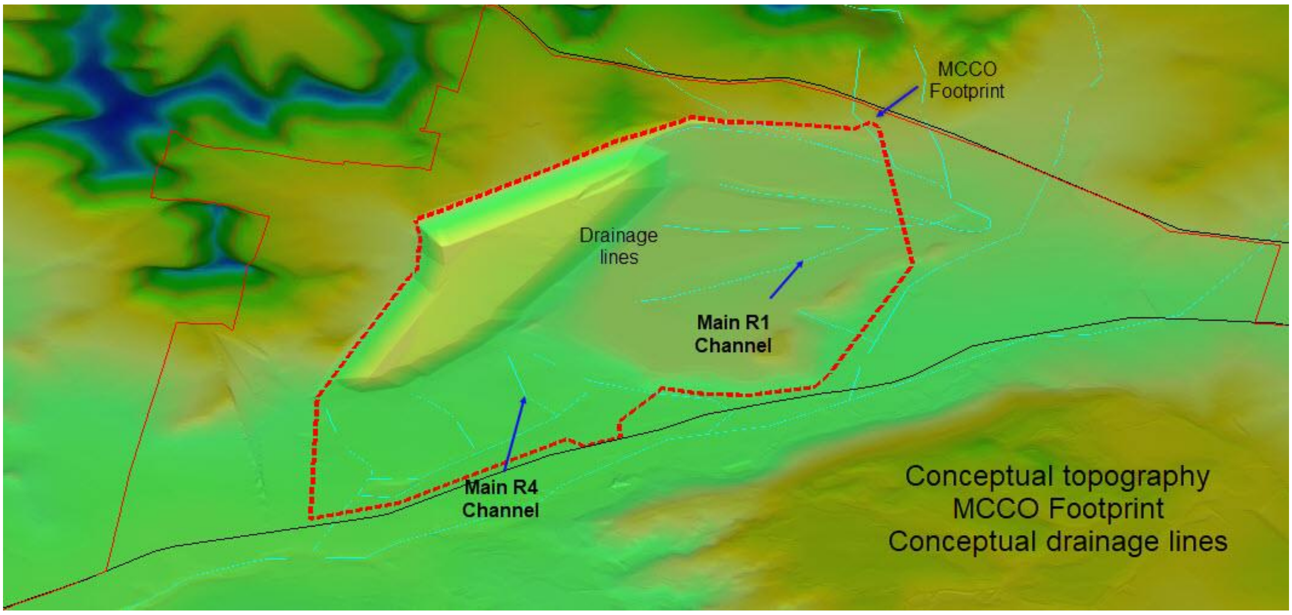


Figure 4.2 Design of typical slope profiles (Source: Hannan 1995)

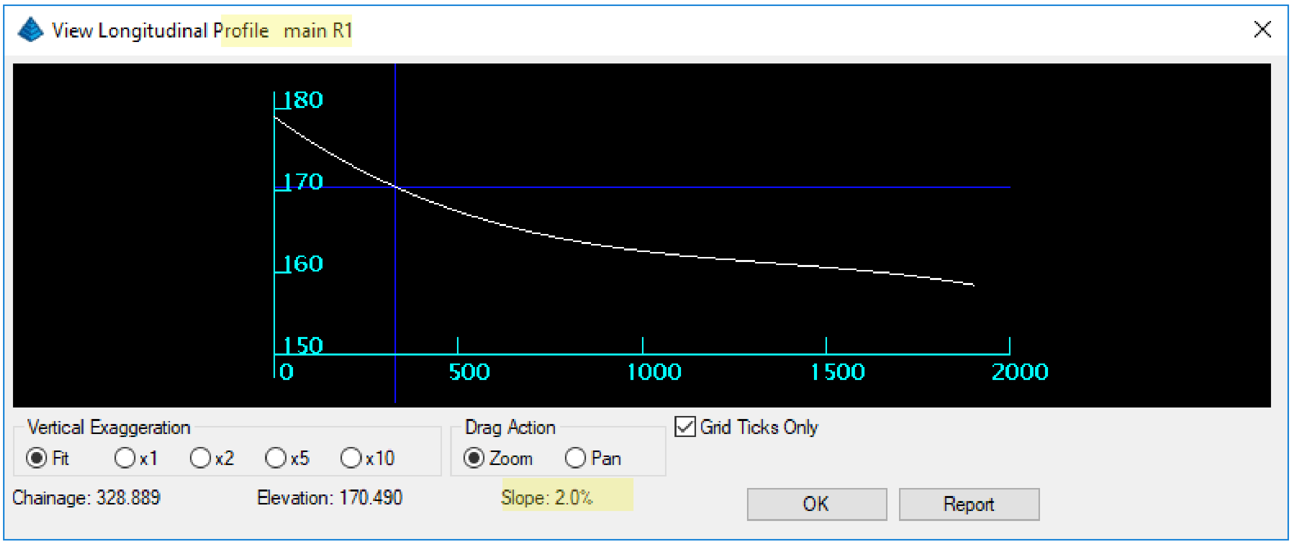
Xenith has attempted to assess the slope compliance of the drainage lines, to these design principles, by examining the profiles of the main drainage channels proposed in the final landform as shown in Figure 11.7.

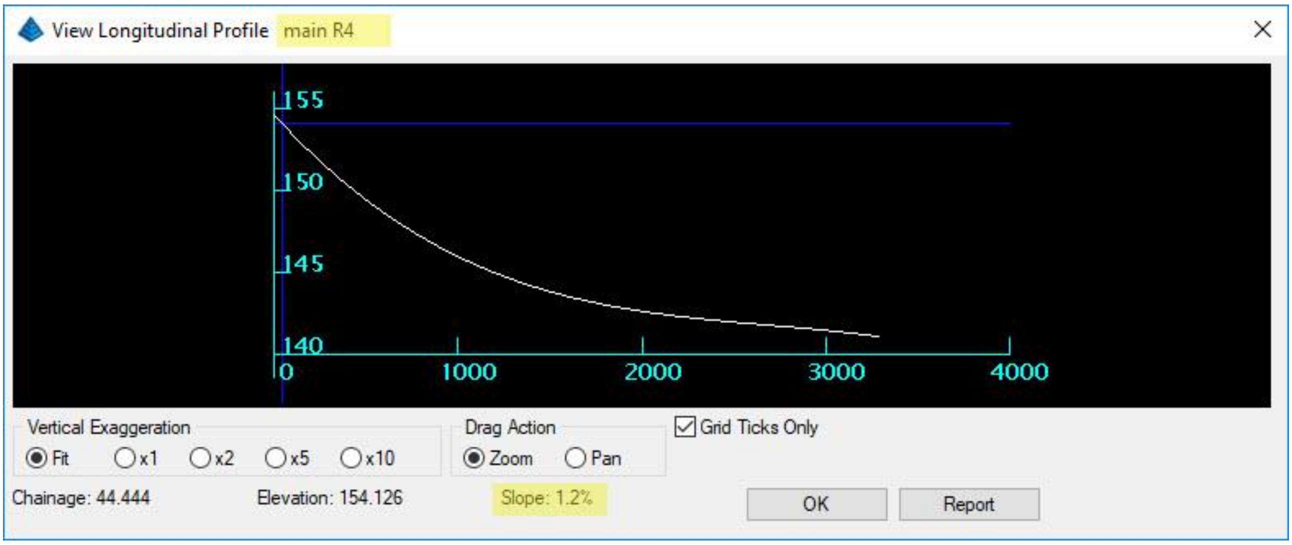
Figure 11.7 – Drainage Channel Plan of Proposed MCCO surface



The following figures present the slope results for two drainage areas examined, name the Main R1 channel and the Main R4 channel. Note: the scale is exaggerated to fit the section. These results confirm the slopes adhere to the concave profile that is inherently more stable from an erosional perspective.

Figure 11.8 – Slope Compliance Measured from Proposed MCCOP Surface





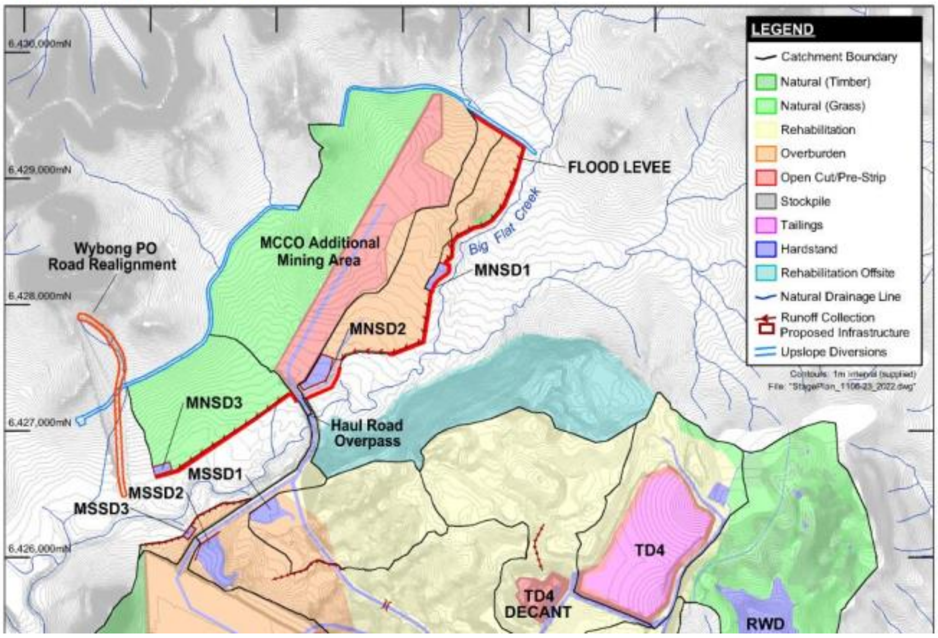
Xenith notes various catchment and water control dams; levee banks have also been proposed in the final landform to separate a variety of water types. Appendix 11 Surface Water Assessment EIS is reproduced below in Figure 11.9 showing the location of the dams.

Xenith can confirm the location of the water control dams relative to the MCCO final landform surface contours and the location of the proposed drainage lines is suitable and should be sufficient to control dirty water egress into Big Flat Creek and surrounding waterways. A detailed groundwater/surface water study was not undertaken by Xenith with the expert's opinion being based on site experience of similar structures.

Figure 11.9 – Extract Appendix 11 -Stage Water Management Plan

3.2.1.1 Year 1

Figure 16 shows the Year 1 contours along with derived total catchment area and sub-catchment area delineation[18] for each storage.



12 CONCLUSION AND RECOMENDATIONS

The conceptual final landform presented in the Mine Plan Options Report and the go forward case for the EIS is considered to be the best option of the 6 cases considered in this report. The final landform presented honours the constraints provided by the Proponent, achieves a volumetric balance over the LOM and presents an appropriate balance of mine planning and economic considerations.

Xenith notes to the commitment in time and cost Mangoola Coal has made to rehandling significant quantities of spoil at the completion of each mining area, in order to achieve improved rehabilitation outcomes and post mining land uses. Mangoola Coal has a strong track record regarding rehabilitation having successfully rehabilitated 532ha (to the end of 2018) of disturbed land within the limits of the approved Mangoola Coal mine disturbance area, with most of the landforms adhering to natural surface principles and demonstrating excellent stability over time.

Xenith has examined the overall Volumetric balance between the mining operations and confirmed all the proposed swollen spoil emplacement fits within the supplied EIS final landform envelopes within acceptable tolerances.

Future LOM mine schedules developed by Mangoola could release additional floor room for the creation of opportunities around more progressive in pit material placement. It is expected an improved schedule sequence in the last strips of the MCCO project would provide Mangoola an opportunity to reduce haulage requirements, spoil rehandling activities and associated costs.

As a result of the investigations in this report, Xenith is of the opinion the proposed conceptual final landform for the MCCO Project, as presented in the EIS, conforms with the objectives of delivering a safe, non-polluting, low maintenance, low risk of erosion surface. Xenith also considers the final (natural surface) landform for the MCCO area to be well suited to reestablishment of native vegetation, in line with the principles currently applied at Mangoola.

APPENDIX A. SUPPLIED REPORTS

Supplied Reports

- PEA Final
- Appendix 2 Mine Plan Options Report
- Appendix 11 Surface Water Assessment
- Appendix 12 Groundwater Impact Assessment
- Application_20190705035428
- Mangoola Coal Continued Operations Project EIS

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APPENDIX 8
Photo Montages

FIGURE 1

Rendered Photomontage from Visual Assessment Location 2

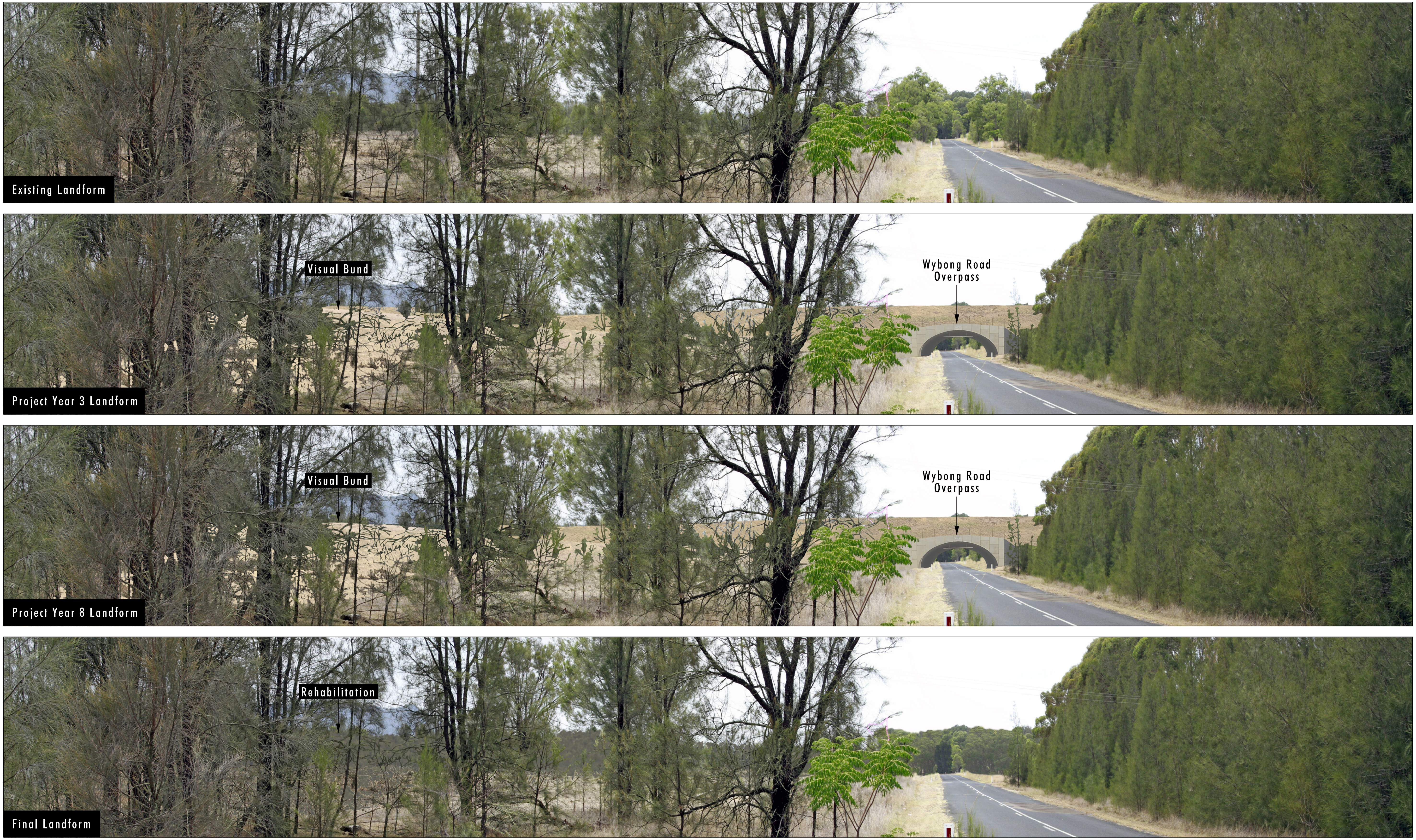

FIGURE 2

Rendered Photomontage from Visual Assessment Location 4

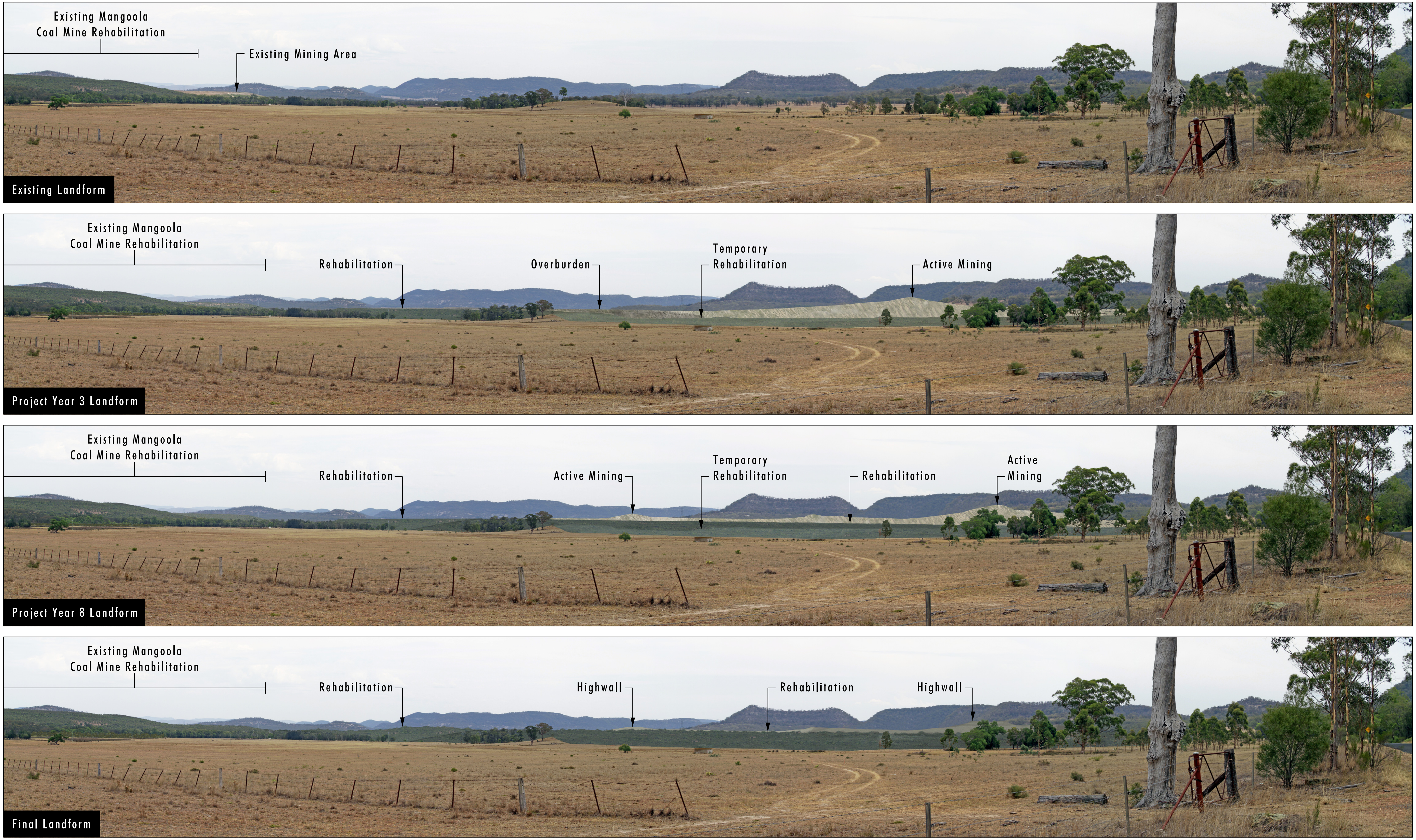

FIGURE 3

Rendered Photomontage from
Visual Assessment Location 9

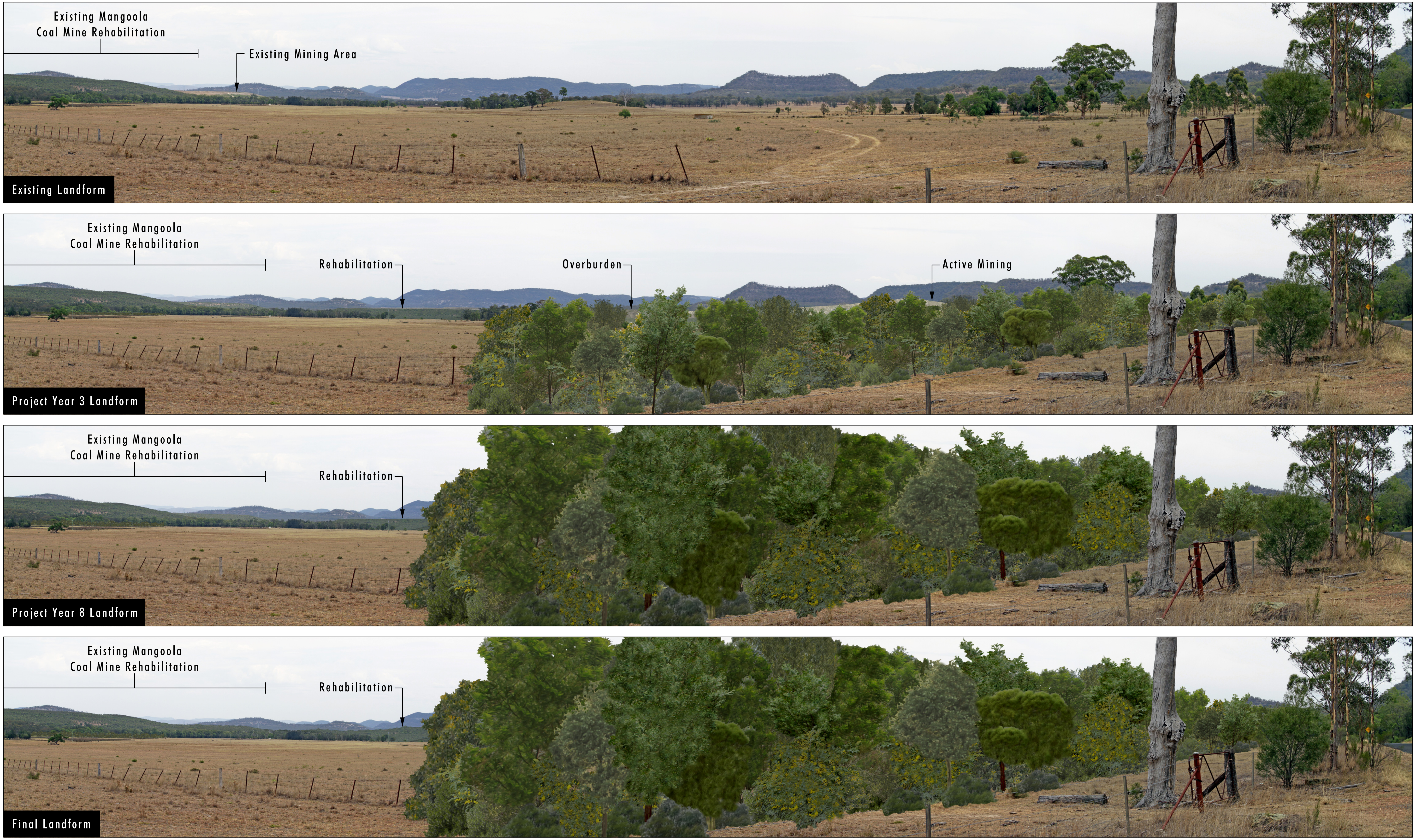

FIGURE 4

Rendered Photomontage from Visual Assessment Location 9 with Tree Screen

APPENDIX 9

Additional Analysis Traffic Report

Memorandum

15 November 2019

To	Umwelt (Australia) Pty Ltd		
Copy to	Daniel Sullivan		
From	Mark Lucas	Tel	+61 2 9239 7141
Subject	Mangoola Coal Continued Operation Project Additional Traffic Analysis	Job no.	2219171

1 Introduction

In April 2019, GHD prepared the *Mangoola Coal Continued Operation Project (MCCO) Traffic and Transport Impact Assessment* (TTIA).

The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The MCCO Project will extend the life of the existing operation, providing for ongoing employment opportunities for the Mangoola workforce.

The MCCO Project is declared a State Significant Development as defined under the provisions of the NSW State Environmental Planning Policy (State and Regional Development) 2011.

The Department of Planning, Industry and Environment issued the Secretary's Environmental Assessment Requirements (SEARs) for the MCCO Project on 15 February 2019. With regard to traffic and transport, the SEARs included the following input from Roads and Maritime Services (Roads and Maritime):

Consideration of the traffic impacts on existing and proposed intersections, in particular, the intersections of the ***Wybong Road / Denman Road and Wybong Road / Golden Highway****, and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generated by the proposed development during both the construction and operational stages.*

To address the SEARs, traffic surveys and SIDRA analysis was completed as part of the TTIA for the following intersections.

- Golden Highway / Wybong Road.
- Wybong Road / the Mangoola Coal Mine Access Road.
- Denman Road / Bengalla Road.
- Denman Road / Thomas Mitchell Drive.

The analysis undertaken in the TTIA indicated that the intersections of interest are expected to operate with a good level of service through to the 2022 horizon year accounting for the vehicle activity associated with the construction of the MCCO Project.

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No change is proposed to the currently approved maximum rate of production (13.5 Mtpa) or the existing approved operational employee numbers and as such, no changes to operational traffic volumes are expected above those that have previously been assessed and approved.

Roads and Maritime reviewed the TTIA and made the following comment in their submission on the MCCO Project EIS issued on the 24th September 2019:

The intersection of New England Highway / Denman Road (Sydney Street) has not been included in this assessment. The assessment states that workers travelling to the site from Muswellbrook would access the site via Bengalla Road or Kyuga Road, and workers from Singleton would use Thomas Mitchell Drive. No traffic, including heavy vehicles, have been distributed through the intersection of New England Highway / Denman Road (Sydney Street). Justification for omitting this intersection from the assessment is requested.

The TTIA as completed for the MCCO Project EIS included an assessment of the intersections that Roads and Maritime requested in the SEARs (i.e. Wybong Road / Denman Road and Wybong Road / Golden Highway) and also considered Denman Road / Thomas Mitchell Drive and Wybong Road and the mine access road, exceeding the SEARs requirements.

However, to address this comment, additional surveys and analysis for the intersection of New England Highway and Sydney Street (a continuation north of Denman Road) have been completed with a summary of the analysis outlined in this memo.

2 Existing road network characteristics

2.1 New England Highway

The New England Highway is an arterial road that forms part of an inland route between Brisbane and Sydney. Within Muswellbrook, it typically provides two travel lanes in either direction, with a 50 km/h speed limit.

The New England Highway intersects Sydney Street at a signalised junction.

2.2 Sydney Street

Sydney Street functions as a sub-arterial road connecting to Denman Road and Bridge Street at Muswellbrook. Sydney Street provides the connection via Denman Road to the southwest to the Golden Highway near Denman. Sydney Street is typically constructed to a rural highway standard, with single traffic lanes in each direction and additional turn lanes at key intersections.

Further to the north-east of New England Highway, Sydney Street's name changes into Bridge Street.

2.3 Traffic surveys

Weekday AM and PM peak period traffic counts were undertaken by Northern Transport Planning and Engineering at the intersection of New England Highway/Sydney Street on 7th November 2019.

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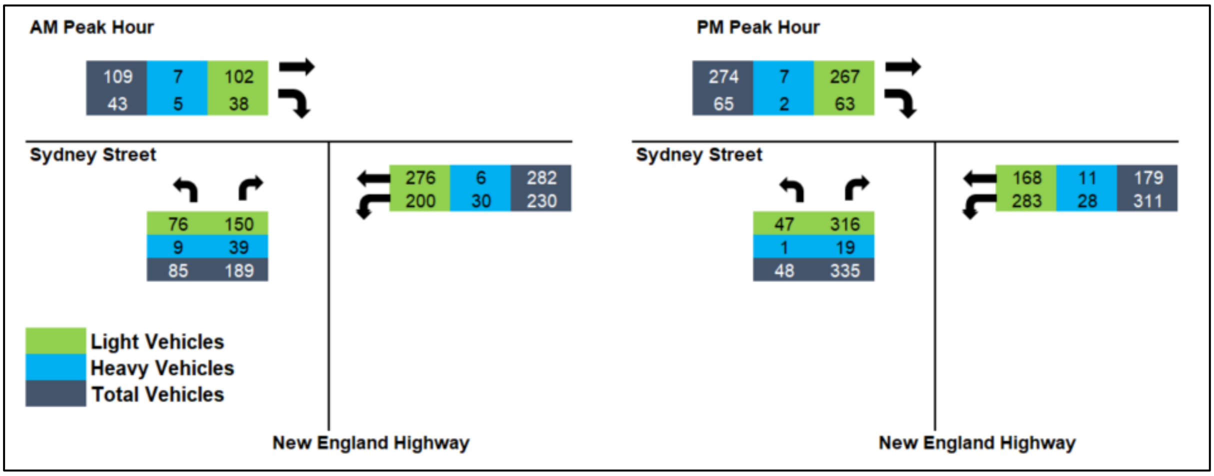
As noted in the MCCO Project EIS standard construction hours for the MCCO Project are between 7:00 am and 6:00 pm. Accordingly, the peak hours construction workers are expected to traverse the intersection of interest are:

- 6:00 am – 7:00 am
- 6:00 pm – 7:00 pm

The current traffic volumes associated with these hours of operation are displayed in Figure 2-1.

Figure 2-1 – Current peak hour traffic volumes



The traffic survey data is included in Attachment A.

2.4 Intersection Analysis

The operation of the intersection of interest has been assessed using SIDRA 8.0 Intersection modelling.

SIDRA calculates the amount of delay to vehicles travelling through the intersection model and, amongst other performance measures, outlines an expected Level of Service (LoS) rating to define the relative operation of traffic movements within the intersection.

Table 2-1 presents the criteria generally applied to LoS intersection operation. The LoS is determined from the calculated delay to traffic movements, which is a representation of driver frustration, fuel consumption and increased travel time. There are six LoS measures ranging from A (very low delay and very good operating conditions) to F (over saturation where arrival rates exceed intersection capacity). Typically, a LoS D or better is considered acceptable, however a LoS E may be acceptable if it also operates with a low degree of saturation.

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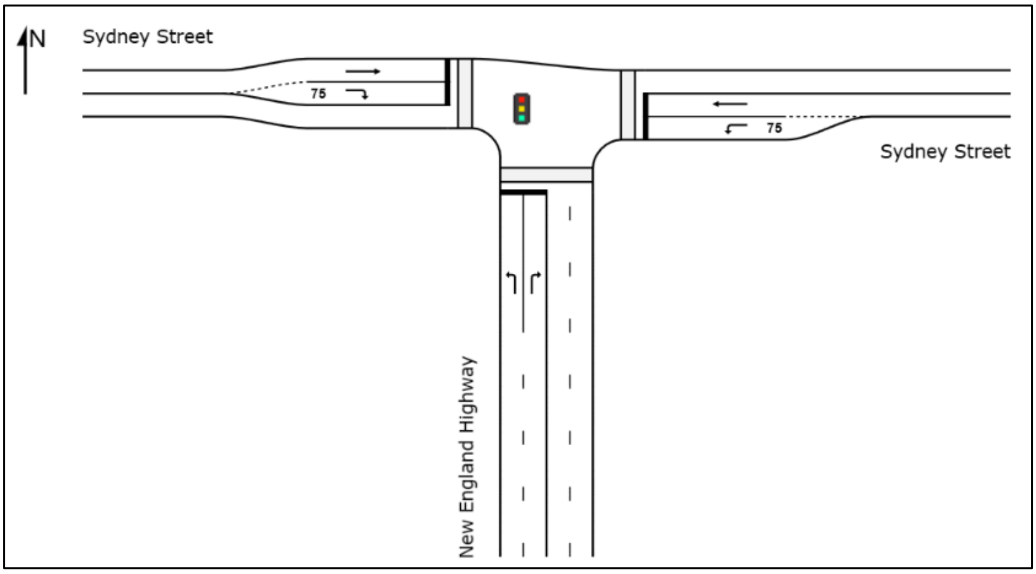
Table 2-1 – Intersection Level of Service criteria

LoS	Average Delay/ Vehicle (sec)	Traffic Signals & Roundabouts	Give-way & Stop signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	28 to 42	Satisfactory	Satisfactory, but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays; roundabout requires other control mode	At capacity; requires other control mode
F	Exceeding 70	Unsatisfactory; requires additional capacity	Unsatisfactory, requires other control mode.

The layout of the intersection of interest (as modelled in SIDRA) is displayed in Figure 2-2.

Figure 2-2 – Intersection layout



To identify signal phasing at the intersection of interest, SCATs data was obtained from Roads and Maritime. The peak hour signal phasing (identified from the SCATs data) and used in the SIDRA model is displayed in Figure 2-3.

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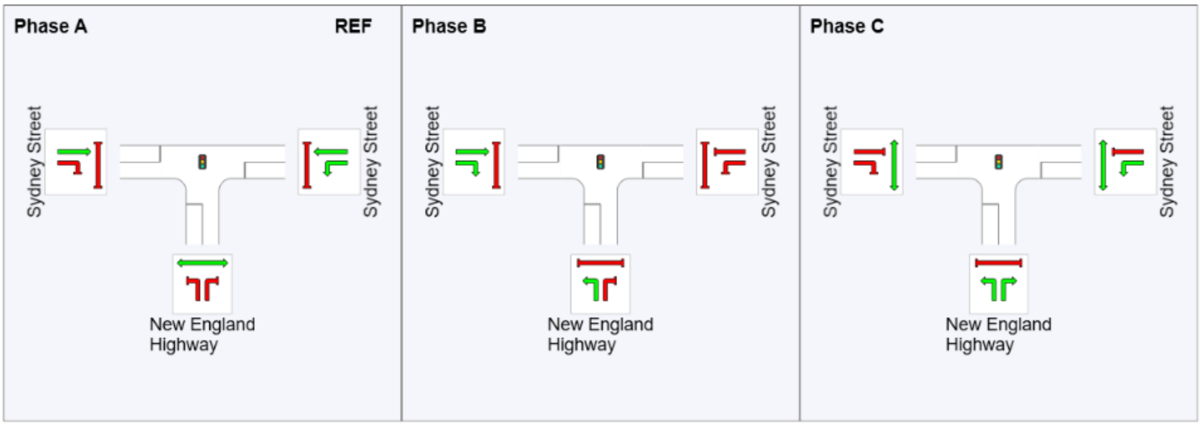
Figure 2-3 - Intersection signal phasing



The results of the SIDRA intersection modelling analysis, based on the existing traffic volumes, phasing and road geometry, are summarised in Table 2-2 with details provided in Attachment B.

Table 2-2 – Current Intersection Performance

Intersection	AM Peak			PM Peak		
	Av Delay (sec)	LOS	95th % Queue (m)	Av Delay (sec)	LOS	95th % Queue (m)
New England Highway	19.9	B	42	23.6	B	88
Sydney Street (east)	17.5	B	65	13.0	A	42
Sydney Street (west)	19.3	B	16	20.6	B	51
Overall Intersection operation	**18.5**	**B**		**18.5**	**B**	

The results in Table 2-2 indicate that the intersection of New England Highway/Sydney Street currently operates with good levels of service, at LoS B or better, during the weekday AM and PM peak periods, when construction workers are expected to traverse the intersection.

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3 Previous trip generation and distribution

Based on the information provided by Mangoola (and included in the TTIA), the MCCO Project construction workforce will peak at approximately 145 workers.

The assumed heavy vehicle activity associated with the MCCO Project is expected to generate:

- An average of up to approximately 31 heavy vehicle movements (inbound and outbound) per day throughout the construction period.
- A peak of approximately 70 heavy vehicle movements (inbound and outbound) per day.

This includes heavy vehicle activity associated with 28 tonne gravel trucks, related to the construction of the proposed Wybong Road Overpass, Wybong Post Office Road, internal access roads and water management systems components. The majority of gravel is proposed to be sourced “internally” from within the Mangoola Coal Mine.

For the purposes of this assessment, the highest peak hour traffic generation for the mine under the peak construction scenario has assumed to be 157 vehicle trips in total, which would consist of the following:

- AM peak hour:
  - Six inbound heavy vehicle movements and six outbound heavy vehicle movements (external).
  - 145 inbound worker movements (light vehicles).
- PM peak hour:
  - Six inbound heavy vehicle movements and six outbound heavy vehicle movements (external).
  - 145 outbound worker movements (light vehicles).

For the purposes of analysis in this memo, the gravel trucks have been excluded from the analysis, as they will have a negligible impact on the roads external to the MCCO Project Area and are not typically expected to traverse the intersection of interest.

At the time of completing the TTIA for the MCCO Project EIS, Mangoola provided residential locations of employees to be used as a guide for formulating assumptions for construction traffic. For the purposes of analysis, it has been assumed that the future construction workforce will have a similar breakdown of residential locations to distribute potential traffic associated with workers travelling to the MCCO Project site from different directions.

As such, the six most common residential locations for permanent employees which captures approximately 75 percent of the total workforce were used to identify percentage values for the proposed residential trip distributions for the MCCO Project construction workforce. The aim was to identify general trends in construction workers residential trip distributions based on available data at the time of the EIS assessment. It should be noted the trends around construction workers residential trip distributions are indicative only as the location of temporary construction workforces is often more related to the availability of temporary accommodation options.

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The key residential locations and the associated expected traffic movements related to the construction workers, as included in the TTIA, are detailed in Table 3-1.

Table 3-1 Construction workers residential trip distribution

Residential Location	Proportion of Employees	Traffic Movements (number of vehicles during peak hour)
Muswellbrook	47%	68
Singleton	14%	20
Denman	13%	19
Scone	13%	19
Merriwa	7%	10
Aberdeen	6%	9
Total	***100%***	***145***

For the purposes of the previous assessment in the TTIA, it was assumed that for:

- Workers residing in Muswellbrook will access the MCCO Project via Denman Road, Bengalla Road, Kayuga Road and Wybong Road. It has been assumed that:
  - 50 percent will access the MCCO Project via Denman Road and Bengalla Road.
  - 50 percent will access the MCCO Project via Kayuga Road and Wybong Road.
- Workers residing in Singleton will access the MCCO Project via Thomas Mitchell Drive, Denman Road, Bengalla Road and Wybong Road.
- Workers residing in Denman will access the MCCO Project via the Golden Highway and Wybong Road.
- Workers residing in Scone will access the MCCO Project via the New England Highway, Kayuga Road and Wybong Road.
- Workers residing in Merriwa will access the MCCO Project via the Golden Highway and Wybong Road.
- Workers residing in Aberdeen will access the MCCO Project via the New England Highway, Kayuga Road and Wybong Road.

As stated previously, no change is proposed to the currently approved maximum rate of production (13.5 Mtpa) or the existing approved operational employee numbers and as such, no changes to operational traffic volumes are expected above those that have previously been assessed and approved.

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4 Updated trip distribution

4.1 Construction workers

As detailed in Section 1, Roads and Maritime has indicated that workers residing in Muswellbrook and Singleton could traverse the intersection of New England Highway and Sydney Street to access and egress the Mangoola Coal Mine.

It is noted that:

- There are multiple ways workers from Muswellbrook could access the mine other than via the intersection of interest:
  - Workers in the north of Muswellbrook could access it via Kayuga Road and Wybong Road (as already assessed in the TTIA).
  - Workers in the south of Muswellbrook could access it via Skellatar Stock Route, Denman Road and Bengalla Road (as already assessed in the TTIA).
- Singleton is to the south of the mine and workers could access the mine via the Golden Highway or via New England Highway and Thomas Mitchell Drive (as already assessed in the TTIA). Both these routes provide a quicker journey compared to travelling through the Muswellbrook Town Centre.

However, to be conservative and respond to Roads and Maritime's comments, the following trip distribution assumptions have been made:

- 75 percent of workers trips from Muswellbrook will access/egress the mine via the intersection of interest (a total of 51 trips in each peak hour).
- 50 percent of workers trips from Singleton will access/egress the mine via the intersection of interest (a total of ten trips in each peak hour).

The majority of workers residing in the north of Muswellbrook are expected to access the mine via Kayuga Road and Wybong Road. For the purposes of analysis, it has been assumed that for the Muswellbrook trips:

- 70 percent of the trips will access/egress the mine from New England Highway from the south.
- 30 percent of trips will access/egress the mine from Sydney Street/Bridge Street from the north-east.

For the Singleton trips, it has been assumed that workers will access/egress the mine from New England Highway (at its intersection with Sydney Street).

We note that Roads and Maritime are planning to construct the Muswellbrook bypass, which will enable vehicles to bypass the Muswellbrook town centre. Information provided by Roads and Maritime suggests that construction of the bypass is expected to commence in 2022 and therefore it will become operational after the completion of the construction of the MCCO Project.

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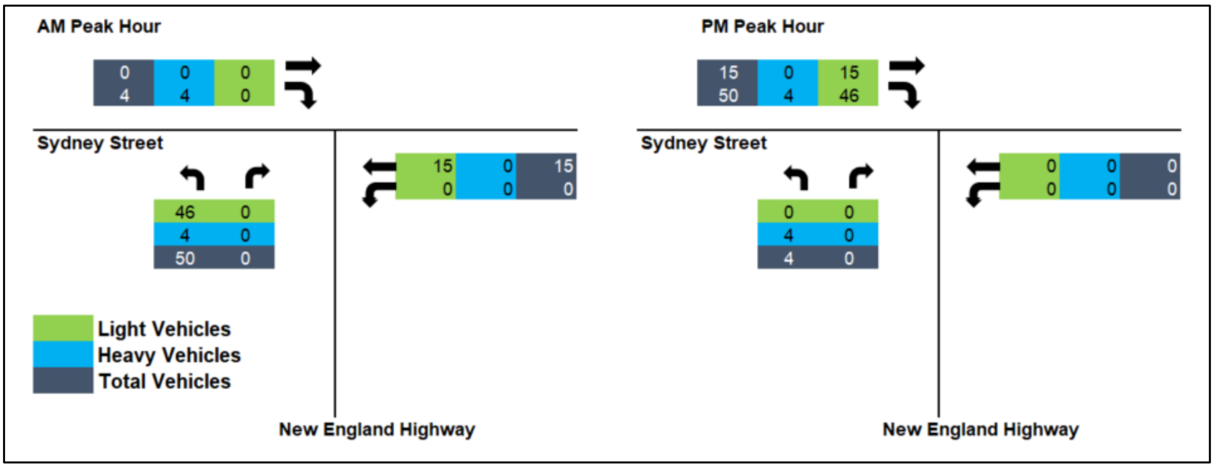
4.2 Heavy vehicles

It was previously assumed in the TTIA that 60 percent of heavy vehicles (external) would access/egress the mine via Muswellbrook. For the purposes of this analysis and to outline a worst-case scenario, heavy vehicle trips have been distributed onto the intersection of New England Highway and Sydney Street.

The expected peak hour trip characteristics of the MCCO Project construction vehicles (in accordance with the trip distribution assessment details in Section 4) are displayed in Figure 4-1.

Figure 4-1 – Peak hour trip generation



5 Updated traffic impact assessment

Construction of the MCCO Project is expected to take approximately 16 months and would be completed in 2022. Intersection traffic modelling, using the SIDRA 8 modelling software, has been undertaken for the following two scenarios in the 2022 horizon year:

- A “no-build” scenario, accounting for background traffic growth only.
- A “build” scenario, accounting for the background traffic growth and the expected peak construction traffic associated with the MCCO Project.

Forecast 2022 AM and PM peak hour traffic volumes (for the periods the construction workers are expected to traverse the intersection) for both of the above scenarios are displayed in Figure 5-1 (no-build) and Figure 5-2 (build).

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Figure 5-1- 2022 “No Build” traffic volumes

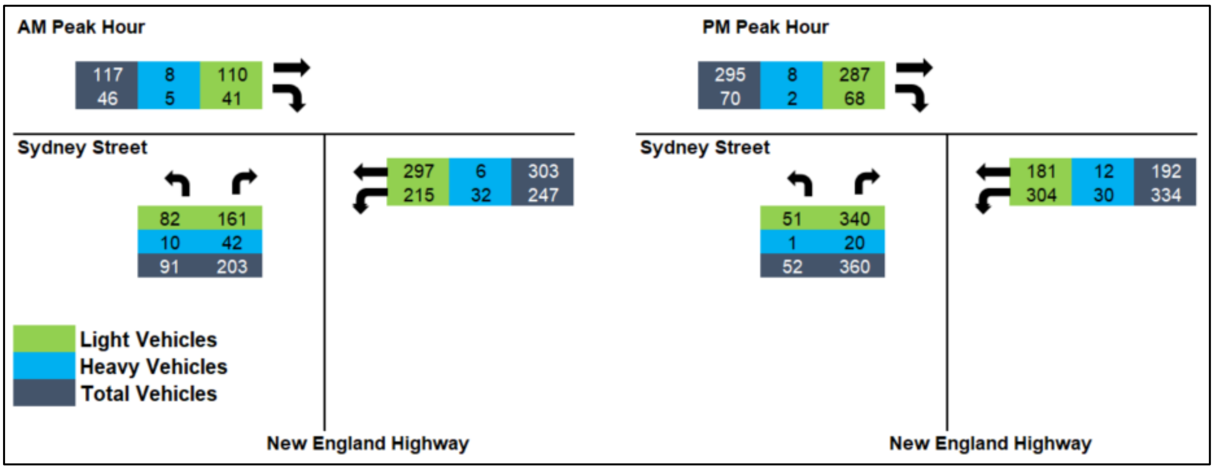
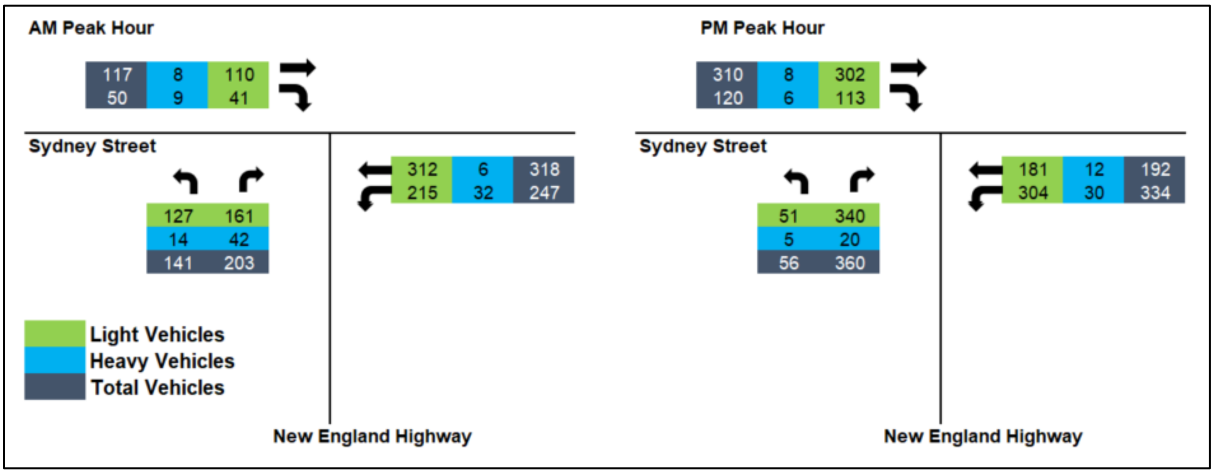


Figure 5-2 – 2022 “Build” traffic volumes



For a conservative basement, a linear annual growth rate of 2.5 percent has been applied to the 2019 surveyed traffic volumes to determine the 2022 “no build” traffic volumes.

This traffic growth rate is higher than the 1.5 percent growth rate specified in the *Muswellbrook Mine Affected Roads Stage 1 – Road Network Plan* report (Cardno, 2015).

The results of the 2022 horizon year SIDRA analysis are summarised in Table 5-1.

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Table 5-1 – 2022 SIDRA results summary

Intersection	AM Peak			PM Peak		
	Av Delay (sec)	LOS	95th % Queue (m)	Av Delay (sec)	LOS	95th % Queue (m)
2022 "No Build" scenario						
New England Highway	20.1	B	46	23.9	B	85
Sydney Street (east)	17.8	B	71	13.1	A	46
Sydney Street (west)	18.1	B	18	20.9	B	56
Overall Intersection operation	**18.5**	**B**		**18.7**	**B**	
2022 "Build" scenario						
New England Highway	19.1	B	46	23.8	B	85
Sydney Street (east)	18.2	B	75	13.1	A	46
Sydney Street (west)	18.7	B	18	27.5	B	59
Overall Intersection operation	**18.5**	**B**		**20.9**	**B**	

The intersection modelling analysis indicates that in the 2022 horizon year, the intersection of interest is expected to operate with an acceptable LoS (i.e. LoS of B or better) for both the "no-build" and "build" traffic scenarios based on the adopted assumptions.

6 Conclusion

In summary, based on the data and conservative assumptions included in this memo, it is predicted that the intersection of New England Highway and Sydney Street will continue to operate with an acceptable LoS, accounting for the construction vehicles, and ongoing operation vehicles, associated with the MCCO Project.

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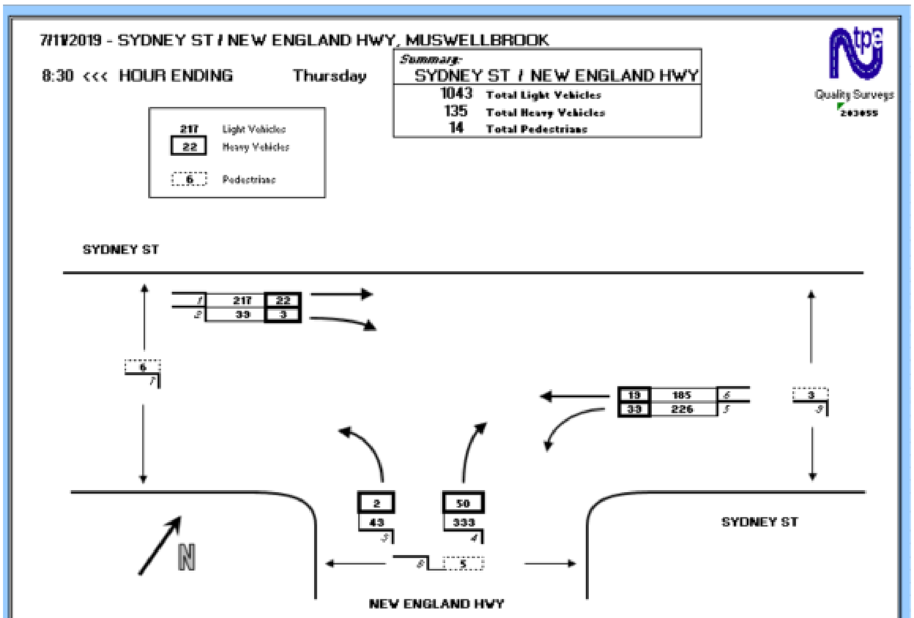
Attachment A – Survey data



7/11/2019 - SYDNEY ST / NEW ENGLAND HWY, MUSWELLBROOK

Light Vehicles

	1	2	3	4	5	6	Total Vehicles 15 MIN	Total Vehicles HOUR	Pedestrians 7	8	9
05:45	14	14	42	21	62	112	265		0	1	0
06:00	16	8	31	20	59	86	220		0	0	0
06:15	29	5	21	30	58	63	206		2	0	0
06:30	22	11	20 <	34	52 <	83 <	222	913	0	6	0
06:45	30	12	22	39	50	70	223	871	0	1	0
07:00	21	10	13	47	40	60	191	842	0	6 <	0
07:15	49	20 <	16	41	51	34	211	847	0	0 <	0
07:30	41	9	13	46	52	47	208	833	0	3	0
07:45	60	11	16	78	43	40	248	858	0	2	0
08:00	49	13 <	6	70	66	51	255	922	1	0	2
08:15	43	5	10	94	48	49	249	960	1	1	0
08:30	65 <	10	11	91 <	69	45	291	1043 <	4 <	2	1 <

Heavy Vehicles

	1	2	3	4	5	6	Total Vehicles 15 MIN	Total Vehicles HOUR
05:45	5	1	3	5	9	2	25	
06:00	3	2	1	6	6	1	19	
06:15	0	0	1	4	13	3	21	
06:30	1	1	3	7	8	2	22	87
06:45	4	1	4	8	4	0	21	83
07:00	2	3	1	20	5	1	32	96
07:15	3	0	2	8	8	5	26	101
07:30	4	1	4 <	8	4	3	24	103
07:45	6	2 <	0	5	8	4	25	107
08:00	3	0	0	17	8	5	33	108
08:15	7	1	1	12	7	5	33	115
08:30	6 <	0	1	16 <	16 <	5 <	44	135 <

All Vehicles

	1	2	3	4	5	6	Total Vehicles 15 MIN	Total Vehicles HOUR
05:45	19	15	45	26	71	114	290	
06:00	19	10	32	26	65	87	239	
06:15	29	5	22	34	71	66	227	
06:30	23	12	23 <	41	60 <	85 <	244	1000
06:45	34	13	26	47	54	70	244	954
07:00	23	13	14	67	45	61	223	938
07:15	52	20 <	18	49	59	39	237	948
07:30	45	10	17	54	56	50	232	936
07:45	66	13	16	83	51	44	273	965
08:00	52	13	6	87	74	56	288	1030
08:15	50	6	11	106	55	54	282	1075
08:30	71 <	10	12	107 <	85	50	335	1178 <

Note Arrows "<" indicate the end time for the peak hour for each turning movement.

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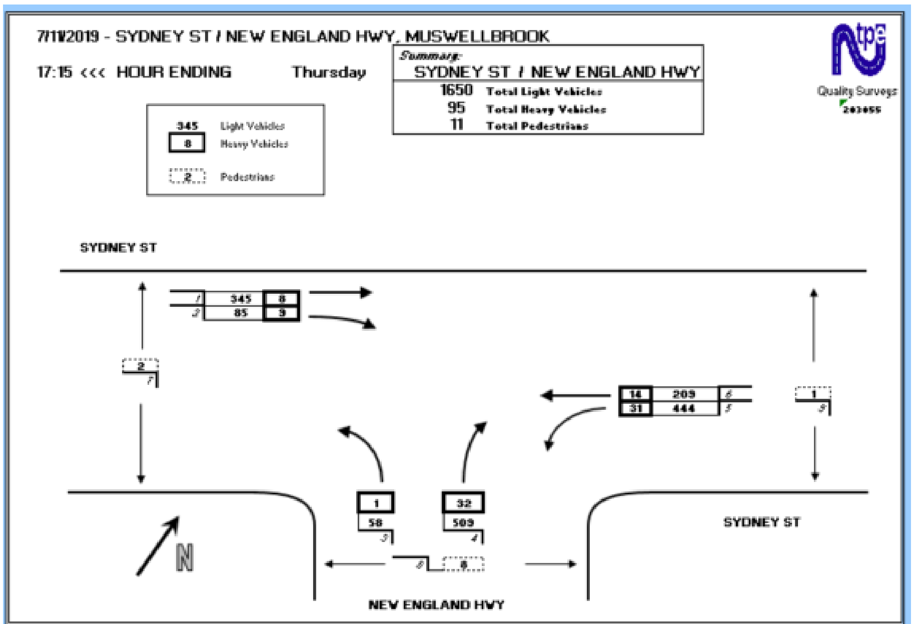

7/11/2019 - SYDNEY ST / NEW ENGLAND HWY, MUSWELLBROOK

Light Vehicles

	1	2	3	4	5	6	Total Vehicles 15 MIN	HOUR	Pedestrians 7	8	9
16:15	95	25	14	116	100	64	414		0	0	0
16:30	84	15	12	152	87	44	394		0	0	0
16:45	90	24	13	110	114	64	415		1	2	1
17:00	87 <	24	15	118	101	45	390	1613	1	4	0
17:15	84	22	18	129 <	142	56	451	1650	0	2	0
17:30	81	22 <	17	113	94 <	68	395	1651 <	2 <	1 <	0
17:45	49	19	21	92	88	54	323	1559	0	1	2
18:00	70	14	19 <	111	91	60	365	1534	1	1	2
18:15	94	21	18 <	76	85	63 <	357	1440	0	1	0
18:30	42	12	9	83	67	36	249	1294	0	1	0
18:45	74	15	12	89	63	37	290	1261	0	0	3 <
19:00	57	15	8	68	68	32	248	1144	0	0	0

Heavy Vehicles

	1	2	3	4	5	6	Total Vehicles 15 MIN	HOUR
16:15	2	1	2	8	11	5	29	
16:30	4	4	0	6	11	2	27	
16:45	1	0	0	10	6	4	21	
17:00	3	2	1 <	7	9 <	6	28	105 <
17:15	0	3 <	0	9	5	2	19	95
17:30	3	1	0	5	4	3	16	84
17:45	5	0	0	8	6	7 <	26	89
18:00	2	0	1	13 <	4	2	22	83
18:15	2 <	2	0	4	5	3	16	80
18:30	0	0	1	3	6	3	13	77
18:45	3	0	0	4	6	3	16	67
19:00	2	0	0	8	11	2	23	68

All Vehicles

	1	2	3	4	5	6	Total Vehicles 15 MIN	HOUR
16:15	97	26	16	124	111	69	443	
16:30	88	19	12	158	98	46	421	
16:45	91	24	13	120	120	68	436	
17:00	90 <	26	16	125	110	51	418	1718
17:15	84	25	18	138 <	147 <	58	470	1745 <
17:30	84	23 <	17	118	98 <	71	411	1735
17:45	54	19	21	100	94	61	349	1648
18:00	72	14	20 <	124	95	62	387	1617
18:15	96	23	18 <	80	90	66 <	373	1520
18:30	42	12	10	86	73	39	262	1371
18:45	77	15	12	93	69	40	306	1328
19:00	59	15	8	76	79	34	271	1212

Note Arrows "<" indicate the end time for the peak hour for each turning movement.

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Attachment B – SIDRA results

MOVEMENT SUMMARY

Site: [AM Peak - 2019 Existing]

New England Highway
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 71 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: New England Highway												
1	L2	89	10.6	0.092	12.3	LOS A	1.4	10.8	0.48	0.66	0.48	42.4
3	R2	199	20.6	0.349	23.4	LOS B	5.2	42.7	0.78	0.77	0.78	37.5
Approach		288	17.5	0.349	19.9	LOS B	5.2	42.7	0.69	0.73	0.69	38.9
East: Sydney Street												
4	L2	242	13.0	0.202	8.5	LOS A	2.9	22.3	0.37	0.65	0.37	44.3
5	T1	297	2.1	0.577	24.9	LOS B	9.1	65.1	0.92	0.77	0.92	37.3
Approach		539	7.0	0.577	17.5	LOS B	9.1	65.1	0.67	0.72	0.67	40.2
West: Sydney Street												
11	T1	115	6.4	0.128	11.0	LOS A	2.2	16.2	0.58	0.47	0.58	43.5
12	R2	56	11.3	0.256	36.5	LOS C	1.8	14.1	0.94	0.74	0.94	33.0
Approach		171	8.0	0.256	19.3	LOS B	2.2	16.2	0.70	0.56	0.70	39.4
All Vehicles		998	10.2	0.577	18.5	LOS B	9.1	65.1	0.68	0.69	0.68	39.6

MOVEMENT SUMMARY

Site: [PM Peak - 2019 Existing]

New England Highway
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: New England Highway												
1	L2	51	2.1	0.051	13.9	LOS A	0.9	6.6	0.50	0.65	0.50	41.7
3	R2	353	5.7	0.510	24.9	LOS B	10.6	77.9	0.81	0.80	0.81	37.0
Approach		403	5.2	0.510	23.6	LOS B	10.6	77.9	0.77	0.78	0.77	37.5
East: Sydney Street												
4	L2	327	9.0	0.242	7.3	LOS A	3.5	26.3	0.30	0.63	0.30	45.0
5	T1	188	6.1	0.322	22.9	LOS B	5.7	41.9	0.81	0.67	0.81	38.1
Approach		516	8.0	0.322	13.0	LOS A	5.7	41.9	0.48	0.64	0.48	42.2
West: Sydney Street												
11	T1	288	2.6	0.325	14.6	LOS B	7.1	50.9	0.67	0.57	0.67	41.7
12	R2	68	3.1	0.502	46.1	LOS D	2.8	20.0	1.00	0.76	1.00	30.4
Approach		357	2.7	0.502	20.6	LOS B	7.1	50.9	0.74	0.61	0.74	38.9
All Vehicles		1276	5.6	0.510	18.5	LOS B	10.6	77.9	0.65	0.68	0.65	39.7

MOVEMENT SUMMARY

Site: [AM Peak - 2022 No Build]

New England Highway
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 71 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: New England Highway												
1	L2	97	10.9	0.100	12.3	LOS A	1.5	11.8	0.49	0.66	0.49	42.3
3	R2	214	20.7	0.375	23.6	LOS B	5.6	46.4	0.79	0.77	0.79	37.4
Approach		311	17.6	0.375	20.1	LOS B	5.6	46.4	0.70	0.74	0.70	38.8
East: Sydney Street												
4	L2	260	13.0	0.217	8.6	LOS A	3.1	24.3	0.37	0.65	0.37	44.2
5	T1	319	2.0	0.619	25.2	LOS B	10.0	70.9	0.93	0.79	0.93	37.2
Approach		579	6.9	0.619	17.8	LOS B	10.0	70.9	0.68	0.73	0.68	40.1
West: Sydney Street												
11	T1	124	6.8	0.139	11.1	LOS A	2.4	17.7	0.59	0.48	0.59	43.4
12	R2	48	10.9	0.222	36.3	LOS C	1.6	12.2	0.93	0.73	0.93	33.0
Approach		173	7.9	0.222	18.1	LOS B	2.4	17.7	0.69	0.55	0.69	39.9
All Vehicles		1062	10.2	0.619	18.5	LOS B	10.0	70.9	0.69	0.70	0.69	39.7

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Memorandum

MOVEMENT SUMMARY

Site: [PM Peak - 2022 No Build]

New England Highway
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: New England Highway												
1	L2	55	1.9	0.056	13.9	LOS A	1.0	7.1	0.50	0.65	0.50	41.6
3	R2	379	5.6	0.547	25.3	LOS B	11.6	85.2	0.83	0.81	0.83	36.8
Approach		434	5.1	0.547	23.9	LOS B	11.6	85.2	0.79	0.79	0.79	37.4
East: Sydney Street												
4	L2	352	9.0	0.260	7.3	LOS A	3.8	28.8	0.30	0.63	0.30	45.0
5	T1	203	6.2	0.347	23.1	LOS B	6.2	45.6	0.82	0.68	0.82	38.0
Approach		555	8.0	0.347	13.1	LOS A	6.2	45.6	0.49	0.65	0.49	42.1
West: Sydney Street												
11	T1	311	2.7	0.350	14.8	LOS B	7.8	55.6	0.68	0.59	0.68	41.6
12	R2	74	2.9	0.540	46.3	LOS D	3.0	21.6	1.00	0.77	1.03	30.3
Approach		384	2.7	0.540	20.9	LOS B	7.8	55.6	0.74	0.62	0.75	38.8
All Vehicles		1373	5.6	0.547	18.7	LOS B	11.6	85.2	0.66	0.68	0.66	39.6

MOVEMENT SUMMARY

Site: [AM Peak - 2022 Build]

New England Highway
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 71 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: New England Highway												
1	L2	148	9.9	0.152	12.6	LOS A	2.4	18.6	0.50	0.68	0.50	42.2
3	R2	214	20.7	0.375	23.6	LOS B	5.6	46.4	0.79	0.77	0.79	37.4
Approach		362	16.3	0.375	19.1	LOS B	5.6	46.4	0.67	0.73	0.67	39.2
East: Sydney Street												
4	L2	260	13.0	0.217	8.6	LOS A	3.1	24.3	0.37	0.65	0.37	44.2
5	T1	335	1.9	0.649	25.6	LOS B	10.6	75.4	0.94	0.81	0.95	37.0
Approach		595	6.7	0.649	18.2	LOS B	10.6	75.4	0.69	0.74	0.70	39.9
West: Sydney Street												
11	T1	124	6.8	0.139	11.1	LOS A	2.4	17.7	0.59	0.48	0.59	43.4
12	R2	53	18.0	0.252	36.6	LOS C	1.7	14.1	0.94	0.74	0.94	32.9
Approach		177	10.1	0.252	18.7	LOS B	2.4	17.7	0.69	0.56	0.69	39.7
All Vehicles		1134	10.3	0.649	18.5	LOS B	10.6	75.4	0.69	0.71	0.69	39.6

MOVEMENT SUMMARY

Site: [PM Peak - 2022 Build]

New England Highway
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: New England Highway												
1	L2	59	8.9	0.063	14.0	LOS A	1.1	8.2	0.50	0.65	0.50	41.5
3	R2	379	5.6	0.547	25.3	LOS B	11.6	85.2	0.83	0.81	0.83	36.8
Approach		438	6.0	0.547	23.8	LOS B	11.6	85.2	0.79	0.79	0.79	37.4
East: Sydney Street												
4	L2	352	9.0	0.260	7.3	LOS A	3.8	28.8	0.30	0.63	0.30	45.0
5	T1	203	6.2	0.347	23.1	LOS B	6.2	45.6	0.82	0.68	0.82	38.0
Approach		555	8.0	0.347	13.1	LOS A	6.2	45.6	0.49	0.65	0.49	42.1
West: Sydney Street												
11	T1	326	2.6	0.368	15.0	LOS B	8.2	59.0	0.69	0.59	0.69	41.5
12	R2	125	5.0	0.932	60.3	LOS E	6.2	45.2	1.00	1.12	1.79	27.1
Approach		452	3.3	0.932	27.5	LOS B	8.2	59.0	0.78	0.74	1.00	36.2
All Vehicles		1444	5.9	0.932	20.9	LOS B	11.6	85.2	0.67	0.72	0.74	38.7

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APPENDIX 10
Mangoola Offsets BSAL Assessment

MINESOILS
LAND & REHABILITATION SPECIALISTS

5th December 2019

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Attention: Daniel Sullivan

Dear Daniel,

Re: Mangoola Coal Continued Operations Project – Offsets BSAL Assessment

The Mangoola Coal Continued Operations Project (MCCO Project) Environmental Impact Statement (EIS) proposed the Wybong Heights property be considered as part of the biodiversity offset strategy. The Agricultural Impact Statement (AIS) completed as part of the MCCO Project EIS identified that the proposed Wybong Heights offset area has a total of 148 ha of regionally mapped Biophysical Strategic Agricultural Land (BSAL), based on the NSW government soils information and regional scale mapping data. The mapped BSAL includes a small area of approximately 7 ha associated with the Wybong Creek floodplain and a larger area of 141 ha on a basalt plateau. As part of the MCCO Project EIS this area was not subject to site verification and for the purposes of the EIS the NSW Government regional mapping was relied upon.

Minesoils Pty Ltd (Minesoils) understands the NSW Department of Primary Industries – Agriculture made a submission on the MCCO Project, in which it raised the issue of 148 ha of regionally mapped BSAL being located in the proposed Wybong Heights Offset Site. Furthermore, that if the regionally mapped BSAL was verified BSAL, there may be conflict in using this for non-agricultural purposes.

Umwelt (Australia) Pty Limited, on behalf of Mangoola Coal Operations Pty Limited, engaged Minesoils to undertake a preliminary, non-invasive verification of the 141 ha of regionally mapped BSAL associated with the basalt plateau, within the proposed Wybong Heights Offset Site. This assessment was undertaken on Friday 8th November 2019 by Clayton Richards a Certified Professional Soil Scientist (CPSS). The assessment did not seek to verify the smaller 7 ha area associated with the Wybong Creek floodplain.

The verification program was undertaken in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* ((Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (DPI-OASFS), 2013)); hereafter referred to as the Interim Protocol. The purpose of this report is to provide the results of the BSAL verification program conducted in accordance with the Interim Protocol.

BSAL is land with a rare combination of natural resources highly suitable for agriculture. These lands intrinsically have the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management practices to maintain this high quality.

The first 4 criteria of the Interim Protocol were used to undertake the non-invasive assessment as shown in **Figure 1**. The on ground photographic evidence is contained in the attached supplement. **Figure 2** shows the areas verified non BSAL and the Interim Protocol criteria used for verification. The following paragraphs provide a summary of the results of each criterion used for the proposed Wybong Heights Offset Site assessment.

<u>Slope</u>: Is slope less than or equal to 10%?

Site assessment of slope gradients was undertaken using a digital elevation model and areas with gradients greater than 10% were considered exclusion sites and are shown in **Figure 2**. Site field assessment of slope gradients was undertaken using a hand held clinometer to verify the results of the digital elevation model. A total of 89.32 ha of the 141 ha project area was verified non BSAL due to slope >10%.

The areas less than 10% slope and greater than 20 ha contiguous are also shown in **Figure 2**. These areas were targeted to undertake further on ground surface assessment for rock outcrop, unattached surface rock fragments and gilgai.

<u>Rock Outcrop</u>: Is there <30% rock outcrop?

There were areas of basalt rock outcrop, however most of this geology was in the form of unattached rock fragments, therefore it was assumed there was less than 30% rock outcrop across the Wybong Heights Offset Site. No areas were verified non BSAL based on this criterion.

<u>Surface Rock</u>: Does <20% of area have unattached rock fragments >60mm diameter?

The two remaining areas greater than 20 ha contiguous were targeted for assessment of surface rock and indicated the majority of the sites assessed contained a greater than 20% area of unattached rock fragments with a diameter greater than 60mm, which resulted in verified non-BSAL as shown in **Figure 2**. A total of 36.39 ha of the 141 ha project area was verified non-BSAL due to surface rock.

Gilgai: Does <50% of the area have gilgais >500mm deep?

Whilst some linear gilgai were present within the proposed Wybong Heights Offset Site, there were no areas with gilgais greater than 500mm deep. Therefore, no areas were verified non BSAL based on this criterion.

Size: Is the contiguous area >20ha?

The remaining areas which passed the first 4 BSAL criteria are isolated areas less than 20 ha. Therefore, the remaining total of 15.33 ha of non-contiguous, less than 20ha areas, were verified non BSAL.

In conclusion, Clayton Richards (CPSS) of Minesoils has undertaken the BSAL Assessment in accordance with the Interim Protocol for site verification of BSAL (OEH 2013), and concludes that all 141 ha of regionally mapped BSAL associated with the basalt plateau, in the proposed Wybong Heights Offset Site is verified non BSAL. These areas have been verified non BSAL based on the assessment of the first 4 criteria of the Interim Protocol including slope, rock outcrop, unattached rock fragments and gilgai. No further BSAL assessment is required for the 141 ha area associated with the basalt plateau. The 7 ha of regionally mapped BSAL associated with Wybong Creek remains unverified for BSAL status based on the Interim Protocol.

Yours sincerely,

C. Richards

Clayton Richards
Director

Mobile: 0408 474 248
E-mail: clayton@minesoils.com.au

CERTIFIED PROFESSIONAL SOIL SCIENTIST
2019
CPSS
Clayton Richards
S01797

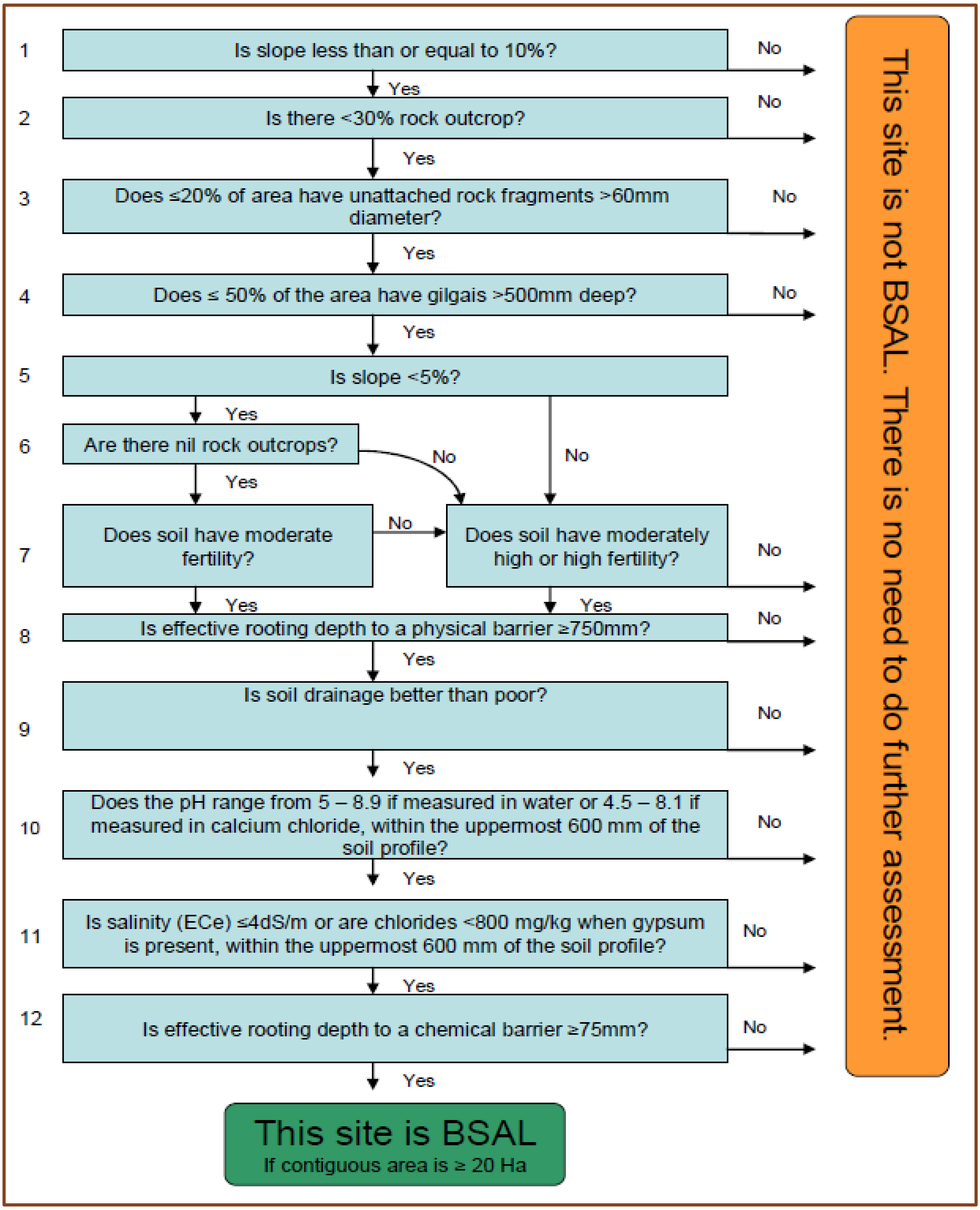

Figure 1: Interim protocol flow chart

umwelt

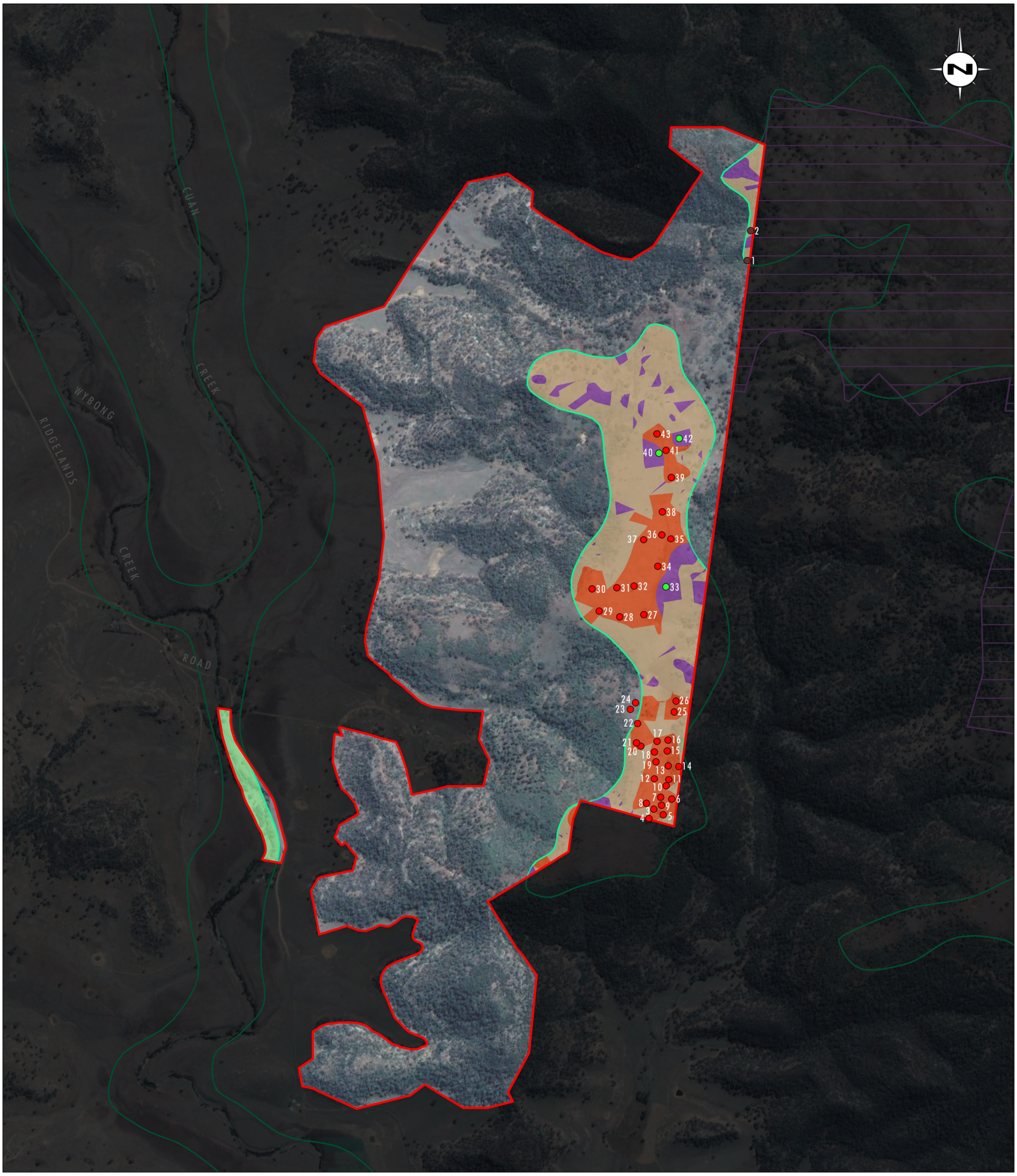

Image Source: Google Earth (Sept 2018)
Data Source: LPI (2018), OEH (2012)
Note: Offset boundaries are based on LPI cadastre

0 0.5 1.0 1.5km
1:30 000

Legend

- Wybong Heights Offset Site
- Regional Trigger Mapped Biophysical Strategic Agricultural Land
- Regionally Trigger Mapped BSAL - Not Verified
- Exclusion (Verified non-BSAL): Slope >10% - Verified non-BSAL
- Exclusion (Verified non-BSAL): Surface rock - >20% Unattached rock fragments >60mm diameter
- Exclusion (Verified non-BSAL): Non Contiguous Areas <20ha
- Equine Strategic Agricultural Land
- Survey Points: Exclusion Sites - Slope >10%
- Survey Points: Exclusion Sites - Surface Rock
- Survey points: Possible BSAL

FIGURE 2

BSAL Verification within the Wybong Heights Property

File Name (A4): 4004_425.dgn
20191205 9.44

Field Observations (slope, rock outcrop, surface rock and gilgai)

Site 1: Verified Non-BSAL - slope and surface rock

Site 2: Verified Non-BSAL - slope and surface rock

Site 3: Verified Non-BSAL - surface rock

Site 4: Verified Non-BSAL - surface rock

Site 5: Verified Non-BSAL - surface rock

Site 6: Verified Non-BSAL - surface rock

Site 7: Verified Non-BSAL - surface rock

Site 8: Verified Non-BSAL - surface rock

Site 9: Verified Non-BSAL - surface rock

Site 10: Verified Non-BSAL - surface rock

Site 11: Verified Non-BSAL - surface rock

Site 12: Verified Non-BSAL - surface rock

Site 13: Verified Non-BSAL - surface rock

Site 14: Verified Non-BSAL - surface rock

Site 15: Verified Non-BSAL - surface rock

Site 16: Verified Non-BSAL - surface rock

Site 17: Verified Non-BSAL - surface rock

Site 18: Verified Non-BSAL - surface rock and shallow

Site 19: Verified Non-BSAL - surface rock

Site 20: Verified Non-BSAL - surface rock

Site 21: Verified Non-BSAL - surface rock

Site 22: Verified Non-BSAL - surface rock

Site 23: Verified Non-BSAL - surface rock and shallow

Site 24: Verified Non-BSAL - surface rock

Site 25: Verified Non-BSAL - surface rock

Site 26: Verified Non-BSAL - surface rock

Site 27: Verified Non-BSAL - surface rock

Site 28: Verified Non-BSAL - surface rock

Site 29: Verified Non-BSAL - surface rock

Site 30: Verified Non-BSAL - surface rock

Site 31: Verified Non-BSAL - surface rock

Site 32: Verified Non-BSAL - surface rock

Site 33: Verified Non-BSAL – Less than 20 ha contiguous area (no surface rock)

Site 34: Verified Non-BSAL - surface rock


Site 35: Verified Non-BSAL - surface rock


Site 36: Verified Non-BSAL - surface rock


Site 37: Verified Non-BSAL - surface rock


Site 38: Verified Non-BSAL - surface rock


Site 39: Verified Non-BSAL - surface rock


Site 40: Verified Non-BSAL – Less than 20 ha contiguous area (no surface rock)

Site 41: Verified Non-BSAL - surface rock and shallow

Site 42: Verified Non-BSAL – Less than 20 ha contiguous area (no surface rock)

Site 43: Verified Non-BSAL - surface rock

APPENDIX 11

Property Value Report
(including peer review by
Knights Frank Newcastle)

TEW
PROPERTY CONSULTANTS

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160 Pacific Highway
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Charlestown NSW 2290

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Our Ref: FR3453

25 October 2019

Mangoola Coal Operations Pty Limited
C/- Mr Nigel Charnock
Manager of Community, Land and Property
Glencore Coal (NSW) Pty Ltd
Private Mail Bag 8
SINGLETON NSW 2330

Dear Nigel,

RE: MANGOOLA COAL CONTINUED OPERATIONS PROJECT (MCCOP) – PROPERTY ANALYSIS – RESPONSE TO OBJECTION SUBMISSIONS

In accordance with your instructions we provide the following considerations and relevant analysis in respect to market trends and movement in property values in the Hunter Valley generally and Muswellbrook Local Government Area (MLGA) specifically.

In addressing the instructions, we are cognisant of objections to the proposed MCCOP presented by a number of landowners in proximity to the project proposal. The MCCOP involves the proposed continuation of open cut mining at Mangoola Coal Mine which is situated some 20km west by road from Muswellbook CBD and some 22km north by road from Denman CBD.

In interpreting the relevant factors raised in objections to MCCOP as submitted by land owners, we have interpreted those objections to adopt a number of hypotheses. We have investigated and analysed available recent sales evidence in support of our considerations and conclusions.

1. **Is it possible to evidence the impact (positive and/or negative) of Mining operations upon the local economy generally and the real estate market specifically – using sales evidence?**

2. **What impacts are capable of support using available recent sales evidence?**

3. **Is it possible to discern - using available recent sales evidence – the scale of impact upon the value of a particular property?**

4. **Is there evidence to support a claim that real estate in proximity to a mining operation is unsalable or otherwise devalued?**

5. **Is it possible to quantify a relationship between proximity to a mining operation and impacts upon property values?**

CRITICAL INFORMATION AND ASSUMPTIONS

In compiling this report, we have been provided with documentation by Mangoola Coal Operations Pty Ltd. We have also investigated and sourced information independently, had discussions with Local Government Authorities and local agents active in the Real Estate market and, where necessary, made assumptions. The activities undertaken, information sources and assumptions include:

- Investigation of commercial property sales system – CoreLogic RPData. 2006 - 2019.
- Accessing Property NSW land values applicable to a variety of land classifications 2012 – 2019.
- Investigation of national statistical analysis for residential housing - Residex-Resitrends NSW 2006 - 2019.
- Relied upon Tew Property Consultants records and experience of market value and compensation assessments specific to mining development consents in the Hunter Valley, New England Tablelands, Central and Southern Highlands.
- Made enquiries of a number of relevant Local Government Authorities.
- Perused the Social Impact Assessment compiled by Umwelt – dated June 2019 wherein the most significant social risks “based upon stakeholder perceptions and unmitigated technical risk analysis” include: Property; … risk of decline in property values due to proximity to the mine operations, perceived inability to sell and move on. Sense of Community and Social amenity impacts; …concerns relating to dust/air quality, increased noise and traffic (road and rail).
- Perused the Environmental Impact Statement compiled by Umwelt – date July 2019 wherein it states amongst other things: “The MCCOP is not predicted to result in adverse impacts on surrounding private agricultural land and the mining operations are expected to continue to coexist with the surrounding agricultural land uses.”
- Perused the Voluntary Land Acquisition and Mitigation Policy (VLAMP) which sets out consistent criteria to be addressed when an applicant is considering impacts of noise and particulate matter on surrounding development.
- Perused Land Owner Objection submissions to the MCCOP – wherein the predominant concerns as we have interpreted from the submissions as relevant to this report, relate to claims of reduced property values; reduced marketability; reduced amenity (including such as noise, dust, traffic, visual impacts).
- Made enquiries of Real Estate Agents active in the relevant property market.
- Visited a number of properties which have transacted in the previous 36 months and spoken with landowners where available and amenable.

Specific data compiled to inform this advice includes:

- Median House Price recordings for the period 2006 – 2019 for Muswellbrook, Singleton Scone, Denman, Aberdeen, Dungog and Gloucester in the Hunter Valley.
- We have also considered sales evidence of rural lifestyle properties and independent rural living units within Muswellbrook Local Government Authority generally and localities which are proximate to coal mining operations particularly. Examples of those sales considered are included in this advice.
- In order to maintain confidentiality of property details, for those properties where we have utilised information which is not in the public domain or which is not accessible to the general public, we have purposely not included data which could inform as to ownership of those specific properties. We have, however, retained a complete data record on our files should our client wish to discuss particular properties further.

CRITICAL INFORMATION AND ASSUMPTIONS (Cont'd)

- We have considered sales volume as indicative of activity in the Real Estate market generally.
- We have also considered the matter of marketing timeframes but do not consider it to be a primary indicator of the prevailing market. A number of factors may impact directly upon the time a particular property is on the market before achieving a sale. Factors such as a rising or falling market will influence the respective vendors/purchasers' perceptions of value and opportunity; opportunistic listings often occur in advance of a perceived sale opportunity (such as anticipated acquisitions by a resources company).
- We have relied upon analysing completed sales and consider them to be the best representation of the market and market movement.
- We understand the data provided in this advice is to be utilised by Mangoola Coal Operation Pty Ltd in conjunction with its primary consultants in respect to the above described MCCOP.
- Should a broader context of the volume of data considered be necessary, this advice should be read in conjunction with previous advice provided to our client.

We have investigated and analysed rural property sales for the period 2006 – 2019 for various locations relevant to the Muswellbrook Local Government Area generally and particularly the Mangoola and Wybong localities.

We have relied upon a range of information from varying sources and included relevant data into this advice.

Relevant considerations include the following:

- The Muswellbrook Central Business District is situated within close proximity to a number of major coal mining projects. Specifically, Muswellbrook CBD is approximately 3.5km east from Mt Pleasant open cut mining operation; 4.0km east from Bengalla open cut mining operation; 5.6km north from Mt Arthur open cut mining operation.
- A substantial number of the existing urban settlement precincts of Muswellbrook have a westerly aspect from the more elevated areas. The elevated westerly aspect available to residential development within the town encompasses a broad panoramic of proximate mining activity.
- Residential sales activity in Muswellbrook in particular (but also other towns and villages of the Upper Hunter Valley) appears to have performed in alignment with activity in the mining sector. That is, a strong mining sector which evidences steady, consistent employment demand, above average wages and a relatively young demographic with a broad skill base, is reflected in the residential market which also evidences strong demand, steady turnover of sales and increasing values. The data presented in this advice evidences a correlation between residential sales volumes and movements in values aligned with fluctuations in the strength of activity in the mining sector.
- It is too simplistic to draw a conclusion from the data that mining activities are the only predictor of movement in values in the local residential Real Estate market. It is however, reasonable to conclude that strong employment prospects, a buoyant local economy and a broad range of available, relatively affordable housing product are a positive influence upon Real Estate values in Muswellbrook and mining is a major contributor to the local economy. Conversely, when the mining sector was experiencing significant economic headwinds in the period between 2012 – 2016 the residential market in Muswellbrook was soft with declining sales volumes and declining house values a feature, year on year, through much of that period.

CRITICAL INFORMATION AND ASSUMPTIONS (Cont'd)

- Notwithstanding close proximity to major mining operations, Muswellbrook's residential market evidenced a significant increase in sales volumes for the year to May 2019 (23.4% over the previous year) and a decline (-8.34%) in median house values. Muswellbrook's performance aligns with that experienced in the larger population centres of the Lower Hunter Valley, including Newcastle and Lake Macquarie, where declines in average house prices and declines in sales volumes were experienced in many suburbs. Most residential markets in NSW declined over the same timeframe. By comparison to the other smaller towns and villages of the mid and upper Hunter Valley – Muswellbrook's housing market faired relatively well during the corresponding timeframe from 2017 – 2019.
- The sales data indicates a strong local economy has positive impacts upon the prevailing residential real estate market.
- Rural lifestyle properties and rural production units can vary markedly and values are influenced by a range of factors including; location, size, topography, use, land classification, available water, services, aspect, potential and scale, type and condition of improvements.
- Rural sales comprise a broad range of assets and varying influencing factors which may bear little or nil relevance to a particular asset being considered.
- Analysis of small, general data sets may be misleading and should not be utilised to indicate trends in any one type of asset without explanation of the basis of comparison and proposed use.
- If considering trends in rural real estate values, it is critical to understand the specific type, size and use of the asset being considered.
- It is our experience and supported by analysed sales evidence that there has been upward movement of rural land values over the previous 14 years to 2019. That movement, however, has not been consistent, rather it has been spasmodic. Particularly, the smaller rural/residential lifestyle parcels are influenced by similar factors to that influencing the value of residential assets in comparable locations.
- Larger rural lifestyle parcels are also influenced by similar factors to those influencing residential assets but do appear to have a resilience to the more standard market forces and movement in values is at times independent of residential values - which may be as a consequence of the capability of those rural assets to also generate modest on farm income (albeit not independent of off farm income) to supplement lifestyle.
- Independent rural living units appear to be less influenced by local impacts and more subject to particular sector related economic performance (which are subject to national and international variations) and regional environmental influences.
- Our analysis of rural sales data in proximity to mining operations indicates as follows:
    - There is limited land situated in close proximity to MCCOP which can be described as independent rural living units for primary production.
    - The majority of rural land holdings in close proximity to the MCCOP are small to medium sized lifestyle parcels with a mix of land classifications and productivity and evidencing improvements of varying age, size and standard.
    - There is recent evidence of sales of small to medium sized lifestyle parcels in proximity MCCOP and other mining operations. Sales investigated include a mix of arm's length sales, including properties marketed through a Licensed Real Estate Agent as well as off market sales. Purchasers include private citizens as well as mining companies taking advantage of an opportunity to purchase land from willing vendors.

CRITICAL INFORMATION AND ASSUMPTIONS (Cont'd)

- Analysis of recorded sales of rural lifestyle parcels indicate a number of relevant considerations including:
  - There is an increasing influence of mining in the general rural localities west of Muswellbrook. As a consequence, there is evidence of a significant volume of land owned by mining companies within the locality.
  - The volume of sales of rural lifestyle parcels to private citizens on land in close proximity to mining operations is therefore thin. The fact that mining companies are active, strategic purchasers of land within proximity of their respective operations is not surprising.
  - The predominance of sales which have been investigated and analysed do not appear to be adversely impacted by environmental factors (such as noise and particulate matter (air quality)). That is, we have assumed, those described environmental factors as they impact the investigated sales evidence, do not exceed the relevant criteria determined by regulators to the extent they have voluntary acquisition rights under the Voluntary Land Acquisition and Mitigation Policy (VLAMP).
  - Our experience, obtained over many years advising both mining companies and land holders in respect to property values, is that those assets which are actively marketed using a licensed Real Estate Agent generally achieve sale prices which are reflective of Market Value. A critical question is – is market value impacted by proximate mining operations?
  - Our analysis of specific sales situated in proximity to the MCCOP indicates those sales appear to be at comparable values to similar assets situated in similar localities with similar land classifications within Muswellbrook LGA, but which are further removed from mining operations.
  - Amongst a range of sales investigated for the purposes of this advice, we have included two rural lifestyle sales within in the tables following (Sale 1 and Sale 13) which are situated in close proximity to mining operations and which evidence sales transactions between private citizens/company interests (sale and resale at close intervals) - the first transaction in each case occurring in 2016 and a subsequent sale transaction occurring in 2019. In each case the subsequent sale represents an increase in value. Notwithstanding the tables representing sales evidence in this report depict repeat sales comprising of just two examples, it is of significance to interpreting impacts upon land values. Sale 1 is adversely impacted by noise under the Bengalla Mine Development Consent (SSD-5170) to the extent sale 1 (an improved asset) is subject to mitigation treatment. Sale 13 is also predicted to be impacted by noise however, it comprises of vacant land and is therefore treated differently in respect to mitigation and acquisition to that of improved assets with residential accommodation situated upon them.
  - Sales transactions achieved indicate there is a fluid market for rural lifestyle assets in the west Muswellbrook and Wybong localities where vendors are prepared to meet the market.

- It is our experience that it is not possible for an expert Valuer to accurately discern a change in market value which may be specifically as a consequence of reduced amenity and the perceived stigma associated with proximity to a particular mining operation assuming:
  - there would be no need to acquire any property under the VLAMP; and
  - the absence of sales evidence to inform discernible change in market value

CRITICAL INFORMATION AND ASSUMPTIONS (Cont'd)

- It is also our experience, that any such impact as may be evident is inversely proportional to proximity to the mining operation. That is, the further removed from the mining operation the land is situated, the less substantial is the detrimental impacts upon the asset and its value.
- Eventually any detrimental impact upon property values becomes indiscernible at a point where the scientific testing verifies environmental factors including such as noise and particulate matter (air quality) do not exceed the relevant criteria determined by the regulators to the extent they have acquisition rights under the VLAMP.
- Amenity issues as arise from real or perceived detrimental impacts including visual intrusion, increased traffic volumes and/or reduced marketability as a consequence of the stigma associated with proximate mining operations are significantly more complicated to assess. Notwithstanding, they may detrimentally impact upon market value, it is difficult to discern a quantum in the absence of comparable sales evidence.
- Our experience of local markets and analysis of sales evidence indicates - at a particular distance from the perceived source of the disruption to amenity – such as a mine operation - where perceptions of a stigma are not real and available sales evidence does not support the proposition that there is a reduction in market value – there is no ability for an expert Valuer to assess a change in market value as a consequence. That is, in the absence of supporting sales evidence it is not possible to accurately discern a detrimental impact upon market value.
- Our experience, supported by analysis of available sales evidence, indicates a perception of stigma does not always translate to a reduction in market value.
- Furthermore, properties which are situated in proximity to a proposed mine – but which are not predicted to be impacted by environmental factors or reduced amenity (to the extent they have acquisition rights under the VLAMP) do not appear to evidence a detrimental impact upon value as a consequence of that proximity. The statistical data of median house prices in Muswellbrook and Property NSW adduced rural land values as well as our independent analysis of available rural sales evidence is supportive of that.
- Therefore, based upon analysis and comparison of the available sales evidence, statutory valuations applied for rating and taxing purposes as well as other statistical data specific to the movement of residential property values in the locality - we draw the conclusion there is nil discernible change in Market Value evident for those rural lifestyle properties surrounding the proposed MCCO Project which could be described as being a consequence of proximity to the proposed mining area.

CONCLUSIONS

Following analysis of statistical data applicable to residential house sales over 14 years as well as investigation and analysis of sales of rural lifestyle properties proximate to mining operations and consideration of Property NSW rural land values for rating and taxing purposes, we have reached the following conclusions in relation to the hypotheses posed.

1. Is it possible to evidence the impact (positive and/or negative) of Mining operations upon the local economy generally and the real estate market specifically – using sales evidence?

It is our experience that the existence of a coal mining operation in proximity to small towns and villages can have a range of impacts upon the market value of real estate, both positive (i.e. beneficial) and negative (i.e. detrimental). It is also our experience that the closer the proximity of a particular property to the actual mining operation, the more direct and accentuated are the negative impacts.

It is difficult, however, to accurately discern the impacts of coal mining upon individual property values as either a percentage of change in market value or a dollar equivalent.

It is our experience that the detrimental impacts of coal mining upon Real Estate values are more likely to be localised or individually evident and a consequence of a particular property's proximity to a mining operation and the detrimental impacts as a consequence of factors such as noise and particulate matter (air quality) and potential consequential health impacts resulting from an exceedance of regulators recommended guidelines (triggering mitigation treatment and/or acquisition rights under the VLAMP) as they relate to occupation or enjoyment of the property, as well as amenity issues as arise from real or perceived detrimental impacts from aspects such as visual intrusion, increased traffic volumes and/or reduced marketability as a consequence of the stigma associated with proximate mining operations.

By comparison, the positive impacts upon Real Estate values as a consequence of coal mining are more broadly experienced by the surrounding community due to factors including; increased employment opportunities, varied/improved skill requirement, enhanced demand for accommodation in general and modern accommodation specifically, demand for improved services, increased spending generally in the community and a generally improved local economy. As a consequence, it is not so easy to discern the positive impact upon a single property. Rather, it is reflected by an enhancement in value generally.

The residential sales data analysed for Muswellbrook over the previous 14 years indicates there is a relationship between operational activities in the mining sector and fluctuations in local Real Estate markets. When the local economy is buoyant and employment prospects are strong, residential Real Estate sales volumes are also strong and values generally increase. Coal mining and ancillary service industries are major contributors to the local economy.

CONCLUSIONS (Cont'd)

2. What impacts are capable of support using available recent sales evidence?

Properties which are situated in proximity to a proposed mine – but which are not predicted to be adversely impacted by environmental factors as exceed regulators criteria to the extent they have acquisition rights under the VLAMP (where such factors exist) or reduced amenity - do not appear to evidence a detrimental impact upon market value as a consequence of that proximity.

The relatively close proximity of Muswellbrook urban development to existing large scale open cut mining operations does not appear to have detrimentally impacted upon the value of residential assets in the town nor the volume of sales.

Since mid 2016, as mining activities strengthened, so did the local residential housing market.

Our analysis of rural lifestyle sales in proximity to mining operations but which are not impacted by environmental factors exceeding regulators criteria, does not indicate a discernible detrimental impact upon market value.

We have reached our conclusions by considering and comparing similar type assets situated in similar localities with similar land classifications, but which are more remote from mining operations.

3. Is it possible to discern - using available recent sales evidence – the scale of impact upon the value of a particular property?

Our analysis of the prevailing market in the Muswellbrook LGA indicates there is no evidence to support the proposition there is a reduction in the market value of rural lifestyle land as a consequence of the proposed MCCOP.

The sales evidence considered does not appear to be adversely impacted by exceedance of regulator criteria and are assumed as such for the purposes of this advice.

We draw particular attention to two rural lifestyle sales (No. 1 and No. 13) in the tables as examples of rural assets which have recorded sale and resale in the previous 3 years and which indicate increasing value notwithstanding they are situated in proximity to mining operations.

The general trend in residential housing, as is depicted in the graph on page 18 of this report, shows a modest increasing value for Muswellbrook and Singleton over the previous 14 years - notwithstanding the urban areas of both towns are in proximity to mining operations.

4. Is there evidence to support a claim that real estate in proximity to a mining operation is unsalable or otherwise devalued?

Sale transactions achieved indicate there is a fluid market for residential assets and rural lifestyle assets in the Muswellbrook LGA generally and the west Muswellbrook localities particularly - where vendors are prepared to meet the market.

CONCLUSIONS (Cont'd)

5. Is it possible to quantify a relationship between proximity to a mining operation and impacts upon property values?

It is our experience that it is not possible for an expert Valuer to accurately discern a change in market value which may be specifically as a consequence of reduced amenity and the perceived stigma associated with proximity to a particular mining operation assuming:

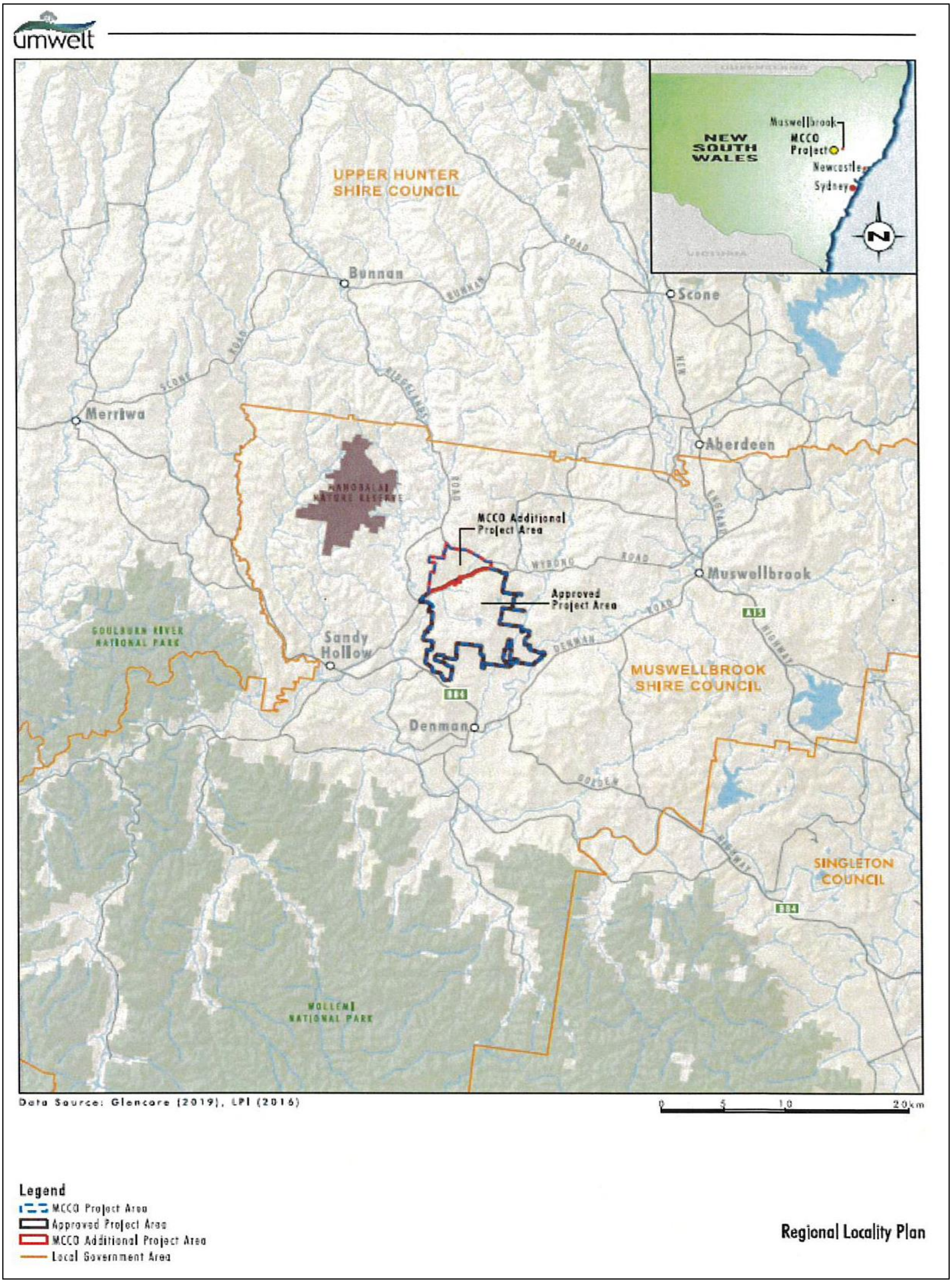
- there would be no need to acquire any property under the VLAMP; and
- the absence of sales evidence to inform discernible change in market value

It is also our experience, that any such impact as may be evident is inversely proportional to proximity to the mining operation. That is, the further removed from the mining operation the land is situated, the less substantial is the detrimental impacts upon the asset and its value.

Eventually any detrimental impact upon property values becomes indiscernible at a point where the scientific testing verifies environmental factors including such as noise and particulate matter (air quality) do not exceed the relevant criteria determined by the regulators to the extent they have acquisition rights under the VLAMP.

MARKET ANALYSIS

Locality Map depicting the existing approved Mangoola project area and the MCCO proposed project area.



MARKET ANALYSIS (Cont'd)

Residential

Residential housing will generally comprise the largest component of total real estate sales when analysing sales evidence of Real Estate transaction in the smaller towns and villages of rural Australia.

As a consequence of the generally higher volume of sales evidence to draw upon (as compared to residential unit sales, commercial sales and/or industrial sales) and the fact that residential houses comprise that component of the broader property market which is most desired and accessible to prospective property purchasers, it also provides the most evident representation of the movement in Real Estate values in a particular locality.

As such, market movement in residential housing is an indicator of the impact of varying factors upon value and may also give an indication of extraordinary factors impacting upon market value in a particular locality at a particular time.

Our considerations of the residential housing market in the Hunter Valley includes residential housing on allotments of up to 1,500m^2 in size which is regarded as a generous allotment for a single home site – even by rural area standards.

Notwithstanding, local and State planning authorities have a desire to effectively incorporate higher density living when planning urban areas, with many recent approvals for housing allotments in rural localities in the Hunter Valley represented in the range 600m^2 – 1,000m^2 per allotment.

Larger towns and cities, however, evidence residential allotment sizes to a minimum of 450m^2 and inner city localities can evidence housing allotments as small as 250m^2 under the prevailing density guidelines.

Singleton and Singleton Heights are influenced by proximate large scale mining operations as well as proximity to the larger population centres of the Lower Hunter Valley including Newcastle and Lake Macquarie.

The opening of the Hunter Expressway in 2014 facilitated a more efficient road connection between Singleton (and the Upper Hunter) to the larger coastal markets of the lower Hunter Valley for services such as accommodation, employment and lifestyle.

Singleton has historically experienced relatively high average income as compared to the rest of NSW and has a relatively high average house value for a small regional centre. Singleton's economy was also historically aligned to that of the larger towns of the mid and Upper Hunter Valley. The Singleton residential market is also historically aligned in respect to demand and value influences and movement in values with local economic impacts as impacted upon the smaller markets of the mid and upper Hunter Valley.

With greater connectivity through road access, Singleton now appears to be increasingly more aligned economically with the larger population centres of the Lower Hunter Valley.

Whereas mining continues as a significant contributor to the Singleton economy, improved transport corridors and ready access to a broader range of services and opportunities has increased the opportunities available to those living in Singleton and choosing to commute to access larger markets.

Those working in the mining industry and who would previously have chosen to live and work in Singleton and Muswellbrook LGA's, can now choose to live in the larger centres of the Lower Hunter Valley and utilise improved road access to commute to work in the mid to upper Hunter Valley.

MARKET ANALYSIS (Cont'd)

Therefore, it appears, whilst a strong mining sector has a significant positive impact upon the smaller local residential and rural lifestyle markets of the towns and villages of the Upper Hunter Valley and has assisted in those markets maintaining and indeed improving sales volumes and values for residential housing over the previous 3 years – Singleton in particular appears to have become more closely aligned economically with the larger population areas of the lower Hunter Valley.

Consequently, it is evidencing similar impacts upon its residential and lifestyle property markets (decline in values and little or nil movement in sales volumes) as have been experienced by the larger population centres of the Lower Hunter Valley.

The statistical data included in the tables following is a record of movement in median sale price for houses in those particular markets in a 12 month period. It is indicative of trends in sale price and sales volumes in those towns and villages.

The relevant data is also represented in a graph (colour coded specifically to each town) and also includes a trend line for house prices applicable to Singleton and Muswellbrook wherein both show a modest incline in house prices over the 14 years.

MARKET ANALYSIS (Cont'd)

Median House Prices and Sales: 2006 – 2019 in Singleton

Village	LGA	Year - 12 months 1/10 - 30/09	No. of Sales	Median House Price	% Increase/ Decrease
Singleton	Singleton	2006	126	$300,000	14.61%
		2007	114	$311,000	4.26%
		2008	95	$308,000	-1.04%
		2009	106	$326,500	6.16%
		2010	104	$341,500	4.48%
		2011	97	$350,500	2.74%
		2012	112	$387,000	10.37%
		2013	88	$391,500	1.13%
		2014	62	$378,000	-3.48%
		2015	48	$340,000	-10.01%
		2016	74	$320,500	-5.80%
		2017	105	$359,204	12.08%
		1/6/2017-31/05/2018	127	$393,800	9.63%
		1/05/2018-30/04/2019	146	$316,209	-19.70%

Source: Residex Pty Ltd, Core Logic RPData and Tew Property Consultants.

Median House Prices and Sales: 2006 – 2019 in Singleton Heights

Village	LGA	Year - 12 months 1/10 - 30/09	No. of Sales	Median House Price	% Increase/ Decrease
Singleton Heights	Singleton	2006	117	$289,500	9.67%
		2007	117	$307,500	7.50%
		2008	98	$321,000	4.51%
		2009	112	$316,000	-1.54%
		2010	95	$348,000	10.12%
		2011	99	$362,500	4.12%
		2012	116	$396,500	9.39%
		2013	71	$389,500	-1.78%
		2014	59	$361,500	-7.24%
		2015	44	$330,000	-8.71%
		2016	64	$330,500	0.21%
		2017	109	$352,532	6.67%
		1/6/2017-31/05/2018	121	$392,476	11.33%
		1/05/2018-30/04/2019	119	$345,446	-11.98%

Source: Residex Pty Ltd, Core Logic RPData and Tew Property Consultants.

MARKET ANALYSIS (Cont'd)

The upper Hunter Valley towns and villages which are also influenced by mining, evidence fluctuating values over the previous three years and generally increased sales volumes over the same period.

This is in contrast to the broader impacts of a residential property slow down and decline in values which prevailed in the majority of locations throughout NSW and indeed in many areas across Australia over the previous 2-3 years.

It is difficult to accurately discern specific reasons attributable to the performance of real estate markets in and around the towns of the mid and Upper Hunter Valley. However, they performed relatively positively in comparison to many smaller towns and villages in regional NSW over the same timeframe.

However, it is reasonable to conclude that a buoyant local economy is a major contributor to the positive performance of the residential housing market and rural lifestyle markets in the described localities and mining is a major contributor to the economy of the Upper Hunter Valley.

It is noteworthy, when interpreting statistical data for the smaller towns such as Denman and Aberdeen, caution should be applied as the relatively small sales volumes may be inordinately influenced by the sale of particular or extraordinary properties.

Notwithstanding the above, Muswellbrook, Singleton, Denman, Aberdeen and Scone each evidenced increased sales volumes and generally positive growth in values for residential Real Estate for the period June 2016 – June 2018 and a decline in values most recently to May 2019.

The increasing sales volumes over the previous 3 years for residential real estate are indicative of a fluid market for Real Estate in close proximity to mining operations with values generally trending upwards over the same timeframe.

MARKET ANALYSIS (Cont'd)

Median House Prices and Sales: 2006 – 2019 in Muswellbrook

Village	LGA	Year - 12 months 1/10 - 30/09	No. of Sales	Median House Price	% Increase/ Decrease
Muswellbrook	Muswellbrook	2006	255	$242,500	8.79%
		2007	272	$247,500	4.01%
		2008	224	$259,000	4.76%
		2009	252	$261,500	0.87%
		2010	274	$287,000	9.90%
		2011	40	$286,500	-0.28%
		2012	292	$324,000	13.05%
		2013	214	$329,000	1.62%
		2014	124	$295,000	-10.28%
		2015	112	$273,000	-7.52%
		2016	160	$259,000	-5.06%
		2017	191	$286,913	10.78%
		1/6/2017-31/05/2018	248	$295,720	3.07%
		1/05/2018-30/04/2019	306	$271,063	-8.34%

Source: Residex Pty Ltd, Core Logic RPData and Tew Property Consultants.

Median House Prices and Sales: 2006 – 2019 in Denman

Village	LGA	Year - 12 months 1/10 - 30/09	No. of Sales	Median House Price	% Increase/ Decrease
Denman	Muswellbrook	2006	28	$209,500	10.25%
		2007	32	$247,000	8.10%
		2008	30	$262,000	6.13%
		2009	26	$267,500	2.10%
		2010	3	$294,000	9.79%
		2011	-		
		2012	26	$400,000	-1.18%
		2013	26	$337,500	6.25%
		2014	9	$319,500	-5.28%
		2015	13	$287,500	-10.00%
		2016	15	$283,000	-1.61%
		2017	31	$318,196	12.44%
		1/6/2017-31/05/2018	32	$310,610	-2.38%
		1/05/2018-30/04/2019	38	$317,345	2.17%

Source: Residex Pty Ltd, Core Logic RPData and Tew Property Consultants.

MARKET ANALYSIS (Cont'd)

Median House Prices and Sales: 2006 – 2019 in Scone

Village	LGA	Year - 12 months 1/10 - 30/09	No. of Sales	Median House Price	% Increase/ Decrease
Scone	Upper Hunter	2006	88	$255,500	13.26%
		2007	104	$283,500	5.30%
		2008	86	$278,000	-1.87%
		2009	89	$295,500	6.17%
		2010	88	$308,500	4.54%
		2011	116	$311,500	0.91%
		2012	146	$344,500	10.64%
		2013	118	$365,500	6.08%
		2014	82	$359,000	-1.86%
		2015	62	$339,500	-5.39%
		2016	82	$314,000	-7.57%
		2017	132	$327,584	4.33%
		1/6/2017-31/05/2018	149	$338,041	3.19%
		1/05/2018-30/04/2019	165	$315,504	-6.67%

Source: Residex Pty Ltd, Core Logic RPData and Tew Property Consultants.

Median House Prices and Sales: 2006 – 2019 in Aberdeen

Village	LGA	Year - 12 months 1/10 - 30/09	No. of Sales	Median House Price	% Increase/ Decrease
Aberdeen	Upper Hunter	2006	43	$193,500	12.71%
		2007	45	$203,500	6.07%
		2008	33	$223,500	9.85%
		2009	37	$247,500	10.81%
		2010	29	$262,500	6.05%
		2011	41	$265,000	0.96%
		2012	41	$294,000	10.90%
		2013	45	$321,500	9.44%
		2014	27	$299,500	-6.88%
		2015	18	$280,000	-6.52%
		2016	22	$262,000	-6.37%
		2017	41	$290,285	10.80%
		1/6/2017-31/05/2018	44	$275,787	-4.99%
		1/05/2018-30/04/2019	51	$241,058	-12.59%

Source: Residex Pty Ltd, Core Logic RPData and Tew Property Consultants.

MARKET ANALYSIS (Cont'd)

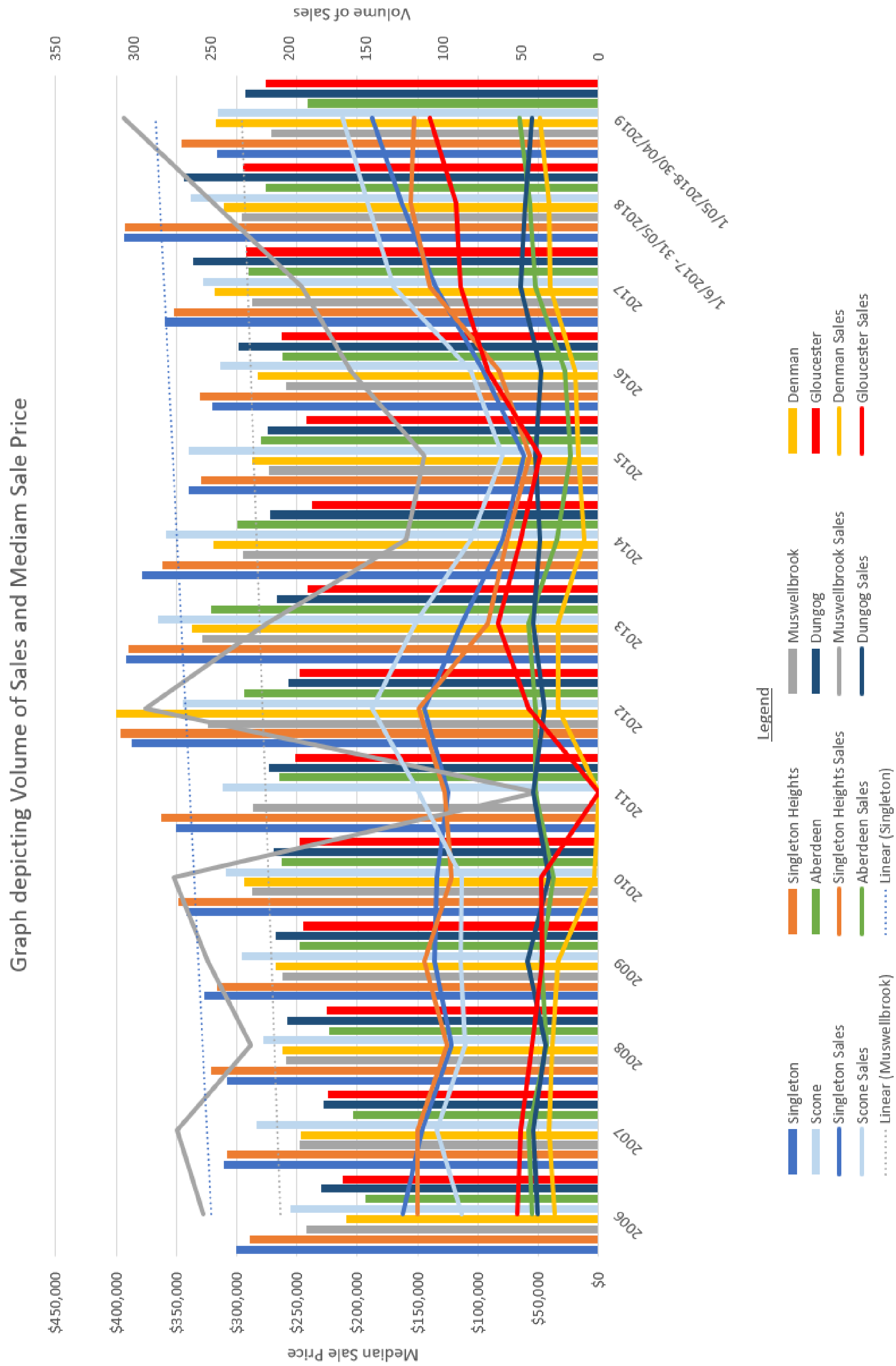
Other Towns and Villages - 2006 – 2019

Village	LGA	Year - 12 months 1/10 - 30/09	No. of Sales	Median House Price	% Increase/ Decrease
Dungog	Dungog	2006	39	$229,500	3.64%
		2007	42	$228,500	4.70%
		2008	34	$258,500	13.06%
		2009	46	$267,500	3.53%
		2010	32	$269,500	0.72%
		2011	42	$273,500	1.50%
		2012	35	$257,000	-6.00%
		2013	42	$267,000	3.78%
		2014	38	$272,000	2.02%
		2015	41	$274,000	0.59%
		2016	37	$298,500	8.97%
		2017	50	$335,951	12.55%
		1/6/2017-31/05/2018	47	$343,393	2.22%
		1/05/2018-30/04/2019	43	$293,365	-14.57%
Gloucester	Gloucester	2006	52	$212,000	4.11%
		2007	50	$224,500	4.64%
		2008	43	$225,000	0.13%
		2009	36	$245,000	8.87%
		2010	37	$248,000	1.25%
		2011	44	$252,000	1.72%
		2012	45	$247,500	-1.80%
		2013	65	$241,500	-2.52%
		2014	50	$237,000	-1.81%
		2015	38	$242,000	2.13%
	MidCoast	2016	71	$263,000	8.55%
		2017	89	$292,026	11.04%
		1/6/2017-31/05/2018	92	$294,346	0.79%
		1/05/2018-30/04/2019	109	$276,407	-6.09%

Source: Residex Pty Ltd, Core Logic RPData and Tew Property Consultants.

MARKET ANALYSIS (Cont'd)

The thin horizontal coloured lines in the graph below represent the movement in sales volume over the period. The vertical coloured bars represent the median house price each annum. The graph depicts movement which is generally aligned with the fluctuations in the mining sector over the previous 14 years. A trend line for both Singleton and Muswellbrook shows modest growth across the period.



MARKET ANALYSIS (Cont'd)

Rural lifestyle

We have investigated and analysed a number of rural lifestyle sales situated in close proximity to existing coal mining operations within the Muswellbrook LGA generally and in particular in the west Muswellbrook localities.

Where those sales have been purchased by coal mining companies but have been purchased following active marketing by a licensed Real Estate Agent, we have described as much as well as our considerations of other factors relevant to the sale.

The below sales are indicative of sales of rural lifestyle properties in proximity to existing mining operations.

The sample of sales evidence analysed and recorded below are indicative of a broader range of rural sales of rural lifestyle assets in proximity to mining operations recorded from January 2017.

Amongst a range of sales investigated for the purposes of this advice, we have included two rural lifestyle sales within in the tables following (Sale 1 and Sale 13) which are situated in close proximity to mining operations and which evidence sales transactions between private citizens (sale and resale at close intervals) - the first transaction in each case occurring in 2016 and a subsequent sale transaction occurring in 2019. In each case the subsequent sale represents an increase in value.

They are indicative of a fluid market for varying rural lifestyle assets situated in varying locations proximate to mining – in circumstances where vendors are prepared to meet the market.

Property NSW land values for rating and taxing purposes applicable to rural properties in the Muswellbrook LGA for the 2018 base year evidences a range of impacts from nil change up to 28% increase in a single year for particular assets.

More generally however, our investigation of land values assigned to rural properties by Property NSW and utilised for rating and taxing purposes, indicates rural land values increased quite modestly over the year to base year 1 July 2018.

The NSW Valuer General in its media release (dated 20 June 2018) in respect to rural land values in the Muswellbrook LGA wherein it represented the average movement in rural land values for rating and taxing purposes across the LGA as occurred between 2017 – 2018 was 4.0% growth in values.

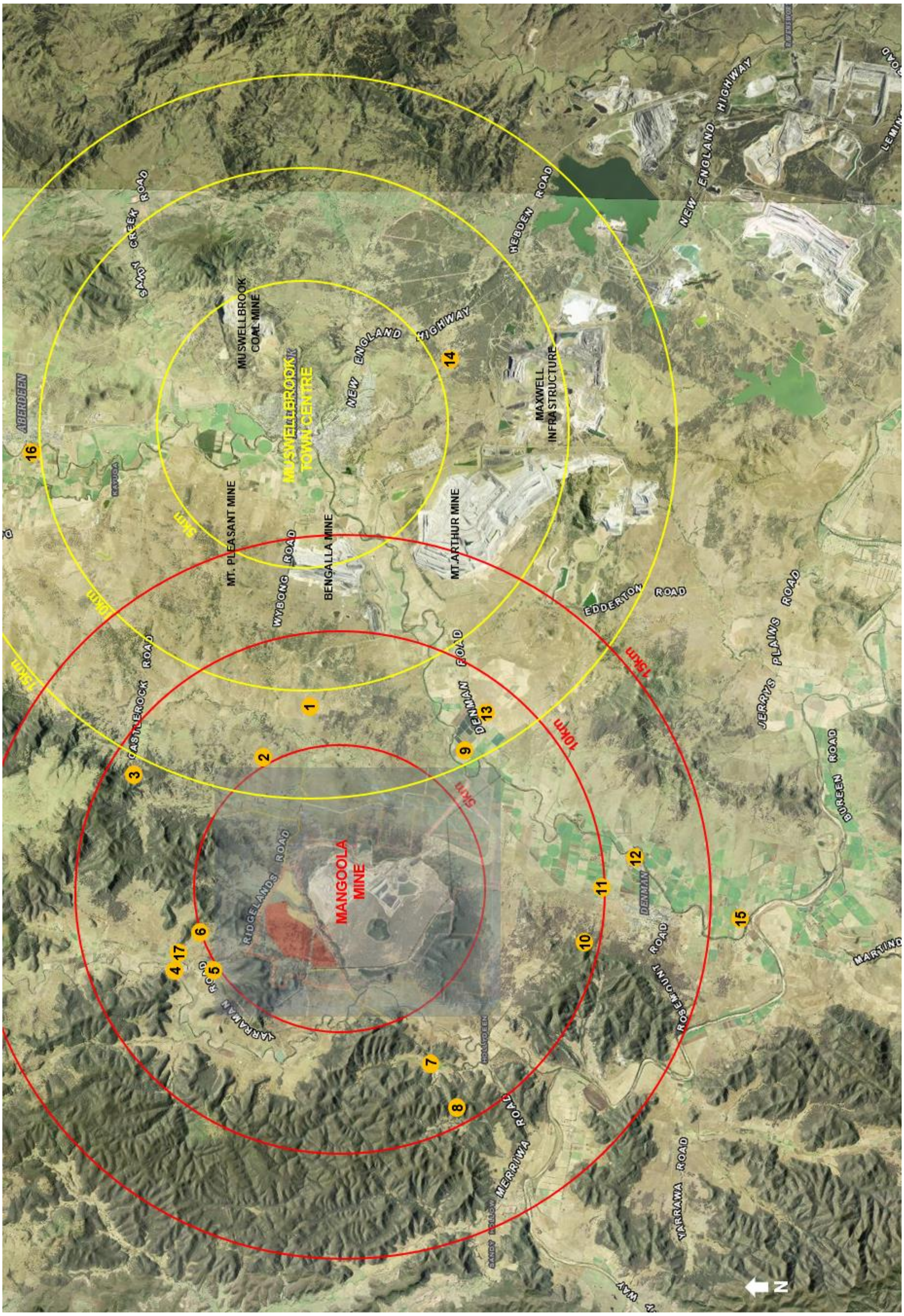
A subsequent report published for the Muswellbrook LGA, represented rural land values increased - on average - by some 1.7% for the year.

Notwithstanding it represents growth in land values assigned for that purpose, the 2017-2018 year is a reduced growth factor as compared to that represented in a report by the Valuer General's contractor for Muswellbrook LGA for the 2016 - 2017 base year which represented growth in rural land values in the range 4% - 10% to base date 1 July 2017.

MARKET ANALYSIS (Cont'd)

The below image depicts Muswellbrook Urban Centre, proximate large scale mining and rural localities in relation to Mangoola Mine in particular and the location of rural lifestyle sales as is aligned to the corresponding numbers in the sales tables later in this report.

The concentric circles delineated on the image are at 5km intervals and evidence the close proximity of relevant large scale mining operations to Muswellbrook's town centre and urban development as well as the general rural landscape surrounding the existing Mangoola Mine.



MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
1	1431 Wybong Road, Castle Rock Lot 21 DP736827 Private purchaser	Jun 2019	$685,000 (Previous sale 6/2016 for $650,000)	27.00	Rural lifestyle property providing gently undulating cleared land with broad road frontage and land. Property features single level weatherboard and colorbond clad residential dwelling, constructed circa 2014. Advertised as 5bed, 2bath Property also features large machinery shed with five roller doors and mezzanine/flat, machinery shed with 3 roller doors, workshop and small shed. Additions include 5 water tanks (approx.. 27,000L/tank each), dam and established fencing. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 5.2km west of Bengalla mine and approximately 6.7km east of Mangoola Mine Reflects a 5.3% increase in value over the previous recent sale. Improvements: $350,000 Land: $335,000	$25,370	$12,407
2	1821 Castlerock Road, Castle Rock Lot 212 DP634465 Mining company purchase	Sep 2018	$750,000	61.37	Comprises cleared grazing land rising up from gently undulating creek flats to undulating cleared grazing. Bisected by small creek. Direct road frontage and comprises large 1960's style cottage which has been added to over recent years, garage/machinery shed, annexed laundry, dilapidated stables/storage, cattle yards, equipped well, rudimentary training track for trotters. Purchased by proximate mining company at negotiated price – market value considerations under no obligation to purchase. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 7.7km northwest of Bengalla Mine and approximately 5.0km northeast of Mangoola Mine Improvements: $250,000 Land: $500,000	$12,220	$8,147

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
3	1216 Castlerock Road, Castle Rock Lot 1 DP715310 Lot 140 DP750915 Mining company purchase	Jun 2019	$895,000	188.50	Large rural lifestyle property providing undulating to steep undulating country which has been selectively cleared towards the road frontage and which rises to timbered slopes and steep timbered ridges. There is a large area of undulating partly cleared land on a plateau above the escarpment which is accessible only via adjoining land. Timbered slopes and ridges = 158.5ha Property comprises an elevated weatherboard and colorbond clad residential dwelling, 3bed, 2bath as well as a large machinery shed with 8 bays and carport. Additions include above ground swimming pool, solar heating, steel cattle yards and dams. 2nd dwelling only part completed. The property was marketed for sale. Purchased by proximate mining company at negotiated price – market value considerations under no obligation to purchase. Zoned RU1 Primary Production & E3 Environmental Management – Muswellbrook LEP 2009 Property is situated approximately 10.9km northwest of Bengalla Mine and approximately 8.8km northeast of Mangoola Mine Improvements: $285,000 Land: $610,000	$4,773	$3,236
4	11 Powers Road, Manobalai Lot 1 DP252956 Private purchaser	Feb 2017	$495,000	51.56	Gently undulating to steep undulating irregular shaped rural property with cleared gently undulating creek flats and frontage to Wybong Creek. The land is bisected by Powers Road. Property comprises an unfinished metal deck clad, and metal roofed single story residential dwelling assumed to comprise 3bed, 1bath. Carport attached. Elevated outlook. Property also features a 3 bay "Dutch" barn and two stables – each with day yards. Zoned E3 Environmental Management – Muswellbrook LEP 2009 Property is situated approximately 6.8km northwest of Mangoola Mine Improvements: $195,000 Land: $350,000	$9,581	$6,788

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
5	31 Yarraman Road, Manobalai Lot 7 DP252956 Mining company purchase	Jul 2019	$700,000	55.52	Gently undulating to undulating irregular shaped rural property with cleared gently undulating grazing and rising to a timbered knoll along the eastern boundary. Corner site has frontage to Ridgelands Road also. Property comprises a raised weatherboard and colorbond clad residential dwelling 3bed, 1bath, 2car and machinery sheds. Additions include inground swimming pool, concrete water tanks and dams. Access to Wybong Creek and 27 units water entitlement form Wybong Creek. Established landscaping. Purchased by proximate mining company at negotiated price – market value considerations under no obligation to purchase. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 5.3km northwest of Mangoola Mine Improvements: $255,000 Land: $445,000 (including water)	$12,608	$8,015
6	840 Ridgelands Road, Manobalai Lot 32 DP848496 Private purchaser	Apr 2017	$520,000	47.33	Sloping irregular shaped rural property with cleared gently sloping grazing and rising to selectively cleared grazing slopes and a small timbered knoll towards the eastern boundary. Property comprises a weatherboard and corrugated iron clad detached single story dwelling, circa 1980's style 4bed, 1bath, double car port and large machinery shed with 4 open bays. Additions include 2 dams and 2 concrete water tanks. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 5.2km northwest of Mangoola Mine Improvements: $200,000 Land: $320,000	$10,986	$6,761

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
7	3062 Wybong Road, Hollydeen Lot 101 DP1216951 Private purchaser	Oct 2018	$289,000	45.30	Large gently undulating predominantly cleared rural grazing block. Bisected by Reedy Creek and impacting upon utility of the land. Elevated home site situated towards road frontage. Zoned RU1 Primary Production & E3 Environmental Management – Muswellbrook LEP 2009 Property is situated approximately 7.9km south-west of Mangoola Mine Improvements: Nil Land: $289,000	N/A	$6,379
8	3320 Wybong Road, Hollydeen Lot 2 DP1060290 Private purchaser	Sep 2017	$320,000	57.26	Heavily timbered undulating to steep undulating bush block. Small undulating partly cleared area towards road frontage facilitating dwelling curtilage. Relocated 1950's style dwelling situated on site. Appears to require significant works to complete. Part renovated brick and weatherboard clad residential dwelling 3bed. Property also features small cottage, 10,000 L holding tank & two 1,000 L PVC water tanks, septic and shed with 3 roller doors. There is a solar system and back battery storage included in the sale. Zoned RU1 Primary Production & E3 Environmental Management – Muswellbrook LEP 2009 Property is situated approximately 9.5km southwest of Mangoola Mine Improvements: $120,000 Land: $200,000	$5,588	$3,492

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
9	1461 Denman Road, Denman Lot 3 DP215827 Private purchaser	May 2017	Understood to total $700,000 including water entitlements (RPData recorded as $450,000)	43.71	Irregular shaped parcel of gently undulating alluvial river flats and approximately 430m river frontage. Property appears to include a center pivot irrigator on the river front and a registered 108ML of water entitlement from the hunter River. NSW Water Register Approval 20CA200307 – WAL578 Domestic and Stock – 8ML (includes additional lots) Approval 20CA204071 – WAL15499 Regulated River (General Security) – 100ML (includes additional lots) Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 6.8km south east of Mangoola Mine Water 108ML @ $2,000/ML = $216,000 Improvements: Nil Land: $484,000	$16,015	$11,072
10	421 Merriwa Road, Denman Lot 22 DP750924 Private purchaser	Mar 2018	$170,000	30.45	Heavily timbered, elongated undulating to steep bush block. Comprises a new insulated colorbond shed including a combustion fire. Dated one bedroom cabin with kitchen and bathroom. Zoned E3 Environmental Management – Muswellbrook LEP 2009 Property is situated approximately 9.2km south of Mangoola Mine Improvements: $50,000 Land: $120,000	$5,582	$3,940

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
11	20 Mangoola Road, Denman Lot132 DP587046 Private purchaser	Sep 2017	$700,000	30.85	Gently undulating cleared river flats – situated opposite rail line. Cleared and fenced grazing land bisected by small creek. Small area towards road frontage is irrigated and cropped. Includes 128ML Bore water entitlement WAL18221 - Aquifer entitlement Regulated Hunter River alluvial water source. Property comprises a two level weatherboard and colorbond clad detached dwelling circa 1970's style 5bed, 3bath. Property also includes hardiplank and colorbond clad storage shed, 5 x PVC water tanks (approx. 27,000L each) and a large open bay machinery shed. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 10.0km south of Mangoola Mine, 15km south west of Mt. Arthur Mine and just north of Denman Water: $500/ML = $64,000 Improvements: $200,000 Land: $436,000	$22,690	$14,132
12	Lot 2 Denman Road, Denman Lot 2 DP1191139 Private purchaser	Mar 2018	Understood to be $1,100,000 including water entitlements (RPdata records Real estate only as $912,500)	32.06	Small rural property with cleared and fenced river flats suitable for irrigation and approximately 1.2km of river frontage. Property comprises a single level dilapidated weatherboard and corrugated iron clad residential dwelling, constructed circa 1930's style – approx. 80sqm. Property also features a 3 bay steel frame hay shed in poor condition, large 2 bay machinery shed, weatherboard and corrugated iron clad bunkhouse/granny flat and centre pivot irrigation. NSW Water Register Approval 20CA201314 – WAL13378 Regulated River (General Security) – 75ML Approval 20CA212862 - Bore Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 11.5km south of Mangoola Mine, 14.4km south west of Mt. Arthur Mine and just east of Denman Water: $2,000/ML = $150,000 Improvements: $250,000 Land: $700,000	$34,310	21,834

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
13	400 Denman Road, Denman Lot400 DP791860 Private purchaser – intercompany transfer.	Apr 2019	$365,000 (Previous sale 9/2016 for $320,000)	40.00	Cleared and fenced grazing block assumed to have a positive prospect of a dwelling entitlement. Rising up from road frontage. Dam on site. Appears to have a dated center pivot on site which is assumed as nil added value. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 8.3km southeast of Mangoola Mine, 7.0km west of Mt. Arthur Mine and 8.5 south west of Bengalla Mine. Reflects a 14.06% increase in value over the previous recent sale. Improvements: Nil Land: $365,000	N/A	$9,125
14	132 Balmoral Road, Muswellbrook Lot 19 DP249301 Private purchaser	Oct 2017	$400,000	10.15	Small rural hobby block gently undulating predominantly cleared land bisected by a small creek towards rear. Incudes rural style post and wire boundary fencing and small holding paddocks fenced with electrified ribbon. Property comprises a small, single level VJ panel and metal deck clad residential dwelling, constructed circa 1980's style. 2bed, 2bath, double car port. Property also features 3 dams, storage shed and creek. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 9.7km southeast of Bengalla Mine and 6.7km east of Mt. Arthur Mine Improvements: $150,000 Land: $250,000	$39,409	$24,305

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
15	420 Dalswinton Road, Dalswinton Private purchaser	Dec 2017	$1,525,000	117.14	Predominately cleared undulating parcel providing frontage to the Hunter River and Goulburn River (at their confluence). The land rises up from road frontage before sloping markedly down to river flats. Comprises alluvial river flats rising to lighter sandy loams (red basalt type). Elevated land is approximately 50ha. Parts of the flats are flood liable. Previously utilised for fodder production on the river flats and general grazing above. We understand the flats are developed for irrigation (it is assumed the condition of underground mains and risers is operative - a center pivot irrigator for the flats is included into the sale). Irrigation entitlement of 243ML. The improvements include a WB/CGI clad dwelling in poor condition, detached shed and other outbuilding all of which appear to be dilapidated. Purchased by proximate owner to be used in conjunction with other land. Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 15.8km south of Mangoola Mine and 18.5km south west of Mt. Arthur Mine Water entitlement 243ML @ $2,000/ML = $486,000 Improvements: $100,000 Land: $939,000	$8,869 (ex water)	$8,016
16	63 Blairmore Lane, Aberdeen Private purchaser	Feb 2018	$1,770,000 (incl water)	54.45	Gently undulating river flats with broad frontage to the Hunter River and vehicle access is off Blairmore Lane and via a formed access road over adjoining properties. Comprises two dated dwellings (one is dilapidated and other is in poor condition), small storage/pump housing, 2 x steel framed metal clad farm sheds each with earth floor an older timber framed shed and a former dairy and small set of cattle yards. Includes 2 x centre pivot irrigators, pump on the river, 200mm underground mains, town water is connected, power is available and connected to all structures. Motivated vendor influence. Property is situated approximately 8.0km north of Mt Pleasant Mine and 12.2km north of Bengalla Mine There is 189ML of general Security River water. Analysed as Improvements $ 320,000 Portable Water $ 425,250 Land value (TFW) $1,024,750	$32,506 ($24,696 / ha ex water)	$18,820

MARKET ANALYSIS (Cont'd)

Sales Evidence – Rural Properties

Map No.	Address	Sale Date	Sale Price	Area (ha)	Comment	Rate/ha Improved	Vacant Land - Rate/ha TFW
17	861 Ridgelands Road, Manobalai Lot 15 DP252956 Private purchaser	Jul 2019	$540,000	9.88	Cleared gently undulating rural hobby block. Property comprises a single level weatherboard and colorbond clad residential dwelling, constructed circa 1980's style. 3bed, 2bath, 2LUG+2CP (detached). Property also features ceiling fans, ducted and wall mount a/c, combustion fireplace, steel cattle yards, detached open bay machinery shed and detached entertainment are/flat. Provides frontage to Wybong Creek Zoned RU1 Primary Production – Muswellbrook LEP 2009 Property is situated approximately 6.5km north west of Mangoola Mine and 16.3km west of Bengalla Mine Water Licence 20CA202536 (diversion works pump) – WAL7287 – Unregulated River Wybong Creek Water Source – 72ML 20CA202676 (diversion works – pump) – WAL6310 & 6311 – Domestic and stock Wybong Creek Water Source 17.5ML 20WA202560 (diversion works – pump) – WAL9342 – domestic and stock Wybong Creek water source – 5ML Improvements $230,000 Portable Water $ 70,000 Land value (TFW) $240,000	$54,656	$24,291

The advice and report have been compiled by us and relies upon our specific instructions, representations by various parties, and information gathered from a range of relevant sources.

The investigations, enquiries and inspections necessary to confirm such matters, as are the province of others having the appropriate and necessary skills have not been undertaken by us. If the information so furnished to us, or our assumptions based on that information, are incorrect, our opinion as to the value assigned may be affected.

This advice is current as at the date of the advice only. The values assessed herein may change significantly and unexpectedly over a relatively short period (including as a result of general market movements or factors specific to the particular property). We do not accept liability for losses arising from such subsequent changes in value. Without limiting the generality of the above comment, we do not assume any responsibility or accept any liability where this valuation is relied upon after the expiration of 3 months from the date of the valuation, or such earlier date if you become aware of any factors that have any effect on the valuation.

This Report has been prepared specifically and confidentially under instructions from Mangoola Coal Operations Pty Limited, Private Mail Bag 8, SINGLETON NSW 2330 and can be relied upon by Mangoola Coal Operations Pty Limited for the described purposes.

This valuation is for the use only for the purposes described and is for no other purpose.

No responsibility is accepted to any third party who may use or rely on the whole or part of the contents of this valuation.

Neither the Valuer, the Firm, its Directors nor other employees have any direct or indirect pecuniary interest in the property being valued, the owner or agent or any other person or entity involved in the property or proposal.

Liability limited by a scheme approved under Professional Standards Legislation.

TEW PROPERTY CONSULTANTS

RW TEW AAPI MRICS
Certified Practising Valuer

5 November 2019

Mangoola Coal Operations Pty Limited
C/- Mr. Brian Pease
Coal Assets Australia
Glencore Coal (NSW) Pty Ltd
Private Mail Bag 8
SINGLETON NSW 2330

Dear Brian,

Re: MANGOOLA COAL CONTINUED OPERATIONS PROJECT (MCCOP) – PROPERTY ANALYSIS – RESPONSE TO OBJECTION SUBMISSIONS

In accordance with your instructions, Knight Frank Newcastle (KFN) has undertaken a critical review of the hypotheses proposed and associated response to said hypotheses in the report prepared by Tew Property Consultants dated 25 October 2019. The hypotheses proposed in the report are as follows:

1. **Is it possible to evidence the impact (positive and/or negative) of Mining operations upon the local economy generally and the real estate market specifically – using sales evidence?**

2. **What impacts are capable of support using available recent sales evidence?**

3. **Is it possible to discern – using available recent sales evidence – the scale of impact upon the value of a particular property?**

4. **Is there evidence to support a claim that real estate in proximity to a mining operation is unsalable or otherwise devalued?**

5. **Is it possible to quantify a relationship between proximity to a mining operation and impacts upon property values?**

KFN's response and review of the above hypotheses is as follows:

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PO Box 2020 Dangar NSW 2309
www.knightfrank.com.au enquiries.newcastle@au.knightfrank.com
Newcastle Corporate Real Estate Services Pty Limited, trading as Knight Frank Newcastle, ABN 48 962 509 406

1. **Is it possible to evidence the impact (positive and/or negative) of Mining operations upon the local economy generally and the real estate market specifically – using sales evidence?**

   Following review of the Tew report whereby the author provides context around the positive and negative impacts of mining operations, KFN is in agreeance with this statement. In relation to the negative impacts, in our experience it is very difficult to ascertain percentage changes in market values the closer the proximity of an individual property is to a mining operation. The market evidence detailed in the Tew report, along with evidence analysed from our own investigations does not show a discernible trend in higher or lower market values depending upon the proximity to mining operations.

   In relation to the positive impacts, we are generally in agreeance with the Tew report. Mining operations in townships such as Muswellbrook provide economic benefit to the local economy by way of increased discretionary and non-discretionary spending within the town. Unlike many rural and regional centres across NSW, Muswellbrook and Singleton generally have higher median household incomes, which is a direct result of proximate mining operations.

   Specifically, in relation to the real estate market we agree with the Tew report that mining operations enhance demand for accommodation in general. We further note that during times of prosperity in the mining industry, towns such as Muswellbrook enjoy higher median house values and low rates of residential vacancies.

2. **What impacts are capable of support using available recent sales evidence?**

   We are in agreeance with the Tew report rationale in this instance. We have reviewed the sales evidence of rural lifestyle properties provided in the Tew report and compared these sales to similar lifestyle holdings in localities removed from mining operations. Whilst other factors such as proximity to services, and climatic conditions associated with location come in to play, we are of the opinion that there is not a discernible trend to suggest that rural lifestyle properties with proximity to mining operations (not impacted by environmental factors exceeding regulation guidelines) are negatively impacted.

3. **Is it possible to discern – using available recent sales evidence – the scale of impact upon the value of a particular property?**

   The sales evidence provided within the Tew report along with further research of the local market suggest that there is no reduction in the market value of rural lifestyle property as a consequence of the proposed MCCOP. In this instance we agree with the Tew report.

4. **Is there evidence to support a claim that real estate in proximity to a mining operation is unsalable or otherwise devalued?**

   Our findings in this instance resulted from analysis of sales evidence detailed in the Tew report along with additional investigations of sales data around the proposed MCCOP project. Our discussions with local real estate agents indicate that the market for rural lifestyle property is liquid with no known evidence of unsalable assets resulting from mining operations.

5. **Is it possible to quantify a relationship between proximity to a mining operation and impacts upon property values?**

   We agree with the Tew report in this regard. Whilst there is evidence in the market to support a detrimental impact on property values as a result of mining operations, this detrimental impact is concentrated to areas whereby factors such as air quality and noise exceed the environmental standards and criteria set by the regulatory authorities.

   In our investigations we were unable to identify a discernible detrimental value trend in locations whereby scientific testing verifies that factors such as noise and air quality do not exceed regulator criteria.

Thank you for your instructions in this matter. Please find enclosed our invoice for your attention.

Yours sincerely

Yours sincerely

Matthew Shaw, AAPI
Partner
Valuation & Advisory
API Member No. 17321
Certified Practising Valuer
Matt.Shaw@au.knightfrank.com
D+ 61 (0) 2 4920 5707

APPENDIX 12

Private Landholder Bore Assessments

Australasian Groundwater
and Environmental Consultants Pty Ltd
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Bowen Hills, QLD 4006 Australia

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JT:ak
G1839Z Private Landholder Bore Census
11 December 2019

Attention:
Daniel Sullivan

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

via email
dsullivan@umwelt.com.au

Dear Daniel,

RE: MCCO Project - Private Landholder Bore Assessments

1 Introduction

Mangoola Coal Operations Pty Limited (Mangoola) operates the Mangoola Coal Mine, which is located about 20 km west of Muswellbrook and 10 km north of Denman in the Hunter Valley, NSW. Mangoola is currently responding to submissions on its proposal to extend the mining area to the north of Big Flat Creek known as Mangoola Coal Continued Operations Project (MCCO Project). Three landholders adjacent to the proposed mining area have provided submissions requesting further information on the potential for their water bores to be affected by the MCCO Project. Umwelt (Australia) Pty Limited, who has been engaged to manage the approvals process on behalf of Mangoola, engaged Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to undertake an assessment of their bores and assist in providing a response to these submissions from the landholders.

2 Objectives and scope of work

The objective of the engagement was to gather further information on the landholder's bores and determine the potential for the bores to be impacted by the MCCO Project. To achieve this objective the scope of work included:

1. Inspecting each bore to gather information on location and usage;
2. Collecting a water sample from each bore for laboratory analysis of water quality; and
3. Using the MCCO numerical modelling to estimate drawdown at the bore,

The results of each of these tasks are described further in the sections below.

3 Private bore inspections

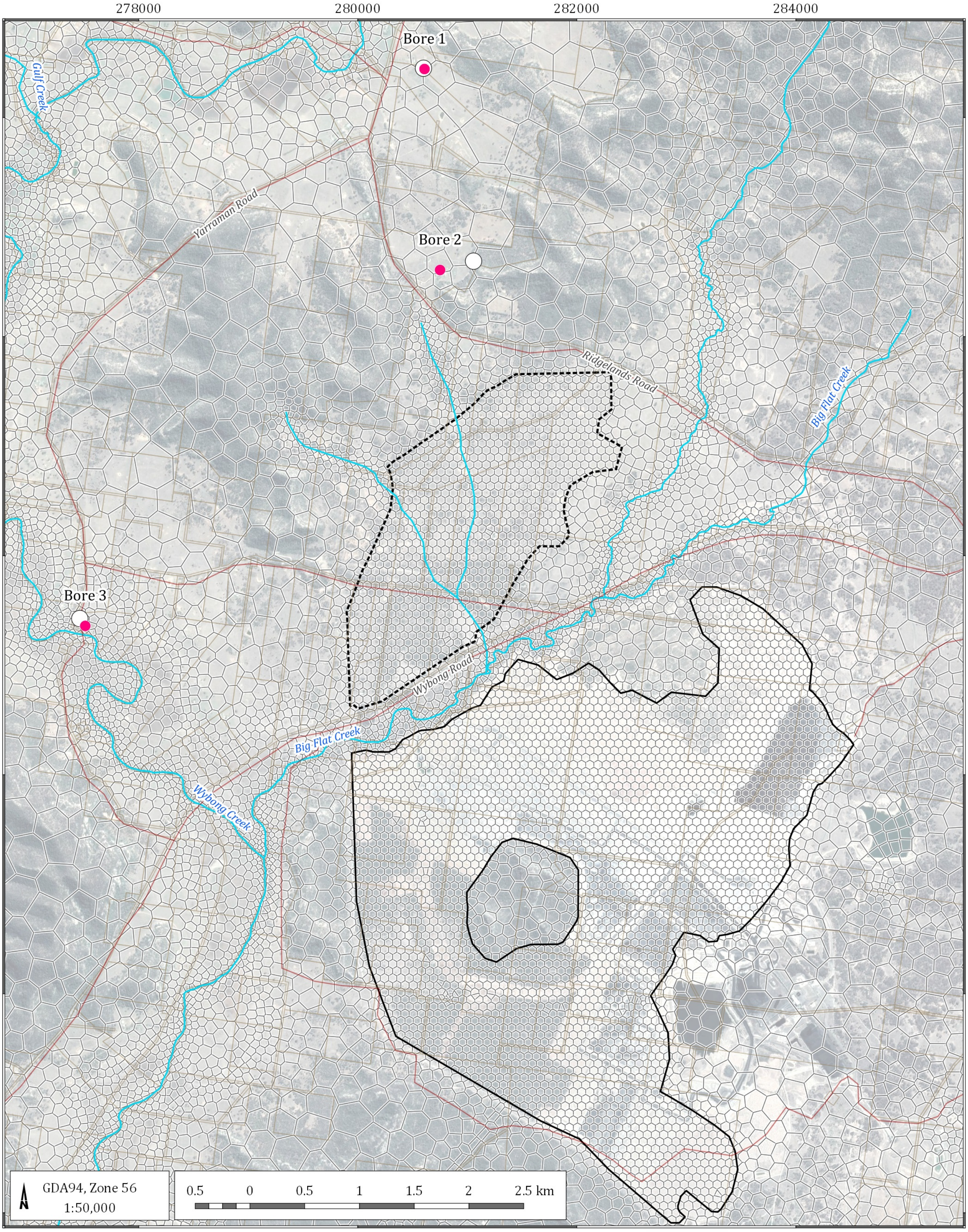
Three property owners provided submissions about the potential for their water bores to be impacted by the MCCO Project as follows:

- Residence 261 - Bore 1;
- Residence 157 - Bore 2; and
- Residence 130 - Bore 3.

A representative of AGE and Mangoola visited each property accompanied by the respective landholders on 23 October 2019. The purpose of the site visits was to:

- locate each bore using a hand-held GPS;
- interview each landholder on the bore details and their water use;
- measure the depth to the water table in each bore and the bore depth; and
- collect a water sample for laboratory analysis.

Information provided by each landholder on their bores is summarised in Table 3.1. The location of each bore, and the location used in the EIS MCCO numerical model are shown on Figure 3.1.



LEGEND

- Inspected bore locations*
- Bore location in MCCO EIS
- Drainage
- Road
- Property boundaries
- MCCO EIS Model Mesh
- Approved Mangoola Coal Mining Area
- Proposed Additional Mining Area

* size of the marker may obscure the exact location of the bore

Mangoola RTS (G1839Z)

Private landholder bore locations

AGE

DATE 02/12/2019

FIGURE No: **3.1**

Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
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Table 3.1 Private landholder bore information

Bore Information	Bore 1	Bore 2	Bore 3
Property	Residence 261	Residence 157	Residence 130
Easting#	0280609	0280751	0277511
Northing#	6432443	6430608	6427358
Drill Date	2018	2011	Unknown*
Purpose	Stock and domestic	Stock and domestic	Stock and domestic
Total depth (m)	94	85	30
Pump depth (m)	84	80	25
Water level (mbgl)	Unable to measure**	Unable to measure**	14.58
Yield during development (L/s)	1.4	6-7	Unknown^^
Yield (currently)	2^	1.5	Unknown
Pump	Electric submersible	Electric submersible	Windmill
Sampled for laboratory analysis	Yes	Yes	Grab only
Electrical conductivity (µS/cm)	12,720	4,112	3,753
pH	6.86	7.27	7.15
Temperature (Celsius)	20.6	21.1	21.9

Note: *# GDA94, MGA Zone 56*
** Present on property at time of acquisition (1999)*
*** Unable to measure due to sealed headworks*
^ Pumps bore dry (requiring 30 minute recovery – landholder information)
^^ Not enough wind to pump and estimate

4 Water quality analysis

Water samples were pumped from Bores 1 and 2 and stored in laboratory supplied sample bottles for transport to the analytical laboratory. A sample could not be pumped from Bore 3 as there was no wind at the time of the inspection. The results of water quality analyses for Bores 1 and 2 are attached. The laboratory analyses indicate the groundwater from Bore 1 and Bore 2 is not suitable for human consumption based on salinity. The salinity of the water sample from Bore 1 indicates a potential for loss of production and a decline in beef cattle condition and health. Bore 2 is suitable for a wide range of stock watering.

5 Numerical Modelling

Figure 3.1 shows the location of each bore measured with a handheld GPS and the location previously assumed during the MCCO EIS. The figure shows the actual locations are slightly different to those represented in the MCCO EIS numerical model. The updated bores locations were used to recalculate the drawdown at each revised location using the MCCO numerical model. The predicted maximum drawdown at each bore is provided in Table 5.1.

Table 5.1 Private bore predicted cumulative drawdown

Bore ID	Total depth (m)	Pump depth (m)	SWL (mbgl)	Model layer at pump depth	Predicted maximum drawdown (m)	
					MCCO EIS	Updated based on site visit
Bore 1	94	84	N/A (Sealed headworks)	4	-	0.182
Bore 2	85	80	N/A (Sealed headworks)	4	3.1	1.296
Bore 3	30	25	14.58	4	-	0.008

The MCCO EIS assumed Bore 3 was 58 m deep, with the inspection indicating the bore has a depth of 30 m. The bores depth was updated in the MCCO numerical model to occur within model layer 4.

Predicted water levels for each bore over time are provided in Figure 5.1 to Figure 5.3. Predicted groundwater levels are for:

- No approved mining or MCCO Project.
- Approved mining only.
- Both approved mining and MCCO Project.

Two graphs are provided for each bore. The first with the predicted water level compared to the pump depth, and the second at a smaller scale where water level trends are evident.

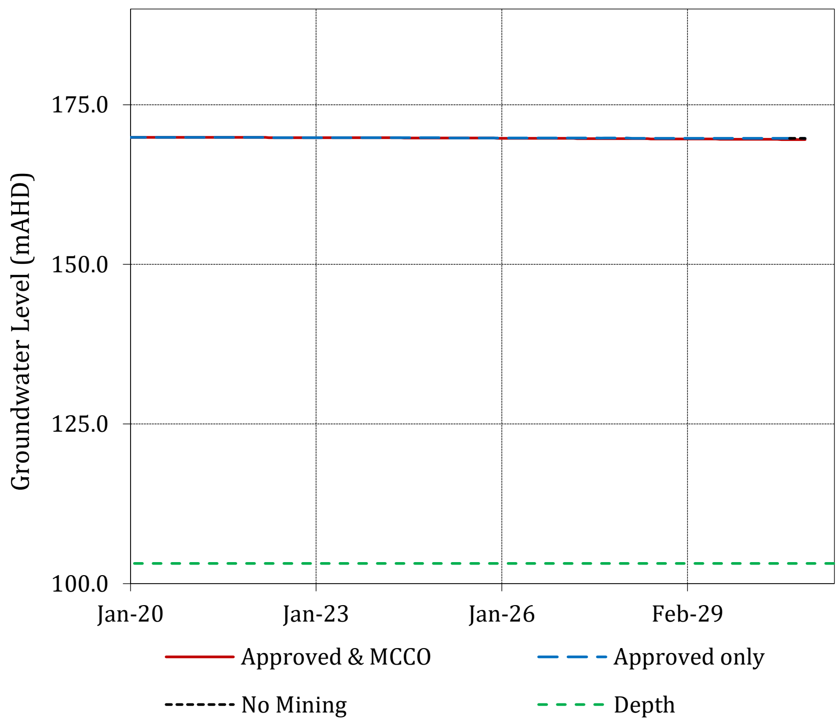


Figure 5.1 Groundwater level for Bore 1

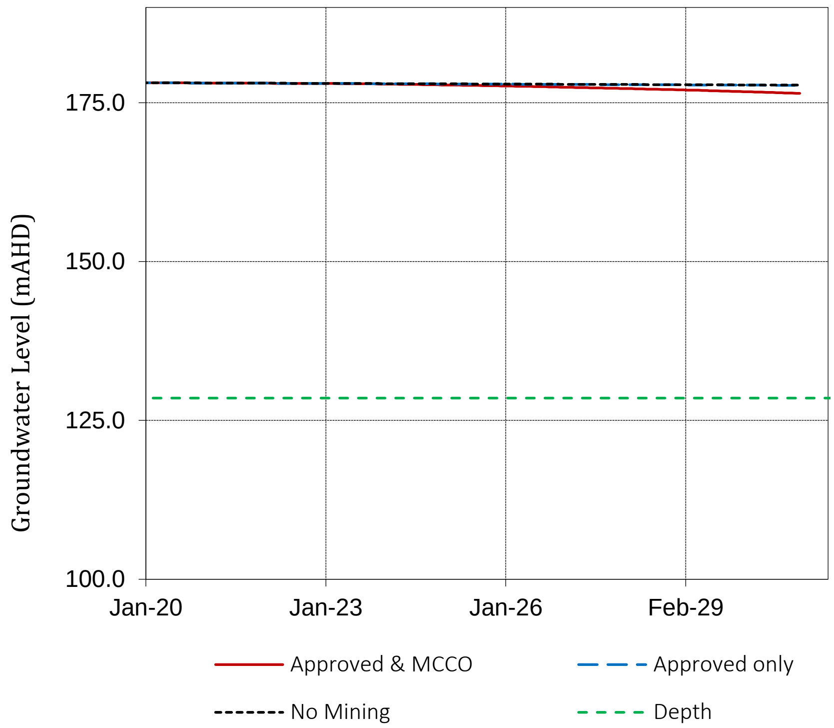


Figure 5.2 Groundwater level for Bore 2

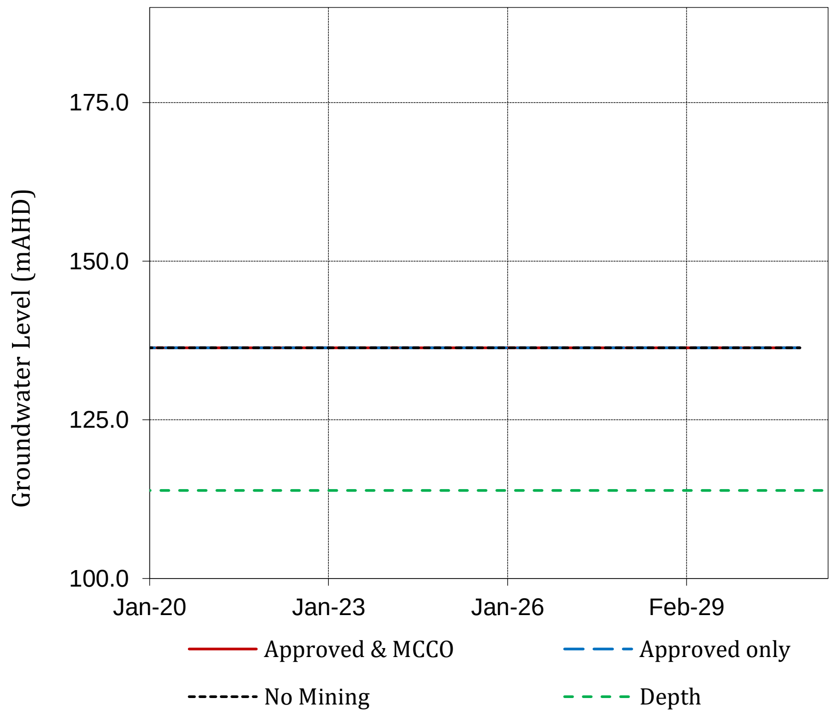


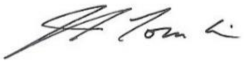
Figure 5.3 Groundwater level for Bore 3

6 Summary and conclusions

The locations of three private bores were determined and updated in the MCCO numerical model. The numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the Aquifer Interference Policy. This means there is no trigger for make good provisions with the landholders. Despite this it is recommended water levels are monitored at each of these bores where access can be arranged to confirm the MCCO model predictions. It is recommended telemetry data loggers are used for the monitoring.

If you have any queries, please do not hesitate to call.

Yours faithfully,



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