

9 September 2021

Ms Tegan Cole
Senior Environmental Assessment Officer
Department of Planning, Industry and Environment
Energy Resources and Industry – Planning and Assessment

By email

RE: MOUNT PLEASANT OPTIMISATION PROJECT – REQUEST FOR INFORMATION

Dear Tegan,

Further to the Department of Planning, Infrastructure and Environment (DPIE) advice regarding the Mount Pleasant Optimisation Project (the Project) (letter dated 12 August 2021) and residual concerns raised by four regulatory agencies and the Department's request for additional information, please find attached MACH Energy's (MACH's) responses enclosed in Attachments A-D.

Please feel free to contact me if you require further information.

Yours sincerely,



Chris Lauritzen
General Manager - Resource Development
Mount Pleasant Operation

Enclosed: Attachment A – Supplementary Environment Protection Authority Advice and MACH's Responses
Attachment B – Supplementary Heritage NSW Advice and MACH's Responses
Attachment C – Supplementary DPIE-Water Advice and MACH's Responses
Attachment D – Supplementary Biodiversity and Conservation Division Advice and MACH's Responses

Attachment A

Supplementary Environmental Protection Authority Advice and MACH's Responses

Air Quality

Clarification of Proactive/Reactive Mitigation Measures Modelled

The Environmental Protection Authority (EPA) (DOC 21/619628) reviewed the supplementary analysis provided by Todoroski Air Sciences, however some residual concern has been expressed regarding the meteorological and particulate matter level triggers applied in the analysis. In particular, the EPA interpreted Figure 2 of Todoroski Air Sciences' supplementary analysis as indicating a trigger lower than the 44 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) value applicable at the Muswellbrook NW monitor had been adopted.

Relevant Quotes:

The current specific triggers from the Air Quality Management Plan for reactive dust management, including wind direction and PM10 concentration, modelled in the additional analysis indicate that generally they are effective in reducing dust levels to below the 24-hour PM10 criterion. However, the details of those triggers are not provided in the Submissions Report. The Submissions Report also states that outside the EPL conditions, MACH only implements equipment shutdowns in response to visible dust, which is subjective.

Further, there is no clarity in the Submissions Report around what was modelled and therefore what the actual trigger levels (PM10 concentration and wind direction) and actions (activities shutdown). This is in part due to the contradictory information provided. For example, Figure 2 of the timeseries of the effect of the reactive measures at receptor 112 appears to be applied prior to the PM10 concentration reaching 44 $\mu\text{g}/\text{m}^3$ (the stop work trigger contained in the EPL). This implies that an alternative trigger has been represented in the modelling, which may be the additional triggers in the AQMP. However, these additional triggers and management responses have not been included or described.

Further, the Submissions Report states the pink spots in Figure 2 indicate the hours in which the adverse triggers activate at the 50 $\mu\text{g}/\text{m}^3$ level. This implies that an additional reactive management trigger has been considered and represented in the additional modelling. As receptor 112 is closest to the Muswellbrook NW monitor, the EPL condition applies (44 $\mu\text{g}/\text{m}^3$ at Muswellbrook NW monitor). If a lower trigger concentration at Muswellbrook NW is required to effectively manage impacts at Muswellbrook, the proponent should clearly identify this.

The EPA considers that the use of visible dust as a management method to be subjective and, as originally requested, requires the proponent to provide the specific meteorological and monitoring triggers used to apply the reactive measures. The information provided is not transparent enough to determine that the reactive management measures have been robustly determined and how they will be implemented.

EPA recommendation: Not adequately addressed.

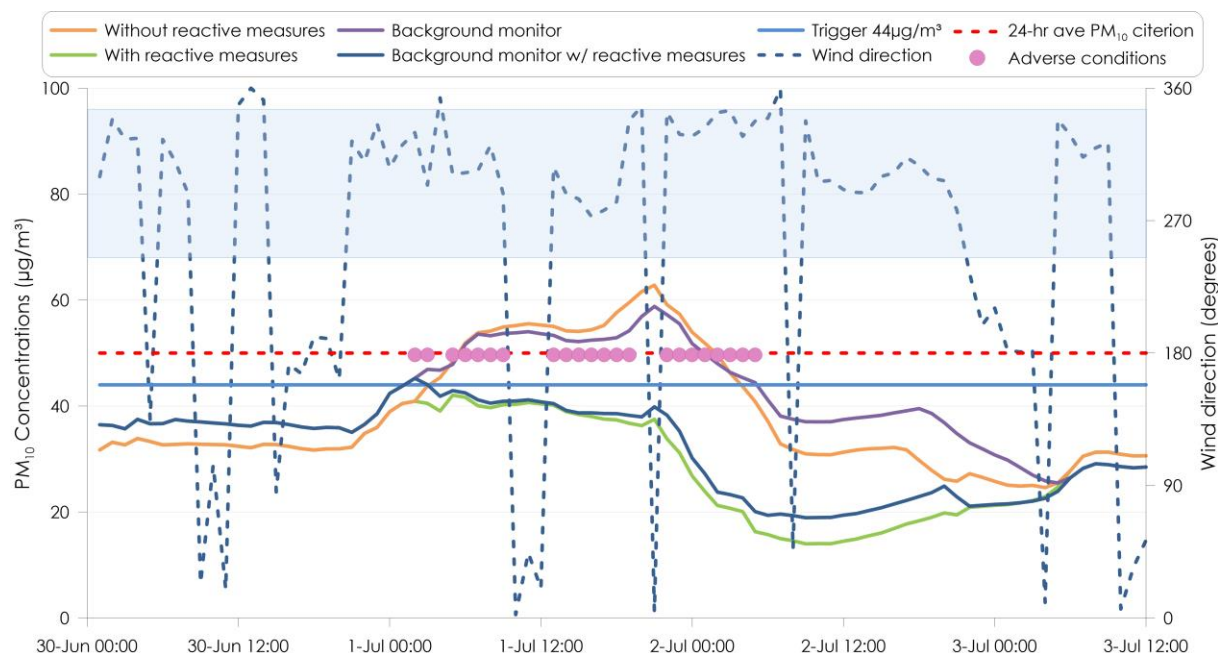
The EPA recommends that the proponent identifies the specific triggers and specific actions that are modelled and therefore proposed to be used to manage particulate emissions and impacts at the affected receptors, both for Muswellbrook and isolated receptors, to demonstrate they will be able to manage the particulate emissions and impacts.

Response:

As described in Todoroski Air Sciences' supplementary advice, the revised analysis applies reactive mitigation measures (i.e. temporarily shutting down activities in the pit and overburden areas, with Coal Handling and Preparation Plant (CHPP) and wind erosion emissions continuing) when the existing real time response trigger levels described in Environment Protection Licence (EPL) 20850 for the Muswellbrook NW monitor, and triggers in the approved *Mount Pleasant Operation Air Quality and Greenhouse Gas Management Plan* for the other real time monitors, occur. No additional, lower, or alternative, trigger levels have been applied in the analysis.

However, following review of EPA's interpretation of Figure 2 in Todoroski Air Sciences' supplementary advice it is evident that the graph could be improved by also presenting the particulate concentrations at the relevant trigger monitoring location, as opposed to only at the sensitive receptor.

An updated version of the graph provided by Todoroski Air Sciences is provided below as Graph 1.



Graph 1 – Timeseries showing the effect of implementing reactive measures at Receiver 112

The updated graph with the additional trace line and monitor trigger level clarifies that the reactive measures have been applied one hour after the applicable 44 µg/m³ particulate level and meteorological trigger occurs at the Muswellbrook NW monitor, even though the predicted particulate matter concentrations at receiver 112 at that time are below the trigger and are also well below the applicable PM₁₀ criteria.

Note that the analysis that Todoroski Air Sciences has conducted is inherently conservative, in that the reactive triggers have been applied based on the predicted particulate level at the relevant monitoring location *assuming Mount Pleasant Optimisation Project emissions remain unmitigated*, and then evaluating the influence that the reactive mitigation measures would have on particulate levels at the relevant private receivers. In practice, the application of Mount Pleasant Operation equipment shutdowns will also reduce the monitored levels at the relevant trigger location (refer Graph 1 – background monitoring location with reactive measures trace), and hence would further reduce the duration that the reactive triggers would need to be applied, and importantly, the duration that particulate levels are above the trigger level at the relevant monitor.

We trust that this additional information and better representation in Graph 1 assists the EPA to understand the application of the reactive measures modelled. We would be happy to facilitate a further discussion of these measures and application via the approved *Mount Pleasant Operation Air Quality and Greenhouse Gas Management Plan*, if that would assist the EPA.

Clarification of Receivers Subject to Acquisition upon Request Rights due to PM₁₀

The EPA requested further information regarding additional receivers that would receive acquisition rights due to the Project.

Relevant Quotes:

The Submissions Report has provided the receptors that have acquisition rights from the approved operations, not from the proposed operations.

EPA advice: It is not explicitly clear if there are additional receptors that will have acquisition rights under the proposal. DPIE should consider requesting further clarity from the proponent.

Response:

The receivers that would be eligible for acquisition upon request rights due to the Project are summarised in Table 1, including a comparison to the current numbers in Development Consent DA 92/97

Table 1
Summary of Land Subject to Acquisition Upon Request Rights

Basis	Development Consent DA 92/97	Project (SSD 10418)
Noise	23, 45, 47, 67, 96, 102, 108, 112, 118, 120, 120c, 121, 136, 143a, 143b, 143c, 143e, 147, 153a, 156a, 157a, 158, 159, 447, 448, 449	136, 143a
Noise and Air	43, 43b	118, 120, 120c, 121, 143b, 143e, 147, 153a, 154, 154b, 156a, 157a, 159
Air	20, 21	112
Total Number of Eligible Receptors	30	16

Noise

Acquisition and Mitigation Upon Request Rights

The EPA states that existing mitigation and acquisition upon request rights for receivers surrounding the Project would be assumed to carry over into any new Development Consent for the Project. However, the EPA also notes that for some receivers, the Environmental Impact Statement (EIS) noise predictions would not qualify the receivers to mitigation or acquisition rights, and therefore they have not been included in the noise limit recommendations.

Relevant Quotes:

The existing consent (DA 92/97) notes thirty (30) receivers with acquisition upon request rights and twenty (20) receivers with mitigation upon request rights (Schedule 3, Conditions 1 and 2). The EPA assumes these rights will be carried over into any SSD approval. ...

Any noise limits recommended by EPA will not include receivers where predicted impacts in the SSD NIA would qualify for voluntary acquisition rights. However, it is noted that some receivers who have voluntary acquisition / mitigation under the existing consent would not qualify on the basis of the predictions in the SSD NIA and hence are included in the noise limit recommendations.

Response:

MACH expects that any Development Consent for the Project would include mitigation and acquisition upon request rights for relevant landholders based on the predictions in the Project EIS.

It is not considered appropriate to retain mitigation or acquisition upon request rights based on a previous approval that is no longer relevant. For example, some receivers currently have mitigation or acquisition upon request rights under Development Consent DA 92/97 due to an approved conveyor option from the Mount Pleasant Operation CHPP to the Bengalla Mine rail loadout facility, which has never been developed and also would not be developed for the Project. Many of these receivers also have similar rights under Bengalla Mine's approval, or in some cases also under Mt Arthur Coal Mine's approval.

Noise Limit Recommendations

The EPA has provided noise limit recommendations for the Project.

Response:

The recommended noise limits provided by the EPA are not consistent with the methodology described in the *Noise Policy for Industry (2017)* (NPfI)¹. For example, the minimum daytime noise level within the recommended conditions is 40 A-weighted decibels, however receivers within Project Noise Assessment Group (NAG) 2 should have a daytime noise level consistent with the relevant assessment criteria (i.e. 42 dBA). There are also some other inconsistencies between the recommended noise limits and those that should apply in accordance with the NPfI (e.g. differing L_{Amax} criteria). MACH is happy to provide an alternative set of draft noise limits for the EPA and DPIE's consideration that are consistent with the Project EIS.

Further, the recommended limits provided by the EPA specify the meteorological conditions where the noise limits would apply. However, the stipulated meteorological conditions are not the same as those modelled in the EIS noise assessment. Under the NPfI, compliance noise limits should be consistent with the meteorological conditions modelled in the EIS.

This is evident when MACH reviews the noise limits recently applied at other nearby operations. For example, EPL 1323 for the nearby Maxwell Underground Project² includes a table stipulating the meteorological conditions applicable for the noise limits in that licence (specifically, Condition L3.3), which are consistent with those modelled in the EIS for the Maxwell Underground Project, not arbitrary default values.

MACH expects that any Development Consent and EPL for the Project would similarly include noise limits developed in accordance with the NPfI and consistent with the meteorological conditions determined to be applicable in the Project EIS.

¹ Environment Protection Authority (2017) NSW Noise Policy for Industry.

² <https://apps.epa.nsw.gov.au/prpoeoapp/ViewPOEOLicence.aspx?DOCID=220900&SYSUID=1&LICID=1323>

Surface Water

Releases Under the HRSTS

With respect to the planned continuation of currently approved controlled releases from the Mount Pleasant Operation under the Hunter River Salinity Trading Scheme (HRSTS) also occurring for the Project, the EPA has recommended conditions of consent.

Relevant Quotes:

The following condition of approval is recommended to revise the site water balance with the aim of minimising licensed extraction from the Hunter River and reducing discharges under the HRSTS:

EPA recommendation:

A site water balance must be developed that:

- ***maximises water recycling and reuse***
- ***minimises water drawn from the Hunter River using WALs***
- ***reduces or eliminates discharges to the Hunter River under the HRSTS***

Response:

MACH is happy to accept a condition requiring continued development of the water balance for the Project as part of the Water Management Plan, including incorporation of site water balance data that will continue to be collected post-approval.

MACH would, however, like to stress that the Mount Pleasant Operation will continue to require controlled discharges under some climatic conditions in accordance with the HRSTS. The suggestion that such discharges could potentially be eliminated does not suitably reflect the inter-annual rainfall variability of the Hunter Valley and the large active areas at major open cuts.

The need for periodic controlled discharges is consistent with the majority of other major open cut mines in the Hunter Valley. It is noted that the HRSTS was developed by the New South Wales (NSW) Government to specifically manage this need in an environmentally sustainable manner. The objects of the scheme are defined in clause 3 of the HRSTS as follows (emphasis added):

- (a) *to minimise the impact of discharges of saline water on irrigation, other water uses and on aquatic ecosystems in the Hunter River catchment:*
 - (i) *at the lowest overall cost to the community, and*
 - (ii) *in a way that provides ongoing financial incentives to reduce pollution, and*
- (b) *to facilitate sustainable water management by industry in the Hunter River catchment.*

Assessment of Discharges under the HRSTS

The EPA has recommended conditions for licensing of the controlled releases under the HRSTS, inclusive of a water pollution impact assessment.

Relevant Quotes:

If, following preparation of the revised water balance, discharges cannot be avoided a water pollution impact assessment would be required to inform licensing considerations consistent with Section 45 of the Protection of Environment Operations Act 1997.

The following condition of approval is recommended to address these issues if discharges are required following a revised water balance.

EPA recommendation:

If discharges are proposed, a water pollution impact assessment will be required to inform licensing consistent with section 45 of the POEO Act. Any such assessment must:

- ***be prepared in consultation with the EPA, with a level of detail commensurate with the potential water pollution risk***
- ***demonstrate that all practical and reasonable measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented***
- ***estimate the frequency and volume of the proposed discharges.***

Response:

MACH understands that the EPA will require a water pollution impact assessment as part of a variation application to incorporate approved controlled discharges to the Hunter River in EPL 20850.

MACH is in the process of preparing an EPL variation application under existing Development Consent DA 92/97 and would welcome an opportunity to meet with the water branch to confirm the nature and form the water pollution impact assessment to be incorporated into the EPL variation application.

Proposed discharges for the Project would remain consistent with the discharge limits established for the approved mine under the EPL variation.

Attachment B

Supplementary Heritage NSW Advice and MACH's Responses

Small Portions of Unsurveyed Land

Desktop Assessment

Heritage NSW (Doc21/554455-3) agreed the broader Project area and surrounding precinct had been subject to extensive Aboriginal heritage survey, and acknowledged that land access limitations precluded survey of some small areas of planned Project development associated with the Northern Link Road (i.e. particularly the Option 1 alignment).

Notwithstanding, Heritage NSW requested that MACH conduct some additional desktop analysis of the unsurveyed areas to inform subsequent field investigations to be conducted in accordance with an Aboriginal Heritage Management Plan once the relevant option has been selected, and land access is available.

Relevant Quotes:

HNSW acknowledge the access circumstances that have prevented the proponent to complete the ACH investigations and agrees that the broader project area and surrounding precinct has been extensively surveyed. It is noted that the RTS states land use disturbance history and low potential for some site types of significance as mitigating factors for excluding surveys at this juncture of the assessment.

The RTS has not considered the entirety of Aboriginal land use patterns and that other Aboriginal site types that may be present despite previous disturbances. It is noted however that the RTS is prepared to undertake surveys post approval. In the interim, HNSW recommend a desktop analysis report of Aboriginal site and landform relationship to calculate the probable distribution pattern of Aboriginal objects of the un-surveyed parcels of land where access issues persist. The report must provide guidance on the scale of field investigations required and which are proportionate to the findings of the analysis.

HNSW would be satisfied that the SEAR would be adequately addressed if an interim desktop assessment was completed pre-project approval. Post approval field investigations must follow and be executed in consultation with the Registered Aboriginal Parties (RAP), under the guidance of the Aboriginal Heritage Management Plan (AHMP).

HNSW accept the response from the proponent regarding survey coverage of Zone C lands. Should there be further development interest in the area, adequate ACH surveys will be conducted, as stated in the proponent's response.

Recommendation 1: Undertake a desktop analysis report of Aboriginal site and landforms associated with the un-surveyed lands. Develop methods to test the findings of the analysis (post project approval if necessary) and if necessary, recommend measures to manage risks to ACH through, the ACHMP process.

Response:

MACH has commissioned Niche to conduct the desktop analysis (refer Attachment B-1), which concluded that the subject area has some potential for Aboriginal artefacts, primarily isolated artefacts and artefact scatters. Niche recommended full supplementary survey of the small subject areas in consultation with Registered Aboriginal Party representatives and salvage of relevant artefacts consistent with the requirements of the Aboriginal Heritage Management Plan prior to disturbance occurring (Attachment B-1). In one area, Niche also advised that a test excavation may be required post-approval if intact deposits are identified by the survey adjacent to the existing Dorset Road (Attachment B-1).

MACH accepts Niche's recommendations and would accept a condition of consent that reflects this requirement.

Test Excavations Associated with Infrastructure Development

Zone A2R-C Pre-disturbance Test Excavations

Heritage NSW (Doc21/554455-3) concurs that test excavations would be required if the relevant sites identified in the ACHA in Zone A2R-C (refer Submissions Report Figure 9) are to be disturbed by the Project. Heritage NSW also notes detailed infrastructure design would determine whether the sites would be subject to Project disturbance.

Relevant Quotes:

The RTS maintains that test excavations at 10 locations within the approved mine operation are unwarranted at this juncture of the project determination. The RTS reasons that the test excavations will be undertaken if future activities (subject to final design) potentially threaten the 10 locations. The RTS has also highlighted that earlier archaeological investigations of these areas report “uncertain” significance (McCardle 2007 in RTS:84) but that test excavations would be necessary if the areas are subject to project disturbance (South East Archaeology 2020a in RTS:84-85).

In weighing the RTS response HNSW refer to the code of archaeological practice which describes that, an archaeological test excavation is necessary when (regardless of whether or not there are objects present on the ground surface) it can be demonstrated that subsurface Aboriginal objects with potential conservation value have a high probability of being present in an area, and the area cannot be substantially avoided by the proposed activity (DECCW 2010:24).

The previous archaeological investigations do not provide definitive statements regarding the potential of significant subsurface objects and the EIS assessment overall does not draw from the voluminous data sets from previous and current investigations to identify landform cultural sensitivity (beyond general statements). HNSW accept that some of the RTS carry weight on this issue for example and as cited in the RTS,

“...the appropriate management strategy for these sites is firstly to ‘reassess impacts with detailed design’, with test excavation if impacts are to occur, then further management as per the SSD AHMP for the site type, level of impacts and significance”. (South East Archaeology 2020a in RTS:85)

Conditional acceptance of RTS

HNSW conditionally accept the RTS on this matter because neither archaeological investigation sufficiently stated the potential conservation value of the 10 areas (significance) and the RTS has indicated that disturbance activities are not proposed at this juncture until final engineering plans are determined. HNSW accept the RTS that these areas will be subject to test excavations at a later stage of project development.

However, if the results of the test excavation program indicates Aboriginal objects of high significance, and in keeping with the principles of the code of practice (which is a component of the SEARs), HNSW expect that avoidance strategies and protection measures be put in place and by default, the proposed ancillary proposal and project water dam activities modified accordingly.

Recommendation 2: A test excavation program for the 10 areas identified in the EIS as Zone A2R-C must be undertaken to inform the project design on the significance of the sites and, if determined high significance, modify the project design accordingly. The test program must be undertaken in partnership with the Registered Aboriginal Parties.

Response:

MACH accepts Heritage NSW's recommendation that, as part of the Project infrastructure detailed engineering design, if any of the 10 relevant sites located in Zone A2R-C where test excavation has been recommended (refer Submissions Report Figure 9) have potential to be disturbed by the Project, MACH would conduct test excavations of the relevant sites in consultation with representatives of the Registered Aboriginal Parties. Should the results of the excavation result in any of these 10 sites being assigned high heritage significance, MACH would modify the design of High Wall Dam 3 (HWD3) to avoid the relevant high heritage significance site.

MACH would accept a condition of consent that is consistent with Heritage NSW's recommendations.

Potential Scarred Trees Subject to Reassessment

Sites West of the Bengalla Mine

Heritage NSW (Doc21/554455-3) has outlined the statutory process that applies to culturally modified trees in NSW and has highlighted that there are due diligence responsibilities associated with cultural heritage assessments.

Relevant Quotes:

The RTS state that several of the trees, that the HNSW submission requests re-assessment, are outside of the MPO project boundary (and responsibility) and yet, the HNSW submission is based on the information provided by the MPO ACH assessment (the EIS). Figure 10 of the RTS place several of the trees within the adjoining Bengalla Mining Lease whilst some are located within an approved water pipeline corridor which, HNSW understand, carries dual interest for the Mt Pleasant project and Bengalla Mine project.

Advice on due diligence responsibility – Culturally modified trees

HNSW is responsible for the management of registered Aboriginal objects and uses the Aboriginal Heritage Information Management System (AHIMS) for that purpose. Under the National Parks and Wildlife Act 1974 a person with knowledge of an Aboriginal object (for example, Aboriginal culturally modified trees) must submit that information to AHIMS using the proscribed method stated in the Act.

There are potential land use planning and regulation uncertainties if the status of the trees is not determined. If confirmed as Aboriginal culturally modified trees, protective management of the trees must be actioned as part the ACHMP or, notification made to the responsible party or landholder.

HNSW take this opportunity to inform the proponent that unauthorized harm to Aboriginal culturally modified trees carries a strict liability offence. It is therefore important that the proponent ensure that their responsibility in this matter is clear and not assume that strict liability is extinguished under the EPA Act, in this instance.

To conclude this matter HNSW request that the proponent carry out or, facilitate, a determination of the trees as previously requested based on, prior knowledge of their existence. Assessment of the trees must refer to the, Field Guide for Identifying and Recording Aboriginal Scarred trees in NSW (DEC 2005).

Recommendation 3: Determine if scarred trees described in Figure 10 of the RTS are Aboriginal culturally modified trees with reference to the Field Guide for Identifying and Recording Aboriginal Scarred trees in NSW (DEC 2005).

Response:

MACH accepts Heritage NSW's advice on the statutory protections afforded to culturally modified trees.

MACH understands that the relevant scarred trees (recommended for some reassessment to determine if they are of Aboriginal origin by Kuskie [Appendix G of the EIS]) are currently listed on Aboriginal Heritage Information Management Systems (AHIMS) as modified trees, and therefore already benefit from the relevant statutory protections. These trees would continue to be treated as culturally modified trees in the Mount Pleasant Operation heritage management database, unless their origin has been verified not to be a culturally modified tree, in consultation with Heritage NSW.

It is noted that the scarred trees in question are not on land that is controlled by MACH, and are located south of Wybong Road (i.e. distant from Mount Pleasant Operation mining activities). Notwithstanding, if following detailed engineering design, any of the relevant scarred trees cannot be avoided by Mount Pleasant Operation ancillary infrastructure, MACH would commission a suitably qualified archaeologist to verify if the relevant scarred tree(s) is of Aboriginal origin consistent with the applicable Heritage NSW guidance documents on the identification and management of scarred trees.

Any verified culturally modified trees that cannot be avoided by the Project would be managed consistent with the recommendations of Kuskie (Appendix G of the EIS), the applicable Aboriginal Heritage Management Plan and relevant NSW Government legislation.

Attachment B-1 – Supplementary Desktop Analysis Report

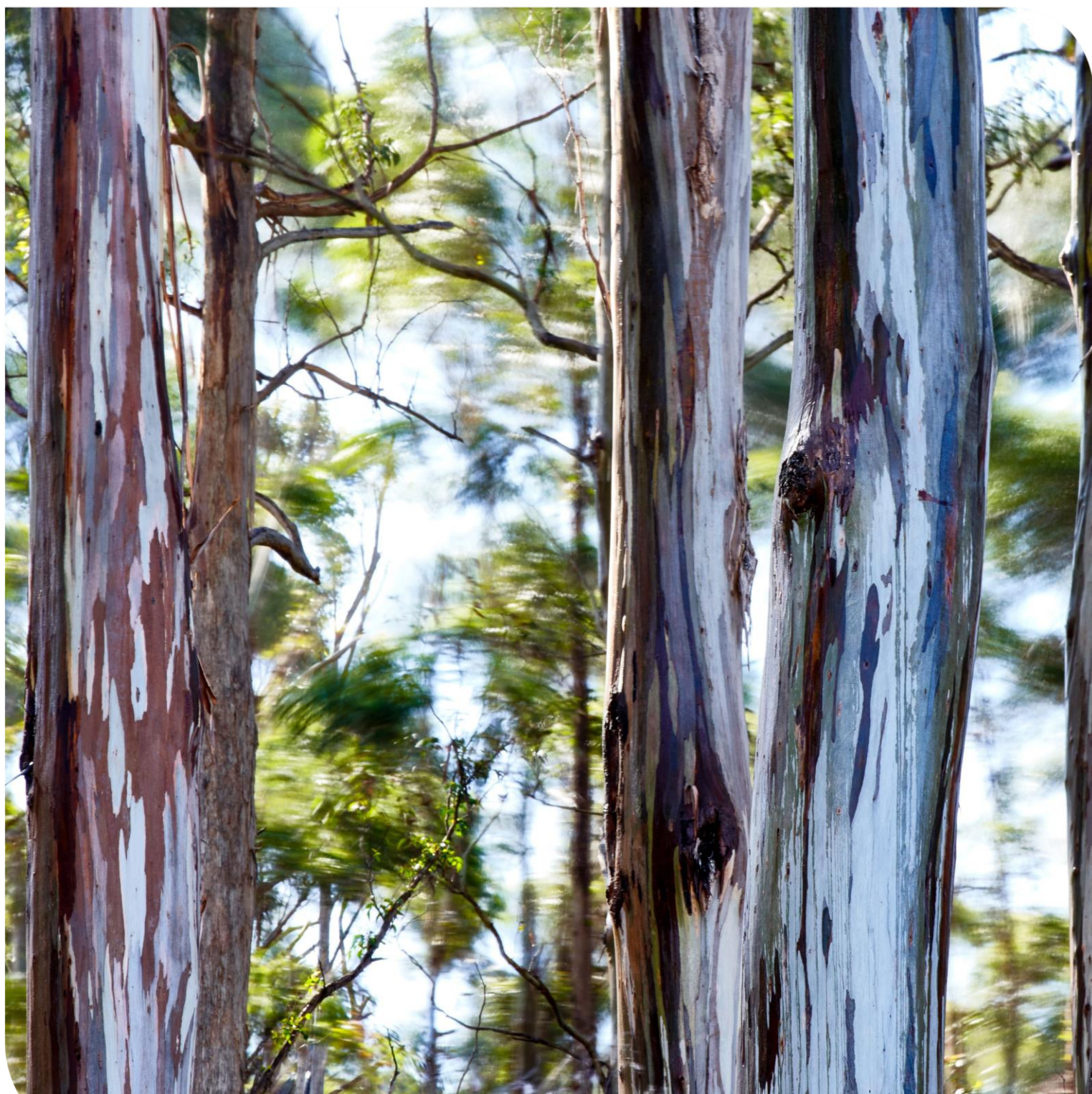
Mount Pleasant Optimisation Project, Muswellbrook NSW

Supplementary Desktop Analysis Report

Muswellbrook Shire Council Local Government Area

Prepared for MACH Energy

Prepared by Niche Environment and Heritage Pty Ltd | 9 September 2021



Document control

Project number	Client	Project manager	LGA
6796	MACH Energy Australia Pty Ltd	Deirdre Lewis-Cook	Muswellbrook Shire Council

Version	Author	Review	Status	Comments	Date
D1	Deirdre Lewis-Cook Riley Finnerty	Clare Anderson	Draft		31 August 2021
D2	Deirdre Lewis-Cook	Resource Strategies Pty Ltd	Draft		2 September 2021
D3	Deirdre Lewis-Cook	Resource Strategies Pty Ltd	Draft		6 September 2021
D4	Deirdre Lewis-Cook	Resource Strategies Pty Ltd	Draft		8 September 2021
D5	Deirdre Lewis-Cook	Resource Strategies Pty Ltd	Final		9 September

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Niche Environment and Heritage Pty Ltd (ACN 137 111 721)
Enquiries should be addressed to Niche Environment and Heritage
PO Box 2443, Parramatta NSW 1750, Australia
Email: info@niche-eh.com

Executive summary

Niche Environment and Heritage (Niche) have been engaged to compile a desktop report that addresses Recommendation 1 of a letter by Heritage NSW (9 August 2021) in reply to the Submissions Report lodged with the Department of Planning Infrastructure and Environment (DPIE) on the Mount Pleasant Optimisation Project (the Project):

“Recommendation 1: Undertake a desktop analysis report of Aboriginal site and landforms associated with the unsurveyed lands. Develop methods to test the findings of the analysis (post project approval if necessary) and if necessary, recommend measures to manage risks to Aboriginal cultural heritage through the Aboriginal Heritage Management Plan (AHMP) process.”

The aim of this desktop analysis report was to consider Aboriginal land use patterns in the unsurveyed sections of the Northern Link Road Alignment Subject Area and develop methods to test the findings of the analysis and where necessary recommend measures to manage risks to Aboriginal cultural heritage.

This report is intended as a desktop analysis report and does not seek to repeat information contained in the primary or addendum Aboriginal Cultural Heritage Assessment (ACHA) (Kuskie 2020). This report is only concerned with the portions of unsurveyed land within the Northern Link Road Alignment and should be read in conjunction with both ACHAs.

A desktop analysis consisting of a slope analysis of the Mount Pleasant Operation (MPO) Site Database, review of GIS aerial mapping and site photos was conducted. The desktop analysis was used together with Kuskie’s (2020) predictive model to compile the following predictive assumptions for the Subject Area:

Area 1 and Area 2

- The moderately inclined slopes within Areas 1 and 2 of the Subject Area have the potential to contain surface Aboriginal sites.
- Isolated finds and artefact scatters are the most likely site types to occur within Areas 1 and 2.
- Scarred trees are likely to occur on moderately inclined slopes, however there is very low potential for scarred trees to occur within Areas 1 and 2 of the Subject Area due to the extensive land clearing and natural attrition within the area.
- Artefacts are more likely to occur in areas of the Subject Area where A Horizon soil deposits are present.
- Sites within Areas 1 and 2 are expected to be of low density (<1 artefact/m²) due to the distance to fresh water from the Hunter River (>5 km).
- The closest proximity to fresh water is the ephemeral first order streams transecting Areas 1 and 2 which may have provided temporary seasonal fresh water during transitory movements; however, Areas 1 and 2 are not considered a primary or secondary environment supportive of group subsistence of any scale.
- The archaeology of Areas 1 and 2 is indicative of transitory movement patterns and would likely be representative of background loss and discard over an extensive period of time.
- Soil deposits within Areas 1 and 2 are likely to be between 10-15 cm deep in areas where disturbance is minimal. Artefact preservation within this deposit would be nil to low.
- The potential for archaeological deposits within Areas 1 and 2 is limited due to the occurrences of sheet erosion and shallow soils.

Area 3

- The existing section of constructed road within Area 3 retains little potential for surface artefacts to be present. The potential for surface artefacts increases in areas outside of the road footprint where A Horizon soils remain intact.
- Area 3 may be a part of a secondary resource zone due to its proximity to the Hunter River and a fourth order watercourse. This Area may likely have potential subsurface deposits provided A Horizon soil deposits remain intact.
- The archaeology of Area 3 is located within an area where more focused and repeated Aboriginal occupation by larger number of people may have occurred (Kuskie 2020:166).

Recommendations based on the Subject Area predictive model are provided in the table below.

Recommendations	
	Unsurveyed Portion of Northern Link Road Alignment Option 1
1.	Recommendations provided in Kuskie's ACHA (2020) and the MPO AHMP (MACH 2019) should be adhered to with regard to the management of site MP14 which is located within Area 2 within the Subject Area.
2.	Given the small area of the Subject Area (14.96 ha), a full coverage field survey of Areas 1, 2 and 3 within the Northern Link Road Alignment should be completed to test the findings of this desktop analysis report.
3.	If additional disturbance is proposed for Area 3 (i.e. in addition to the existing road footprint), field survey should be conducted. Should the field survey identify any intact A Horizon soils, a program of subsurface testing should be completed to test the level of disturbance within the area and to test the findings of this desktop analysis report.
4.	Field survey and subsurface testing (if required) must be conducted in consultation with the Registered Aboriginal Parties (RAPs), under the guidance of the Aboriginal Heritage Management Plan (AHMP).
5.	The procedures outlined in the current MPO AHMP (MACH 2019) should be used to manage any newly recorded sites during the field survey.
	General
6.	All workers should be inducted into the Subject Area, so they are made aware of their obligations under the <i>National Parks and Wildlife Act 1974</i> , any future SSD development consent, and the current MPO AHMP (MACH 2019).
7.	In the unlikely event that human remains (skeletal material) are discovered, the procedures outlined in the AHMP are to be followed.

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1. Introduction

1.1 Proponent and project background

MACH Energy has prepared a State Significant Development (SSD) application for the Mount Pleasant Optimisation Project (the Project). In 2020 Kuskie completed an Aboriginal Cultural Heritage Assessment (ACHA) in support of the SSD application and an addendum ACHA was completed the same year (Kuskie 2020) to address minor amendments to components of the project. During the assessment approximately 14.96 ha of land of the Northern Link Road Alignment was unable to be surveyed due to land access issues.

MACH Energy lodged a Submissions Report with the Department of Planning Infrastructure and Environment (DPIE) to address concerns raised by members of the public, and regulatory agencies. Subsequently, Heritage NSW (9 August 2021) provided supplementary advice to the DPIE on Aboriginal heritage matters. Three recommendations were provided by Heritage NSW:

- **Recommendation 1:** Undertake a desktop analysis report of Aboriginal site and landforms associated with the unsurveyed lands. Develop methods to test the findings of the analysis (post project approval if necessary) and if necessary, recommend measures to manage risks to Aboriginal Cultural Heritage (ACH) through the Aboriginal Heritage Management Plan (AHMP) process.
- **Recommendation 2:** A test excavation program for the 10 areas identified in the EIS as Zone A2R-C must be undertaken to inform the project design on the significance of the sites and, if determined high significance, modify the project design accordingly. The test program must be undertaken in partnership with the Registered Aboriginal Parties (RAPs).
- **Recommendation 3:** Determine if scarred trees described in Figure 10 of the Submissions Report are Aboriginal culturally modified trees with reference to the Field Guide for Identifying and Recording Aboriginal Scarred trees in NSW (DEC 2005).

Niche Environment and Heritage (Niche) have been engaged to address Recommendation 1 and compile the desktop analysis report for the unsurveyed sections of the Northern Link Road Alignment Option 1 in order to satisfy Heritage NSW Recommendation 1. The aim of this desktop analysis report is to consider the entirety of Aboriginal land use patterns and develop methods to test the findings of the analysis should Option 1 be developed post-approval and recommend measures to manage risks to ACH through the AHMP process.

This report is intended as a desktop analysis report and does not seek to repeat information contained in the primary or addendum ACHA (Kuskie 2020). This report should be read in conjunction with the primary and addendum ACHA and is only concerned with the portions of unsurveyed land within the Northern Link Road Alignment.

1.2 Proposed activity

The proposed activity includes the closure of a section of Castlerock Road and development of the Northern Link Road to connect Dorset Road and Castlerock Road to the west of the MPO Mining Leases. The alignment of the Northern Link Road would be revised for the Project to improve the safety of the intersection between the Northern Link Road and Castlerock Road.

During construction of the Northern Link Road, soil would be stripped and stockpiled adjacent to the road corridor, or other suitable previously cleared areas. Stockpiled soil would either be used for rehabilitation along the road corridor or transported to the Project mining area for use in rehabilitation activities (MACH Energy 2021 Section 3:17).

1.3 Statutory controls

The Mount Pleasant Optimisation Project is an SSD application currently in assessment phase.

There are no existing Aboriginal Heritage Impact Permits (AHIPs) for Areas 1 and 2. Portions of Area 3 of the Subject Area is covered by an existing AHIP (AHIP#C0002092).

1.5 Investigators and contributors

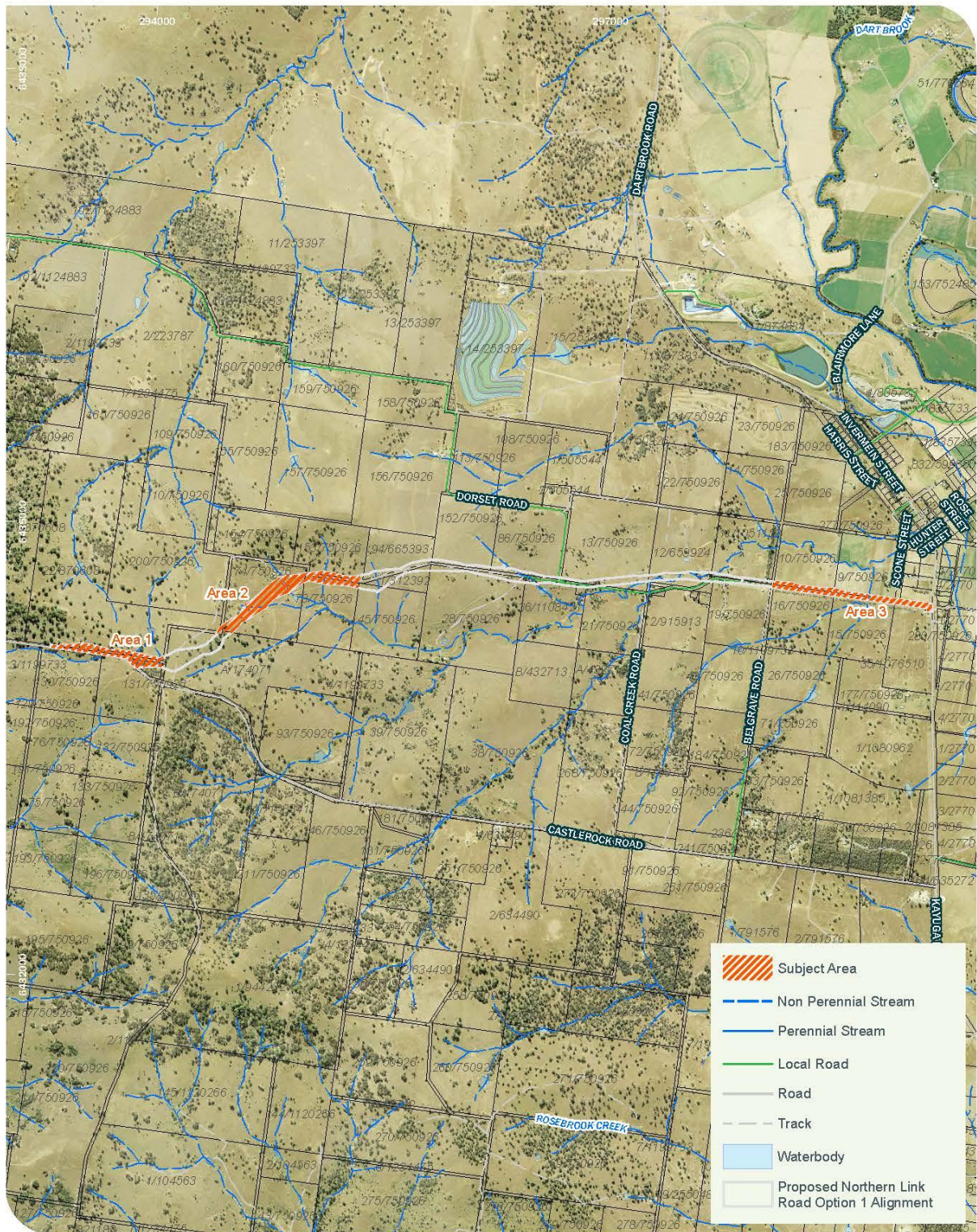
The contributors to this desktop analysis report and their project roles are listed in Table 1 below.

This report was written by Deirdre Lewis-Cook and Riley Finnerty (Niche).

Table 1: Contributors, affiliations, and contributions

Contributor	Affiliation	Contribution	Qualification	Years' experience
Clare Anderson	Niche	Project Director and quality control	BA (Hons)	14
Deirdre Lewis-Cook	Niche	Project Manager, Author	BA MA(Hons)	10
Riley Finnerty	Niche	Researcher, Author	BA (Hons)	2
Greg Tobin	Niche	GIS, Mapping	Assoc. Dip. Eng	11

Figure 2: Location of the Subject Area (Source: Niche)



2. The subject area

2.1 The subject area

The unsurveyed 14.96 ha of land that makes up the current Subject Area can be divided into three (3) areas located along the proposed Northern Link Road Alignment. These three areas comprise of both the previously surveyed and unsurveyed sections and are located within three zones previously defined by Kuskie (2020):

- Two (2) sections (11.08 ha) are located within Zone B4 on the western side of the proposed Northern Link Road Option 1 Alignment and are not covered by an existing AHIP. Both sections have not been previously surveyed.
- One (1) section (3.88 ha) is located within Zones B1, B3 and B4 on the eastern side of the proposed Northern Link Road Option 1 Alignment. Areas within Zones B1 and B3 are covered by an existing AHIP (AHIP#C0002092). Areas within Zones B1 have been previously surveyed. A large proportion of the previously unsurveyed area (Zones B3 and B4) within this section is located within the existing Dorset Road footprint and the current approved alignment of the Northern Link Road.

The Subject Area is located along the northern SSD application boundary within Mining Leases (ML) 1497 and 1708 and is located less than 10 km north-west of Muswellbrook, in the Central Lowlands of NSW and within Muswellbrook Shire Council LGA (Figure 1 and 2).

For ease of reference, this report will refer to the three components of the Subject Area in the following manner:

- Area 1: Unsurveyed land comprising 3.64 ha that makes up the western-most portion of Zone B4 within the proposed Northern Link Road Option 1 Alignment.
- Area 2: Unsurveyed land comprising 7.44 ha that makes up the eastern portion of Zone B4 within the proposed Northern Link Road Option 1 Alignment.
- Area 3: Land comprising 3.88 ha that makes up the eastern-most portion of the proposed Northern Link Road Alignment. The area includes both surveyed (0.85 ha) and unsurveyed land (3.03 ha) and is also coincident with the approved Northern Link Road alignment. As Area 3 comprises a number of small areas of surveyed and unsurveyed land and also some land within the existing AHIP #C0002092, for simplicity it is treated as a single area throughout this report.

2.2 Environmental and archaeological context of the subject area

The Subject Area is located within the Central Lowlands region of the Hunter Valley. The landscape of which is characterised by undulating or gently hilled landscape (Niche 2017). This includes gently to moderately inclined simple slopes (Figure 3), with gently inclined ridge crests, spur crests and hillocks with gently to moderately inclined ephemeral drainage depressions (Kuskie 2020). The surrounding landscape of Mount Pleasant rests at an elevation of 368 m Australian Height Datum, forming the slopes situated towards the south-west of the Subject Area.

Soil landscapes provide a proxy for both available resources, through associated vegetation and stone outcrops, and assist in understanding soil profiles and other factors which influence the preservation of Aboriginal objects. The Subject Area consists of two soil landscapes as mapped by Kovac and Laurie (1991), see Figure 4:

- **The Roxburgh soil landscape:** This soil landscape occurs in Area 1 and Area 3 of the Subject Area. It is associated with the undulating low hills to the west of the Hunter Soil Landscape. Slopes are 0-10% with lengths of 800-1200 m and a local relief of 60-120 m. Within this soil landscape, drainage lines occur at intervals of 300-1500 m. To the west of the Hunter River floodplains, Yellow Podzolic soils occur on upper- to mid-slopes with Red Solodic soils on more rounded hills. Lithosols occur on crests and Yellow Soloths have been recorded in some gullies (Kovac and Lawrie 1991). Dark reddish brown sandy loams comprise the A1 horizon between 0-0.10 m with a transition to a light brown medium clay B Horizon (0.10-0.25 m).
- **The Brays Hill soil landscape:** This soil landscape occurs in Area 2 of the Subject Area and is characterised by undulating low hills to the west of Muswellbrook. Slopes are from 6-10% with lengths of 800-1200 m and a local relief of 60-80 m. Further sheet erosion has occurred on many of the hillslopes after extensive clearing of native vegetations. The soils consist of Red Clays on mid to upper slopes, with Black Earths and Grey Clays on mid to upper slopes. Brown Clays may occur on midslopes, with Yellow Solodic Soils on the lower slopes and Alluvial Soils in drainage depressions. Red-brown Earths occur on some crests and upper slopes with Rendzinas Red Clays and Black Earths (Kovac and Lawrie 1991). Dark brown silty loam comprises A1 Horizon between 0-0.15 m and transition to a reddish-brown medium clay B Horizon (0.15-0.55 m).

The potential for archaeological deposits within these soil landscapes is limited due to the occurrences of sheet erosion and shallow soils. This would have been exacerbated by the widespread removal of native vegetation leading to severe gully and stream bank erosion. The soils within the Subject Area and MPO have been described as duplex (texture contrast soils), with a colluvial topsoil (A unit) overlaying unrelated pedal clays formed by in situ weathering of bedrock (B unit or horizon) (Kuskie 2020). The A Horizons of the duplex soils covering most of the simple slopes and higher landforms along the valleys are thin, therefore limits any evidence of older archaeological deposits. Furthermore, it has been concluded that the B horizons of these duplex soils have negligible potential to contain Pleistocene (greater than 10,000-year-old) archaeological deposits (Kuskie 2020).

The Subject Area is located within the Permian era Singleton Coal Measures of the Sydney-Gunnedah basins (Singleton SI56-01 1:250,000 geological map). The underlying geology of the Subject Area is characterised by sandstone, shale, mudstone, conglomerate and coal. The nature of the local geological formations has significant implications for Aboriginal land use, primarily with procuring stone materials for manufacturing and modifying stone tools. Stone procurement is influenced by the physical characteristics of the source area, the overall abundance of the material, quality (flaking properties) and accessibility of the raw materials. The lack of outcrops and quarries within the Subject Area suggests that raw materials for stone tools would have been imported from outside the Subject Area. Similarly, sandstone rock formations can provide resources and evidence of Aboriginal occupation, such as deposits of artefacts in rock shelters or overhangs, rock art, and grinding grooves on exposed bedrock or isolated cobbles/boulders. No such formations have been identified within the Subject Area.

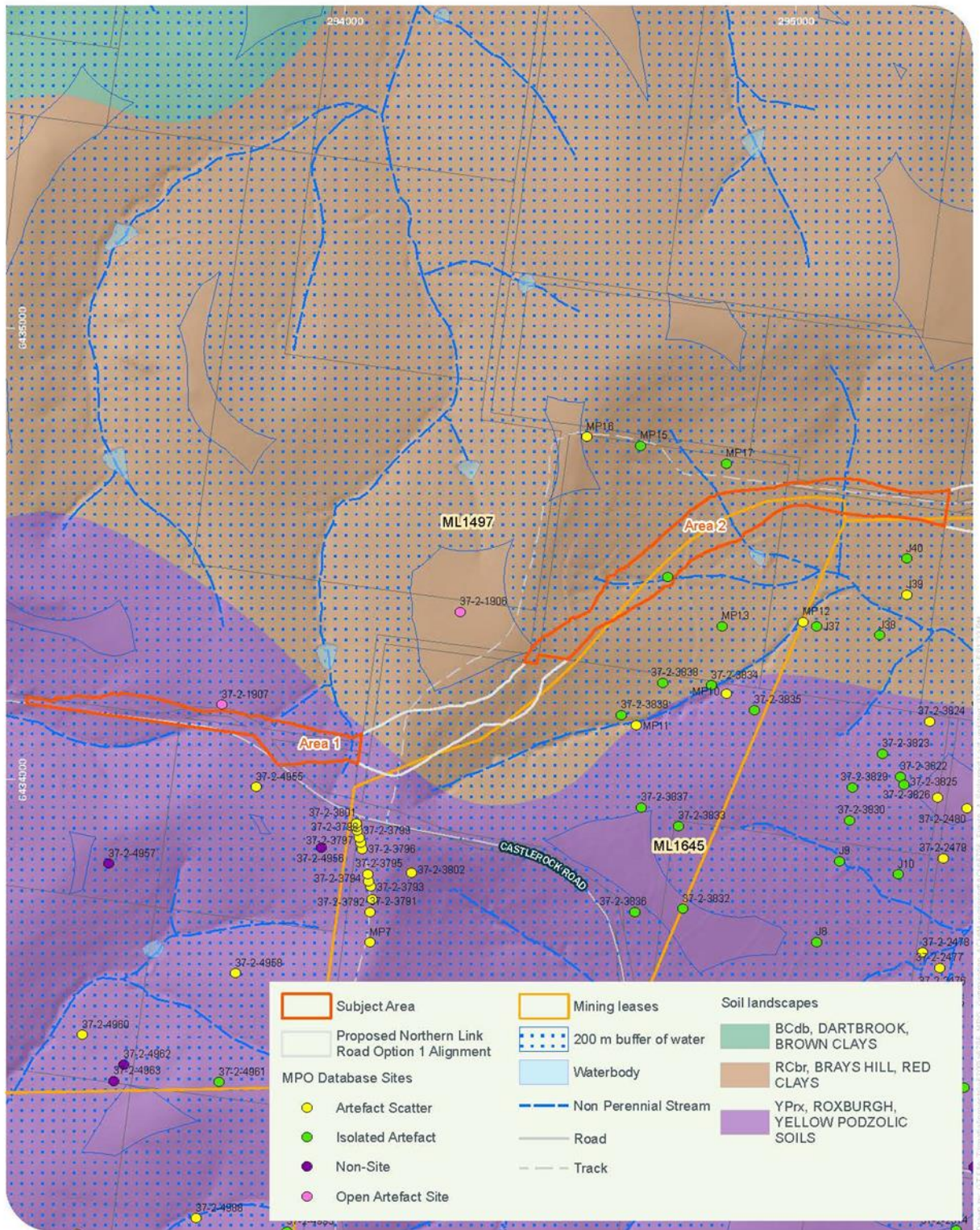
Within the landscape of Areas 1 and 2, some of the flora once used as resources exploited by the local Aboriginal population are still present, such as the various species of Box, Gum and Ironbark. Ground cover consists of grasses, including, Wiregrass (*Aristida* spp.) and Wallaby Grass (*Danthonia* spp.), acacia shrubs, and nightshade. Research conducted and compiled by Umwelt (2007) and Anderson (2007) lists the local plants and their potential Aboriginal uses (compiled by Kuskie 2020). Area 3 is located approximately 1 km from the Hunter River and is located within 200 m of Hunter alluvial soils making it a secondary resource zone; however, it comprises of road easement and grass ground cover suggesting that the A Horizon soil has been compromised.

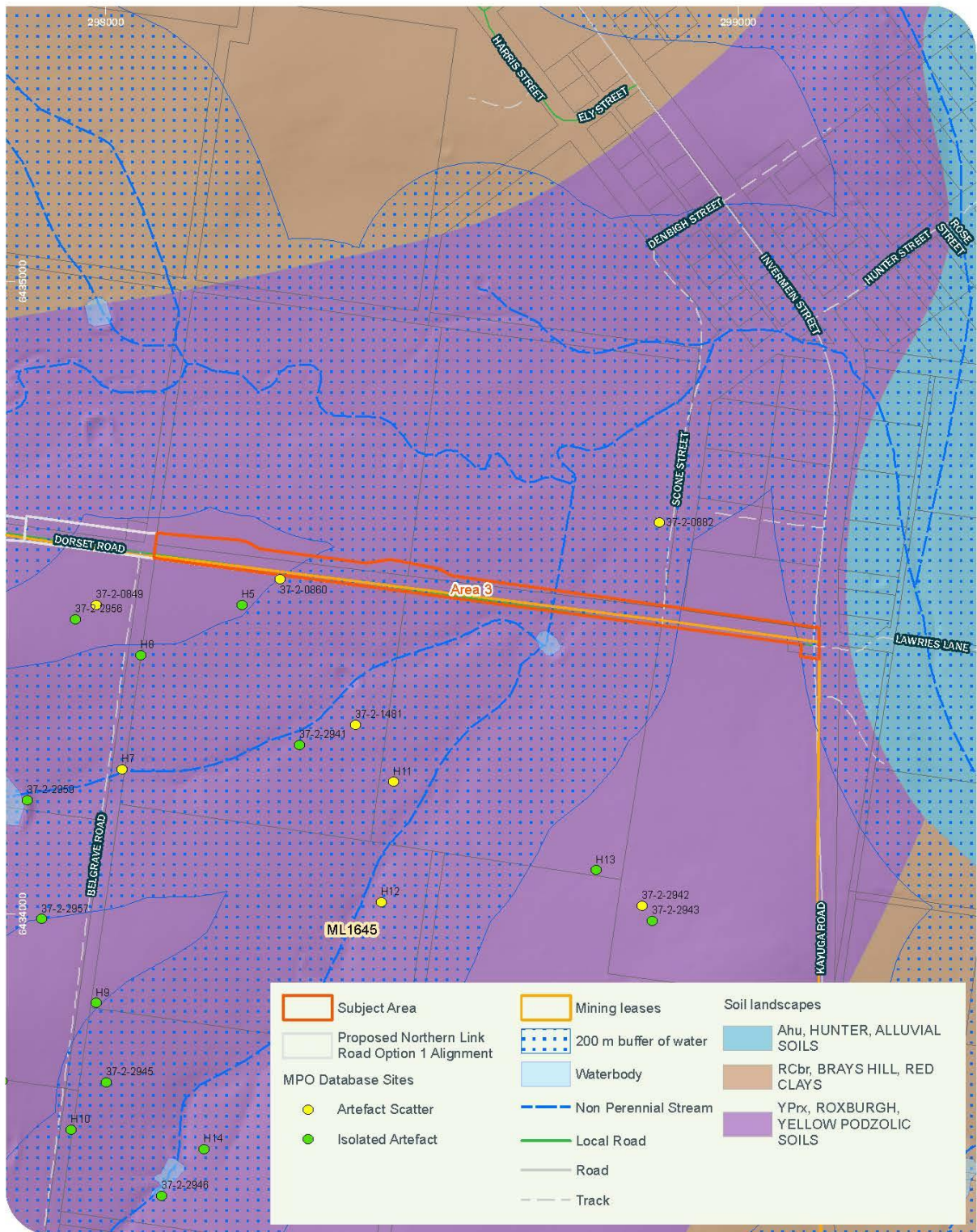
Plant resources such as bark extracted from native trees for making canoes and shields would have been abundant in the area. Utilising seeds and plants would have also been part of the resources collected in the area. Previous research from Enright (1914) and Brayshaw (1986) reports on early settlers' observations of resource exploitation, including various birds, snakes, wombat, grey kangaroo, red wallaby, koala, bandicoot, possum, fruit bats, lizards, goanna, pademelon, flying squirrel and native cats. Marine resources along the watercourses and Hunter River would have provided freshwater fish, mussels and crayfish. The exploitation and resource strategies employed by Aboriginal occupants in the Subject Area would have been dictated by the locality and seasonal availability of these resources.

2.3 Past land use and disturbance

The proposed Northern Link Road Alignment has been disturbed by the existing Dorset and Castlerock roads, pastoral disturbances and land clearance associated with European settlement in the 1800s. Some types of disturbance that may be visible on the ground within Areas 1 and 2 could include grazing of livestock, fencing, pastures, and construction of contour banks (Kuskie 2020). These practices result in the erosion of hillslopes and watercourses and subsequent deposition of soils onto the middle and lower portions of drainage lines, disturbing any potential archaeology to remain *in-situ*. Many of these disturbances would have been exacerbated by the continuation of agricultural activities, construction of roads and access tracks. Disturbance types associated with Area 3 include land clearance and the construction of Dorset Road. The surface has been disturbed and it is doubtful that any subsurface potential remains intact beneath the road. Overall, the survival and integrity of Aboriginal sites within the Subject Area may have been affected by the range of these activities.

Figure 4: Soil landscapes and hydrology in the local area (Source: Niche)





3. Summary of background information

3.1 The Subject Area

Numerous archaeological reports have been prepared over the decades for the MPO Mining Lease lands. Five archaeological assessments have assessed sections of the current Subject Area and have inferred archaeological potential within the Subject Area (See Table 2).

Table 2: Summary of past Aboriginal archaeological assessments within the Subject Area at MPO

Author	Date	Title	Assessment details
ERM Mitchell McCotter	1997b	<i>Mount Pleasant Mine EIS Fine Rejects Emplacement Area Archaeological Investigations</i>	<p>ERM Mitchell McCotter undertook some supplementary assessments to complement the 1995 assessment and survey areas that previously had not been considered as part of the mine plan. During this assessment a further 24 Aboriginal sites were identified that comprised of 79 artefacts. Site distribution was comparable to the pattern previously identified by Rich (1995).</p> <p>More than half of the recorded sites were located on slopes (55%) and most sites were assessed as being of low archaeological significance.</p> <p>While it appears that this study overlaps with the majority of Areas 1 and 2, there is insufficient evidence that it was surveyed.</p>
Selimiotis and Slack (Scarp Archaeology)	2009	<i>Technical Advisor Report: Cultural Heritage Investigations Stage 5 Mount Pleasant Mine, Hunter Valley</i>	<p>Rio Tinto Coal Australia Pty Limited (RTCA) and Coal & Allied industries Pty Ltd (CAN) commissioned Scarp Archaeology to provide a Technical Advisor for Stage 5 of the cultural heritage assessment. A total of 136 Aboriginal sites were recorded including 113 isolated finds, 20 artefact scatters and three (3) possible scarred trees. Details of site locations, descriptions, metric analysis, and recommendations are provided within this report.</p> <p>This archaeological assessment appears to overlap with the Areas 1 and 2 resulting in the mid-section having been surveyed during this assessment.</p>
Selimiotis (Scarp Archaeology)	2010a	<i>Technical Advisor Report: Cultural Heritage Investigations of the Proposed Broomfield Aboriginal Cultural Heritage Conservation Area for the Mount Pleasant Coal Mine</i>	<p>RTCA commissioned Scarp Archaeology to carry out an ACHA of the proposed conveyor easement, adjacent the Subject Area. A total of 64 Aboriginal archaeological sites were found including 55 isolated finds, six (6) artefact scatters and three (3) possible scarred trees. Results were consistent with previous surveys and artefact densities were similar to the intensity previously recorded sites.</p> <p>Just under half of the sites recorded were located on hill slopes.</p>

Author	Date	Title	Assessment details
Kuskie	2020	<i>Mount Pleasant Optimisation Project, Hunter Valley, New South Wales: State Significant Development Application – Aboriginal Cultural Heritage Assessment.</i>	<p>South East Archaeology was engaged by MACH Mount Pleasant Operations Pty Limited to undertake an ACHA Report for a SSD Application for the proposed Project. This ACHA considered 1,900 heritage sites within the MPO Aboriginal Site Database Area, including approximately 1,909 open artefact sites and 13 scarred trees.</p> <p>The assessment did not include a field inspection of all of the current Subject Area due to land access issues.</p>
Kuskie	2020	<i>Mount Pleasant Optimisation Project, Hunter Valley, New South Wales: State Significant Development Application – Aboriginal Cultural Heritage Assessment – Addendum Report to Assess Minor Amendments.</i>	<p>Subsequent to the completion of Kuskie (2020) ACHA Report, minor amendments to components of the Project were made which were addressed in the Addendum Report. This included minor changes to the extent of the Project Open Cut and Waste Rock Emplacement Landforms; Existing Approved Surface Development (Revision F); Northern Link Road Option 1; Northern Link Road Option 2; Infrastructure Area Envelopment; and the Approximate Disturbance Area to be Relinquished. Any changes to these areas including increased or decreased impacts to Aboriginal heritage sites were outlined in Tables 1-9.</p> <p>The assessment did not include a field inspection of the current Subject Area due to land access issues.</p>

3.2 The surrounding region

Table 3 provides a list of the archaeological assessments that have been undertaken to date within the broader landscape surrounding the Subject Area, many of which are discussed in detail in the primary and addendum ACHAs (Kuskie 2020) and this discussion will not be repeated here. These assessments are important in the establishment of inductive modelling which relies on existing studies and site records to find correlations between site locations and environmental attributes (Canning 2005). This form of predictive modelling is the most widely used within Australian cultural heritage management and is extremely beneficial in regions where extensive archaeological assessments have been undertaken, such as the current region surrounding the Subject Area.

Table 31: Summary of past Aboriginal archaeological assessments at MPO (source: Kuskie 2020 and Niche).

Author	Date	Title
Effenberger, S.	1993	<i>Survey Supplement Archaeological Survey and Assessment Dartbrook 66 kV Proposed Transmission Line.</i> Unpublished report by Envirosiences Pty Ltd to Shortland Electricity.
Ruig, J.	1993	<i>A Report on an Archaeological Survey of the Proposed Optic Fibre Route from Castle Rock to Muswellbrook, Upper Hunter, NSW.</i> Unpublished report to Telecom Australia.
Rich, E.	1993	Proposed Bengalla Coal Mine, Muswellbrook NSW: Archaeological Survey for Aboriginal Sites. Unpublished report to Envirosiences Pty Ltd.

Author	Date	Title
Rich, E.	1995	<i>Mt Pleasant Coal Lease, New Muswellbrook, NSW: Archaeological survey for Aboriginal sites.</i> Unpublished report to ERM Mitchell McCotter Pty Ltd and Coal & Allied Operations Pty Ltd.
ERM Mitchell McCotter	1995	<i>Mount Pleasant Coal Lease, Muswellbrook NSW: An archaeological survey for Aboriginal sites</i>
ERM Mitchell McCotter	1996	<i>Mt Pleasant EIS North-West Emplacement Area Archaeological Investigation.</i> Unpublished report to Coal & Allied Operations Pty Limited.
ERM Mitchell McCotter	1997a	<i>Mount Pleasant Mine Environmental Impact Statement</i>
ERM Mitchell McCotter	1997b	<i>Mount Pleasant Mine EIS Fine Rejects Emplacement Area Archaeological Investigations</i>
White	1998	<i>Archaeological Salvage of Sites B10 & B33, Bengalla Mine, Hunter Valley, NSW.</i> Unpublished report to Bengalla Mining Company.
ERM	2007a	<i>Bengalla Link Road (Stage Two) Aboriginal Archaeological Assessment.</i> Unpublished report to Hansen Bailey Pty Ltd.
ERM	2007b	<i>Bengalla Mine Section 90 #2621 Aboriginal Heritage Salvage Collection Report.</i> Unpublished report to report to Hansen Bailey
HLA Envirosciences	2007	<i>Aboriginal Heritage Assessment: Mount Pleasant Block 1</i>
McCardle Cultural Heritage Management	2007	<i>Mount Pleasant Indigenous Archaeological Assessment Stage 2</i>
Roberts, L.	2007	<i>Aboriginal Cultural Survey State 3 Mount Pleasant, NSW.</i> Unpublished report to Coal & Allied Operations Pty Ltd.
Anderson, L. (Nur-Run-Gee Pty Ltd.)	2007	<i>Coal & Allied Stage 4 Mount Pleasant Aboriginal Cultural and Heritage Report.</i> Unpublished report to Coal & Allied.
Selimiotis and Slack (Scarp Archaeology)	2009	<i>Technical Advisor Report: Cultural Heritage Investigations Stage 5 Mount Pleasant Mine, Hunter Valley.</i> Unpublished report to Rio Tinto Coal Australia.
Selimiotis (Scarp Archaeology)	2010a	<i>Technical Advisor Report: Cultural Heritage Investigations of the Proposed Broomfield Aboriginal Cultural Heritage Conservation Area for the Mount Pleasant Coal Mine, Hunter Valley, Muswellbrook LGA.</i> Unpublished report to Rio Tinto Coal Australia.
Selimiotis (Scarp Archaeology)	2010b	<i>Technical Advisor Report: Cultural Heritage Investigations Conveyor Easement Survey, Mount Pleasant Mine, Hunter Valley.</i> Unpublished report to Rio Tinto Coal Australia.
Central Queensland Cultural Heritage Management (CQCHM)	2010	<i>Mount Pleasant Project Modification Aboriginal Cultural Heritage Assessment Report.</i> Unpublished report to Coal & Allied Operations Pty Limited.
Selimiotis and Slack (Scarp Archaeology)	2012	<i>Technical Advisor Preliminary Advice: Cultural Heritage Investigations – Mount Pleasant Mine, Hunter Valley Stage 6.</i> Unpublished report to Rio Tinto Coal Australia
AECOM	2013	<i>Bengalla Continuation of Mining Project Aboriginal Archaeology and Cultural Heritage Impact Assessment.</i> Unpublished report to Hansen Bailey
Rio Tinto Coal Australia Pty Ltd (RTCA)	2014	<i>Aboriginal Cultural Heritage Management Plan Mount Pleasant Coal Mine (DA92/97 as modified 19 September 2011).</i> Prepared by Rio Tinto Coal Australia.
Cameron, D and Deacon, J.	2016	<i>Aboriginal Cultural Heritage Assessment Report for the Mount Pleasant Coal Mine (DA 92/97) 2016 Aboriginal Heritage Impact Permit Application.</i> Unpublished report for Rio Tinto Coal Australia Pty Limited.
Kuskie (South East Archaeology)	2016	<i>Report on Aboriginal Heritage Due Diligence Assessment of Proposed Water Supply Pipeline at Mount Pleasant Operation, Hunter Valley, New South Wales.</i> Unpublished report to MACH Energy Australia Pty Limited.

Author	Date	Title
Regal <i>et al.</i>	2017	<i>Mount Pleasant Operation Rail Modification Aboriginal Cultural Heritage Assessment.</i> Unpublished report to MACH Energy Australia Pty Ltd.
AECOM	2017	<i>Bengalla Continuation of Mining Project: Aboriginal Archaeological Salvage Program.</i> Unpublished report to Bengalla Mining Company Pty Ltd.
Kuskie (South East Archaeology)	2017a	<i>Mount Pleasant Operation, Hunter Valley, New South Wales: Aboriginal Heritage Reassessment of Four Previously Report Scarred Trees.</i> Unpublished report to MACH Energy Australia Pty. Limited.
Burns, M.	2017a	<i>Scar Tree Assessment Report Mt Pleasant Mine.</i> Unpublished report by Global Soil Sciences to MACH Energy Australia Pty Limited.
Kuskie (South East Archaeology)	2017b	<i>Mount Pleasant Operation, Hunter Valley, New South Wales: Aboriginal Heritage Reassessment of 11 Previously Reported Scarred Trees.</i> Unpublished report to MACH Energy Australia Pty Limited.
Burns, M.	2017b	<i>Second Scar Tree Assessment Report Mount Pleasant Mine.</i> Unpublished report by Global Soil Sciences MACH Energy Australia Pty Limited.
Kuskie (South East Archaeology)	2017c	<i>Mount Pleasant Operation, Hunter Valley, New South Wales: Aboriginal Heritage Reassessment of Three Previously Reported Scarred Trees.</i> Unpublished report to MACH Energy Australia Pty Limited.
Burns, M.	2017c	<i>Third Scar Tree Assessment Report Mount Pleasant Mine.</i> Unpublished report by Global Soil Sciences MACH Energy Australia Pty Limited.
Niche	2017	Mount Pleasant Operation Rail Modification – Aboriginal Cultural Heritage Assessment
Kuskie (South East Archaeology)	2019	<i>Mount Pleasant Operation, Hunter Valley, New South Wales: Aboriginal Heritage Reassessment of 19 Previously Reported Scarred Trees.</i> Unpublished report to MACH Energy Australia Pty Limited.
Niche	2019a	<i>Aboriginal Object Due Diligence Assessment Mount Pleasant Operations ETL Realignment Muswellbrook, NSW.</i> Unpublished report to Ausgrid.
Niche	2019b	<i>Aboriginal Object Due Diligence Assessment Mount Pleasant Operations Clean Water Diversion Muswellbrook, NSW.</i> Unpublished report to MACH Energy Australia Pty Limited.
Niche	2019c	<i>Mount Pleasant State Significant Development Application Historic Heritage Assessment.</i> Unpublished report to MACH Energy Australia Pty Limited
Kuskie	2019	Mount Pleasant Operation, Hunter Valley, New South Wales: Aboriginal Heritage Reassessment of 19 Previously Reported Scarred Trees
Niche	2020	Mount Pleasant Operations (MPO) – MOD 4 Surface Salvage Collection
Kuskie	2020	Mount Pleasant Optimisation Project, Hunter Valley, New South Wales: State Significant Development Application – Aboriginal Cultural Heritage Assessment – Addendum Report to Assess Minor Amendments.
Kuskie	2020	Mount Pleasant Optimisation Project, Hunter Valley, New South Wales: State Significant Development Application – Aboriginal Cultural Heritage Assessment.
Kuskie (South East Archaeology)	2020	<i>Mount Pleasant Operation, Hunter Valley, New South Wales: Report on Salvage of Open Artefact Sites Between December 2018 and February 2019 under Aboriginal Heritage Impact Permit #C0002092.</i> Unpublished report to MACH Mt Pleasant Operations Pty Limited.
Niche	2021	MPO – Areas D1 and D2 – Aboriginal Objects Desktop Due Diligence Assessment
Niche	2021	MPO – Demolition of Belgrave Homesteads – Aboriginal Objects Desktop Due Diligence Assessment
Niche	2021	Mount Pleasant Operations (MPO) –Surface Salvage July 2021

Author	Date	Title
Niche	2021	Mount Pleasant Operations (MPO) –Surface Salvage June 2021

3.3 Slope analysis

Slope analysis was undertaken using LiDAR mapping and Speight's slope classification (Speight 2009). Table 4 and 5 provides a breakdown of the Subject Area by slope classification. In summary:

- Almost 71% of the Subject Area (Areas 1, 2 and 3) comprised moderately inclined slopes.
- Some small areas of level ground (< 2%) exist in sections where the alignment traverses minor ridge lines with almost 20% of very gently inclined to gently inclined slopes creating drainage depressions. These slopes drain to various first order tributaries.
- Slope gradient appears to be greater Areas 1 and 2 east compared to Area 3 which appears to mostly consist of very gently inclined slopes.

Table 4: Summary of slope classification present within Subject Area (source: MACH Energy and Niche).

Slope Classification	Slope Percentage (%)	Area (ha)	Percentage of Subject Area
Level	0.0 – 0.018	0.27	1.81
Very gently inclined	0.018 – 3.055	2.97	19.86
Gently inclined	3.055 – 5.678	1.11	7.41
Moderately inclined	5.678 – 32.49	10.61	70.92

Table 5: Summary of slope classification present within Subject Area (source: MACH Energy and Niche).

Area within Subject Area	Slope Classification	Slope Percentage (%)	Area (ha)	Percentage of Subject Area
Area 1	Level	0.0 – 0.018	0	0
	Very gently inclined	0.018 – 3.055	0.03	0.20
	Gently inclined	3.055 – 5.678	0.16	1.06
	Moderately inclined	5.678 – 32.49	3.45	23.06
Area 2	Level	0.0 – 0.018	0.02	0.14
	Very gently inclined	0.018 – 3.055	0.04	0.27
	Gently inclined	3.055 – 5.678	0.22	1.47
	Moderately inclined	5.678 – 32.49	7.15	47.79
Area 3	Level	0.0 – 0.018	0.25	1.67
	Very gently inclined	0.018 – 3.055	2.90	19.39
	Gently inclined	3.055 – 5.678	0.73	4.88
	Moderately inclined	5.678 – 32.49	0.01	0.07

The MPO Site Database shows that, of the 1951 recorded sites within the Mining Lease boundaries, 6 site types exist: isolated finds (n=953); artefact scatters (n=918); non-sites (n=41); scarred trees (n=14), open artefact sites (n=24); and a spiritual place (n=1). When looking at the occurrence of sites by type (Table 6 and Table 7) in conjunction with slope classification:

- Aboriginal sites are more likely to occur on moderately inclined slopes (75%).
- Only 6.3% of Aboriginal sites occur on very gently inclined slopes.
- Of the total number of MPO sites, isolated artefacts (49%) were the most frequently occurring site type followed by artefact scatters (48%).

- Most MPO sites occur within 200 m of watercourses. Areas 1 and 2 are located 200 m from various first order watercourses while Area 3 is located within 1 km of the Hunter River and just over 200 m from a high order watercourse to the north.

Table 6: Summary of MPO site occurrence within slope classifications (source: MACH Energy and Niche).

Slope Classification	Number of Sites	Percentage (%)
Level	62	3.2
Very gently inclined	123	6.3
Gently inclined	272	13.9
Moderately inclined	1458	74.6
Steeply inclined	33	1.7
Very steeply inclined	3	0.3

Table 7: Summary of MPO site type occurrence within slope classifications (source: MACH Energy and Niche).

Slope Classification	Site Type	Number of sites
Level	Artefact Scatter	34
	Isolated Artefact	27
	Non-Site	1
	Scarred Tree	0
	Open Artefact Site	0
Very gently inclined	Artefact Scatter	58
	Isolated Artefact	61
	Non-Site	2
	Scarred Tree	1
	Open Artefact Site	1
Gently inclined	Artefact Scatter	130
	Isolated Artefact	129
	Non-Site	7
	Scarred Tree	3
	Open Artefact Site	3
Moderately inclined	Artefact Scatter	696
	Isolated Artefact	715
	Non-Site	29
	Scarred Tree	10
	Open Artefact Site	8
Steeply Inclined	Artefact Scatter	12
	Isolated Artefact	18
	Non-Site	2
	Spiritual Place	1
Very steeply inclined	Isolated Artefact	3

4. Predictive model

4.1 Subject area predictive model based on Kuskie (2020)

Kuskie (2020) provides the most current and comprehensive predictive modelling relating to the Subject Area and broader surrounds using inductive modelling methods. The following is a predictive model for the Subject Area using Kuskie's predictive model.

Artefact Scatters:

An artefact scatter can be defined as either the presence of two or more stone artefacts within 50 or 100 metres of each other, or where a concentration of artefacts has a higher density than the surrounding low density 'background scatter' (Kuskie 2020). Artefact scatters are a common site type in the region and the exiting MPO. Many sites which consist of artefact scatters are mainly identified within exposures created by erosion or disturbance to the land, particularly around watercourses and drainage lines. There is potential for stone artefacts to occur within the Subject Area wherever A Horizon soils are present, apart from areas which have been substantially impacted by recent land-use. Areas 1 and 2 are considered to be outside of Kuskie's (2020) primary or secondary zones, where transitory movement is typically associated with landforms such as simple slopes, ridge crests, spur crests and lower order watercourses. Within these landforms, artefact densities are typically low to very low (<1 artefact / m²) which is consistent with background discard. Area 3 is located within a secondary resource zone increasing the potential for subsurface deposits representing more frequent occupation from larger groups of people.

While the slope analysis conducted by Niche suggests that artefacts are more likely to be found on moderately inclined slopes, Kuskie (2020) suggests that the movement of soils may cause the redistribution of the artefacts down the slope. The potential for archaeological deposits along the slopes of Areas 1 and 2 may be limited due to the occurrences of sheet erosion and shallow soils. It is unknown what soil deposits remain intact beneath the road within Area 3.

Bora / Ceremonial Sites:

Bora grounds are site types associated with ceremonies which are typically made of two circular depressions in the earth, sometimes edged with stone (Kuskie 2020). These sites occur on soft sediments in river valleys, occasionally on rocky, ground that may be associated with stone arrangements. The potential for bora/ceremonial sites within the Subject Area is considered very low due to moderate slopes within the western section. Due to processes such as sheet erosion and the extensive history of land-use, remains of these sites are unlikely to survive. An analysis of the MPO Site Database suggests that bora / ceremonial sites would be unlikely to occur within the Subject Area.

Burials:

Human remains tend to be placed in hollow trees, caves, or sandy deposits. Typically, burials are only identified when eroding out of sand deposits or creek banks, or when disturbed by development. The probability of burials detected during archaeological fieldwork is extremely low, with rare exemptions of one burial near Mount Arthur North (Kuskie 2000). The potential for burials within the Subject Area are considered very low due to agricultural tree clearing and lack of proximity to suitable sandy deposits.

Carved Trees:

Carved tree sites were still relatively common in NSW in the 20th Century (Kuskie 2020: 141) which were used as markers for ceremonial or symbolic areas, including burials. The potential for carved trees within the Subject Area is considered low, mostly due to extensive land clearing, vegetation removal and natural attrition (bush fires). Some evidence of tree carving may occur on mature native trees that have remained, however generally the potential is nil to low for carved trees to occur within the Subject Area based on the fact that no carved trees have been recorded within the Project area.

Grinding Grooves:

Grinding grooves are sites characterised by elongated narrow depressions in soft rocks (particularly sedimentary) and are generally found along the banks of watercourses and rocky outcrops. These sites are associated with resource processing such as sharpening axes, grinding seeds, other plant matter and animal foods. These site types typically occur on sedimentary bedrock along watercourse and open sandstone surfaces in other contexts (e.g., simple slopes, slabs, rock shelters). The potential for grinding groove sites within the Subject Area is assessed as nil to low, given the minimal presence of suitable geology (exposed sandstone bedrock) and absence of permanent waterbodies.

Quarry Sites:

Quarry sites are associated with the procurement of stone for knapping activities. This refers to outcrops of bedrock where there is clear evidence of procurement activities such as pits, discarded hammerstones and large deposits primary flaking debris. These sites will only be located in landscapes where exposed outcrops of suitable stone types are present. The potential for lithic quarry sites within Areas 1 and 2 of the Subject Area are relatively low to moderate with some areas in the western section rock outcrops may occur. Based on previous research (Rich 1993, Kuskie 2020) areas of potential for stone knapping within the Subject Area and surrounds have been identified as low to moderate.

Rock shelter Sites:

Rock shelters are geological formations including rock overhands, shelters and caves which were used by Aboriginal people. These sites only occur where suitable geological formations are present and may contain artefacts, deposits, rock art or grinding grooves. Some may occur in isolated rock formation (boulders) or along more extensive rock formations (cliffs). Due to the lack of suitable geological formations within the Subject Area, the potential for rock shelter sites is considered very low. This is further reinforced by the lack of identified rock shelters within the immediate locality and limited occurrence within the Central Lowlands.

Scarred Trees:

Scarred trees are sites where scars are formed by the removal of bark for use in manufacturing canoes, containers, shields or shelters. The potential for scarred trees within Areas 1 and 2 of the Subject Area is considered very low, mostly due to the extensive land clearing and natural attrition within the area. Possible remnants of scarred trees would be found where mature trees and original vegetation have survived. There are no trees within Area 3.

Stone Arrangements:

Stone arrangements include circles, mounds, lines or other patterns of stone arranged by Aboriginal people. Some of these sites are associated with bora grounds or ceremonial sites. These are typically found on hill tops and ridge crests which contain stone outcrops or surface stone where minimal impacts from recent land use have occurred. Kuskie suggests that stone arrangements are likely to be found on hill tops and ridge crests. Given that these landform units do not occur within the Subject Area it is unlikely that stone arrangements will be found within Areas 1 and 2. Stone arrangements are unlikely within Area 3.

Waterhole / Wells:

Waterholes/wells are natural depressions in boulders or exposed bedrock, known as pan-holes or gnamma holes which retain water and utilised by Aboriginal people (Kuskie 2020). Due to the lack of suitable geology and absence of evidence within the wider area, the potential for these features to occur within the Subject Area is very low. There are no wells or waterholes within Area 3.

4.2 Subject area predictive model based on Kuskie (2020) and Niche's slope analysis

A slope analysis of the MPO Site Database was conducted and compared to Kuskie's (2020) predictive model. The slope analysis showed that, at a broad level, most sites (75%) within the MPO Mining Lease boundaries tended to occur on moderately inclined slopes. At a more localised level, it was shown that the vast majority of the Subject Area comprises of moderately inclined slopes. This would indicate that there is greater potential for Areas 1 and 2 to contain surface artefacts compared to Area 3. Slope analysis alone; however, cannot be used to predict site occurrences due to the lack of detail and variables it takes into consideration. For example, slope analysis does not consider distance to fresh potable water which is one of the most important environmental variables in Australian hunter-gatherer archaeological modelling (Canning 2005). Therefore, the slope analysis should be considered alongside other methods of predictive modelling. Inductive modelling is one of the most used modelling types in Australian cultural heritage management and relies on existing studies and site information to find correlations between site locations and environmental attributes (Canning 2005). When looking at the results of the slope analysis in conjunction with Kuskie's (2020) predictive model we can make the following predictive assumptions:

Areas 1 and 2

- The moderately inclined slopes within Areas 1 and 2 of the Subject Area have the potential to contain surface Aboriginal sites.
- Isolated finds and artefact scatters are the most likely site types to occur within Areas 1 and 2.
- Scarred trees are likely to occur on moderately inclined slopes, however there is very low potential for scarred trees to occur within the Subject Area due to the extensive land clearing and natural attrition within the area.
- Artefacts are more likely to occur in areas of the Subject Area where A Horizon soil deposits are present.
- Sites within Areas 1 and 2 east are expected to be of low density (<1 artefact/m²) due to the distance to fresh water from the Hunter River (>5 km).
- The closest proximity to fresh water is the first order streams transecting Areas 1 and 2 which may have provided seasonal fresh water during transitory movements; however, Areas 1 and 2 are not considered a primary or secondary environment supportive of group subsistence of any scale.
- The archaeology of Areas 1 and 2 is indicative of transitory movement patterns and would likely be representative of background loss and discard over an extensive period of time.

- Soil deposits within Areas 1 and 2 are likely to be between 10-15 cm deep in areas where disturbance is minimal. Artefact preservation within this deposit would be nil to low.
- The potential for archaeological deposits within Areas 1 and 2 is limited due to the occurrences of sheet erosion and shallow soils.

Area 3

- The existing section of constructed road within Area 3 retains little potential for surface artefacts to be present. The potential for surface artefacts increases in areas outside of the road footprint where A Horizon soils remain intact.
- Area 3 may be a part of a secondary resource zone due to its proximity to the Hunter River and a fourth order watercourse. This zone may likely have potential subsurface deposits provided A Horizon soil deposits remain intact.
- The archaeology of Area 3 is located within an area where more focused and repeated Aboriginal occupation by larger number of people may have occurred (Kuskie 2020:166)

5. Management and mitigation measures

In accordance with the brief, the following section outlines the proposed method to test the findings of the analysis prior to disturbance of these areas post-approval and recommend measures to manage risks to ACH through the AHMP process.

As noted above, there is the potential for low densities and frequencies of surface Aboriginal stone artefacts to occur within Areas 1 and 2 of the Subject Area. These Aboriginal objects are not associated with primary or secondary resource zones and are likely to represent transient movement across the landscape. The soils within these two areas are predicted to be shallow and subject to contour banking and erosion and unlikely to contain intact, deposits of sufficient depth to preserve occupation dates of significant age (Kuskie 2020). There is potential, albeit low, for culturally modified trees to be present due to past vegetation clearance. Although there is little likelihood that any surface artefacts remain within Area 3 and, like Areas 1 and 2, soils within this area are predicted to be shallow and destroyed by road construction and unlikely to contain intact, deposits of sufficient depth to preserve occupation dates of significant age. To date, the Registered Aboriginal Parties have not identified any specific cultural values of the Subject Area during previous assessments, outlined in Section 3 of this report.

It is proposed that an ACH and archaeological field survey of all previously unsurveyed land within the impact footprint of the Subject Area would be undertaken to test the model once land access was available and prior to impact with representatives of the RAPs, in accordance with the procedures outlined in the approved MPO AHMP (MACH 2019:25):

“Where potential impacts will occur within the MPO and the area has not previously been subject to heritage survey or assessment, MPO will engage a suitably qualified archaeologist and representatives of the RAPs to undertake a heritage survey of that area to prior to undertaking any ground disturbance works.”

The survey would aim to achieve full coverage of the impact footprint. Survey would be undertaken in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b).

A report would be prepared, outlining the results of the survey. The report would include:

- Detailed records of the consultation conducted with RAPs and how any comments received throughout the survey and reporting process were considered
- An assessment of significance in accordance with the significance criteria set out in the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) and *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (ICOMOS 2013)
- Details of the sites/objects and/or places and their locations within the Subject Area and an assessment of potential impacts from the proposed activity
- Management and mitigation measures for the Aboriginal objects, with consideration of the current conditions of consent and AHMP (see Table 8).
- Surface collection / salvage of any newly recorded sites should be collected at time of survey or prior to the commencement of any impacts consistent with the requirements of the AHMP.

Table 8: Summary of MPO AHMP procedures (source: MACH 2019).

Requirement	Recommendation
Procedures for site recording	Must be undertaken by a suitably qualified archaeologist experienced in detailed recording of the relevant site type.
	Must be undertaken in consultation with attending RAPs.
	All data collected will be submitted to the Heritage NSW for inclusion in the relevant AHIMS site record.
	A reassessment of the site's significance will be undertaken, if warranted.
	The MPO Aboriginal Heritage Site Database and Appendix C of the AHMP will be updated as required.
Protocols for surface collection	To be undertaken by a combined team of suitably qualified archaeologists and representatives of the RAPs, and will involve systematic collection procedures selected by the suitably qualified archaeologist(s) with respect to the nature and extent of the evidence and collection area including: <ul style="list-style-type: none"> • Delineation of the collection area and the flagging of all visible artefacts within each site; • The recording of artefact locations using a GPS (and other techniques where appropriate such as using measurements offset from baselines, or within a grid such as 5 x 5 m²; • Photography of the site; and • Collection and bagging of identified artefacts (with a unique sequential number for each artefact within each site recorded and labelled on the bag containing the item).
	Written notification of sites cleared for ground disturbance works will be provided by the attending archaeologist to MACH Energy on a progressive basis as sites are salvaged. All surface collected artefacts will be assigned a unique sequential number for data analysis purposes (if required). Analysis of surface artefacts will be conducted off site on a progressive basis.
	Should a previously recorded site not be able to be located after a reasonable search then the site will be considered to have been salvaged for the purposes of this AHMP. The MPO Aboriginal Heritage Site Database and Appendix C of the AHMP will be updated to note that the site was not recovered.
Procedures for scarred tree removal	In the event that scarred trees are identified and require salvage and removal, a methodology has been developed based on an industry best practice scarred tree removal and relocation procedure and will be employed to remove and store any scarred trees directly impacted by the MPO.
	The removal methodology for any Aboriginal scarred trees is outlined in Appendix E of the AHMP.
	The identification of trees as 'scarred trees' may include the involvement of an arborist or forestry specialist with relevant experience. The determination of the origin of the tree's scarring may also involve an archaeologist with relevant experience. If considered to be of likely cultural origin, the archaeologist and/or arborist or forestry specialist will offer advice on the tree's removal, in consultation with the attending RAPs.
	The removal of a confirmed Aboriginal scarred tree will follow the four step procedure outlined below: <ol style="list-style-type: none"> 1. Pre-removal preparation. 2. Removal/relocation. 3. Storage. 4. Management/preservation. Mount Pleasant Operation (DA 92/97) - Aboriginal Heritage Management Plan (02) 00940522-003 31
	As described in Section 1.1 of the AHMP, should a possible scarred tree be identified and then later be determined not to be of Aboriginal origin by a suitably qualified

Requirement	Recommendation
	<p>archaeologist and arborist or forestry specialist in consultation with the attending RAPs, a technical report would be prepared. This report would be provided to the Heritage NSW and made available to all RAPs. A copy would also be forwarded to the AHIMS registrar so that the status of the tree can be appropriately updated (as necessary).</p> <p>In the event that a previously identified scarred tree is determined to not be of Aboriginal origin, no further management according to the principles outlined in this document (including salvage or removal) would be required.</p> <p>Where controlled salvage excavation is determined to be warranted (based on advice from a suitably qualified and experienced archaeologist and in consultation with the attending RAPs), the following process will generally be implemented at a level appropriate to the extent and nature of the site:</p> <ul style="list-style-type: none"> Controlled salvage excavation will be undertaken by a suitably qualified archaeologist(s), with assistance provided by the attending RAPs. All excavation will be carried out manually using trowels, shovels and mattocks (where appropriate). Open area excavation will proceed in 1 m² units. All excavation units (i.e. shovel test pits and open area 1 x 1 m² squares) will be assigned a unique identifier The first excavation unit will be excavated and documented in 5 centimetres (cm) spits (or other suitable spit size as deemed appropriate by the suitably qualified archaeologist) at each area – either PAD or site – being investigated. Based on the evidence of the first excavation unit, 10 cm spits or sediment profile/stratigraphic excavation (whichever is smaller) may then be implemented. Excavation will cease at culturally sterile units or bedrock in all instances – the identification of sterile stratigraphic units will draw upon a geomorphological understanding of the wider MPO area. Photographic and/or scale-drawn records of exposed soil profiles in open area excavations will be made. If specific archaeological features (e.g. hearths) are identified, the entire feature will be excavated and recorded. Features will be photographed and scale plans drawn. All excavated soils will be wet or dry-sieved (dependent on composition) through 5 mm and/or 3 mm sieves, as deemed appropriate by a qualified archaeologist, and in accordance with the Heritage NSW policy <i>Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales</i> (DECCW, 2010a). All material remaining in the sieve will be sorted by a qualified archaeologist to identify and retain all cultural items. All remaining non-cultural material will be discarded. Artefacts recovered from sieving will be retained in plastic zip-lock bags and labelled with appropriate provenance data and assigned a unique reference number. A standard data recording form will be used for each 1 x 1m² excavation unit and will include (as a minimum) site name, date, recorder, square identifier, volume of deposit excavated per spit and number of spits. Upon completion of excavation, the location of all excavation units will be incorporated into the topographic survey plan for the site. All excavation units will be backfilled upon conclusion of excavations at the site. <p>The above requirements may be modified for any particular site based on advice from a suitably qualified archaeologist (e.g. based on the on-ground conditions, nature of the soils, site safety requirements etc.).</p>

6. Conclusions and recommendations

Heritage NSW (9 August 2021) requested that a desktop analysis report be completed pre-project approval that analysed:

“.....Aboriginal site and landform relationship to calculate the probable distribution pattern of Aboriginal objects of the un-surveyed parcels of land where access issues persist. The report must provide guidance on the scale of field investigations required and which are proportionate to the findings of the analysis.”

Slope analysis suggests that Areas 1 and 2 within the Subject Area have the potential to contain surface artefacts; however, the archaeological context of the broader region (Kuskie 2020) suggests that expected site occurrences will be of low density and indicative of transitory movement by Aboriginal people, most likely travelling to / from the Hunter River to the east.

Desktop analysis of Area 3 suggests that moderate slopes rarely occur within this area but that there is a greater chance of subsurface deposits. Construction of Dorset Road may indicate that the shallow soils within this area have been destroyed by the road’s construction and are unlikely to contain intact, deposits of sufficient depth.

Predicted Aboriginal objects within the Subject Area (Areas 1, 2 and 3) include stone artefacts in areas where the A Horizon soil deposit remains intact. Although scarred trees are likely to occur within moderately inclined slopes, there is very low potential for scarred trees to occur within the Subject Area due to the extensive land clearing and natural attrition. The Subject Area is unlikely to contain intact A Horizon soil deposits greater than 10-15 cm and therefore has low subsurface potential.

Recommendations based on the Subject Area predictive model are provided in the table below.

Recommendations	
	Unsurveyed Portion of Northern Link Road Alignment Option 1
1.	Recommendations provided in Kuskie’s ACHA (2020) and the MPO AHMP (MACH 2019) should be adhered to with regard to the management of site MP14 which is located within Area 2 within the Subject Area.
2.	Given the small area of the Subject Area (14.96 ha), a full coverage field survey of Areas 1, 2 and 3 within the Northern Link Road Alignment should be completed to test the findings of this desktop analysis report.
3.	If additional disturbance is proposed for Area 3 (i.e. in addition to the existing road footprint), field survey should be conducted. Should the field survey identify any intact A Horizon soils, a program of subsurface testing should be completed to test the level of disturbance within the area and to test the findings of this desktop analysis report.
4.	Field survey and subsurface testing (if required) must be conducted in consultation with the Registered Aboriginal Parties (RAPs), under the guidance of the Aboriginal Heritage Management Plan (AHMP).
5.	The procedures outlined in the current MPO AHMP (MACH 2019) should be used to manage any newly recorded sites during the field survey.

Recommendations	
	General
6.	All workers should be inducted into the Subject Area so they are made aware of their obligations under the <i>National Parks and Wildlife Act 1974</i> , any future SSD development consent, and the current MPO AHMP (MACH 2019).
7.	In the unlikely event that human remains (skeletal material) are discovered, the procedures outlined in the AHMP are to be followed.

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Contact Us

Niche Environment and Heritage
02 9630 5658
info@niche-eh.com

NSW Head Office – Sydney
PO Box 2443 North Parramatta
NSW 1750 Australia

QLD Head Office – Brisbane
PO Box 540 Sandgate
QLD 4017 Australia

Sydney
Brisbane
Cairns
Port Macquarie
Illawarra
Coffs Harbour
Central Coast
Gold Coast
Canberra



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Our services

Ecology and biodiversity

Terrestrial
Freshwater
Marine and coastal
Research and monitoring
Wildlife Schools and training

Heritage management

Aboriginal heritage
Historical heritage
Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals

Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Biodiversity offsetting

Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)

Attachment C

Supplementary DPIE-Water Advice and MACH's Responses

Water Licencing

Dartbrook Water Source and Water Management Plan

DPIE-Water and Natural Resources Access Regulator (NRAR) (OUT21/8970) have reiterated relevant water licensing requirements and recommended that the existing Water Management Plan be updated post-approval to reflect all Water Access Licences held by the Project.

Relevant Quotes:

1 Post Approval Recommendations:

- a. *The proponent should ensure that prior to water take, sufficient water entitlements are held under approved Water Access Licences (WAL) for all predicted water take. This includes the 13 ML/year of predicted take from the Dart Brook Water Source.*
- b. *The existing Water Management Plan (WMP) should be revised to reflect all WALs held by the project and their conditions of approval.*

Response:

MACH agrees with these recommendations, which are consistent with commitments made in the EIS.

Groundwater

Management of Potentially Acid Forming Material

DPIE-Water and NRAR (OUT21/8970) have requested further information regarding the proposed management and monitoring of potentially acid forming (PAF) material.

Relevant Quotes:

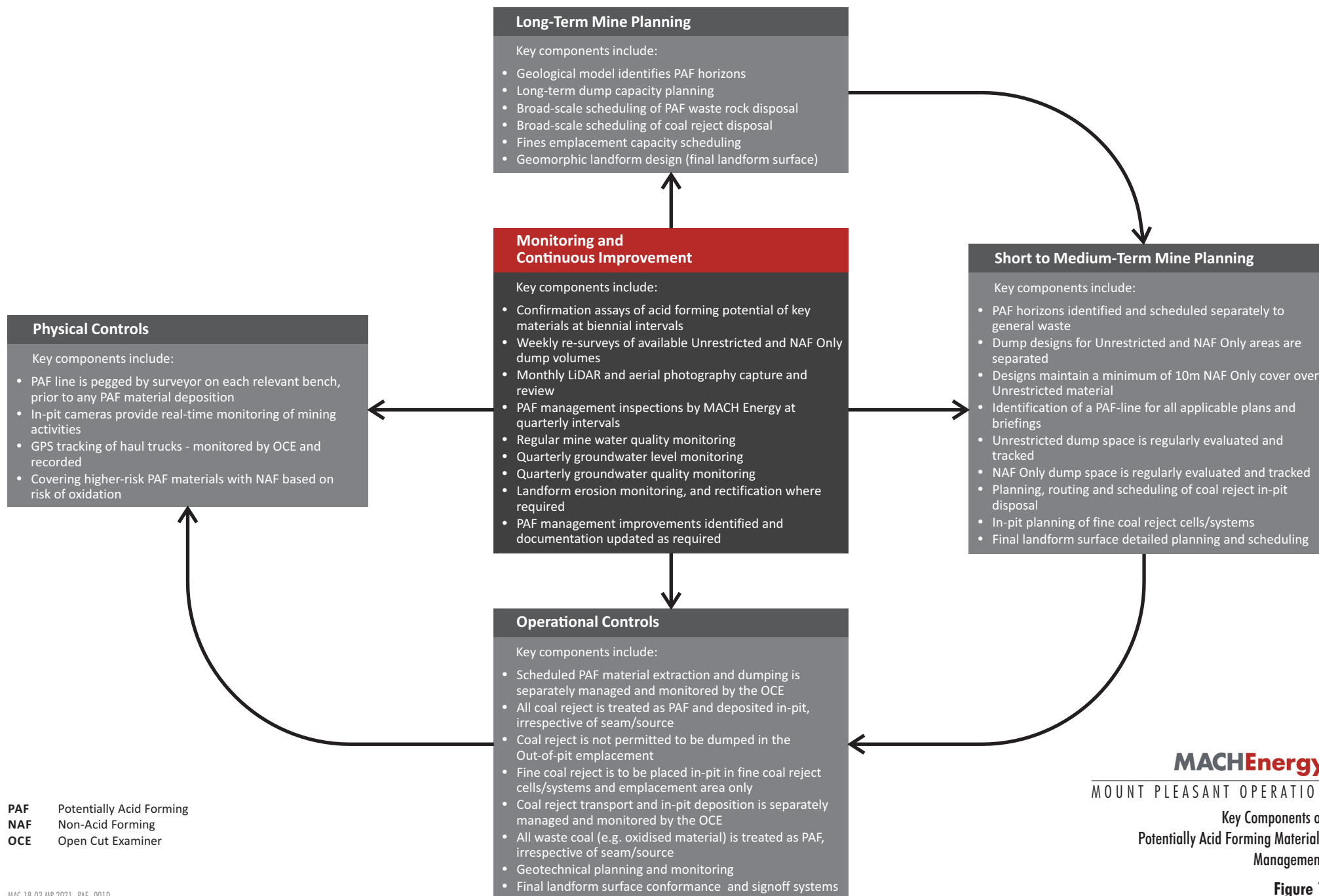
2 Pre-approval Recommendation:

The proponent should provide additional details regarding the proposed management and monitoring of Potential Acid Forming (PAF) material, including but not limited to: a site map showing, handling and storage/containment location(s), handling protocols, emplacement plan and procedures, monitoring and mitigation of potential impacts.

Response:

In responding to the request for additional detail on the management of PAF material over the life of the Project, MACH is providing further documentation of current operational procedures employed to manage PAF material at the Mount Pleasant Operation. Such procedures would continue to be developed and refined based on the development of the mine and ongoing monitoring of environmental performance over the life of the Project, and are therefore subject to change due to continuous improvement (Figure 1).

As stated in the Submission Report, the Project Geochemistry Assessment (Appendix K of the EIS) concluded the waste rock materials generated from the Project would generally be expected to be non-acid forming (NAF). The acid base accounting test work indicates, however, that a small portion of waste rock materials (the Archerfield sandstone interburden) and coal rejects generated from processing of the Edderton and Wynn Seams would be PAF.



PAF Waste Rock Management

Figure 1 describes the key controls that are currently being applied at the Mount Pleasant Operation to manage PAF material deposited in the Eastern Out-of-Pit Waste Rock Emplacement and during in-pit disposal.

Because the proportion of PAF waste rock material is quite modest relative to the total volume of waste rock being managed on-site, PAF material can be identified in-pit, separately handled and emplaced with the general run-of-mine NAF material as long as sufficient NAF cover is maintained. This is because most overburden and interburden materials at the Mount Pleasant Operation are classified as NAF, have excess acid neutralising capacity, and have low oxidisable sulfur content (Appendix K of the EIS).

PAF interburden material is covered with NAF waste material within timeframes determined by the relative reactivity of the material.

To ensure that PAF material is not emplaced within 10 metres (m) of the outer surfaces of the final landform, MACH maintains two separate types of waste emplacement areas, Unrestricted emplacement areas (i.e. PAF material can be emplaced in conjunction with general run-of-mine waste in these areas), and NAF Only emplacement areas.

As part of these controls the Unrestricted and NAF Only emplacement areas within the waste rock emplacement and the designation between these two areas (i.e. the “PAF line”) is regularly reviewed. The “PAF line” is also periodically adjusted based on the latest geomorphic landform designs to maintain a minimum of 10 m of NAF cover over Unrestricted waste disposal areas (Figures 2 to 4).

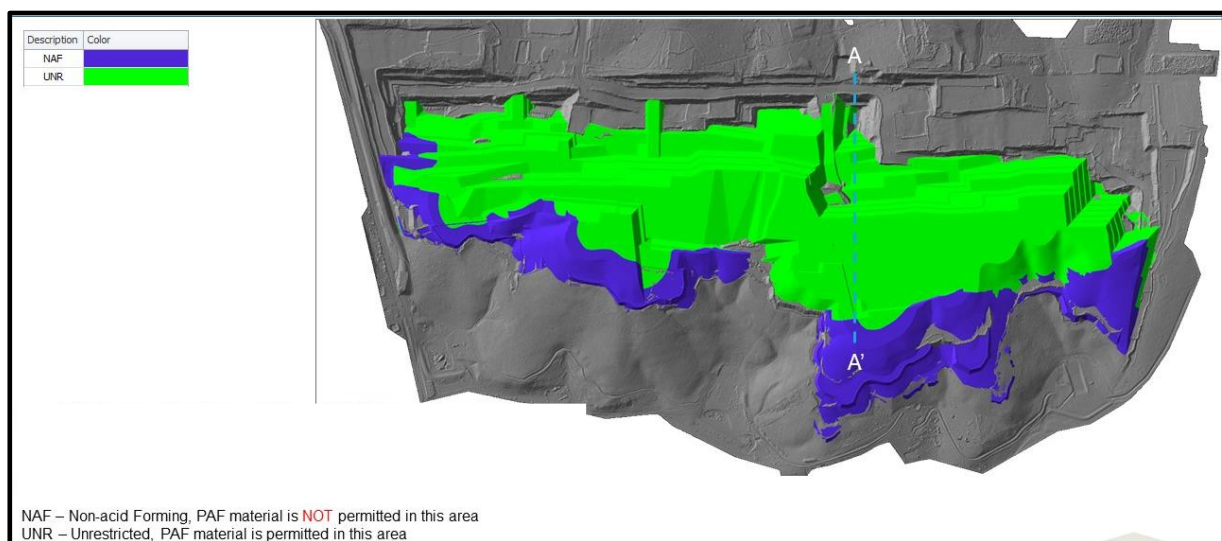


Figure 2 – Medium Term, Example of 2 Years Planned Unrestricted and NAF Only Dump Areas*

* Section A-A1 is presented on Figure 3

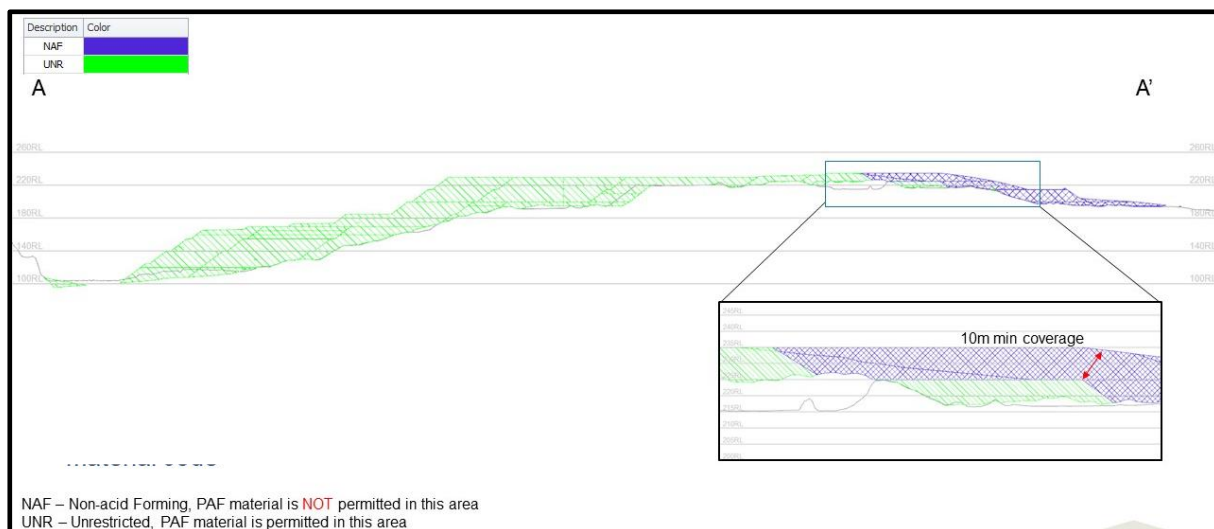


Figure 3 – Medium Term, Example Cross-Section of 2 Years Planned Unrestricted and NAF Only Dump Areas*

* The location of Section A-A1 is presented on Figure 2

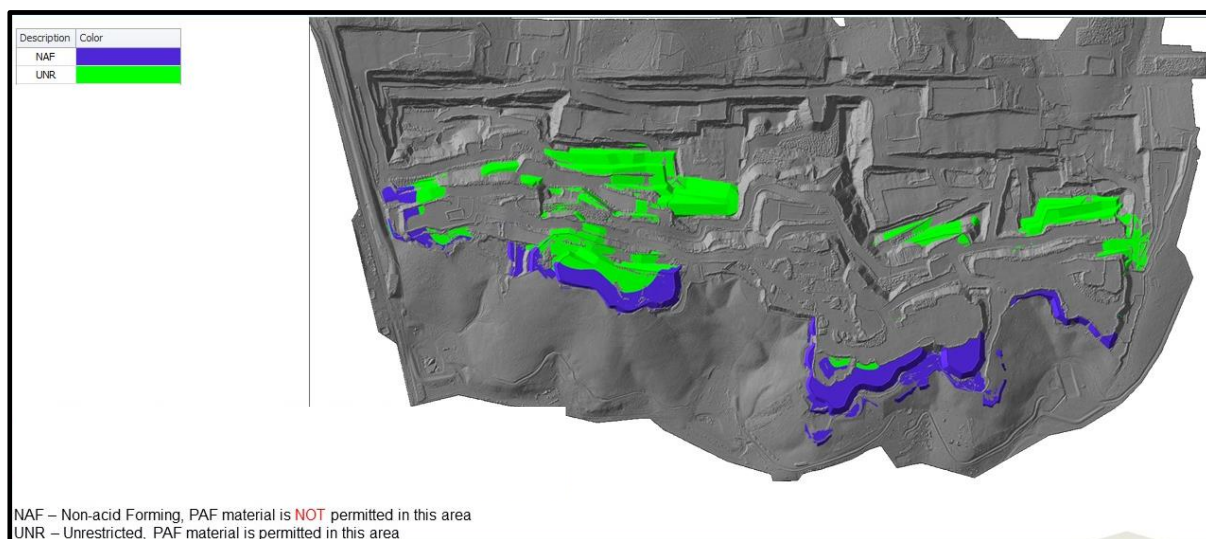


Figure 4 – Short-Term, Example of Currently Available Unrestricted and NAF Only Dump Areas

The “PAF line” is pegged out by surveyors on the ground on each relevant waste rock bench so equipment operators can dump to the specified limit, depending on which emplacement area is relevant to the activity. Global Positioning System (GPS) tracking of mine equipment and a range of other controls are in place to manage this process (Figure 1).

Coal Reject Management

As described on Figure 1, all coal reject hauled to the open cut is treated as PAF material and is disposed in-pit. It is noted that the coal seams at the Mount Pleasant Operation dip westwards, and therefore the pit floor also slopes westwards.

Coarse coal reject material is hauled from the CHPP and managed by the Open Cut Examiner (OCE), with these materials reporting to specific in-pit Unrestricted dump areas that are identified for that shift. Coarse rejects are covered with NAF waste material within timeframes determined by the relative reactivity of the material.

Fine rejects are not currently trucked for in-pit disposal, as all fine rejects currently report to the Fines Emplacement. Over the life of the Project fines emplacement cells would be established in-pit (within the Unrestricted emplacement area) to manage the geotechnical aspects of emplacing a proportion of Project fine reject within the integrated waste emplacement. The planning for and scheduling of fines emplacement cells within the integrated waste emplacement would be managed through both long term and short term mine planning, and a range of suitable operational and physical controls will be established and implemented over the life of the Project to manage this new operational activity (Figure 1).

Management and Monitoring

PAF materials are already mined by the approved Mount Pleasant Operation and the potential for leachate drainage is effectively managed in accordance with the approved Mining Operations Plan, with surface water and groundwater monitoring undertaken in accordance with the approved Water Management Plan. MACH is also developing further associated QA/QC procedures to effectively manage PAF material at the Mount Pleasant Operation, based on operational experience.

Further detail regarding the management of PAF materials would be documented in Mining Operations Plans/Rehabilitation Management Plans for the Project, which would be periodically prepared in consultation with the Resources Regulator and other relevant government agencies over the life of the mine.

Attachment D

Supplementary Biodiversity and Conservation Division Advice and MACH's Responses

Biodiversity

Biodiversity Offsets

Biodiversity and Conservation Division (BCD) (DOC21/554869-3) has provided recommendations that the existing Mount Pleasant Operation offsets be secured by Biodiversity Stewardship Sites and the Project offsets should meet the requirements of the *Biodiversity Conservation Act 2016*.

Relevant Quotes:

1. BCD recommends that the existing offsets for the Mount Pleasant Mine are secured by Biodiversity Stewardship Sites.

Recommendation 1

The proponent should provide an offset that meets the requirements of the Biodiversity Conservation Act 2016.

Response:

MACH will continue to consult with the DPIE, BCD and the Commonwealth Department of Agriculture, Water and the Environment (DAWE) on appropriate security mechanisms for the existing biodiversity offsets required by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) under EPBC 2011/5795, and resolution of additional biodiversity offsets for the Project in compliance with the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act).

Plant Community Types

BCD (DOC21/554869-3) has requested further information on the selection process to determine Plant Community Types (PCTs) 483 and 618.

Relevant Quotes:

2. The proponent should provide a list of all Plant Community Types considered as potential matches to on-ground vegetation that were matched to PCTs 483 and 618 and describe the selection process to determine the final PCT match.

Response:

Dr Colin Driscoll (Hunter Eco) has prepared further information (Attachment D-1) on the selection process to determine PCTs 483 and 618. Dr Colin Driscoll (Hunter Eco) concludes:

The Biodiversity Development Assessment Report was prepared in accordance with the Biodiversity Assessment Method that requires:

The assessor must identify and map the distribution of PCTs, or the most likely PCTs, and all TECs on the subject land. The identification must be in accordance with the NSW PCT classification as described in the BioNet Vegetation Classification.

*... PCTs 483 and 618 are the only PCTs available in BioNet Vegetation Classification that are the most likely matches to the local communities dominated by or containing the hybrid box *Eucalyptus albens* <---> *moluccana* as described in the Mount Pleasant Optimisation Project (SSD-10418) Biodiversity Development Assessment Report.*

Matters of National Environmental Significance

BCD (DOC21/554869-3) has requested further information regarding the assessment of Matters of National Environmental Significance (MNES).

Relevant Quotes:

3. BCD recommends that additional information on the assessment of Matters of National Environmental Significance is provided to enable the bilateral assessment to be completed.

Response:

A copy of the MNES Protected Matters Search that was undertaken at the start of the assessment is provided in Attachment D-2.

The Project is being assessed under the NSW Assessment Bilateral Agreement as it will require approval under both the BC Act and the EPBC Act. Under the Bilateral Agreement, the NSW Government assesses development applications on behalf of the Commonwealth Government.

The Commonwealth Government has endorsed the NSW Biodiversity Offsets Scheme under the BC Act through the Bilateral Agreement, which means the NSW Biodiversity Offsets Scheme can be used to address Commonwealth offset requirements.

Two alternative alignments of the western section of the revised Northern Link Road alignment are being considered by MACH and both alignments are subject to the EPBC Act referral (EPBC 2020/8735). Option 1 is the currently preferred option as it skirts the Mining Lease boundary and would have a disturbance area of approximately 31.9 hectares (ha). Option 2 is the less preferred option and would have a disturbance area of approximately 25.9 ha. Only one of these options would be developed, with the final alignment to be selected based on detailed engineering design and any associated land access constraints. Both alignments have been assessed in the Biodiversity Development Assessment Report (BDAR) in accordance with the Biodiversity Assessment Method (BAM).

A BOS was submitted with the BDAR and is in accordance with the BAM. The BAM contains a no net loss standard. Section 7.6 of the BDAR outlines the potential offset mechanisms available to meet the like-for-like credit requirements under the BC Act, such as establishing a Biodiversity Stewardship Site or payments to the NSW Biodiversity Conservation Fund. With respect to MNES matters, the offsetting will be the retirement of like-for-like credits. A summary of the specific number and class of like-for-like biodiversity credits for threatened species and communities listed under the EPBC Act are listed in Table 34 of the BDAR (and credit reports are in Attachments L and O of the BDAR).

Specific offsetting requirements for MNES matters are as follows:

Box-Gum Woodland CEEC listed under the EPBC Act

Between 22.5 ha and 26.4 ha of Box-Gum Woodland CEEC³ listed under the EPBC Act would be cleared (depending on the road alignment) requiring between 229 and 307 ecosystem credits to be retired (Table 2). No potential indirect impacts require credits.

³ Equivalent to the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions Critically Endangered Ecological Community (CEEC) listed under the BC Act and the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC listed under the EPBC Act.

Striped Legless Lizard (Delma impar)

Between 23.3 ha and 27.4 ha of Striped Legless Lizard habitat would be cleared (depending on the road alignment) requiring between 225 and 293 ecosystem credits to be retired (Table 2). No potential indirect impacts require credits.

Other Species

Based on the information available in the EPBC Act Referral (EPBC 2020/8735), DAWE considered (in the input into the Secretary's Environmental Assessment Requirements [SEARs]) that the Action is likely to have a significant impact on the Swift Parrot and Regent Honeyeater. However, the Action is unlikely to have a material adverse impact on these species as neither species has been recorded at the Mount Pleasant Operation during past or present surveys, no breeding habitat for these species is present (Attachment B of the BDAR), and the DPIE (2021a)⁴ do not recognise the Subject land as important habitat for these species (negating the need for species credits).

Based on the information available in the EPBC Act Referral, DAWE considered (in the input into the SEARs) that there was a real chance or possibility that the Action would significantly impact the Austral Toadflax (*Thesium australe*) and Slaty Red Gum (*Eucalyptus glaucina*). Targeted surveys for these two flora species have subsequently been undertaken and neither species was recorded in the Action area and surrounds (Attachment A of the BDAR) or known to occur nearby (Figure 24 of the BDAR). Therefore, it is considered unlikely that the Action would adversely (or significantly) impact either of these species.

⁴ Department of Planning, Industry and Environment (2021a) Biodiversity Offsets and Agreement Management System (BOAMS). Website: <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-offsets-scheme/biodiversity-offsets-and-agreement-management-system>

Table 2
Credit Requirement for Threatened Species and Communities Listed Under the EPBC Act

Threatened Species or Community (Listed under the EPBC Act)	Credits Required as Calculated by the BAM	Credit Generated from Offsets in Remnant Vegetation	Credit Generated from Offset Proposed by Other Means	Comments on the Proposed Offset	Relevant Page Numbers in the EIS and Appendices
Box-Gum Woodland CEEC listed under the EPBC Act	Northern Link Road Option 1: 307 (17 credits of PCT 483, 237 credits of PCT 483 SG, 5 credits of PCT 618, 16 credits of PCT 1606 and 32 credits of PCT 1606 DNG) Northern Link Road Option 2: 229 (104 credits of PCT 483, 72 credits of PCT 483 SG, 2 credits of PCT 483 SG DNG, 5 credits of PCT 618, 16 credits of PCT 1606 and 30 credits of PCT 1606 DNG)	0	0	A BOS was submitted with the BDAR and is in accordance with the BAM. Section 7.6 of the BDAR outlines the potential offset mechanisms available to meet the like-for-like credit requirements under the BC Act, such as establishing a Biodiversity Stewardship Site or payments to the NSW Biodiversity Conservation Fund.	EIS: Section 7.10.6 BDAR: Section 7 Section 7.6 Attachments L and O (credit reports)
Striped Legless Lizard (<i>Delma impar</i>)	Northern Link Road Option 1: 293 Northern Link Road Option 2: 225	0	0	With respect to MNES matters, the offsetting will be the retirement of like-for-like credits. A summary of the specific number and class of like-for-like biodiversity credits for threatened species and communities listed under the EPBC Act are listed in Table 34 of the BDAR (and credit reports are in Attachments L and O of the BDAR).	

Flooding and Flood Risk

Sandy Creek Riparian Monitoring

BCD (DOC21/554869-3) has provided a recommendation that a Water Management Plan should be developed that incorporates the establishment of baseline conditions and assesses impacts to Sandy Creek riparian ecology.

Relevant Quotes:

4. A water management plan should be developed for the project that includes monitoring of water and riparian vegetation condition to establish baseline conditions and assess impacts of changes to surface and groundwater flows to Sandy Creek riparian ecology including freshwater mussels noted by the local indigenous community. Appropriate trigger values and compensatory works should be developed.

Response:

The Mount Pleasant Operation operates in accordance with an approved Water Management Plan that already includes water quality and stream health monitoring, including water quality and stream health monitoring on Sandy Creek, Dart Brook, Muscle Creek and the Hunter River.

Stream health is monitored bi-annually during spring and autumn using the Australian River Assessment System (AusRivAS) aquatic invertebrate monitoring protocol. In addition to the aquatic macroinvertebrate sampling, the existing stream health monitoring also includes:

- fish observations;
- site water quality;
- stream condition; and
- presence of aquatic and riparian edge plants.

Should the Project be approved, water quality and stream health monitoring would continue to be conducted in accordance with an approved Water Management Plan, including the application of appropriate surface water impact trigger levels.

The results of water quality and stream health monitoring and any associated management measures would continue to be reported in the Mount Pleasant Operation Annual Review over the life of the Project.

Sandy Creek Water Quality Triggers

BCD (DOC21/554869-3) has provided a recommendation that further water quality testing should be undertaken, for use in the development of relevant water quality trigger values for Sandy Creek.

Relevant Quotes:

6. Further water quality testing should be undertaken outside of areas currently impacted by the project. Water quality trigger values should be based on levels which will provide adequate protection to the ecology and users of Sandy Creek.

Response:

As described in the Submissions Report, salinity is naturally elevated in the Sandy Creek catchment and the Fines Emplacement Area and Environment Dam 2 (ED2) have not affected downstream water quality.

As described in Section 7.9.5 of the EIS, the existing Surface and Ground Water Response Plan, which is included in the Water Management Plan for the Mount Pleasant Operation, would be reviewed and revised subject to the conditions of any Development Consent for the Project.

The Surface and Ground Water Response Plan would describe any additional measures and procedures that would be implemented over the life of the Project to respond to any potential exceedances of surface water related criteria and contingent mitigation, compensation, and/or offset options if downstream surface water users are adversely affected by the Project.

Fines Emplacement Area – Seepage Controls

BCD (DOC21/554869-3) has requested further clarification on relevant seepage flow management measures associated with the Fines Emplacement Area and ED2.

Relevant Quotes:

5. Clarification is required regarding installation of the seepage flow management measures for the fines emplacement area and ED2. Management measures need to be developed to ensure that surface and seepage flows are contained on site for all stages of the project including post rehabilitation.

Response:

The Fines Emplacement Area is an existing facility at the Mount Pleasant Operation which is operated in accordance with appropriate engineering standards to minimise the potential for seepage, through measures such as maintaining the decant pond away from the embankment, and minimising the volume of water in the decant pond.

The existing facility already incorporates an existing seepage recovery system, including a foundation drain and a clay fill cut-off key. The foundation drain outlets to a seepage management manhole, and any seepage is collected in ED2, periodically tested, and pumped back to the facility.

New Dams Risk Assessment

BCD (DOC21/554869-3) has provided a recommendation that risk assessments should be undertaken for all proposed Project dams, and relevant major dams should then be referred to Dams Safety NSW.

Relevant Quotes:

7. During detailed design, a risk assessment should be undertaken for all proposed dams. The design of any spillway should ensure that the spillway and embankment do not cause risk to downstream receivers in the event of a local flood event. New or altered dams which are found to pose risk to life will require referral to Dam Safety NSW.

Response:

MACH concurs with the BCD's recommendation, and designs all major structures to meet suitable engineering standards. MACH also notes that Dams Safety NSW is aware of the Project and its associated existing and proposed dams.

Attachment D-1 – Hunter Eco (2021) Review of Response to Submissions Report



MACH Energy Australia
PO Box 2115
DANGAR NSW 2309

7 September 2021

Attn: Chris Lauritzen

**Mount Pleasant Optimisation Project (SSD-10418)
Review of Response to Submissions Report 23/7/21**

In March 2021, the NSW Biodiversity Conservation Division (BCD) provided:

Table 8 of Attachment A of the BDAR should be updated to include the list of all Plant Community Types (PCTs) considered, the closeness of fit in relation to floristic composition, vegetation structure, soils, position in landscape, substrate, geographic location, and the overall confidence of the match... BCD recommends that the proponent lists all Plant Community Types considered as potential matches to on-ground vegetation and describes the selection process for biotic and abiotic factors.

The Mount Pleasant Optimisation Project Baseline Flora Report was subsequently revised as part of the Mount Pleasant Optimisation Project – Submissions Report.

In their response, BCD required the following among other matters, and this letter provides the response.

The proponent should provide a list of all Plant Community Types considered as potential matches to on-ground vegetation that were matched to PCTs 483 and 618 and describe the selection process to determine the final PCT match.

Note that Grey Box x White Box Grassy Woodland and Grey Box x White Box - Spotted Gum Grassy Woodland was assigned to PCT 483 and Forest Red Gum Grassy Open Forest was assigned to PCT 618.

PCTs 483 and 618 are the only PCTs available in BioNet Vegetation Classification that are the most likely matches to the local communities based on floristic composition and vegetation structure. The Biodiversity Development Assessment Report was prepared in accordance with the Biodiversity Assessment Method that requires:

*The assessor must identify and map the distribution of PCTs, **or the most likely PCTs,** and all TECs on the subject land. The identification must be in accordance with the NSW PCT classification as described in the BioNet Vegetation Classification.*



Background

During field surveys, only two box-barked eucalypt species were identified across the study area: *Eucalyptus albens* <---> *moluccana* (Hybrid White Box/Grey Box [Albemol]) and *Eucalyptus moluccana* (Grey Box).

The first mention of Albemol was by McRae and Cooper (1985) describing the vegetation of the Merriwa area, and the origin of the concept appears to be from work by Pryor and Johnson (1971) in which they note that "...there is certainly an extensive breakdown between *E. albens* and *E. moluccana* in the Hunter River Valley of New South Wales." In fact, the earliest observation of such a possibility is by J. L. Boorman in 1904, referred to in Maiden (1920):

(e) A White Box from Gulgong (J. L. Boorman), "plentiful all over the low-lands of this district," adds another to forms of *E. hemiphloia*¹. Compared with typical var. *albens* its fruits are smaller, its pedicels are absent, and it is markedly constricted at the orifice, giving the fruits a distinctly ovoid appearance. Specimens from other districts connect absolutely with the type.—(Proc. Linn. Soc. N.S.W., 1904, pp. 760–1).

Subsequently, the hybrid has been reported from the Mount Pleasant area by Peake (2006) and others. Cumberland Ecology (2010), in support of their identification of the hybrid on Rio Tinto Mount Pleasant land, conducted a wide geographic area search supported with specimen identification by the Sydney Herbarium. Cumberland Ecology (2010) concluded that the hybrid occurred extensively across approximately 190,000 hectares.

The existence of Hybrid White box/Grey Box is acknowledged in the following threatened ecological community determinations:

- Central Hunter Valley eucalypt forest and woodland ecological community.
<http://environment.gov.au/biodiversity/threatened/communities/pubs/130-conservation-advice.pdf>
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions.
<https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Scientific-Committee/Determinations/2020/white-box-yellow-box-final-determination-ceec.pdf>

PlantNET (2021) describes *Eucalyptus albens* as having juvenile leaves, adult leaves and buds **glaucous**. No glaucousness was observed in any of the fibrous-barked boxes across the study area.

Plate 1 shows an example of fruit from White Box (*Eucalyptus albens* [glaucous]), hybrid White box/Grey Box (*Eucalyptus albens* x *moluccana*) and Grey Box (*Eucalyptus moluccana*).

¹ *Eucalyptus hemiphloia* was an early name that included varieties *albens* and *moluccana*.

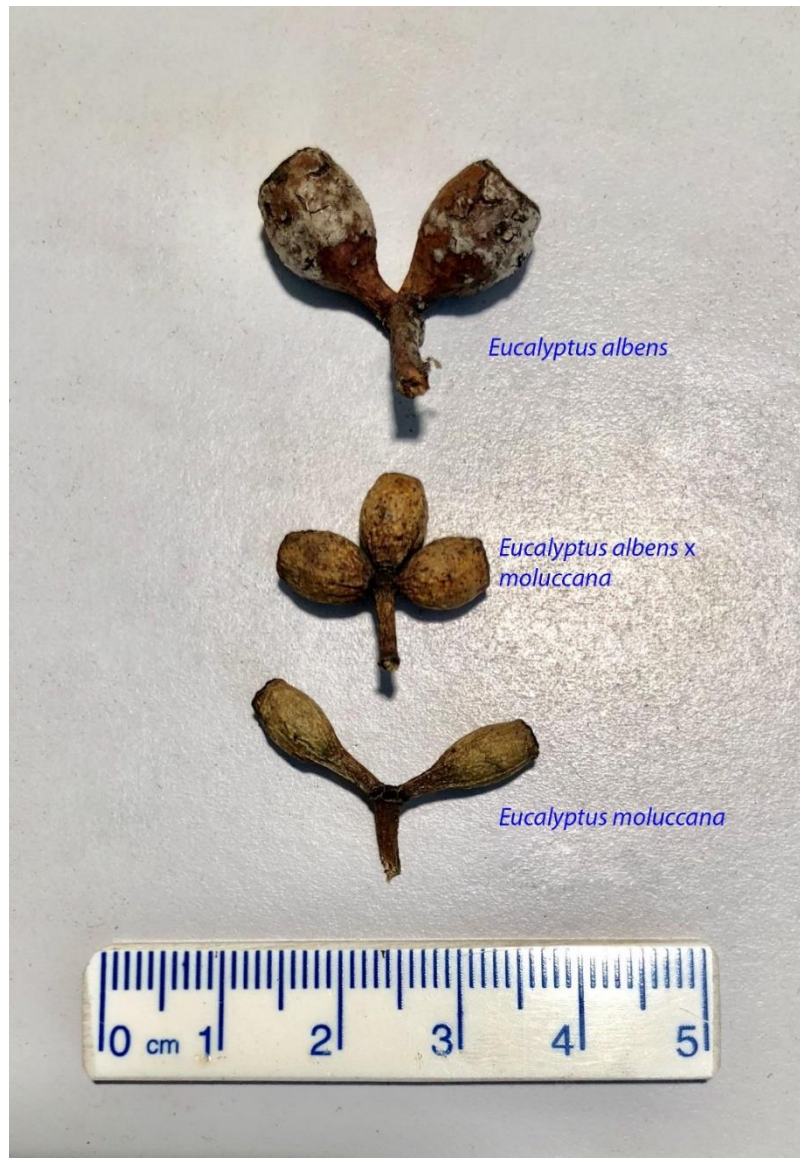


Plate 1: Examples of Box fruit²

(*Eucalyptus albens* from the Liverpool Plains; *Eucalyptus albens* x *moluccana* from Mount Pleasant; *Eucalyptus moluccana* from south of Singleton)

Mount Pleasant Vegetation Communities

Hunter Eco (2021) mapped the distribution of 6,358 canopy tree species across the Mount Pleasant Operation Mining Leases, which included the land that is the subject of the current application (SSD-10418). It is important to note that there was a clear delineation between the occurrence of the hybrid and Narrow-leaved Ironbark (*Eucalyptus crebra*) with negligible mixing. Within the hybrid distribution there was a sub-group containing Spotted Gum (*Corymbia maculata*). Two vegetation communities were recognised: Grey Box x White Box Grassy Woodland and Grey Box x White Box - Spotted Gum Grassy Woodland. A creekline containing sparse fragments of woodland included patches of Forest Red Gum (*Eucalyptus tereticornis*), Yellow Box (*Eucalyptus melliodora*), the hybrid box, Rough-barked Apple (*Angophora floribunda*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). This riparian community was referred to as Forest Red Gum Grassy Open Forest.

² Note the similarity of the *Eucalyptus albens* x *moluccana* fruit shape with the 1904 description by J.L. Boorman quoted above.



Plant Community Type Assignment Methodology

Plant Community Types (PCTs) are named according to the dominant species in the Upper Stratum. Naming may also be supplemented with additional information such as class, formation, physiographic attributes and/or geographic location (Sivertson 2008).

In order to classify the vegetation as particular PCTs, the BioNet Vegetation Classification PCT database (DPIE 2021) was downloaded. Probable PCTs were extracted by conducting an initial Structured Query Language (SQL) query search to find all PCTs having the dominant local community canopy species listed in the Upper Stratum Species field. The relevance of each listed PCT was assessed by considering additional listed canopy species and structural attributes.

Had there been PCTs with these attributes closely similar, further comparison might have been made against Mid and Ground Stratum species as well as geographic or edaphic attributes to separate PCTs. However, this was not found to be necessary because Upper Stratum species differences were clear cut and no amount of similarity between Mid or Ground stratum species would result in a different PCT being selected. For example, a local community with Upper Stratum dominated by White Box could not be identified as a PCT dominated by Grey Gum based on lower stratum species similarities.

Grey Box x White Box Grassy Woodland Assignment

The search results in Table 1 show the only four PCT available that list *Eucalyptus albens* <--> *moluccana* in the Upper Stratum. As described under 'Assessment', three of those PCTs are excluded, leaving PCT 483 as the most likely best fit. Accepting that the dominance of the hybrid is the primary feature of this community, there are no alternative PCTs available in the BioNet Vegetation Classification (DPIE 2021) that are more likely to have a better fit.

It was also found that none of the alternative PCTs (Table 1) have the hybrid in combination with Spotted Gum (*Corymbia maculata*).

Another approach was to take the White Box or Grey Box component of the hybrid as being representative and querying the data for PCTs containing either of these species in the Upper Stratum, restricting the search to occurrences within the Interim Biogeographic Regionalisation for Australia (IBRA) Sydney Basin Bioregion, Hunter sub-region.

Table 2 provides the 12 PCTs containing White Box in the Upper Stratum species list and assessment shows that none of these PCTs match the subject community based on either canopy species content or on structural grounds. Table 3 provides the 16 PCTs containing Grey Box in the Upper Stratum species list and again, assessment shows that none of these PCTs match the subject community based on either canopy species content or vegetation structure.

It was also found that only two of the alternative PCTs, 1600 and 1604 (Table 3), include Spotted Gum (*Corymbia maculata*), neither of which are representative of the vegetation present.

Note that the writer is familiar with all but two of the PCTs listed in the below tables and would readily recognise them in the field.

Table 1 PCT Options having *Eucalyptus albens* <--> *moluccana* in Upper Stratum Species

PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Grey Box x White Box Grassy Woodland and Grey Box x White Box - Spotted Gum Grassy Woodland
483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Liverpool Range; Pilliga; Talbragar Valley; Inland Slopes; Capertee Valley;	<u><i>Eucalyptus albens</i> <--> <i>moluccana</i></u> ; <i>Eucalyptus moluccana</i> ; <i>Eucalyptus albens</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus melliodora</i> ;	Selected: based on the dominant presence of the hybrid <i>Eucalyptus albens</i> <--> <i>moluccana</i> .
484	Derived tall spear grass grassland on mainly basalt hills of the Liverpool Plains, Liverpool Range and in the upper Hunter Valley (Merriwa district), south-eastern Brigalow Belt South Bioregion	Liverpool Plains; Liverpool Range; Pilliga; Inland Slopes; Capertee Valley;	<i>Eucalyptus melliodora</i> ; <i>Angophora floribunda</i> ; <u><i>Eucalyptus albens</i> <--> <i>moluccana</i></u> ; <i>Eucalyptus albens</i> ;	Excluded: not a tall spear grass grassland community
617	Narrow-leaved Ironbark - box - Mock Olive shrubby open forest mainly on basalt slopes over sandstone in the upper Hunter Valley, Brigalow Belt South Bioregion and Sydney Basin Bioregion	Kerrabee; Liverpool Range; <u>Hunter</u> ; Pilliga; Ellerston;	<i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ; <i>Angophora floribunda</i> ; <i>Brachychiton populneus</i> subsp. <i>populneus</i> ; <i>Callitris endlicheri</i> ; <u><i>Eucalyptus albens</i> <--> <i>moluccana</i></u> ;	Excluded: not a <i>Eucalyptus crebra</i> community. No <i>Callitris endlicheri</i> across the study area.
618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	<u>Hunter</u> ; Kerrabee; Liverpool Range; Tomalla; Ellerston; Upper Hunter;	<u><i>Eucalyptus albens</i> <--> <i>moluccana</i></u> ; <i>Angophora floribunda</i> ; <i>Eucalyptus blakelyi</i> <--> <i>tereticornis</i> ; <i>Eucalyptus melliodora</i> ; <i>Brachychiton populneus</i> subsp. <i>populneus</i> ; <i>Eucalyptus eugenioides</i> ; <i>Eucalyptus crebra</i> ;	Excluded: No hybrid <i>Eucalyptus blakelyi</i> <--> <i>tereticornis</i> present and no other Red Gum present

Table 2 PCT Options having *Eucalyptus albens* in Upper Stratum Species within the Hunter IBRA sub-region

PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Grey Box x White Box Grassy Woodland and Grey Box x White Box - Spotted Gum Grassy Woodland
496	Yellow Box - White Box - Silvertop Stringybark – Blakely's Red Gum grass shrub woodland mainly on the Liverpool Range, Brigalow Belt South Bioregion	Liverpool Plains; Liverpool Range; Peel; Tomalla; Ellerston; Hunter ;	<i>Eucalyptus albens</i> ; <i>Eucalyptus laevopinea</i> ; <i>Eucalyptus melliodora</i> ; <i>Eucalyptus blakelyi</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus moluccana</i> ; <i>Acacia melanoxylon</i> ;	Excluded: All upper stratum species absent.
541	Silvertop Stringybark - Rough-barked Apple grassy open forest of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion	Eastern Nandewars; Peel; Moredun Volcanics; Walcha Plateau; Armidale Plateau; Bundarra Downs; Yarrowyck-Kentucky Downs; Tingha Plateau; Liverpool Range; Glenn Innes-Guyra Basalts; Severn River Volcanics; Mummel Escarpment; Barrington; Tomalla; Ellerston; Hunter ;	<i>Eucalyptus laevopinea</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus blakelyi</i> ; <i>Eucalyptus nortonii</i> ; <i>Eucalyptus albens</i> ; <i>Eucalyptus dives</i> ; <i>Eucalyptus goniocalyx</i> ;	Excluded: All upper stratum species absent.
563	White Box - Silvertop Stringybark +/- White Cypress Pine grass shrub open forest of the southern Nandewar Bioregion and New England Tableland Bioregion	Eastern Nandewars; Tingha Plateau; Moredun Volcanics; Kaputar; Walcha Plateau; Bundarra Downs; Peel; Liverpool Range; Armidale Plateau; Yarrowyck-Kentucky Downs; Ellerston; Hunter ;	<i>Eucalyptus albens</i> ; <i>Eucalyptus laevopinea</i> ; <i>Angophora floribunda</i> ; <i>Callitris glaucophylla</i> ; <i>Eucalyptus blakelyi</i> ; <i>Eucalyptus melliodora</i> ; <i>Eucalyptus dealbata</i> ;	Excluded: All upper stratum species absent.
588	White Box - White Cypress Pine shrubby hills open forest mainly in the Nandewar Bioregion	Liverpool Plains; Eastern Nandewars; Inverell Basalts; Kaputar; Peel; Northern Basalts; Liverpool Range; Nandewar Northern Complex; Bundarra Downs; Tomalla; Ellerston; Hunter ;	<i>Eucalyptus albens</i> ; <i>Callitris glaucophylla</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus dealbata</i> ; <i>Eucalyptus melliodora</i> ; <i>Eucalyptus melanophloia</i> ;	Excluded: All upper stratum species absent.
617	Narrow-leaved Ironbark - box - Mock Olive shrubby open forest mainly on basalt slopes over sandstone in the upper Hunter Valley, Brigalow Belt South Bioregion and Sydney Basin Bioregion	Kerrabee; Liverpool Range; Hunter ; Pilliga; Ellerston;	<i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ; <i>Angophora floribunda</i> ; <i>Brachychiton populneus</i> subsp. <i>populneus</i> ; <i>Callitris endlicheri</i> ; <i>Eucalyptus albens</i> <--> <i>moluccana</i> ;	Excluded: Not a Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) community
1586	White Box - Sticky Daisy Bush - Bead Bush shrubby woodland with semi - evergreen vine thicket elements of the Central Hunter Valley	Barrington; Ellerston; Hunter ; Karuah Manning; Kerrabee; Liverpool Range; Mummel Escarpment; Pilliga; Tomalla; Upper Hunter; Yengo;	<i>Eucalyptus albens</i> ;	Excluded: Not shrubby woodland and no evergreen vine thicket elements
1587	White Box - Blackthorn shrubby woodland on sandstone ranges of the Sydney Basin	Hunter ; Kerrabee; Liverpool Range; Inland Slopes; Inland Slopes; Pilliga; Wollemi; Yengo; Kanangra; Bathurst; Burraborang; Capertee Valley;	<i>Eucalyptus albens</i> ; <i>Brachychiton populneus</i> ;	Excluded: Not shrubby woodland



PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Grey Box x White Box Grassy Woodland and Grey Box x White Box - Spotted Gum Grassy Woodland
1606	White Box - Narrow-leaved Ironbark – Blakely's Red Gum shrubby open forest of the central and upper Hunter	Barrington; Ellerston; Hunter ; Karuah Manning; Kerrabee; Liverpool Range; Mummel Escarpment; Pilliga; Tomalla; Upper Hunter; Yengo;	<i>Eucalyptus albens</i> ; <i>Eucalyptus crebra</i> ; <i>Eucalyptus blakelyi</i> ;	Excluded: Does not contain Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) or Blakely's Red Gum (<i>Eucalyptus blakelyi</i>)
1609	White Box - White Cypress Pine - Native Olive woodland of upper Hunter and northern Wollemi	Kerrabee; Liverpool Range; Inland Slopes; Inland Slopes; Pilliga; Talbragar Valley; Wollemi; Tomalla; Ellerston; Upper Hunter; Hunter ; Capertee Valley;	<i>Eucalyptus albens</i> ; <i>Callitris glaucophylla</i> ; <i>Brachychiton populneus</i> ;	Excluded: No White Cypress Pine (<i>Callitris glaucophylla</i>)
1611	Narrow-leaved Ironbark - Black Cypress Pine shrub - grass woodland upper Hunter and northern Wollemi	Hunter ; Kerrabee; Liverpool Range; Pilliga; Wollemi; Yengo; Ellerston;	<i>Eucalyptus crebra</i> ; <i>Callitris endlicheri</i> ; <i>Eucalyptus albens</i> ;	Excluded: No Narrow-leaved Ironbark <i>Eucalyptus crebra</i> ; <i>Callitris endlicheri</i>
1613	White Box - Red Box shrubby woodland on sandstone ranges of the Sydney Basin	Hunter ; Kerrabee; Inland Slopes; Inland Slopes; Pilliga; Wollemi; Bateman; Kanangra; Burragorang; Capertee Valley;	<i>Eucalyptus albens</i> ; <i>Eucalyptus polyanthemos</i> ;	Excluded: no Red Box (<i>Eucalyptus polyanthemos</i>)
1687	White Box - Grass Tree - Spinifex woodland of the Upper Hunter	Tomalla; Ellerston; Hunter ;	<i>Eucalyptus albens</i> ;	Excluded: not a Grass Tree - Spinifex community

Table 3 PCT Options having *Eucalyptus moluccana* in Upper Stratum Species within the Hunter IBRA sub-region

PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Grey Box x White Box Grassy Woodland and Grey Box x White Box - Spotted Gum Grassy Woodland
496	Yellow Box - White Box - Silvertop Stringybark – Blakely's Red Gum grass shrub woodland mainly on the Liverpool Range, Brigalow Belt South Bioregion	Liverpool Plains; Liverpool Range; Peel; Tomalla; Ellerston; Hunter ;	<i>Eucalyptus albens</i> ; <i>Eucalyptus laevopinea</i> ; <i>Eucalyptus melliodora</i> ; <i>Eucalyptus blakelyi</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus moluccana</i> ; <i>Acacia melanoxylon</i> ;	Excluded: All upper stratum species absent.
571	Ribbon Gum - Rough-barked Apple - Yellow Box grassy woodland of the New England Tableland Bioregion and NSW North Coast Bioregion	Moredun Volcanics; Binghi Plateau; Yarrowyck-Kentucky Downs; Eastern Nandewars; Armidale Plateau; Nandewar Northern Complex; Walcha Plateau; Tenterfield Plateau; Severn River Volcanics; Wongwibinda Plateau; Peel; Beady River Hills; Round Mountain; Nightcap; Bundarra Downs; Tingha Plateau; Northeast Forest Lands; Deepwater Downs; Stanthorpe Plateau; Inverell Basalts; Kaputar; Glenn Innes-Guyra Basalts; Barrington; Tomalla; Ellerston; Hunter ;	<i>Eucalyptus viminalis</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus melliodora</i> ; <i>Eucalyptus blakelyi</i> ; <i>Eucalyptus laevopinea</i> ; <i>Eucalyptus moluccana</i> ;	Excluded: All upper stratum species absent
617	Narrow-leaved Ironbark - box - Mock Olive shrubby open forest mainly on basalt slopes over sandstone in the upper Hunter Valley, Brigalow Belt South Bioregion and Sydney Basin Bioregion	Kerrabee; Liverpool Range; Hunter ; Pilliga; Ellerston;	<i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ; <i>Angophora floribunda</i> ; <i>Brachychiton populneus</i> subsp. <i>populneus</i> ; <i>Callitris endlicheri</i> ; <i>Eucalyptus albens</i> <--> <i>moluccana</i> ;	Excluded: not a Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) community
623	Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion	Hunter ; Kerrabee; Liverpool Range;	<i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ; <i>Brachychiton populneus</i> subsp. <i>populneus</i> ;	Excluded: not a Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) community
762	Cabbage Gum open forest or woodland on flats of the North Coast	Cataract; Chaelundi; Yuraygir; Coffs Coast and Escarpment; Macleay Hastings; Comboyne Plateau; Mummel Escarpment; Ellerston; Upper Hunter; Karuah Manning; Rocky River Gorge; Guy Fawkes; Scenic Rim; Clarence Sandstones; Clarence Lowlands; Hunter ; Burringbar-Conondale Ranges;	<i>Eucalyptus moluccana</i> ; <i>Eucalyptus tereticornis</i> ; <i>Angophora floribunda</i> ;	Excluded: no Cabbage Gum (<i>Eucalyptus amplifolia</i>) across the study area
1178	Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast	Mummel Escarpment; Upper Hunter; Karuah Manning; Hunter ; Yengo;	<i>Eucalyptus glaucina</i> ; <i>Eucalyptus moluccana</i> ; <i>Eucalyptus crebra</i> ;	Excluded: no Slaty Red Gum (<i>Eucalyptus glaucina</i>) across the study area



PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Grey Box x White Box Grassy Woodland and Grey Box x White Box - Spotted Gum Grassy Woodland
1585	Grey Gum - Grey Box shrub - grass open forest on sandstone ranges of the Sydney Basin	Hunter ; Kerrabee; Pittwater; Upper Hunter; Wollemi; Wyong; Yengo;	<i>Eucalyptus punctata</i> ; <i>Eucalyptus moluccana</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>) across the study area
1600	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	Hunter ; Karuah Manning; Upper Hunter; Wyong; Yengo; Ellerston;	<i>Corymbia maculata</i> ; <i>Eucalyptus fibrosa</i> ; <i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ;	Excluded: no Red Ironbark (<i>Eucalyptus fibrosa</i>) across the study area
1603	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Ellerston; Hunter ; Karuah Manning; Kerrabee; Liverpool Range; Mummel Escarpment; Tomalla; Upper Hunter; Wyong; Yengo;	<i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ;	Excluded: not a Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) community
1604	Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	Ellerston; Hunter ; Karuah Manning; Kerrabee; Liverpool Range; Mummel Escarpment; Pittwater; Tomalla; Upper Hunter; Wyong; Yengo;	<i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ; <i>Corymbia maculata</i> ;	Excluded: not a Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) community
1608	Grey Box - Grey Gum - Rough-barked Apple – Blakely's Red Gum grassy open forest of the central Hunter	Ellerston; Hunter ; Karuah Manning; Kerrabee; Mummel Escarpment; Tomalla; Upper Hunter; Wyong; Yengo; Liverpool Range;	<i>Brachychiton populneus</i> ; <i>Eucalyptus moluccana</i> ; <i>Eucalyptus punctata</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus blakelyi</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>) across the study area
1655	Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	Ellerston; Hunter ; Kerrabee; Liverpool Range; Pilliga; Tomalla; Upper Hunter; Wollemi; Wyong; Yengo;	<i>Eucalyptus moluccana</i> ; <i>Eucalyptus dawsonii</i> ; <i>Callitris endlicheri</i> ;	Excluded: not a Slaty Box (<i>Eucalyptus glaucina</i>) community
1657	Bulga Wattle low closed forest on sandstone slopes of the central Hunter	Hunter ; Kerrabee; Pittwater; Wyong; Yengo;	<i>Acacia bulgaensis</i> ; <i>Eucalyptus punctata</i> ; <i>Eucalyptus moluccana</i> ; <i>Callitris endlicheri</i> ;	Excluded: no Bulga Wattle (<i>Acacia bulgaensis</i>) across the study area
1691	Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Barrington; Ellerston; Hunter ; Inland Slopes; Karuah Manning; Kerrabee; Liverpool Range; Mummel Escarpment; Inland Slopes; Pilliga; Tomalla; Upper Hunter; Wollemi; Wyong; Yengo;	<i>Eucalyptus crebra</i> ; <i>Eucalyptus moluccana</i> ; <i>Brachychiton populneus</i> ;	Excluded: not a Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) community
1748	Grey Box grassy open forest of the Central and Lower Hunter Valley	Ellerston; Hunter ; Karuah Manning; Kerrabee; Mummel Escarpment; Tomalla; Upper Hunter; Wyong; Yengo;	<i>Eucalyptus moluccana</i> ; <i>Eucalyptus punctata</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>) across the study area
1800	Cumberland Swamp Oak riparian forest	Hunter ; Cumberland;	<i>Casuarina glauca</i> ; <i>Eucalyptus moluccana</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus baueriana</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: not a swamp forest



Forest Red Gum Grassy Open Forest Assignment

Querying the BioNet Vegetation Classification PCT database (DPIE 2021) for PCTs containing the hybrid box along with *Eucalyptus melliodora* and/or *Eucalyptus crebra* and/or *Angophora floribunda* in the upper stratum, and restricted to the Hunter IBRA sub-region, resulted in only PCT 618. Leaving out the hybrid box resulted in three PCTs (Table 4), with PCT 618 being the best match.

Querying PCTs containing Forest Red Gum in the Upper Stratum restricted to the Hunter IBRA sub-region (Table 5) resulted in 12 PCTs, none of which matched the composition of the vegetation community in the study area.

Conclusion

The Biodiversity Development Assessment Report was prepared in accordance with the Biodiversity Assessment Method that requires:

*The assessor must identify and map the distribution of PCTs, **or the most likely PCTs,** and all TECs on the subject land. The identification must be in accordance with the NSW PCT classification as described in the BioNet Vegetation Classification.*

As described in the discussion above, PCTs 483 and 618 are the only PCTs available in BioNet Vegetation Classification that are the most likely matches to the local communities dominated by or containing the hybrid box *Eucalyptus albens* <---> *moluccana* as described in the Mount Pleasant Optimisation Project (SSD-10418) Biodiversity Development Assessment Report.

Yours Faithfully
HUNTER ECO

A handwritten signature in black ink that reads "Colin Driscoll". The signature is fluid and cursive, with the first name "Colin" being more prominent than the last name "Driscoll".

Dr Colin Driscoll
Environmental Biologist

Table 4 PCT Options within the Hunter IBRA sub-region having *Eucalyptus melliodora*, *Eucalyptus crebra* and *Angophora floribunda* in Upper Stratum Species

PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Forest Red Gum Grassy Open Forest
618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	<u>Hunter</u> ; Kerrabee; Liverpool Range; Tomalla; Ellerston; Upper Hunter;	<i>Eucalyptus albens</i> <--> <i>moluccana</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus blakelyi</i> <--> <i>tereticornis</i> ; <i>Eucalyptus melliodora</i> ; <i>Brachychiton populneus</i> subsp. <i>populneus</i> ; <i>Eucalyptus eugenioides</i> ; <i>Eucalyptus crebra</i> ;	Selected: <i>Eucalyptus albens</i> <--> <i>moluccana</i> , <i>Angophora floribunda</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus melliodora</i> and <i>Eucalyptus crebra</i> all recorded in this local community
1308	White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion	Northern Basalts; Pilliga; Liverpool Plains; Liverpool Range; Talbragar Valley; Nandewar Northern Complex; Inverell Basalts; Kaputar; Peel; Ellerston; Inland Slopes; Kerrabee; <u>Hunter</u> ;	<i>Eucalyptus albens</i> ; <i>Callitris glaucophylla</i> ; <i>Angophora floribunda</i> ; <i>Brachychiton populneus</i> subsp. <i>populneus</i> ; <i>Eucalyptus melliodora</i> ; <i>Eucalyptus dealbata</i> ; <i>Eucalyptus crebra</i> ; <i>Eucalyptus melanophloia</i> ;	Excluded: No White Cypress Pine (<i>Callitris glaucophylla</i>) across the study area
1314	White Cypress Pine - Silver-leaved Ironbark - Tumbledown Red Gum shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion	Northern Basalts; Pilliga; Liverpool Plains; Liverpool Range; Nandewar Northern Complex; Inverell Basalts; Kaputar; Peel; Severn River Volcanics; Stanthorpe Plateau; Eastern Nandewars; Ellerston; Kerrabee; <u>Hunter</u> ;	<i>Callitris glaucophylla</i> ; <i>Eucalyptus melanophloia</i> ; <i>Eucalyptus dealbata</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus blakelyi</i> ; <i>Eucalyptus albens</i> ; <i>Eucalyptus crebra</i> ; <i>Eucalyptus melliodora</i> ; <i>Callitris endlicheri</i> ; <i>Eucalyptus caleyi</i> subsp. <i>caleyi</i> ;	Excluded: No White Cypress Pine (<i>Callitris glaucophylla</i>), Silver-leaved Ironbark (<i>Eucalyptus melanophloia</i>) or Tumbledown Red Gum (<i>Eucalyptus dealbata</i>) recorded across the study area

Table 5 PCT Options having *Eucalyptus tereticornis* in Upper Stratum Species within the Hunter IBRA sub-region

PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Forest Red Gum Grassy Open Forest
485	River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion)	Liverpool Range; Kerrabee; <u>Hunter</u> ;	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> ; <i>Eucalyptus tereticornis</i> ; <i>Angophora floribunda</i> ;	Excluded: not a River Oak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>) community
621	Grey Gum - Rough-barked Apple alluvial flat woodland in the upper Hunter Valley, mainly Sydney Basin Bioregion	Liverpool Range; Kerrabee; <u>Hunter</u> ;	<i>Eucalyptus punctata</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus tereticornis</i> ; <i>Allocasuarina torulosa</i> ; <i>Eucalyptus crebra</i> ; <i>Eucalyptus saligna</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>) recorded across the study area



PCT	PCT Name	IBRA Sub-region(s)	Upper Stratum Species	Assessment Forest Red Gum Grassy Open Forest
622	Grey Gum - Forest Red Gum - Yellow Box grassy tall open forest on mid-slopes of the Hunter Valley - North Coast escarpment	Mummel Escarpment; Ellerston; Liverpool Range; Tomalla; Barrington; Upper Hunter; Hunter ;	<i>Eucalyptus biturbinata</i> ; <i>Eucalyptus melliodora</i> ; <i>Eucalyptus tereticornis</i> ; <i>Eucalyptus laevopinea</i> ; <i>Angophora floribunda</i> ; <i>Allocasuarina torulosa</i> ; <i>Eucalyptus eugenioides</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>) recorded across the study area
1583	Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	Barrington; Comboyne Plateau; Karuah Manning; Macleay Hastings; Mummel Escarpment; Tomalla; Walcha Plateau; Upper Manning; Ellerston; Upper Hunter; Hunter ;	<i>Eucalyptus eugenioides</i> ; <i>Eucalyptus biturbinata</i> ; <i>Angophora subvelutina</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>), Thin-leaved Stringybark or Broad-leaved Apple recorded across the study area
1588	Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast	Hunter ; Pittwater; Wyong; Yengo; Karuah Manning;	<i>Eucalyptus paniculata</i> ; <i>Eucalyptus umbra</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: no Grey Ironbark (<i>Eucalyptus paniculata</i>) or Broad-leaved Mahogany (<i>Eucalyptus umbra</i>) recorded across the study area
1594	Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter	Ellerston; Hunter ; Karuah Manning; Kerrabee; Pittwater; Upper Hunter; Wyong; Yengo;	<i>Eucalyptus amplifolia</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: no Cabbage Gum (<i>Eucalyptus amplifolia</i>) recorded across the study area
1598	Forest Red Gum grassy open forest on floodplains of the lower Hunter	Ellerston; Hunter ; Karuah Manning; Kerrabee; Upper Hunter; Wyong; Yengo; Pittwater;	<i>Eucalyptus tereticornis</i> ; <i>Eucalyptus punctata</i> ; <i>Angophora floribunda</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>) recorded across the study area
1714	River Oak - White Cedar Grassy Riparian Forest of the Dungog Area and Liverpool Ranges	Liverpool Range; Tomalla; Ellerston; Upper Hunter; Karuah Manning; Hunter ;	<i>Casuarina cunninghamiana</i> ; <i>Eucalyptus tereticornis</i> ; <i>Melia azedarach</i> ;	Excluded: not a River Oak (<i>Casuarina cunninghamiana</i>) community
1731	Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	Ellerston; Hunter ; Karuah Manning; Kerrabee; Liverpool Range; Mummel Escarpment; Tomalla; Upper Hunter; Wyong; Yengo;	<i>Casuarina glauca</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: not a Swamp Oak (<i>Casuarina glauca</i>) community
1748	Grey Box grassy open forest of the Central and Lower Hunter Valley	Ellerston; Hunter ; Karuah Manning; Kerrabee; Mummel Escarpment; Tomalla; Upper Hunter; Wyong; Yengo;	<i>Eucalyptus moluccana</i> ; <i>Eucalyptus punctata</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: no Grey Gum (<i>Eucalyptus punctata</i>) recorded across the study area
1749	Grey Gum - Red Gum - Paperbark shrubby open forest on coastal lowlands of the Northern Sydney Basin and Lower North Coast	Karuah Manning; Hunter ; Wyong;	<i>Eucalyptus punctata</i> ; <i>Eucalyptus tereticornis</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus canaliculata</i> <- -> <i>punctata</i> ;	Excluded: no Grey Gum r (<i>Eucalyptus punctata</i>) recorded across the study area
1800	Cumberland Swamp Oak riparian forest	Hunter ; Cumberland;	<i>Casuarina glauca</i> ; <i>Eucalyptus moluccana</i> ; <i>Angophora floribunda</i> ; <i>Eucalyptus baueriana</i> ; <i>Eucalyptus tereticornis</i> ;	Excluded: not a Swamp Oak (<i>Casuarina glauca</i>) Forest



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Attachment D-2 – EPBC Act Protected Matters Report



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

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[Details](#)

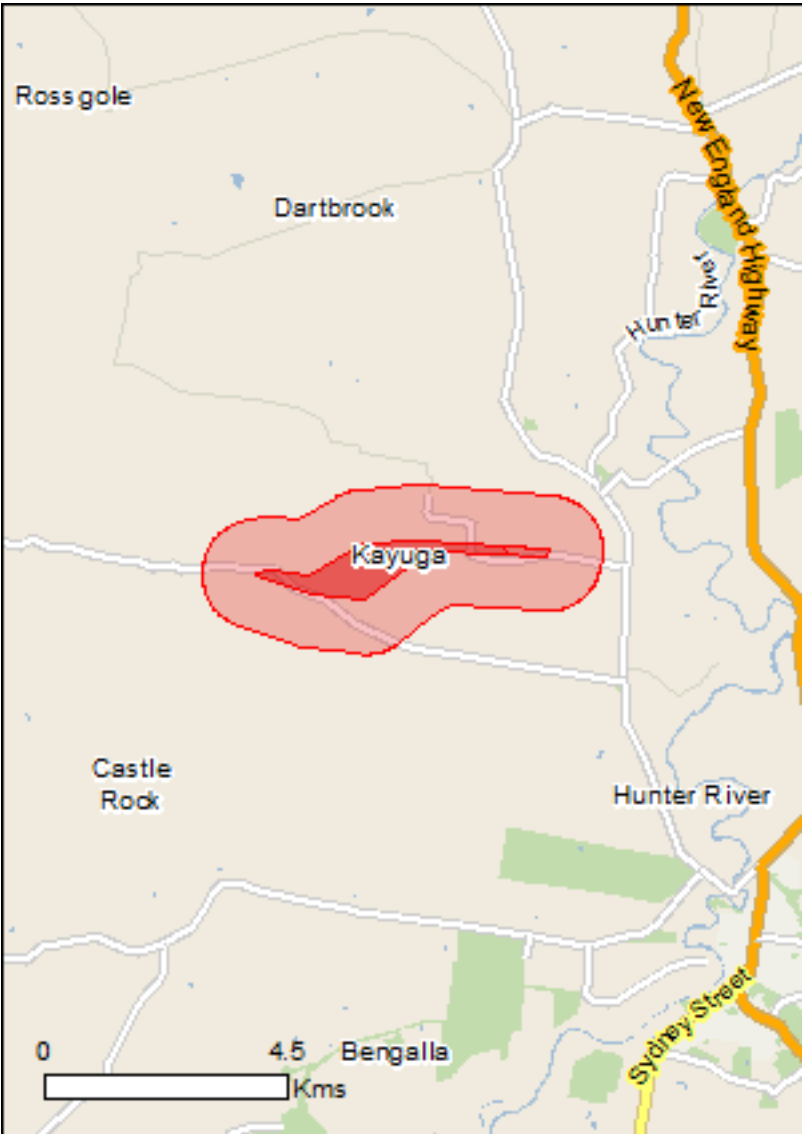
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

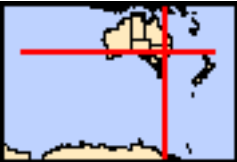
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 1.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	22
Listed Migratory Species:	13

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	30
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)		[Resource Information]
Name	Proximity	
Hunter estuary wetlands	100 - 150km upstream	

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community may occur within area
Hunter Valley Weeping Myall (Acacia pendula) Woodland	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species

[Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat likely to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur

Name	Threatened	Type of Presence
Motacilla flava Yellow Wagtail [644]		within area Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]	
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	area Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Regional Forest Agreements	[Resource Information]
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Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species	[Resource Information]
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Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.21 150.80667,-32.21028 150.80667,-32.21306 150.81611,-32.21389 150.825,-32.21 150.83056,-32.20694 150.83694,-32.20778 150.85528,-32.20667 150.85556,-32.20528 150.83389,-32.20583 150.82444,-32.21028 150.81556,-32.20972 150.80917,-32.21 150.80667

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
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- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.