

Luddenham Quarry Modification 5 Submissions Report

Prepared for Coombes Property Group & KLF Holdings
December 2020



Luddenham Quarry - Modification 5

Submissions Report

Report Number

J190749 RP#39

Client

Coombes Property Group and KLF Holdings Pty Ltd

Date

2 December 2020

Version

Final

Prepared by



Janet Krick

Associate

2 December 2020

Approved by



Dr Philip Towler

Associate Director

2 December 2020

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

© Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

Table of Contents

1	Introduction	1
1.1	Overview	1
1.2	Background	1
1.3	Purpose of this report	3
2	Analysis of submissions	5
2.1	Breakdown of submissions	5
2.2	Categorisation of matters raised	6
3	Actions taken since submission of the Modification Report	7
3.1	Refinements to proposed modification	7
3.2	Stakeholder engagement	7
3.3	Further technical assessment and investigations	9
3.4	Other activities	10
4	Response to submissions	11
4.1	Department of Planning, Industry & Environment	11
4.2	Department of Infrastructure, Transport, Regional Development and Communities	16
4.3	DPIE Water and NRAR	19
4.4	Environment Protection Authority	20
4.5	Transport for NSW	36
4.6	Western Sydney Planning Partnership	39
4.7	Western Sydney Airport	41
4.8	Environment, Energy and Science	44
4.9	Heritage NSW	52
4.10	Liverpool City Council	55
4.11	Regional NSW – Mining, Exploration & Geoscience	62
4.12	NSW Rural Fire Service	63
4.13	Airservices Australia	64
5	Updated evaluation merits	65
	References	67

Appendices

Appendix A Submissions summary	A.1
Appendix B Update mitigation measures	B.1
Appendix C Pavement investigation report	C.1
Appendix D Biodiversity Development Assessment Report	D.1
Appendix E Concept design and filling strategy	E.1
Appendix F Water sampling laboratory results	F.1

Tables

Table 2.1	Categories of matters raised	6
Table 3.1	Summary of stakeholder consultation	8
Table 3.2	Summary of estimated pavement remaining life	9
Table 4.1	Final landform and land use compatibility with the Agribusiness zone objectives	13
Table 4.2	Final landform and land use Compatibility with the Environment and Recreation zone objectives	14
Table 4.3	Analysis methods and parameters	26
Table 4.4	Water quality results (October 2020)	27
Table 4.5	Summary of revised annual water balance results	32
Table 4.6	Right turn warrant assessment into Adams Road from Elizabeth Drive (without development traffic)	37

Figures

Figure 1.1	Proposed modification	4
Figure 4.1	Aerotropolis SEPP zoning	15
Figure 4.2	Watering control effectiveness for unpaved travel surfaces (US EPA 1985)	23
Figure 4.3	Revised water balance results – typical dry rainfall year	31
Figure 4.4	Revised water balance results typical median rainfall year	31
Figure 4.5	Revised water balance results – typical wet rainfall year	32
Figure 4.6	Modelled daily discharges	33
Figure 4.7	Austrroads warrant design charts for rural intersection turning lanes	37
Figure 4.8	Sight distance assessment for eastbound traffic on Elizabeth Drive	38
Figure 4.9	Results of test excavation	54

1 Introduction

1.1 Overview

In late 2019, CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), acquired the property at 275 Adams Road, Luddenham New South Wales (NSW) (Lot 3 in DP 623799, 'the subject property') within the Liverpool City Council municipality. The subject property is host to an existing shale/clay quarry (the quarry site). CPG owns, develops, and manages a national portfolio of office, retail, entertainment, land, and other assets. The company's business model is to retain long-term ownership and control of all its assets. CPG has the following staged vision to the long-term development of the subject property:

- **Stage 1** Quarry Reactivation: **Solving a problem.** The subject of the proposal to modify (Modification 5) Luddenham Quarry's SSD consent DA No. 315-7-2003 under Section 4.55(1A) of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act).
- **Stage 2** Advanced Resource Recovery Centre and Quarry Rehabilitation: **A smart way to fill the void:** CPG in partnership with KLF Holdings Pty Ltd (KLF) and in collaboration between the circular economy industry and the material science research sector, intends to establish a technology-led approach to resource recovery, management, and reuse of Western Sydney's construction waste, and repurposing those materials that cannot be recovered for use to rehabilitate the void. This will provide a sustainable and economically viable method of rehabilitating the void for development.
- **Stage 3** High Value Employment Generating Development: **Transform the land to deliver high value agribusiness jobs.** CPG intends to develop the rehabilitated quarry site into a sustainable and high-tech agribusiness hub supporting food production, processing, freight transport, warehousing, and distribution, whilst continuing to invest in the resource recovery research and development (R&D) initiatives. This will deliver the vision of a technology-led agribusiness precinct as part of the Aerotropolis that balances its valuable assets including proximity to the future Western Sydney Airport (WSA) and Outer Sydney Orbital.

This Submissions Report relates to the modification application (MOD 5) relating to the delivery of Stage 1 as described above.

1.2 Background

CPG in partnership with KLF (the applicants) are seeking to reactivate quarrying operations at the site, an existing clay/shale quarry in the Greater Western Sydney region of NSW.

Quarrying operations were originally approved under consent DA No. 315-7-2003 (the consent, and now classified as State significant development (SSD)). The existing consent has been modified three times (MOD1 to MOD3). A fourth modification (MOD4) was withdrawn. The quarry is currently approved to produce and transport up to 300,000 tonnes per annum (tpa) of clay and shale product, with quarry operations approved until 31 December 2024, although rehabilitation and some other activities may continue past this date.

CPG and KLF are seeking to reactivate quarrying operations through an approved modification (MOD5) of the consent (the proposed modification) to avoid sterilisation of a regionally significant resource that is identified in Schedule 1 of the Sydney Regional Environmental Plan No 9 – Extractive Industry (No 2 – 1995).

In parallel to the proposed modification, the applicants have submitted a SSD application to establish a construction and demolition waste advanced resource recovery centre (ARRC) on the subject property (Stage 2), with the intention of making a future application to fill the quarry void with unrecyclable materials to provide a sustainable and economically viable method of rehabilitating the void for development consistent with the vision of the State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 (the Aerotropolis SEPP).

The scope of the proposed modification is described in detail in Chapter 2 of the Modification Report (EMM 2020a) and is summarised as follows:

- the use of the existing site access from Adams Road by quarry vehicles;
- upgrade (including sealing) of the site access road and its intersection with Adams Road as required, and upgrades to the existing internal road network;
- new stockpiling area, weighbridge and other site infrastructure within Lot 3 DP 623799;
- the operation of some additional quarry equipment and a small increase to the daily maximum number of trucks;
- removal of references to activities on Commonwealth-owned land previously known as Lot 1 DP 838361 (now a part of Lot 101 DP 1236319) from the consent;
- update of the existing surface water management system;
- removal of the northern noise bund during construction of the ARRC; and
- administrative modification of some other conditions of consent to align with current government policy and/or site conditions (ie reduced development footprint).

An overview of the proposed modification is shown in Figure 1.1.

The proposed modification does not seek to increase the quarry void footprint, production rate or hours of operation. It is not proposed to extend the quarry life beyond 2024, so the proposed quarry operations will be complete prior to the scheduled start of Western Sydney Airport operations in 2026.

A portion of Adams Road, between the subject property access road and Elizabeth Drive, will be upgraded by the applicants so that the pavement is suitable for use by heavy vehicles (up to 19 m in length).

The consent is proposed to be modified under Section 4.55(1A) of the EP&A Act as it will have minimal environmental impacts which are generally restricted to the proposed change in site access and minor changes to quarry operations.

The modification application for MOD 5 and the Modification Report were submitted to the Department of Planning, Industry and Environment (DPIE) on 6 August 2020. DPIE referred the Modification Report to government agencies, Western Sydney Airport (WSA), Air Services Australia and local residents for comment and subsequently received advice from these groups.

1.3 Purpose of this report

DPIE wrote to the applicants on 22 October 2020, requesting responses to the matters raised in the responses to the EIS. In this correspondence, DPIE also requested a response to additional matters raised by DPIE's Resource Assessments team in relation to rehabilitation of the quarry site. Accordingly, this Submissions Report has been prepared by EMM Consulting Pty Limited (EMM) in accordance with the draft DPIE document *Guidance for State Significant Projects - Preparing a Submissions Report* (DPIE 2019). It also provides a response to DPIE's request for further information in relation to the rehabilitation of the quarry, noting that infilling of the quarry void will be subject to a separate modification application.

This report also provides information on the proposed modification that has been prepared since the submission of the Modification Report, including refinements to the proposed modification, further technical studies and stakeholder consultation.

\\E:\msvr1\emm\Jobs\2019\1907.49 - GPG Luddenham Quarry\GIS\02_Maps\Modification_Reporting\WR004_ProposedModification_20201130_04.mxd 30/11/2020



- KEY**
- Study area
 - Cadastral boundary
 - Proposed site modifications
 - Approved extraction footprint
 - Existing noise bunds
 - Existing stockpiling area
 - Extended stockpiling area
 - Internal road
 - Site entry infrastructure (incl. offices, amenities, weighbridge)
 - Equipment laydown area

Modification 5 proposed layout

Luddenham Quarry - Modification 5
Submissions report
Figure 1.1



2 Analysis of submissions

2.1 Breakdown of submissions

A total of 14 submissions were received from government agencies and organisations. These submissions have been categorised as follows:

Commonwealth government submissions

A submission was received from the Commonwealth Department of Infrastructure, Transport, Regional Development and Communications.

NSW government agency submissions

Eight submissions providing comment on the proposed modification were received from the following NSW government agencies:

- Environment Protection Authority;
- Heritage Council of NSW;
- Heritage NSW – Aboriginal Cultural Heritage Regulation;
- DPIE Water and the Natural Resources Access Regulator (NRAR);
- DPIE Environment, Energy and Science;
- Rural Fire Service (NSW RFS);
- Regional NSW – Mining, Exploration and Geoscience (MEG);
- Transport for NSW (TfNSW); and
- Western Sydney Planning Partnership (WSPP).

Local Government submissions

A submission was received from the Liverpool City Council (LCC).

Organisation / company submissions

Two submissions were received from organisations:

- WSA; and
- Airservices Australia.

It is noted that while many of the above agencies and organisations raised matters to be addressed, their respective submissions were in the form of comments with no submissions objecting to the proposed modification.

Appendix A provides a summary of the submissions received and the matters raised.

2.2 Categorisation of matters raised

Matters raised in the submissions have been classified as one of the following five categories in accordance with the DPIE (2019):

- the scope of the proposed modification;
- procedural matters;
- the environmental, social or economic impacts of the proposed modification;
- the merits of the proposed modification; and
- issues that are beyond the scope of the proposed modification assessment.

Each of these categories has been divided into sub-categories, which align with the content of the Modification Report and supporting technical assessments as outlined in Table 2.1.

Table 2.1 Categories of matters raised

DPIE (2019) guideline category	Sub-category
The proposed modification	Clarification of onsite activities
	Road upgrade
Procedural matters	Requirement to prepare a Biodiversity Development Assessment Report
	Stakeholder engagement
	Post approval requirements
	Water licensing
Environmental, social or economic impacts	Traffic
	Air quality
	Noise
	Biodiversity
	Surface water
	Groundwater
	Rehabilitation
	Hazardous materials
	Bushfire
	Heritage
	Visual
Merits of the project	Strategic planning - alignment with Aerotropolis SEPP
Issues beyond the scope of the proposed modification	Matters relating to infilling the quarry void
	Matters relating to the ARRC
	Final land use of subject property

3 Actions taken since submission of the Modification Report

3.1 Refinements to proposed modification

Minor refinements have been made to the scope of MOD 5 as described in Chapter 2 of the Modification Report, predominantly in response to submissions received and the results of additional technical assessments and investigations as outlined below:

- in response to DITRDC's and WSA's submissions, the applicants propose, rather than remove Condition 35, as proposed in the Modification Report, that the requirement for annual rehabilitation audits be postponed, to 12 months following the completion of approved extraction activities;
- retain irrigation activities as per the current consent; and
- limit upgrades Adams Road to pavement upgrades to accommodate heavy vehicles up to 19 m-in-length and allow the current LCC heavy vehicle restrictions to be listed. No further road upgrades are proposed for MOD 5.

3.2 Stakeholder engagement

Stakeholders consulted since the preparation of the Modification Report are outlined in Table 3.1.

Table 3.1 Summary of stakeholder consultation

Stakeholder	Consultation method	Outcome	Response
EES	Email correspondence	Email correspondence with EES regarding whether the BDAR for the ARRC could be updated to include MOD 5 disturbance footprint. ESS advised a separate BDAR would be required for MOD 5	A BDAR has been prepared for the proposed modification. A summary of the key findings of the BDAR is provided in Section 3.3.2 with the complete BDAR included in Appendix D.
LCC	Meeting with Council 17/7/2020	Discussion regarding lifting heavy vehicle limit on Adams Road between site access and Elizabeth Drive and upgrades to Adams Road. Council requested pavement testing to inform upgrade requirements.	The applicant commissioned a pavement investigation report. The outcomes of this report are summarised in Section 3.3.1 with the complete report included in Appendix D.
	Meeting with Council 26/11/2020	Further discussion regarding the required upgrades to the northern end of Adams Road and the Elizabeth Drive/Adams Road with a focus on this MOD 5 application. The applicant provided an overview of the proposed approach to these upgrades as described in Section 3.3.1 below. Council requested additional information to assist in their assessment of the proposed upgrade approach	The work required for road surface condition, topographic survey and a conceptual road design will be prepared prior to determination of the modification. It is believed that the other matters should be addressed as part of detailed design required for the Section 138 (of the <i>Roads Act 1993</i>) application and the application to lift the load limit on the northern section of Adams Road. Consultation with Council will be ongoing.
DPIE	Email and phone correspondence	Discussions regarding infilling of the quarry void and final land use.	The applicant commissioned a concept design filling strategy. This strategy is summarised in Section 3.3.3 with the complete report included in Appendix E.

3.3 Further technical assessment and investigations

The following subsections summarise the findings of further technical assessments and investigations carried out since the submission of the Modification Report.

3.3.1 Pavement investigation

At the request of LCC, a pavement investigation for Adams Road was prepared by Durkin Construction Pty Ltd (Durkin 2020). This investigation is contained in Appendix C of this Submissions Report. The investigation was undertaken along a 340 metre (m) section of Adams Road from the Elizabeth Drive intersection to the subject property access with the purpose being to investigate the existing condition of the pavement and provide an estimate of the remaining structural life of Adams Road. The outcomes of the investigation are intended to provide the basis for a works plan to ensure suitability of Adams road to accommodate traffic associated with the MOD 5 reactivated quarry operations and ARRC development.

The pavement investigations included shallow borehole investigations, Falling Weight Deflectometer (FWD) testing, Dynamic Cone Penetrometer (DCP) test and sampled pavement material for laboratory testing. Based on analysis of information derived from the FWD data, Durkin recommended division of results into two sections:

- Section 1 commencing at the Elizabeth Drive/Adams Road intersection and extending south along Adams Road for 250 m; and
- Section 2 commencing 250 m south of the Elizabeth Drive/Adams Road intersection extending to 340 m south of the Elizabeth Drive/Adams Road intersection, immediately south of the proposed quarry intersection.

The investigation used the outcomes of the pavement investigations in combination with the background and projected heavy vehicle traffic volumes associated with MOD 5 and the ARRC to determine the remaining life of the existing road pavement. A summary of the estimated remaining life for the existing and MOD 5 scenarios is presented in Table 3.2 (noting the estimated remaining life was capped at 20 years for the purpose of the analysis).

Table 3.2 Summary of estimated pavement remaining life

Scenario	Section 1 (within 250 m of the Elizabeth Drive/Adams Road intersection)	Section 2 (north and south of the proposed quarry intersection)
Existing traffic	20	0
MOD 5	11	0

The results indicate, Section 2 of Adams Road is considered to have reached the end of its structural life and will require upgrading regardless of whether MOD 5 is approved. Section 1 of Adams Road has a lifespan of approximately 20 years under existing traffic loading and of 11 years based on the predicted traffic heavy vehicle traffic volumes associated with MOD 5.

As noted in Table 3.1 above, Council has requested additional information to assist in their assessment of the proposed upgrade approach. Accordingly, an assessment of road surface condition, topographic survey and a conceptual road design will be prepared prior to determination of the modification. Consultation with Council will be ongoing as part of the Section 138 (of the *Roads Act 1993*) application and the application to lift the load limit on the northern section of Adams Road.

3.3.2 Biodiversity Development Assessment Report

MOD 5 will not result in clearance of native vegetation outside of the approved quarry footprint. Accordingly, a Biodiversity Development Assessment Report (BDAR) waiver application was lodged with the Scoping Report (EMM 2020) and subsequently appended to the Modification Report. Notwithstanding EES requested in its response to the Modification Report, that a BDAR be prepared to provide further information regarding the biodiversity values at the subject property and to assess the potential for MOD 5 to directly or indirect impact on these values.

Accordingly, a BDAR has been prepared by EMM and is appended to this Submissions Report as Appendix D. The BDAR confirmed that there would be no direct or indirect impacts on threatened species or native vegetation as a result of MOD 5. Potential indirect impacts on biodiversity values as a result of quarry pit dewatering and operation of the quarry's water management system are approved under the existing SSD consent.

3.3.3 Concept design and filling strategy

As noted in Section 1.3, the infilling of the quarry void will be subject to a separate modification application and therefore is outside of the scope of MOD 5. Notwithstanding, in response to DPIE's request for further information regarding the infilling of the void and the conceptual final landform and to respond to matters raised in government agency submissions, the applicants have commissioned InSitu Advisory to prepare a concept design and filling strategy (CDFS) (InSitu 2020) (contained in Appendix E). This CDFS provides an overview of this future activity and demonstrates the feasibility of infilling the quarry void with construction and demolition non-recyclable residues to achieve a geotechnically stable developable landform to accommodate future agribusiness land use aligned with the strategic objectives of the Aerotropolis SEPP. The CDFS provides infilling design considerations, the potential for gas generation (if any) and design requirements for final capping. It also provides an indicative filling methodology, including indicative plant that would be required for infilling and compaction activities.

3.4 Other activities

3.4.1 Mining lease application

As clay and shale are classified as "minerals" under the Mining Act, the quarry is classified as a mine requiring a mining lease (ML), accordingly the applicants have submitted a ML application ("MLA 592") which is currently under assessment by MEG.

3.4.2 Water licensing

As outlined in Section 4.3.6 of the Modification Report, groundwater intercepted by the quarry pit was estimated to be 5 m³/day (Douglas Nicolaisen & Associates 2003). The project therefore requires a water access licence (WAL) under the *Water Management Act 2003* (WM Act) for 1.8 ML/year from the Sydney Basin Central Groundwater Source regulated by the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011.

Accordingly, the applicants have applied to NRAR for a zero share WAL. This zero share WAL was granted on 10 November 2020. The applicant has engaged a broker to secure sufficient entitlement on the open market.

4 Response to submissions

Responses to the comments contained within the 14 federal, state and local government and organisation submissions received are provided in the following subsections. Comments from the respective government agencies and organisations are presented in text boxes, with each respective comment followed directly with a response.

4.1 Department of Planning, Industry & Environment

4.1.1 Final landform and land use

i Final landform and land use consistency with existing approval and management plans

The Department notes the rehabilitation of the quarry site has been raised as a key issue in the agency advice. The Department is seeking further clarification of how the conceptual final landform and end use included in the Modification Report aligns with the existing approved outcomes included in the quarry's Environmental Impact Statement (EIS) and the approved Site Rehabilitation Plan and the Vegetation Management Plan under DA 315-7-2003.

a Consistency with EIS

Section 1.3.1 of the original quarry EIS (Douglas Nicolaisen and Associates 2003) outlined that:

Rehabilitation material will be sourced from selected and controlled locations such that it satisfies the criteria for Inert Waste Class 2 specified by the NSW EPA. This decision allows the site to be rehabilitated without it becoming a 'rubbish dump' with all the attendant environmental and management problems..... Because of the time span between commencement of extraction operations and the commencement of rehabilitation activity and the resultant uncertainty of source and tonnage of acceptable materials, it is proposed that a separate application be lodged for the rehabilitation development closer to the time of such work being possible.

The original quarry EIS, notwithstanding acknowledgment that a separate application to fill the quarry would be required, provided an assessment of the filling operations at Section 4.2 and 4.5. The Department of Infrastructure, Planning and Natural Resources (DIPNR)'s assessment report recognised that the filling of the void did not form part of the current proposal, however recognised that the infilling of the void could constitute one of the approaches to the rehabilitation.

b Consistency with Site Rehabilitation Plan

Previous post quarrying land use objectives for the site are detailed in the existing Site Rehabilitation Plan (SRP) (Connacher Environmental Group 2009) prepared in accordance with Condition 33 of the existing consent. In summary, the SRP objectives were distinctly different from those in the 2003 EIS and contemplated the quarry pit being left as open void at closure with treatment limited to re-contouring and stabilising the void batters. The SRP also inferred the potential for alternate end land uses other than the rural/pastoral final land use 'base case'.

It is noted that Condition 36 of the consent requires:

Prior to 5 years of the estimated completion of extractive activities at the site, the Applicant shall submit a report to the Department identifying the final land use of the site and the method of treatment of the final void.

While the proposed final land form and land use is not consistent with the SRP, implicit in Condition 33 and 36 is a recognition that the SRP represents an interim approach pending the report 5 years prior to project completion and any future application to fill the void. This is reflected in the Site Rehabilitation Plan prepared by Conacher Environmental Group in April 2009, where the stand-alone rehabilitation approach was to be a temporary outcome pending a later application to fill the void.

It is noted that the Final Land use report as required by Condition 36 has been prepared by the applicants and was appended to the Modification Report (Appendix L).

c Consistency with the Vegetation Management Plan

The requirements for the rehabilitation and protection of Oaky Creek as a riparian zone (biodiversity end land use) are prescribed in Condition 34 of the existing consent, which required that a vegetation management plan (VMP) be developed to address:

- the revegetation of the riparian zone of Oaky Creek;
- the protection, establishment, and maintenance of this riparian zone (including protection of remnant native vegetation); and
- the restoration of any areas within this riparian zone disturbed by the development.

A VMP (UBM Ecological Consultants 2009) has been prepared to meet this condition. The key objective of the VMP to restore and protect the Oaky Creek riparian zone is consistent with the final landform and land use. Infilling of the quarry void will provide stable land within the Environment and Recreation zone portion (approximately 1.2 ha in size) of the quarry site that can be developed to enhance and protect the biodiversity values of the Oaky Creek and the identified threatened species habitat and ecological communities within the riparian zone (as documented in the BDAR contained in Appendix D).

ii Rehabilitation, final landform and land use consistency with the objectives of Aerotropolis SEPP zoning

The Department wishes to confirm how the proposed rehabilitation, final landform and land uses for the quarry site would align with and meet the objectives of the site’s land use zonings of ‘Agribusiness’ and ‘Environment and Recreation’ under the State Environmental Planning Policy (Western Sydney Aerotropolis) 2020.

Consideration of how the proposed rehabilitation, final landform and land uses for the quarry site align with the objectives of the quarry site’s land use zonings of Agribusiness, and Environment and Recreation are outlined in Table 4.1 and Table 4.2. These tables also consider the site’s compatibility with these zones if the filling of the quarry is not achieved through the proposed site development stages. The subject property in the context of the Aerotropolis and new zonings is shown in Figure 4.1.

Table 4.1 Final landform and land use compatibility with the Agribusiness zone objectives

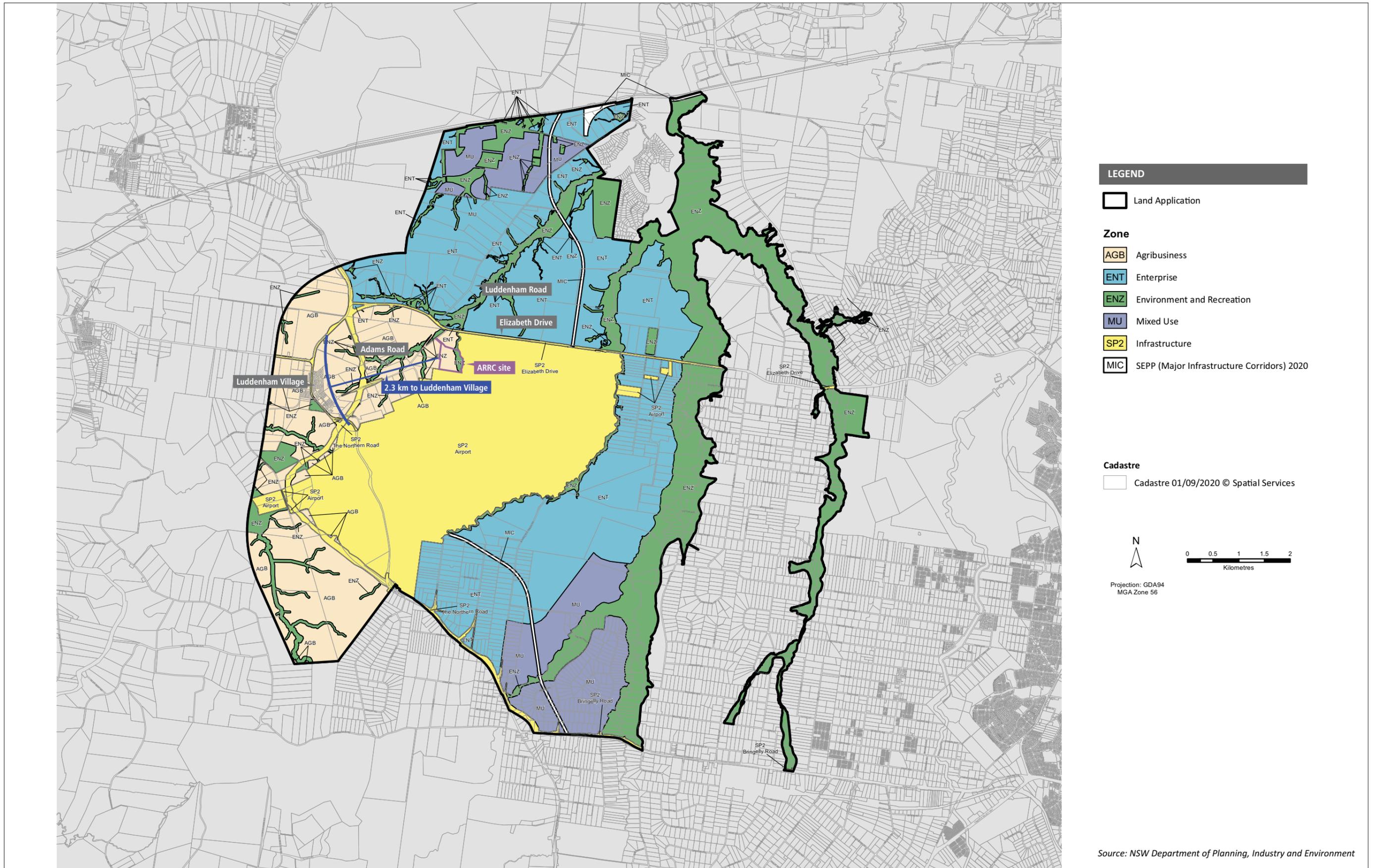
Objective	Infilling void to achieve final agribusiness land use	‘Do nothing’ alternative (quarry void retained)
To encourage diversity in agribusiness, including related supply chain industries and food production and processing that are appropriate for the area	<p>Infilling of the quarry void will provide stable developable land which will be developed to meet this objective.</p> <p>It is noted that the draft Aerotropolis Precinct Plan for the Agribusiness precinct, envisages the subject property will form part of a “neighbourhood hub” or “employment hub” with the precinct plan indicating commercial warehouse type developments on the subject property. According the final land use will also meet the vision of the draft Precinct Plan.</p>	The unfilled quarry void would constrain the realisation of this objective with less than 50% of the site available for development aligned with this objective.
To encourage sustainable and high technology agribusiness, including agricultural produce industries.	Infilling of the quarry void will provide stable developable land which will be developed to meet this objective.	As above.
To enable sustainable agritourism	Infilling of the quarry void to provide stable developable land which could be developed to meet this objective.	As above.
To encourage development that is consistent with the character of Luddenham village	<p>As shown in Figure 4.1, Luddenham Village is located 2.3 km to the south-west of the subject property and therefore the infilling of the void and final agribusiness land use will not impact on the character of Luddenham village.</p> <p>It is noted that the final agribusiness land use as envisaged in the Final Land Use Report is considered consistent with the final land use shown in the draft Aerotropolis Precinct Plan (WSPP 2020).</p>	As shown in Figure 4.1, Luddenham Village is located 2.3 km to the south-west of the subject property and therefore the ‘do nothing’ alternative is not considered to impact on the character of Luddenham village.

Table 4.1 Final landform and land use compatibility with the Agribusiness zone objectives

Objective	Infilling void to achieve final agribusiness land use	'Do nothing' alternative (quarry void retained)
To maintain the rural landscape character and biodiversity of the area.	As noted above, the draft Aerotropolis Precinct Plan for the Agribusiness precinct, envisages the subject property will form part of a “neighbourhood hub” or “employment hub” with the precinct plan indicating commercial warehouse type developments on the subject property. The final land use would be designed to avoid impacts on the biodiversity values associated with the Environment and Recreation zoned land on the subject property.	See Table 4.2.

Table 4.2 Final landform and land use Compatibility with the Environment and Recreation zone objectives

Objective	Infilling void to achieve final agribusiness land use	'Do nothing' alternative (quarry void retained)
To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.	This objective is not relevant to the subject property as it has no areas of high ecological, scientific, cultural or aesthetic values.	This objective is not relevant to the subject property as it has no areas of high ecological, scientific, cultural or aesthetic values.
To protect the ecological, scenic and recreation values of waterways, including Wianamatta–South Creek and its tributaries.	This objective is not relevant to the subject property.	This objective is not relevant to the subject property.
To provide a range of recreational settings and activities and compatible land uses.	Due to the proximity to the WSA, the subject property is not considered suitable for outdoor recreational activities due to airport noise impacts. This objective is therefore considered not applicable.	Due to the proximity to the WSA, the subject property is not considered suitable for outdoor recreational activities due to airport noise impacts. This objective is therefore considered not applicable.
To protect and conserve the environment, including threatened and other species of native fauna and flora and their habitats, areas of high biodiversity significance and ecological communities	Infilling of the quarry void will provide stable land within the Environment and Recreation zone portion of the quarry site that can be developed to enhance and protect the biodiversity values of the Oak Creek and the identified threatened species habitat and ecological communities within this riparian zone (refer Appendix D).	The unfilled quarry void would constrain the realisation of this objective as the area of Environment and Recreation zoned land intersecting the quarry void would remain as a void.



Source: NSW Department of Planning, Industry and Environment

State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 Land Zoning Map

Luddenham Quarry Modification 5 Submissions Report

Figure 4.1

4.1.2 Rehabilitation activities and composition of infill material

The Department is interested in understanding the timing of proposed rehabilitation activities and the composition of inert infill material to be used for backfilling the final void.

i Timing of quarry rehabilitation activities

Infilling of the quarry void and preparing the quarry site for future agribusiness land use will be subject to a separate modification application to the quarry consent. Pending approval of this future modification application, infilling activities (including installation of an appropriate liner and a leachate collection system) will commence following completion of extraction in December 2024.

The rate of filling is unknown at this stage and will be dependent on market forces and the demand for resource recovery as the Aerotropolis develops. It is anticipated, however that the void could take in the order of 15 years to fill subject to market conditions.

ii Composition of infilling materials

Infilling of the void with non-recyclable residues represents a commercially viable method of site rehabilitation. Non-recyclable residues are generally mixed wastes from construction and demolition and select commercial and industrial resource recovery operations. These wastes are classified under the waste classification guidelines (EPA 2014) as general solid waste (non-putrescible) and represent the small proportion of waste that is unable to be economically recovered and recycled. Non-recyclable residues can consist of building waste, construction spoils, plastics, treated and untreated timber, glass, metals and cardboards.

4.2 Department of Infrastructure, Transport, Regional Development and Communities

4.2.1 Airport regulatory framework

While the proposed activity is not on the Airport Site, the development could consider the Airport regulatory framework, including the Airport Plan 2016; Airport (Environmental Protection) Regulations; the Construction Environmental Management Plans (CEMPs).

This submission is noted. Section 4.2.2 of the Modification Report addressed the Obstacle Limitation Surface (OLS) for the Western Sydney Airport which has been declared under the provisions of the Airports Act and Airports (Protection of Airspace) Regulations 1996 (Airports Regulations).

Airspace in the vicinity of the Western Sydney Airport is protected under the Airports Act and Airports regulations. The OLS extends outward and upward from ground level from the runway location (WSA Co n.d.). The site is within the 'inner horizontal surface RL 125.5 m AHD [Australian Height Datum].

The proposed modification will not impact on the WSA OLS or protected airspace and is therefore not a controlled activity within the airport's protected airspace and will not require approval from the airport operator, WSA.

4.2.2 Impacts on WSA

The Proponent should demonstrate reasonable consideration of the potential impacts of proposed development on Airport operations. This assessment is essential to informing balanced and coherent planning and development outcomes around the Airport Site.

The Department notes the current expiry date for the quarry of 31 December 2024, which would remove any incompatibility with the scheduled start of Airport operations in 2026.

The Department recommends that the Proponent engage directly with WSA in relation to NASF Guideline C- Managing the Risk of Wildlife Strikes in the Vicinity of Airports, in particular the management of water bodies and other wildlife attracting activities on site. We also recommend that ongoing wildlife analysis be conducted and any potential wildlife attracting activities restricted.

As noted, quarrying operations will be completed prior to the scheduled commencement of Airport operations in 2026.

Infilling of the quarry void (pending future approval) will occur concurrently with the operation of the WSA. An aviation impact assessment, considering wildlife attraction will be carried out as part of the environmental assessment for this future approval. It is emphasised that filling the quarry void, which will otherwise contain water, will remove a wildlife hazard immediately adjacent to the WSA.

As outlined in Section 3.3, in response to matters raised in government agency submissions, a CDFS for future infilling of the quarry has been prepared (contained in Appendix E). The CDFS demonstrates the feasibility of infilling the quarry void with construction and demolition non-recyclable residues, without impacting on WSA operations to achieve a geotechnically stable developable landform to accommodate future agribusiness land use. The CDFS notes that facilities that dispose of general solid waste (non-putrescible) waste, specifically construction and demolition residual wastes, with good operational practices do not normally attract wildlife, specifically birds or scavengers due to the nature of the waste handled at the facility. Unlike putrescible waste facilities that do attract these pests due to food scraps and other organics being present.

The *Wildlife Strike and Birdstrike Risk Review* (EMM 2020x) conducted as part of the ARRC application recommended a number of mitigation measures which would likely be incorporated in the management of infilling activities.

4.2.3 Rehabilitation audits

DITRDC note the Proponent wishes to remove the requirements under Condition 35 of the existing approval, whereby audits must be carried out annually by a qualified rehabilitation consultant. We would prefer rehabilitation monitoring to be maintained to ensure that rehabilitation efforts occur during active operations and close-out operations of the quarry. This is to avoid any impact on the National Airports Safeguarding Framework (NASF) principles and airport certification process, prior to Airport operations commencing in 2026. In particular, landfill material may generate landfill gas, and management of any gas (eg flaring) would need to be continually monitored and assessed.

The proposed modification proposed the removal of Condition 35 as there will be limited opportunities to carry out progressive rehabilitation of the quarry during reactivation and ongoing quarrying operations. In response to DITRDC's concerns, the applicants propose, rather than remove this condition, that the requirement for annual rehabilitation audits be postponed, to 12 months following the completion of approved extraction activities.

The CDFS (Appendix E) for future infilling of the quarry notes that the wastes proposed as part of the infill material are general solid non-putrescible waste and, as such, not anticipated to produce significant amounts of landfill gas.

4.2.4 Traffic and transport

DITRDC supports the decision to remove all references to access, activities and potential impacts occurring on the Commonwealth land (Lot 1 DP 838361 now a part of Lot 101 DP 1236319) from consent as these now form part of the Airport Site and access to this land is no longer permitted. Regarding access arrangements, DITRDC note previous access to the quarry occurred through Commonwealth-owned land and that the Proponent has discussed an approach to assessing staged changes to the road network with the DPIE, TfNSW and Liverpool City Council. DITRDC recommend the Proponent liaise with the Airport operator (WSA) and the Department to agree a timeline and any changes to access arrangements that impact on the surrounding road network. This will ensure any potential impacts have been considered and managed or mitigated where appropriate.

This submission is noted. The MOD 5 *Traffic Impact Assessment* (EMM 2020e) has assessed the required changes to quarry access arrangements to use the subject property access off Adams Road. No changes or upgrades to the road network will be required with the exception of pavement work on Adams Road. WSA will be notified, prior to the start of road upgrade work on Adams Road.

4.3 DPIE Water and NRAR

4.3.1 Groundwater

i Water Access Licence

The proponent should obtain a Water Access Licence (WAL), post approval, for any groundwater inflows above 3 ML/year that do not fall under the WAL exemption detailed in the Water Management Regulation (General) 2018, Schedule 4, Clause 7.

Please note, if any groundwater inflows are used for the project consumption or supply the WAL exemption would not apply.

This submission is noted. As outlined in Section 3.4.2 the applicants have applied to NRAR for a zero share WAL. This zero share WAL was granted on 10 November 2020. The applicant has engaged a broker to secure sufficient entitlement on the open market.

ii Groundwater monitoring bore

DPIE Water notes that the groundwater monitoring bore BSM2 – one of three monitoring bores considered in prior approvals, had sustained damage and produced unrepresentative results during a prior monitoring round.

Accordingly, DPIE Water recommends that the proponent rehabilitates the damaged bore or construct an equivalent replacement monitoring bore for BSM2.

This submission is noted. The MOD5 Qualitative Groundwater Assessment (EMM 2020d) identified that the BSM2 bore, located to the east of the quarry adjacent to the internal road, was previously damaged resulting in unrepresentative groundwater quality results. This bore will be rehabilitated or replaced prior to the recommencement of groundwater monitoring following reactivation of the quarry.

4.4 Environment Protection Authority

4.4.1 Air quality

i Request for potential worst-case scenario

Assessment of a potential worst-case scenario accounting for proposed increase in daily activities has not been provided.

The AQIA includes a modelling scenario established on estimated emissions based on the maximum approved extraction rate of 300,000 tpa. However, this modelling scenario does not include potential impacts from the proposed maximum daily operations. For instance, based on the information provided in the emissions inventory, the assumed number of truck movements per day is approximately 80, which is not reflective of the proposed peak operations (ie 100 truck movements).

The inclusion of a modelling scenario based on maximum daily operations including expected peak truck movements is likely to result in higher project-related increments and potential additional predicted exceedances.

The EPA recommends the proponent revises the AQIA to include a worst-case scenario representative of expected maximum daily operations, including maximum peak daily truck movements.

MOD 5 does not propose to increase the extraction rate or daily quarrying activities. As outlined in Section 6.7.3 of the Modification Report, the Environmental Assessment report (Benbow Environmental 2014) prepared to support MOD 3, outlined approximately 40 trucks a day are approved to access the site. According to Condition 2 of the consent, the applicant is to carry out operations generally in accordance with the EIS and the subsequent environmental assessments supporting the respective proposed modification applications. Therefore, it is considered that approximately 40 trucks (80 movements) a day are currently approved. Given that some variation around the 80 movements daily would be expected, a maximum of 100 truck movements a day is considered to be generally in accordance with the current consent.

Notwithstanding, consideration has been given below to the estimated emissions based on peak truck movements of up to 100 trucks per day.

The proposed peak truck movements of up to 100 truck movements per day is relevant only to movements associated with the transfer of product. Relative to total on-site emissions, emissions produced from the truck movements relating to product transfer account for:

- 27% of total PM₁₀ emissions; and
- 25% of total PM_{2.5} emissions.

The emission inventory assumes product trucks carry 32 tonnes per load, therefore 9,375 loads are needed to move 300,000 tonnes per annum. Assuming 250 operational days a year, this equates to 75 truck movements per day. For a peak day scenario of 100 truck movements per day, PM₁₀ and PM_{2.5} emissions from product transport would increase by approximately 33% (from 75 to 100 movements) which represents an increase in total emissions of 8–9%.

Applying a 9% increase to the predicted 24-hour average PM₁₀ concentrations for each day of the year results in a maximum potential increase in 24-hour average PM₁₀ concentration of 0.9 µg/m³. This potential change for a peak day scenario is considered insignificant in the context of the impact assessment criterion and existing background (see Chapter 4 of the Air Quality Impact Assessment, Modification Report Appendix E).

With the addition of the background levels and the contribution from the construction of the WSA, this potential change for a peak day scenario predicts an additional day over the impact assessment criterion at R3 and R6. However, this cumulative scenario adds the maximum daily increment from the construction of the WSA (6.9 µg/m³ at Hubertus Club) to every day of the year¹. It is very unlikely that a peak day scenario for product transportation would correspond with the same day as the maximum increment from the WSA construction and on a day when background concentrations are already elevated. It is also noted that the maximum daily increment from the construction of the WSA (6.9 µg/m³) is for bulk earthworks. The construction schedule for the WSA indicates that 'early earthworks' is already completed, with the next phase of bulk earthworks completed by Q3 2021 and the final phase completed by Q3 2022. From Q3 2022 onwards, the construction would focus on airport infrastructure and the predicted maximum daily increment is significantly less (3.7 µg/m³) at the Hubertus Club. If the predicted maximum daily increment of 3.7 µg/m³ is added to every day of the year, there would be no exceedances for a peak day scenario.

Applying a 9% increase to the predicted 24-hour average PM_{2.5} concentrations for each day of the year results in a maximum potential increase in 24-hour average PM_{2.5} concentration of 0.2 µg/m³. This potential change for a peak day scenario is considered insignificant in the context of the impact assessment criterion and existing background. With the addition of background and the contribution from the construction of the WSA, this potential change for a peak day scenario would not result in additional days over the impact assessment criterion.

ii Reasonable and feasible emission controls

It is unclear if all reasonable and feasible emission controls are being implemented.

Results exhibited in the AQIA do not predict any additional exceedances. However, it should be noted that the cumulative results at the closest receptors are equal or close to the EPA's 24-hour and annual impact assessment criteria.

Whilst no additional exceedances are predicted, modelling results of a worst-case scenario based on the proposed maximum daily truck movements could result in higher project-related increments and additional predicted exceedances.

The EPA recommends the proponent nominates and commits to implementing all feasible and reasonable emissions controls, including benchmarking mitigation measures against best-practice. This includes consideration of the assessment results, accounting for expected peak daily operations.

The applicants commit to implementing best practice dust management at the quarry site as documented in Section 7 of the AQIA, all reasonable and feasible emission controls will be implemented at the site, including:

- a water cart will operate on the internal unsealed haulage routes as required;
- the access road between Adams road and the weighbridge will be sealed;
- drop heights will be minimised when loading trucks;
- watering will be applied to the crushing plant as required to minimise dust emissions;
- double handling of material will be avoided where possible;
- site-wide vehicle speed limits will be applied;

¹ Only the maximum 24-hour average PM₁₀ concentrations was reported in the WSA EIS

- disturbance of stabilised ground cover will be avoided where possible; and
- meteorological forecasts will be used to predict when the risk of dust emissions are high (due to adverse wind conditions) and preparatory measures will be implemented, including:
 - watering surfaces so they are moist prior to hot and windy conditions;
 - planning additional water spraying during the day;
 - ceasing some activities or reducing activity levels; and
 - re-scheduling product dispatch.

The controls listed above are consistent with best practice dust management for the extractive industry. The response in Section 4.3.1(i) above has demonstrated that additional exceedances are unlikely for a peak day scenario of product haulage. Notwithstanding, additional controls can be achieved for product hauling by increasing the water application rate. The modelling presented in the AQIA assumes a control efficiency of 75%, based on control using 'Level 2 watering' defined as >2 litres per m² per hour in the NPI Emission Estimation Technique Manual for Mining. This application rate is not an upper limit and is calculated from the equation provided in (Buonicore and Davis 1992), as follows:

$$C = 100 - \frac{0.8pdt}{i}$$

Where:

- C** = average control efficiency (%);
- p** = potential average hourly daytime evaporation rate, millimetres per hour (mm/hr);
- d** = average hourly daytime traffic (h-1);
- i** = application intensity (litres per square metre); and
- t** = time between applications.

The 75% control for Level 2 watering, although universally applied, is based on arbitrary input data, including an assumption of high summertime evaporation (2 mm/hr) and 30 truck movements per hour. Using the same assumptions but reducing the truck movements per hour down to 10 (for the quarry peak hour), the control efficiency achieved using the same application rate would be greater than 90%. The achievement of higher levels of control from watering is supported in the AP-42 Emission Factors in Section 13.2.2, Unpaved Roads, of US EPA (2006) which plots the relationship between watering control efficiency and moisture ratio (defined as the ratio of moisture content for watered and unwatered roads). This relationship is shown in Figure 4.2, demonstrating that greater than 75% control can be achieved if the moisture ratio is increased above 3.

In summary, dust controls at the quarry site can be increased for peak day scenarios as required. A comprehensive air quality management plan will be developed which will document the applicants commitment to best practice dust management and outline key performance indicators used to measure the effectiveness of these controls.

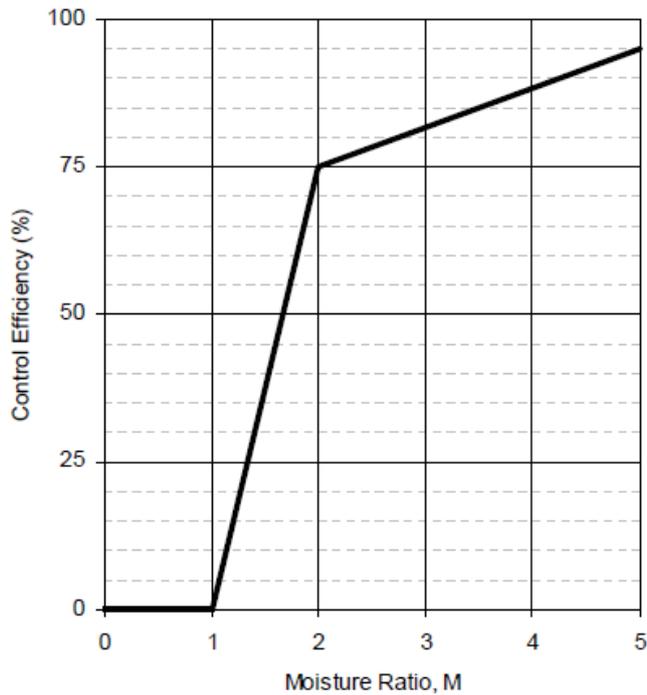


Figure 4.2 Watering control effectiveness for unpaved travel surfaces (US EPA 1985)

iii Cumulative impacts from future operations

Cumulative impacts from future operations at the premises have not been included.

The EPA is aware that the proponents are seeking a staged approach to the development of the premises at 275 Adams Road Luddenham. Since operations for both stages (Stage 1 and Stage 2) will occur concurrently and will take place within the same premises, the assessment should include an assessment of potential cumulative impacts from the two operations.

The EPA recommends the AQIA is revised to include the potential cumulative impacts from the concurrent operation of the proposed quarry and the ARRC.

The reactivation of the quarry is independent of approval of the ARRC and therefore should be considered independently of the ARRC. However, the cumulative impacts associated with MOD 5 and the operation of the ARRC are considered in the air quality impact assessment prepared for the ARRC which the EPA has reviewed and provided comment. This approach has been discussed with DPIE resource assessments team and confirmed as appropriate.

In accordance with the existing consent, the quarry will cease extraction in December 2024. It is noted that, if approved, the ARRC will be constructed and in the early stages of operations during the time that quarry extraction and ARRC operations will occur concurrently. The ARRC will increase throughput progressively as the development of the Western Sydney Aerotropolis progresses and the demand for C&D resource recovery and recycled product increases and therefore peak operations of the ARRC will not occur concurrently with the quarry.

Infilling of the quarry void and final rehabilitation will be subject to a separate application. Cumulative impacts of the ARRC and infilling activities will be modelled in the technical assessments that will be prepared to support this future application.

4.4.2 Noise and vibration

i Predicted operational noise levels

Whilst the EPA considers the proponent has appropriately assessed the noise impacts of the proposal, the EPA provides the following comments regarding negotiated agreements.

The predicted operational noise levels in Table 5.1 of the NVIA are higher, and in some cases significantly so, than the Project Noise Trigger Levels (PNTLs) derived in Table 3.3 at receivers R3-R6. These predicted noise levels at receiver R3-R6 are above those which EPA would normally allow under an EPL. As existing noise mitigation measures (noise bunds) are already in place, the proponent proposed to enter into negotiated agreements with the affected landholders in accordance with the procedures in the Government's Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum and Extractive Industry Developments (VLAMP – NSW Government, 2018) to address residual noise impacts.

- (a) The EPA recommends that DPIE should only consider approval of the proposal if negotiated agreements are in place. Accordingly, DPIE should also include a condition in any approval for the proposal, if granted, that the proponent must provide evidence of an agreement having been reached with each of the landowners identified in the NVIA as experiencing noise emissions more than 2 dB(A) above the PNTLs.
- (b) If these agreements can be reached, the EPA also recommends adopting a daytime LAeq(15 minute) operational noise criterion of 42 dBA at receiver R7, noise limits at other sensitive locations will not be required as they are further away from the project site.

The EPA notes that the future land uses, the noise environment, in the area surrounding the proposal may change as a result of the development of the Western Sydney Airport and Western Sydney Aerotropolis. Any land rezoning which may occur as a result of these developments may also result in changes to the noise criteria applicable to sensitive receiver locations identified in the NVIA. This may in turn mean that the terms of the negotiated agreements referred to above may change, or that they may no longer be required. The EPA recommends DPIE and the proponent should keep these matters under review and make any revisions as necessary.

The Aerotropolis SEPP commenced on 1 October 2020. This rezoned the subject property and surrounding land holdings. Land holdings, including the subject property, between the Western Sydney Airport site and Elizabeth Drive to the north and to the west (to The Northern Road) has been zoned Agribusiness with areas along waterways zoned Environment and Recreation. The land zoning map of the Aerotropolis SEPP is shown Figure 4.1.

Accordingly, all receivers identified in the MOD 5 *Noise and Vibration Impact Assessment* (NVIA) (EMM 2020b) have now been rezoned Agribusiness. The key objectives of the Agribusiness zone are to encourage diversity in agribusiness, including related supply chain industries and food production and processing that are appropriate for the area and to encourage sustainable and high technology agribusiness, including agricultural produce industries (ie commercial/industrial land use). It is also noted, that under the new Agribusiness zoning, development of new residential accommodation is a prohibited.

The NVIA for MOD 5, prepared prior to the commencement of the Aerotropolis SEPP, discussed the imminent rezoning. As foreseen in the NVIA, the residual residences surrounding the subject project are now considered isolated residences in a commercial/industrial zone as per the *Noise Policy For Industry* (NPfI) (EPA 2017) definition based on the objectives of the Agribusiness zone. Accordingly, they have been assessed against the relevant amenity criteria of LAeq, 15min 68 dB as discussed in the NVIA – reflecting the SEPPs vision for this zone. This criterion will be met at all residences and therefore the mechanisms described in the VLAMP, such as negotiated agreements, will not be required.

ii Construction noise

The NVIA predicts significant construction noise impacts at receivers R3 and R6, of 16 dB and 15 dB above the relevant noise management levels. The EPA recommends that all construction activities be carried out during the recommended standard hours in the EPA's Interim Construction Noise Guideline, and that all feasible and reasonable noise mitigation and management measures be implemented to minimise construction noise impacts at sensitive receivers.

As outlined in the MOD 5 NVIA, construction works will be of short duration (estimated to be 4–6 weeks), with the noisiest works (construction of the access road) occurring over approximately 4 weeks. Construction works will be conducted during standard construction hours only.

The MOD 5 NVIA and Modification Report committed to noise monitoring during the initial stages of construction to determine if actual construction noise levels are above NMLs. If this occurs, the applicant will implement the following recommendations from the Interim Construction Noise Guideline (ICNG) (DECC 2009) to manage construction noise:

- application of feasible and reasonable work practices to minimise noise;
- inform potentially impacted residents of the nature of the works to be carried out, expected noise levels and duration and relevant contact details; and
- negotiation with the neighbours where noise from work outside standard hours is predicted to exceed the relevant NML by more than 5 dB.

These measures are widely applied as many construction sites throughout Sydney are close to residences.

4.4.3 Surface water

i Management and disposal of saline water from quarry pit and water management dam

Satellite images of the site shown existing water in the quarry pit and water management dam. Details about the existing stored water are not provided in the SWA but it is likely that the water has collected from previous operations, rainfall and the continued ingress of groundwater. The EPA notes that the electrical conductivity (salinity) of the water in the quarry pit was 45,900 $\mu\text{S}/\text{cm}$ when it was last sampled in 2018 and has been increasing in salinity since it was first sampled in 2017. Similarly, the water management dam monitoring results from 2015-2018 shown an increasing trend in salinity with the electrical conductivity of the water being 14,700 $\mu\text{S}/\text{cm}$ in 2018.

The increasing salinity of the water in the quarry pit and water management dam is likely to be a result of ongoing evaporation and concentration of dissolved solids. The continued seepage of groundwater into the quarry pit (5 kL/day) contributes further dissolved solids to the stored water.

By comparison, the salinity of Upper South Creek close to the confluence with Cosgrove Creek is less than 2,000 $\mu\text{S}/\text{cm}$ (Western Sydney Airport EIS, 2016) which is typical of a freshwater environment and consistent with default trigger values for salinity in low land rivers (ANZG 2018). If the stored water from the quarry pit or water management dam is discharged to the environment it is likely to cause non-trivial hard to the waterways, including potentially toxic effects on freshwater macroinvertebrates.

The proponent does not address the management of the existing saline water stored in the quarry pit and water management dam. There is no assessment of the volume of water currently stored on site and how that impacts on the water balance and quality of any proposed operational discharges. The proponent must detail how they are going to appropriately dispose of the existing saline water in the quarry pit and water management dam before commencing quarry operations.

The EPA recommends the proponent obtains contemporary water quality data for the existing water stored in the quarry pit and water management dam including but not limited to physical and chemical stressors (DO, EC, pH, dissolved solids, total suspended solids), major ions, nutrients and dissolved metals to inform the appropriate disposal of the water prior to commencing quarry operations. The proponent must provide details of how they will appropriately dispose of the existing stored water.

a Existing water quality

EMM collected samples from Oakey Creek, the Water Management Dam and the quarry pit on 13 October 2020, during dry weather conditions. Monitoring analytes and analysis methods from the sampling event are presented in Table 4.3 and sample results presented in Table 4.4 with reference to the ANZG (2018) default guideline values (DGVs). As outlined in Table 4.4, results for electrical conductivity (EC) in both the quarry pit and the Water Management Dam, while elevated above the DGV, were an order of magnitude lower than the EC results from 2018 referred to in EPA's submission.

Table 4.3 Analysis methods and parameters

Category	Sampling analytes	Analysis method
Physio-chemical properties	pH, electrical conductivity, turbidity, total suspended solids, total dissolved solids	Analysis undertaken by a NATA certified laboratory
Nutrients	total nitrogen, ammonia, oxidised nitrogen and total kjeldahl nitrogen, total phosphorus, and reactive phosphorus	
Metals (dissolved)	Al, As, Cr (total), Cd, Cu, Fe, Mn, Ni, Pb and Zn	

Table 4.4 Water quality results (October 2020)

	Units	LOR	DGV	Oaky Creek (upstream of site)	Oaky Creek (downstream of site)	Oaky Creek (online storage adjacent site)	Water Management Dam	Quarry Pit
General water quality								
pH	-	0.01	6.5-8.5	7.85	7.84	7.82	8.42	8.65
Electrical Conductivity	µS/cm	1	125-2,200	851	764	782	1,550	5,970
Total Dissolved Solids	mg/L	10	-	463	388	398	780	3,290
Total Suspended Solids	mg/L	5	-	<5	50	16	6	13
Turbidity	NTU	0.1	6-50	12.6	19.7	6.4	4.3	3.1
Total Hardness as CaCO ₃	mg/L	1	-	148	98	119	185	604
Nutrients								
Ammonia	mg/L	0.01	0.02	0.03	<0.01	<0.01	0.01	0.01
Oxidised Nitrogen	mg/L	0.01	0.04	<0.01	0.07	0.04	<0.01	6.51
Total Kjeldahl Nitrogen	mg/L	0.1	-	0.4	0.2	0.2	1	1.4
Nitrite	mg/L	0.01	-	<0.01	0.07	0.04	<0.01	6.38
Nitrate	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	0.13
Total Nitrogen	mg/L	0.1	0.5	0.4	0.3	0.2	1	7.9
Reactive Phosphorus	mg/L	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Total Phosphorus	mg/L	0.01	0.05	0.01	0.01	0.01	0.03	<0.01
Dissolved Metals								
Aluminium	mg/L	0.01	0.055	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	mg/L	0.001	0.013	<0.001	<0.001	0.001	<0.001	<0.001

Table 4.4 **Water quality results (October 2020)**

	Units	LOR	DGV	Oaky Creek (upstream of site)	Oaky Creek (downstream of site)	Oaky Creek (online storage adjacent site)	Water Management Dam	Quarry Pit
Cadmium	mg/L	0.0002	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.0014	0.0014	0.001	<0.001	<0.001	0.002	0.002
Lead	mg/L	0.0034	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	1.9	0.027	0.144	0.026	0.002	0.002
Nickel	mg/L	0.011	0.011	<0.001	<0.001	<0.001	0.001	0.003
Zinc	mg/L	0.008	0.008	0.026	<0.005	<0.005	<0.005	<0.005
Boron	mg/L	0.05	0.370	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	mg/L	0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05

b Management of quarry water

CPG and KLF are in discussions with construction contractors working on the WSA site regarding arrangements to transfer the existing water in the quarry pit to these contractors for use in construction dust suppression for the extensive earthworks currently underway on the WSA site.

Water would be pumped to a dam or spigot within the WSA site. The hose would cross the shared boundary between the WSA site and the subject property. This will avoid the need for the contractors' water carts to use the public road network.

ii On-site water management and water balance

The water balance indicates that potable water is required to supplement water available from the water management dam for dust suppression even during a wet year, while 28.2 ML overflows to Oaky Creek. During a median rainfall year, the water management dam is predicted to overflow approximately 8 times discharging a total of 4.4 ML of water to Oaky Creek. The proponent is proposing that this discharge is licensed under the Protection of the Environment Operations Act 1997.

In exercising its licensing functions, the EPA must consider the practical measures that could be taken to prevent, control, abate or mitigate pollution. Discharge of polluted water should generally only be considered after other options have been shown to not be viable or to deliver less satisfactory environmental outcomes overall.

The water management dam drains a small catchment and receives pumped water from the quarry pit. Water must be pumped from the pit to allow quarrying operations to occur. The water management basin, while sized consistent with Managing Urban Stormwater Volume 2E Mines and Quarries (DECC, 2008) for the small catchment it collects runoff from, does not have enough capacity to avoid or minimise discharges following transfers from the quarry pit. The basin capacity should be re-assessed considering the frequency and volume of transfers from the quarry pit.

The quarry pit itself is used as a sediment basin for the purposes of sediment control and it captures run off from the disturbed areas of the quarry. It is sized appropriately for its catchment consistent with Managing Urban Stormwater Volume 2E Mines and Quarries (DECC, 2008).

Inadequate details are provided on the pumping arrangements to transfer water from the quarry pit. This includes the operational protocols and whether the pump intake has been situated to avoid resuspending sediment that has settled in the pit.

It is noted that the previous quarry operator used a second, smaller sediment dam as part of the site's water management system in addition to the water management basin.

The EPA recommends the proponent

- (a) considers options for increasing onsite storage capacity in areas outside the quarry pit to support increased reuse, reduce potable water use and avoid or minimise discharges;
- (b) provides an updated water balance to account for any increases in storage;
- (c) demonstrates that the water management dam sizing is consistent with Managing Urban Stormwater Volume 2E Mines and Quarries (DECC, 2008) when transfers from the quarry pit are included in the volume of water that is collected in the dam;
- (d) demonstrate that transferred water is adequately retained in the water management basin to control sediment pollution in accordance with Managing Urban Stormwater Volume 2E Mines and Quarries (DECC, 2008).

a Onsite storage capacity

In response to EPA's submission, further work has been carried out to refine the modified quarry water management system. This confirmed that by increasing the depth of the Water Management Dam, while retaining the existing footprint, the dam can accommodate 7 ML of water.

Accordingly, prior to the recommencement of quarry operations, the Water Management Dam will be increased in depth to provide a minimum capacity of 7 ML, which is greater than the minimum design volume of 6.6 ML calculated using the methods specified in *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom) and *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries* (DECC 2008) (refer Section 4.5 of the surface water assessment). It is noted maintenance work on this Water Management Dam is approved under the existing quarry consent and will not impact on adjacent native vegetation.

In addition, it is proposed to store some water in the pit during and following high rainfall to prevent the discharge of turbid water.

b **Water balance model revision**

The site water balance model was revised to include the following:

- an increase in Water Management Dam size to 7 ML;
- supply of water for quarry dust suppression activities from the quarry pit to supplement the supply from the Water Management Dam; and
- changes to the pumping rules from the quarry pit to the Water Management Dam to maintain a minimum of 1.5 ML in the dam (equivalent to the minimum design volume required for the Water Management Dam and the sediment zone volume for the quarry pit determined in Section 4.5 of the MOD 5 *Surface Water Assessment* (EMM 2020c)).

The distribution of water across the site, estimated by the revised water balance model for typical dry (10th percentile), median (50th percentile) and wet (90th percentile) rainfall years, is presented in Figure 4.3, Figure 4.4 and Figure 4.5 respectively.

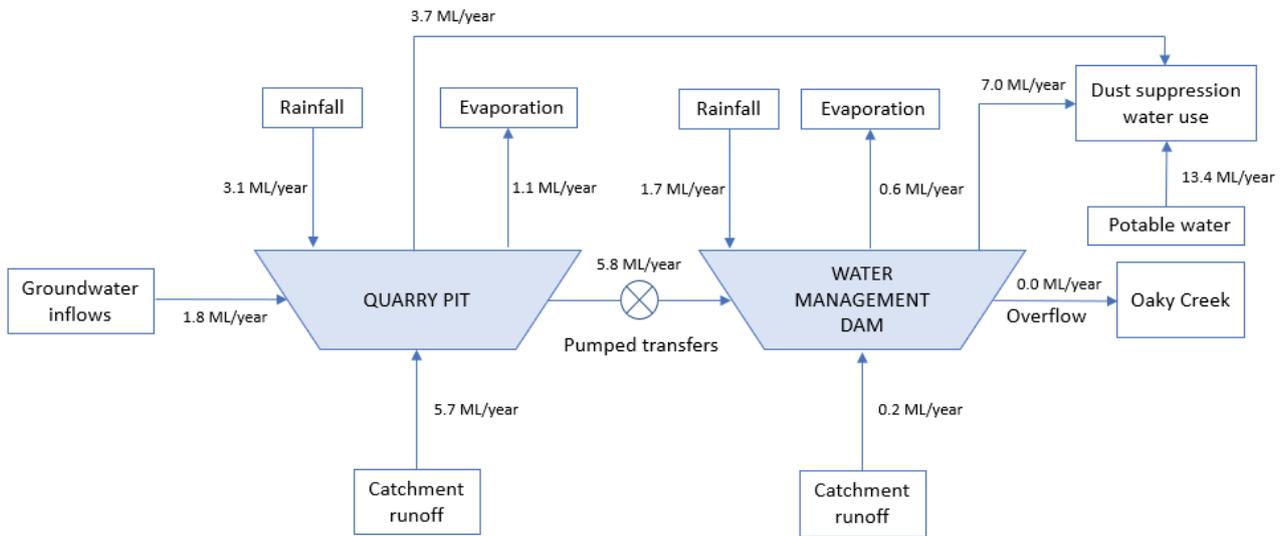


Figure 4.3 Revised water balance results – typical dry rainfall year

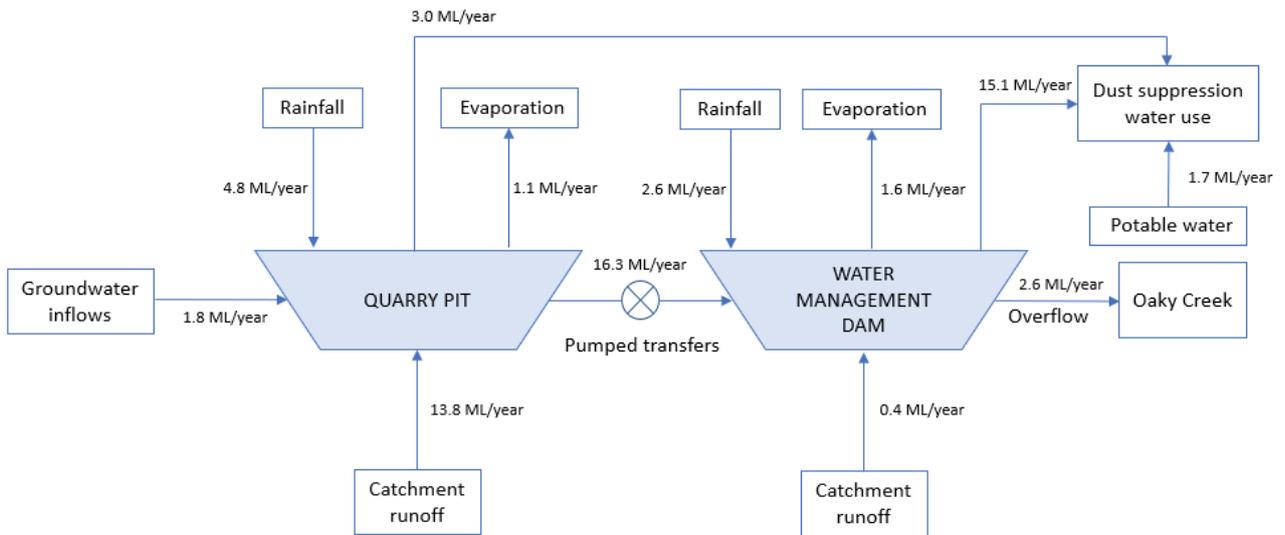


Figure 4.4 Revised water balance results typical median rainfall year

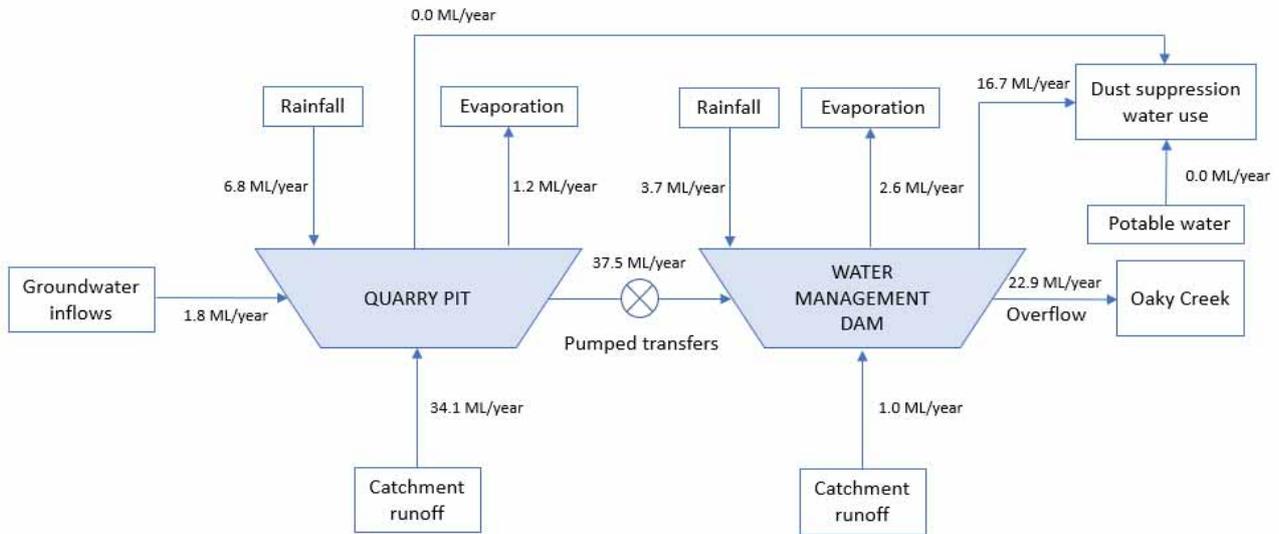


Figure 4.5 Revised water balance results – typical wet rainfall year

Table 4.5 provides a summary of the overall inputs and outputs of the water management system for a typical dry (10th percentile), median (50th percentile) and wet (90th percentile) rainfall year.

Table 4.5 Summary of revised annual water balance results

	Dry (10th percentile) rainfall year	Median (50th percentile) rainfall year	Wet (90th percentile) rainfall year
	ML/year	ML/year	ML/year
INPUTS			
Rainfall and runoff	10.7	21.6	45.6
Groundwater inflows into quarry pit	1.8	1.8	1.8
Potable water supply	13.4	1.7	0.0
Total inputs	25.9	25.1	47.4
OUTPUTS			
Evaporation	1.7	2.7	3.8
Dust suppression	24.1	19.8	16.7
Discharge to Oaky Creek	0.0	2.6	22.9
Total outputs	25.8	25.1	43.4

The revised water balance results indicate that over 91% of the demand for dust suppression can be supplied by harvested catchment runoff under median (50th percentile) rainfall conditions. The additional use of water captured in the quarry pit and Water Management Dam to supply dust suppression activities (as modelled in the revised water balance) will further minimise the demand from potable water supply. Potable water supply for dust suppression was modelled to occur when the supply from the Water Management Dam and quarry pit was depleted and was not modelled to occur at the same time as discharges to Oaky Creek.

c Water discharge

Discharges to Oaky Creek will occur via the Water Management Dam spillway when the Water Management Dam is full. Figure 4.6 presents overflow statistics over the 131 historical rainfall record modelled by the revised water balance. For clarity, the discharge is shown on a logarithmic axis and the values of 0 ML/day are not plotted.

Overflows of the Water Management Dam are predicted to occur on less than 3% of days. Overflows will typically occur intermittently over several days during wet weather periods when there are several days of material rainfall. On average, overflow events will occur two times per year, which is consistent with the requirements of *Managing Urban Stormwater Volume 2E Mines and Quarries* (DECC 2008). Overflows are expected to cease shortly after the wet weather conditions end and runoff subsides. Importantly, overflows are only expected to occur when streamflow in receiving watercourses is naturally elevated.

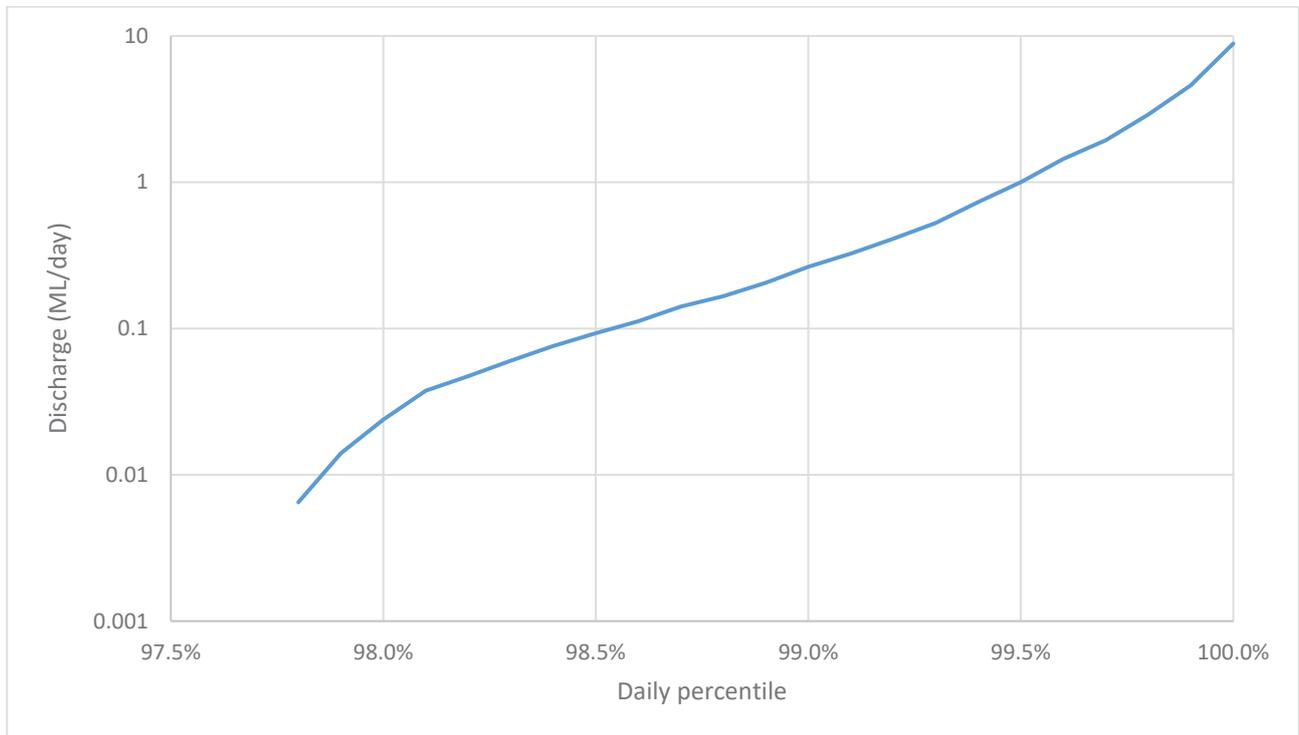


Figure 4.6 Modelled daily discharges

The water quality data for the sediment ponds, discharge point and receiving environment used in the SWA were collected by the previous licensee and there's uncertainty about the sampling method and flow within Oaky Creek at the time of sampling. The data provides an indication of water quality during previous operations but cannot be used to consider the impact of discharges on the environmental values of the receiving waters.

The data indicates that the water discharged from the sediment pond is likely to exceed ANZECC (2000) guidelines for salinity and the ANZG (2018) default guideline value for copper. The SWA concludes that the water quality of the discharges from the water management dam is expected to have similar characteristics to the water quality within the creek upstream of the site. This conclusion appears to be based on pH and TSS and does not consider electrical conductivity (salinity) or potential metals.

The EPA understands that it is likely the EPA will receive an application for a new EPL for extractive activities at the site. It should be noted that if discharges cannot be avoided, the proposed discharge point cannot be considered for licensing until a water pollution impact assessment is completed with appropriate, contemporary data. The EPA notes that the proponent will update the water management plan for the site to address licence requirements and consent conditions.

The EPA notes the water quality data for the sediment ponds, discharge point and receiving environment used in the SWA were collected from previous licensee and there's uncertainty about the sampling method and flow within Oaky Creek at the time of sampling. This data cannot be used to consider the impact of future discharges, and the data indicates that the water discharged from the sediment pond is likely to exceed ANZECC (2000) guidelines for salinity and the ANZG (2018) default guideline values for copper.

The EPA recommends the proponent:

(a) prepare a revised discharge characterisation and water pollution impact assessment if discharges cannot be avoided. This assessment should be consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) and NSW Government policy regarding the NSW WQOs and should include:

- a characterisation of the quality of the proposed discharges in terms of the concentrations and loads of all pollutants present at non-trivial levels, under typical and worst-case conditions – this should be based on new monitoring data;
- describe the nature and degree of impact that any proposed discharges will have on the receiving environment;
- an assessment of the impact of discharges on the environmental values of the receiving waterways with reference to the relevant guideline values for slightly to moderately disturbed ecosystems. Demonstrate how the proposal will be designed and operated to:
 - protect the NSW Water Quality Objectives for receiving waters where they are currently being achieved; and
 - contribute towards achievement of the NSW Water Quality Objectives over the time where they are not currently being achieved;
- details of practical measures proposed to address any residual impacts.

As outlined in Section 4.4.3 (i) above, water quality sampling was carried out to characterise the existing quality of the Water Management Dam and Oaky Creek. The results shown in Table 4.4 indicate that EC within the Water Management Dam was 1,550 $\mu\text{S}/\text{cm}$ within the DGV range (although slightly elevated compared to Oaky Creek – with results ranging from 764 $\mu\text{S}/\text{cm}$ to 851 $\mu\text{S}/\text{cm}$ and copper concentrations slightly elevated (0.002 mg/L) compared to the DGV).

The water balance was revised to increase site storage and operating rules to a practicable level (refer Section 4.4.3 (ii)). As shown by the revised water balance, the modifications to the quarry water management system will reduce the predicted overflows from the site from a total annual volume of 4.4 ML/year predicted in the MOD 5 Surface Water Assessment to 2.6 ML/year in a median year (Table 4.5).

An oil and water separator and sediment trap will be installed immediately upstream of the Water Management Dam. The use of in pit storage to store water in excess of the capacity of the Water Management Dam will allow additional time water treatment time and increase the removal of suspended solids by sedimentation.

A discharge characterisation assessment will be undertaken post-approval (within 12 months of commencement of operations - providing discharges occur). This will allow more monitoring data to be collected during the initial operation of the quarry to help inform ongoing water management at the quarry site. The discharge characterisation assessment will address the matters recommended by the EPA.

As outlined in Chapter 7 of the MOD 5 Surface Water Assessment, the water management plan for the site will be updated, in consultation with the EPA, to include the new water management strategy for the quarry following approval of the proposed modification.

4.4.4 Groundwater impacts during infilling of quarry void

The management and potential discharge of the intercepted groundwater will need to be considered in the Stage 2 development proposal (filling of the void), including (but not limited to) installation of an appropriate liner for the quarry pit and assessing the potential interaction for the filled void with groundwater. The EPA understands that SEARS are currently being prepared for the Stage 2 development proposal.

As noted, infilling of the quarry void will be subject to a separate modification application. This application will assess the potential impacts of the infilling activities on groundwater.

Notwithstanding, the applicants have commissioned a concept design and filling strategy (CDFS) that outlines the measures that will be incorporated into the infilling design. The CDFS is provided in Appendix E.

The CDFS includes the installation of an appropriate liner and a leachate collection system to mitigate risks on groundwater. The CDFS notes that Bringelly/shale (ie the quarry product) has been proven to be suitable for lining at nearby waste centres, subject to meeting design, construction and testing requirements.

4.4.5 Staging of the development

It is not clear when the proponent will seek consent to fill the quarry void with waste and prepare the void for the repurpose, as outlined in the Stage 3 of the planned development of the site (ie developing the rehabilitation quarry site into a sustainable and high-tech agribusiness hub supporting food production, processing, freight transport, warehousing, and distribution, whilst continuing to invest in the resource recovery research and development (R&D) initiatives.)

The EPA assumes that this will not occur under Stage 1 of the development and has therefore not commented on these works in relation to Mod 5. The EPA recommends the proponent make it abundantly clear which stage of the overall intended development that they intend to seek approval to fill the quarry void with waste and prepare the void for that purpose.

Infilling of the quarry void and preparing the quarry site for future agribusiness land use will be subject to a separate modification application of the quarry consent. Pending approval of this future modification application, infilling activities will commence following completion of extraction in December 2024.

It is noted that the infilling of the void with non-recyclable residues represents a commercially viable method of site rehabilitation. The rate of filling is unknown at this stage and will be dependent on market forces and the demand for resource recovery as the Aerotropolis develops. It is anticipated, however that the void could take in the order of 15 years to fill subject to market conditions.

4.5 Transport for NSW

4.5.1 Elizabeth/Adams Road intersection upgrade

TfNSW requests the intersection of Elizabeth Drive and Adams Road intersection to be upgraded with right turn treatment to be provided. A concept design plan is to be submitted for approval to TfNSW and should be in accordance with Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections, TfNSW Supplement to Austroads Guide to Road Design and to Australian Standards.

The MOD 5 *Traffic Impact Assessment (TIA)* (EMM 2020e) assessed a peak of 100 daily truck movements between 7.00 am to 6.00 pm equating to 10 movements in the peak hours. These trucks will be accessing and exiting the site via the northern section of Adams Road between the site access road and Elizabeth Drive.

The requirement for a dedicated right turning lane (eg basic, auxiliary lane and channelised) on Elizabeth Drive has been assessed in accordance with the Austroads intersection design standards *Guide to Traffic Management Part 4, Intersections Interchanges and Crossings Management* based on the peak hourly through and turning traffic movements at the intersection. The Austroads warrant design chart for rural intersection turning lanes for a design speed between 70 km/h and 100 km/h is shown in Figure 4.7, where:

- curve 1 (red line) represents the boundary between a basic right turn (BAR) and a channelised short right turn (CHR(S)) turn treatment and between a basic left turn (BAL) and an auxiliary short left turn (AUL(S)) turn treatment; and
- curve 2 (blue line) represents the boundary between a CHR(S) and a full length CHR treatment and between an AUL(S) and a full length AUL or CHL treatment. The choice of CHL over an AUL will depend on factors such as the need to change the give way rule in favour of other manoeuvres at the intersection and the need to define the more appropriate driving path by reducing the area of bitumen surfacing.

If a particular turn from a major road is associated with some geometric minima (for example, limited sight distance, steep grade), consideration should be given to the adoption of a turn treatment of a higher order than that indicated by the warrants. For example, if the warrants indicate that a BAR turn treatment is acceptable for the relevant traffic volumes, but limited visibility to the right-turning vehicle is available, consideration should be given to the adoption of a CHR(S) or CHR turn treatment instead. Another example is a major road on a short steep downgrade where numerous heavy vehicles travel quickly down the grade, in which case it would not be appropriate to adopt a BAL turn treatment. Instead, an AUL(S) or an AUL would be a preferred treatment.

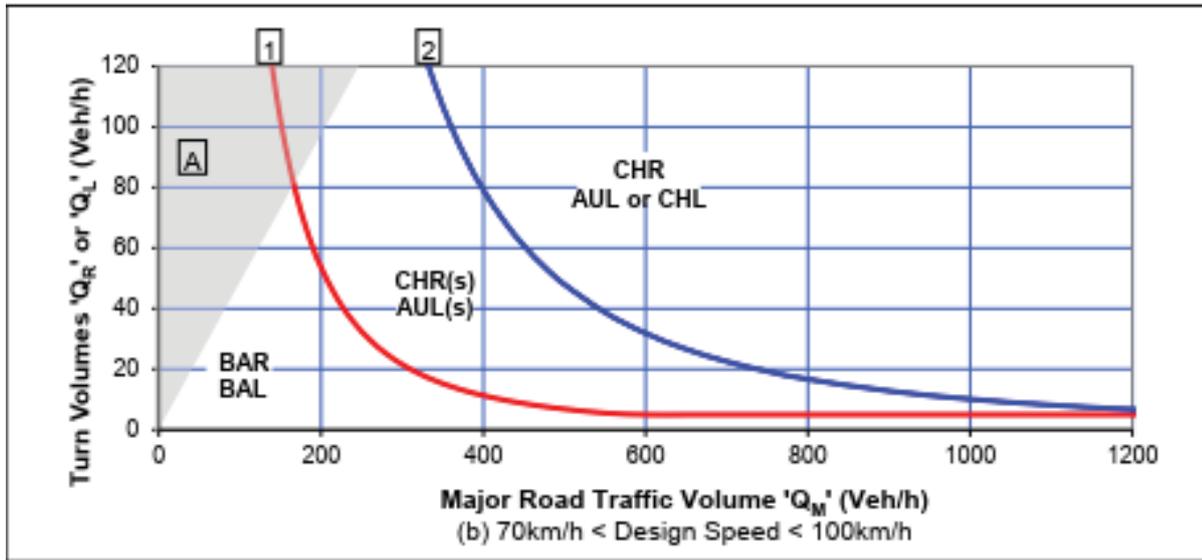


Figure 4.7 Austroads warrant design charts for rural intersection turning lanes

The requirement for additional right turn traffic lane for a design speed lower than 100 km/h is read from Figure 4.7. Elizabeth Drive has a posted speed limit of 80 km/h, which indicates a design speed limit of 90 km/h. The right turn requirement for the baseline traffic is shown in Table 4.6. The traffic volumes have been extracted from the MOD 5 TIA.

Table 4.6 Right turn warrant assessment into Adams Road from Elizabeth Drive (without development traffic)

Year	Peak	Major road traffic volume	Turn volume	Required turn treatment
2020	AM	1,046	59	CHR
	PM	1,251	115	CHR
2024	AM	1,082	72	CHR
	PM	1,129	149	CHR

The right turn warrant assessment (Table 4.6) indicates that a CHR treatment is currently required (without development traffic). In accordance with Austroads (2017a) *Guide to Road Design (Part 4A)*, a total of a 151-m-long right turn lane (95 m deceleration lane, 30 m taper and 26 m storage) would be required. This would extend most of the way to the Elizabeth Drive/Luddenham Road intersection.

However, it is not proposed to construct a dedicated right turn bay on Elizabeth Drive for the eastbound traffic as part of MOD 5 for the following reasons:

- During 2024, the forecast baseline traffic at this intersection will be 1,282 during the AM peak and 1,669 during the PM peak respectively of which only 10 movements in each peak period will be quarry-related.
- As noted in Section 2.5 of the MOD 5 TIA, there have been only two minor (non-casualty) crashes at Elizabeth Drive/Adams Road intersection for the last five years for which data are available (2014 to 2018). This does not represent a significant safety issue at this intersection considering the intersection currently carries 1,249 vehicles during the AM peak and 1,455 vehicles during the PM peak.

- A dedicated right turn bay is not feasible at this location due to the existing creek and the bridge over Cosgroves Creek on Elizabeth Drive, about 30 m west of the Adams Road intersection. The bridge would need to be widened at significant cost to accommodate a right turn bay in accordance with Austroads requirements. Upgrading the major road infrastructure as part of MOD 5 approval is not financially viable for MOD5 given that extraction will cease in 2024.
- It is noted that NSW government funding has recently been granted to design a realignment of Adams Road and Luddenham Road. The potential future corridor for the realignment is indicated in the Aerotropolis SEPP mapping. This future upgrade is expected to bypass the northern section of the current Adams Road and the existing Elizabeth Drive / Adams Road intersection.

4.5.2 Sight distance

TfNSW has reviewed the submitted information and has concerns regarding the limited sight line for eastbound traffic on Elizabeth Drive and inability to stop behind a truck waiting to turn right onto Adams Road.

In accordance with *Austroads Guide to Road Design Part 3 (Geometric Design)* (Austroads 2016), the minimum stopping sight distance (SSD) providing for a general minimum 2 second driver reaction time on an 80 km/h road is 131 m for trucks and 114 m for cars.

The sight distance for the eastbound traffic on Elizabeth Drive on approach to Adams Road meets the minimum requirement of 131 m, as stipulated in Austroads (2016).



Figure 4.8 Sight distance assessment for eastbound traffic on Elizabeth Drive

4.5.3 Swept paths

A swept path diagram demonstrating a B-double vehicle, which will access the site, able to manoeuvre at the intersection of Elizabeth Drive and Adams Road intersection without encroachment should be submitted to TfNSW for review.

It is proposed that quarry trucks associated with MOD5 are restricted to a maximum length of 19 m unless Adams Road and the Elizabeth Drive/Adams Road intersection are upgraded, either as part of the ongoing upgrades to the surrounding road network by TfNSW or LCC, as part of the development of the Aerotropolis or as part of the ARRC Project (if approved).

4.5.4 Summary

Given the above, the Elizabeth Drive/Adams Road intersection does not need to be upgraded as part of the MOD 5 application.

It is noted that the ARRC will generate significantly more traffic than MOD5 and it is proposed to upgrade the intersection as part of the ARRC project if it is approved.

4.6 Western Sydney Planning Partnership

4.6.1 Strategic planning context

i Precinct planning

Precinct Planning for the Agribusiness and Wianamatta-South Creek precincts is being undertaken by the Planning Partnership and proposed to be completed in late 2020. This application has not been able to benefit from the outcomes of this process.

The draft *Aerotropolis Precinct Plan* (WSPP 2020) and *Overview of the Agribusiness Precinct Plan* (2020) were released in November 2020. These plans do not address the existing quarry or how the site in its current configuration is to meet the long-term objectives for the Agribusiness zone. However while not the subject of the MOD5 application, it is noted that the built form of the ARRC (Stage 2 of site development) is closely aligned the envisaged surrounding buildings and the final landuses of the site (Stage 3 of site development), that will enabled by commercial extraction of the quarry and its rehabilitation through filling, will be directly compatible with the objectives for the Agribusiness zone.

ii Land uses compatible with the Aerotropolis

The Draft Western Sydney Aerotropolis Plan acknowledges the need to transition land uses in the Agribusiness precinct over time. The ending of quarry operations and remediation of the site, prior to the opening of the Airport, is consistent with this.

It is acknowledged in Section 2.4 of the draft Plan, land uses and urban forms will evolve as the Aerotropolis changes. Land uses, buildings and structures could change from short-to medium-term uses to longer-term advanced and creative industry uses.

Section 2.4 also acknowledges that new enabling industries such as building materials production, to facilitate construction of the Aerotropolis, may be permitted subject to interface mitigation treatments and an ability for the site to transition to higher order uses compatible with airport operations over time.

While this application only addresses the short-term use of the site until 2024, the long-term vision of the site within the report could meet the intent of this section of the draft Plan.

The site is located adjacent to WSA and is well setback from the existing Adams Road. No listed scenic or significant vistas near the quarry footprint have been identified. It is acknowledged the precinct will evolve over time and once the site is rehabilitated it could integrate with the remainder of the precinct.

The applicant agrees with these statements. Section 2.4 of the final Western Sydney Aerotropolis Plan (2020) (Aerotropolis Plan) retains the key theme of enabling industries transitioning to higher order uses over time. As outlined Section 3.3.1 of the Modification Report and summarised in Section 1.1 above, the continued operation of the quarry represents an existing “enabling” industry providing an economic basis on which the site can be developed to provide innovative resource recovery solutions in the medium to long-term, and long-term agribusiness land uses achieving the objectives of the Aerotropolis Plan to transition land use to a high-value job-creating uses that are compatible with future airport operations.

4.6.2 Aboriginal heritage

It is reported that the proposed modification is unlikely to harm Aboriginal objects. Nevertheless, the Aerotropolis is being planned with Connecting with Country in mind and should the modification be given consent all processes to mitigate loss of heritage should be met.

The applicant agrees with these statements. As is noted, no impacts to Aboriginal objects is predicted as a result of MOD5, in part as there will be very little additional ground disturbance.

The mitigation measures outlined in Section 6.11.5 of the Modification Report will be incorporated into the updated operational environmental management plan for quarry operations including:

- AHIMS site #45-5-2280 will continue to be avoided and protected by fencing;
- the riparian corridor along the western bank of Oaky Creek will continue to be avoided by quarrying activities; and
- the work will proceed with caution and the following actions will be taken in accordance with the Aboriginal Heritage Due Diligence report (EMM 2020j) recommendation that in the event that unexpected Aboriginal objects, sites or places are discovered, DPIE will be notified as soon as practicable after they are first identified.

4.7 Western Sydney Airport

4.7.1 Air quality

i Air quality modelling

The Air Quality modelling for the quarry does not consider the operation of the proposed ARRC which is a different approach to that taken for the air quality modelling for the proposed ARRC EIS. The ARRC EIS considered the scenario (scenario 1) of the concurrent operation of the quarry, ARRC and construction phase of WSA (although not bulk earthworks). In that scenario air quality exceedances were forecast.

As per the response to the EPA in Section 4.4.1 (iii), cumulative impacts associated with the concurrent operation of the ARRC are considered in the air quality impact assessment prepared for the ARRC. The reactivation of the quarry is not contingent on approval of the ARRC (if approved) and therefore has been considered independently of the ARRC. This approach has been discussed with DPIE resource assessments team and confirmed as appropriate.

In accordance with the existing consent, the quarry will cease extraction in December 2024. It is noted that the ARRC, if approved, will be constructed and in the early stages of operations during the time that quarry extraction and ARRC operations will occur concurrently. The ARRC will increase throughput progressively as the development of the Western Sydney Aerotropolis progresses and the demand for C&D resource recovery and recycled product increases and therefore peak operations of the ARRC will not occur concurrently with the quarry.

Infilling of the quarry void and final rehabilitation will be subject to a separate application. Cumulative impacts of the ARRC and infilling activities will be modelled in the technical assessments that will be prepared to support this future application.

4.7.2 Noise and vibration

i Consideration of operational vibration impacts

The assessment only considered vibration impacts from construction. It does not assess operational vibration impacts. Further construction vibration impacts are only assessed in relation to human comfort response and nearest residential receivers. It does not appear to consider potential vibration impacts (from construction or operation of the quarry or the site rehabilitation activities) on the airport. The vibration assessment appears to be based solely on proximity to the site rather than any modelling activities.

The assessment documented that vibration impacts from envisaged construction works satisfied the human response limits at 40 m, and well below the limit for structural damage. The WSA fuel farm is located well beyond the 40 m distance to the construction works or pit activities and therefore will clearly satisfy both human response and structural damage criteria. Levels of vibration from crushing operations are well below vibration levels generated by vibratory rollers proposed for compaction during construction works.

It is expected that airport operations in proximity to the fuel farm would generate higher levels of vibration due to mass of vehicles and proximity than any activities conducted on the quarry site (noting that the MOD5 activities will cease in 2024 before airport operations are planned to commence in 2026). Furthermore, it is expected that the tank farm, taxiways and runways are designed to withstand a low-level earthquake activity that would far exceed any potential vibration from the site.

4.7.3 Traffic and transport

i Consideration of cumulative traffic growth

The TIA has considered the cumulative traffic growth associated with the Airport and surrounding infrastructure and concludes that quarry traffic would not deteriorate the operation of existing intersections and roads. The TIA states that quarry traffic will be less than 2% of the total traffic forecast to use Adams Road, so is not expected to have a significant impact on traffic flow and safety. However, it is unclear if the TIA has considered the construction traffic associated with the airport and other infrastructure projects occurring in the area.

As detailed in Section 6.7.4 (iii) of the Modification Report, the future traffic volumes used to inform the MOD 5 TIA were provided by TfNSW based on the Strategic Travel Forecasting Model (STFM). The STFM includes historical traffic levels (ie including existing land uses such as the approved quarry) and the traffic levels forecast generated by the staged Western Sydney Airport and Aerotropolis development.

ii Consideration of airport's and other projects' construction traffic

The increase in heavy vehicle movements associated with the quarry operations are likely to interact with construction vehicles accessing the airport and surrounding sites.

As outlined in the MOD 5 TIA, Adams Road currently has a 3-tonne load limit, restricting its use by heavy vehicles. The northern section of Adams Road, between the subject property access road and Elizabeth Drive, will be upgraded by the applicant so that the pavement is suitable for use by heavy vehicles. This will allow the load limit to be lifted and the northern section of Adams Road to be used to access the site. No quarry-related heavy vehicle traffic will travel south on Adams Road so will not interact with airport construction vehicles accessing the WSA site via the Northern Road.

As outlined in Section 4.5 above, in 2024, the forecast traffic at the Elizabeth Drive / Adams Road intersection will be 1,282 during the AM peak and 1,669 during the PM peak respectively of which only 10 movements in each peak period will be quarry related. Accordingly, potential interactions between quarry and WSA construction related traffic will not be significant in the broader context of the airport development.

4.7.4 Rehabilitation and final land use

i Conditions of consent relevant to rehabilitation and final land use

- The application report states that “Without approval of the proposed modification, the quarry will remain dormant and the void will remain unfilled, preventing the realisation of a number of key benefits”. Such a statement does not address the requirements of the conditions of consent to rehabilitate the quarry. In particular, Conditions 33-36 specify the requirements for site rehabilitation which must be complied with irrespective of the modification application
- The modification report states “...final rehabilitation of the site is subject to separate development consent application”. The existing conditions of consent do not require a separate development application for site rehabilitation and the applicant's intentions are unclear.
- WSA further notes, that to date Condition 36 has not been complied with

This matter is addressed in Section 4.1.1.

ii Quarry rehabilitation

- The approach to site rehabilitation is unclear. The Mod 5 application refers to the original 2003 EIS, the 2009 Site Rehabilitation Plan and the recent SSD application for the proposed ARRC on the site and the Final Land Use Report (Appendix L to the modification report). The 2009 Site Rehabilitation Plan assumed a final land use that is rural/pastoral, whilst the modification proposes a final land use that is commercial/industrial use.
- The Final Land Use Report also refers back to the 2003 EIS as well as the proposed ARRC SSD application as methods for filling the quarry void. These reports adopt differing Site Rehabilitation Strategies. Further, the 2009 Site Rehabilitation Strategy states a number of matters would be addressed in more detail in a subsequent Site Rehabilitation Strategy which was presumed to be prepared in 2018. This has not been prepared as far as WSA is aware.
- There should be a single and clear Site Rehabilitation Strategy. The approach to rehabilitation, the timeframes for activities need to be more clearly detailed. In particular, the Mod 5 application appears to rely on the approval of the proposed waste management facility referred to in the ARRC for filling of the quarry void. The ARRC proposal is subject to a separate assessment and approvals process and the Mod 5 application should not rely on the approval of the ARRC for the filling strategy and site rehabilitation.
- The materials for filling the quarry pit are unspecified and the timeframe for filling and rehabilitation is unspecified. A time limit for quarry and site rehabilitation should be imposed.
- Given the lack of information and clarity around the rehabilitation plan, the potential impacts on the airport cannot be fully assessed. The potential impacts associated with the filling, including rehabilitation methods needed to assess potential impacts on the airport. These may include air quality impacts; vibration impacts and wildlife hazards.

These matters are addressed in Section 4.1 and Section 4.2.

iii Rehabilitation audits

WSA notes the applicant is seeking to delete Condition 35 of Schedule 4 of the consent, which requires annual audits to be carried out by a qualified rehabilitation consultant. WSA opposes the deletion of Condition 35 and considers that annual performance audits of rehabilitation should be undertaken.

This is addressed in Section 4.2.3.

iv Compaction methods relevant to rehabilitation

No information is provided on what compaction methods may be required for the filling of the quarry void to make the land suitable for the intended future uses.

Rehabilitation of the void by infilling will be subject to a future application and noise and vibration assessment. The CDFS contained in Appendix E provides an indicative plant list and filling methodology anticipated to be used during infilling and rehabilitation activities.

v Rehabilitation phase air quality impacts

Further information is also required regarding the rehabilitation phase and its potential air quality impacts as this is not addressed in the assessments within the modification report. It is important that any potential air quality impacts related to the rehabilitation of the quarry are properly addressed.

Infilling of the quarry void will be subject to a separate modification application of the quarry consent. This application which will be informed by detailed technical assessments including air quality modelling. However, it is generally noted that infilling of the quarry would be actively managed reducing the potential for windblown dust generation compared to an inoperative quarry and that the infilling activities are expected to be less intensive than quarrying activities so dust emissions will be lower than from the MOD 5 activities assessed in the MOD 5 *Air Quality Impact Assessment* (EMM 2020a).

4.7.5 Surface water

i Overflow and discharges to Oaky Creek

The quarry site contains two sediment dams, and the modification report states that one dam will be decommissioned as it has not been adequately maintained. It is also noted that the remaining sediment dam will receive catchment run-off as well as pumped transfers from the quarry pit. Under a typical median rainfall year, the sediment basin is predicted to overflow and discharge to Oaky Creek.

Appropriate water quality treatment measures should be implemented to ensure appropriate treatment of water prior to discharge off site into Oaky Creek.

As described in Section 4.4.3(ii) the Water Management Dam will overflow at times. Water quality treatment measures will be implemented to ensure appropriate treatment of water prior to discharge off site into Oaky Creek.

4.7.6 Groundwater

The modification report does not appear to consider potential future leachate from the filling of the quarry void. The nature of the fill material is unknown except that it is proposed to be unrecyclable material which assumes the ARRC proposal will be approved. There is potential for future contamination of groundwater if this is not adequately considered and managed.

See Section 4.4.4.

4.8 Environment, Energy and Science

4.8.1 Biodiversity

i BDAR waiver request

There is no capacity under the BC Act to waive the requirement to prepare a BDAR for a modification to a development application. EES considers a BDAR should be required because:

- Important details which relate to this modification, and which may have a bearing on the level of direct and indirect impacts on biodiversity values, are lacking from the documents accompanying the proposal;
- Insufficient consideration and assessment of potential impacts on the vulnerable Southern Myotis, endangered Green and Golden Bell Frog (GGBF) and endangered Cumberland Plain Land Snail have been made.

EES requested in its response to the Modification Report, that a BDAR be prepared to provide further information regarding the biodiversity values at the subject property and to assess the potential for MOD 5 to directly or indirect impact on these values.

Accordingly, a BDAR has been prepared by EMM and is appended to this Submissions Report as Appendix D. The BDAR confirmed MOD 5 will not result in direct or indirect impacts on biodiversity values in the quarry site. Southern Myotis, Green and Golden Bell Frog (GGBF) and Cumberland Plain Land Snail are addressed in the following subsections.

ii Impacts associated with quarry water management system

The BDAR waiver request states “The Proposed modification will not result in direct impacts to native vegetation on the site.” (Table 2, page 5). However, the modification report states, “The surface water management system for the quarry has been revised as part of the proposed modification (refer to Section 6.4 and Appendix G) and will include an oil and water and sediment trap immediately upstream of the Water Management Dam” (page 39). This report also shows “piped drainage” into the Water Management Dam in Figure 6.6. The impacts of this infrastructure on the vegetation (PCT 1800) adjacent to the Water Management Dam and Sediment Dam 1, and associated threatened species habitat, have not been discussed and assessed. This vegetation may provide habitat for the Green and Golden Bell Frog and, as discussed in the recent EES comments for the SSD 10446 (dated 13/08/2020), and the Cumberland Plain Land Snail.

Overall, the development of the site will reduce the areas of open water on the subject property, consistent with the reduction of wildlife strike risk to the airport.

The revised water management system for the quarry proposed in MOD 5 will decommission Sediment Dam 1 (the sediment dam to the south of the Water Management Dam referred to as Pond 4 in the MOD 5 BDAR). This sediment dam will continue to remain in place and receive flows from its current catchment area until such time as the ARRC (if approved) is constructed. At this time, this sediment dam will be removed and replaced with an engineered onsite detention basin (OSD) as identified in the ARRC EIS (EMM 2020x).

Potential impact associated with the removal of this waterbody during construction of the ARRC will be considered in the revised BDAR for the ARRC (which will be submitted to DPIE with the Submissions Report for the ARRC in due course).

Figure 6.6 of the MOD 5 Surface Water Assessment shows an indicative layout of the revised surface water management system. The piped drainage would be installed to avoid impacts on native vegetation within the existing disturbance footprint of the internal road. Piped drainage will be sited to avoid the patch of PCT 1800 Grey Box - Forest Red Gum grassy woodland (PCT 1800) between the internal road and Water Management Dam.

iii Southern Myotis habitat

- The BDAR waiver report notes Southern Myotis were detected feeding over the two large dams in the north east of the site and roosting in low numbers under a concrete bridge at the southeast boundary of the site (page 5). Clarification is required as to whether the waterbody in the quarry pit also provides feeding habitat for Southern Myotis and whether the proposed dewatering of the pit will remove habitat. Further details are required on this, particularly as Table 3.1 in the Mod 5 report states “recommencement of quarrying operations will deter use of the quarry void by birds and other wildlife” (page 34).
- As access via the Commonwealth land is no longer required, clarification is required as to whether the concrete bridge in the south east corner of the site is now proposed to be removed. Further details are required on the roosting habitat provided under the bridge and if the bridge is to be removed details are required on the potential impact on Southern Myotis.
- The Mod 5 report and the BDAR waiver discuss the existing disused farm shed and note that it is not considered to be suitable microchiropteran bat habitat, but neither of the reports provide any further details, photographs, etc on why the shed is not suitable habitat. Additional information is required to justify why the shed is not suitable habitat.

The riparian habitat within the subject property contains areas of dams and standing water associated with Southern Myotis and Swamp Oak Floodplain Forest EEC. The quarry pit currently contains some water which may be used by Southern Myotis although this was not observed at the time of survey. The existing consent (DA 315-7-2003) allows water bodies to be impacted in certain ways as part of the quarry's water management system, including dewatering the quarry pit. MOD 5 would not add to (or alter) those impacts.

Southern Myotis were recorded roosting in a culvert beneath the former approved access for the quarry. The former approved access road over Oaky Creek will no longer be used (due to the WSA development). The culvert is located on Commonwealth land. The applicants have no access to, or control of, the bridge so EES will need to consult with WSA regarding their concerns regarding the bridge.

The disused farm shed building was not deemed suitable to support roosting microbats. The building is an open large tin shed, with no roof voids. No staining or microbat scats were observed at potential entry points suitable to be used by microbats. Further detail on the disused farm shed is provided in the Section 5.3 of the BDAR.

iv Green and Golden Bell Frog habitat

- The BDAR for the related proposal SSD 10446 contains inconsistent information relating to targeted surveys for the Green and Golden Bell Frog (GGBF). While Table 5.12 states "egg mass were detected during the nocturnal searches listed above", Table 5.16 states "Not recorded during targeted surveys." EES notes that Bionet contains a recent record for this species from 2019, approximately 2.7 km northwest from the site near The Northern Road.
- Potential impacts to GGBF have not been considered in terms of the quarry void and associated water (see comments below) and this is important because "Quarries, brickpits, mining sites, STPs, bunded or otherwise 'retained' areas, detention basins, drains, scrapes, depressions and farm dams along with the more natural coastal or floodplain wetland features.... Are all candidate sites for occupation of this species... such sites are occupied and used mainly as breeding habitat" (from the EIS guidelines at <https://www.environment.nsw.gov.au/resources/nature/GAndGbellfrogEia0703.pdf>).
- The BDAR waiver request states "The proposed modification does not require any changes to non-natural water bodies. Therefore, it is unlikely that there will be any impact to threatened species on the site." But, as noted above, the modification report refers to decommissioning of Sediment Dam 1 and the potential impacts of this to GGBF have not been considered.
- The BDAR waiver request states "The desktop assessment and site visits did not identify any non-native vegetation on site with the potential to provide habitat for any potential threatened species". However, the EIA guidelines for GGBF state "Foraging habitat requirements include tall, dense, grassy vegetation and tussock forming vegetation is known to be used for foraging and shelter... Over-wintering sites are another important habitat component that requires consideration in any site assessment... Such sites include the bases of dense vegetation tussocks, beneath rocks, timber, within logs or beneath ground debris including human refuse such as sheet iron, etc." and examples of these types of habitat are found across the subject property.
- The site does contain non-native vegetation and human-made structures (rubbish) that could provide habitat for this species but neither the modification report, nor the BDAR waiver request adequately address this.

It is noted that the text identified is presented in the methodology section of the ARRC BDAR and is meant to refer to the search method for frog egg masses. Green and Golden Bell Frog (including egg mass) were not detected during targeted surveys. Section 5.3.3 of the MOD 5 BDAR outlines further details on the target Green and Golden Bell Frog survey undertaken.

As noted above, quarry dewatering is approved under the existing consent.

The Mod 5 report states Sediment Dam 1 has not been actively maintained for around 2 years while the quarry has been inactive and is overgrown with vegetation. It is unclear if decommissioning of Sediment Dam 1 is proposed as part of the Mod 5 proposal, or as part of the separate SSD 10446 application. This needs to be clarified.

EES notes that Sediment Dam 1 (Figure 6.3 of Mod 5) equates to Pond 4 (Figure 5.2 of the BDAR for SSD 10446) which equates to OSD (onsite detention, Figure 1.2 BDAR SSD 10446). EES in its submission for SSD 10446 advised “Regarding the onsite detention (OSD) storage, the SWA states “Discharges are predicted to occur from the onsite detention storage into Oaky Creek. Scour protection and energy dissipation will be constructed at the discharge location and at the confluence with Oaky Creek to reduce erosion potential associated with the increased flow rates from the immediate site.” It is not stated in the BDAR or in the SWA how the water will be delivered to Oaky Creek but the final drawing of the SWA shows a structure for this (drawing titled “Stormwater Catchment Plan” drawing 030, AMDT D). Figure 1.2 of the BDAR shows no such structure and its impacts have not been considered. The full impacts of the OSD storage needs to be assessed in the BDAR.

It appears Sediment Dam 1 is to be decommissioned to construct the OSD at this location as part of SSD 10446, but this needs to be clarified.

As Sediment Dam 1 has not been used for two years and it appears neither the quarry pit nor the Water Management Dam have been used during this time, the waterbodies may now provide habitat for native fauna.

In order to assess the potential impacts of the Mod 5 proposal on the non-natural water bodies and the habitat they potentially provide further details are required on the non-natural waterbodies on site, including:

- provision of additional photographs of the existing condition of the quarry pit waterbody, Sediment Dam 1 and the Water Management Dam;
- the environmental assets currently provided by the non-natural waterbodies;
- native fauna known to occur or potentially inhabit/use the waterbodies and/or the area surrounding the waterbodies;
- the environmental impacts of dewatering the quarry pit on native fauna (including any water dependent species) and include details on:
 - The existing size, volume and depth of the quarry pit waterbody;
 - The volume of water that is proposed to be dewatered from the quarry pit to the Water Management Dam to allow quarry operations to recommence;
 - The proposed time frame for dewatering the quarry pit (eg the duration and the time of year the dewatering is proposed);
 - Ongoing dewatering over the longer term throughout the life of the quarry;
- the environmental impacts of decommissioning Sediment Dam 1 on native fauna (including any water dependent species);
- mitigation measures to protect and manage native fauna potentially impacted by the dewatering/decommissioning.

The revised water management system for the quarry proposed in MOD 5 will decommission Sediment Dam 1 (the sediment dam to the south of the Water Management Dam referred to as Pond 4 in the MOD 5 BDAR). This sediment dam will continue to remain in place and receive flows from its current catchment area until such time as the ARRC (if approved) is constructed. At this time, this sediment dam will be removed and replaced with an engineered onsite detention basin (OSD) as identified in the ARRC EIS (EMM 2020x).

An assessment of the removal of this sediment dam and proposed OSD (including OSD discharge structure) will be included in the revised BDAR for the ARRC (to be submitted with the ARRC Submissions Report in due course).

Consideration of the biodiversity values, of non-natural waters forming part of the existing quarry’s water management system is included in the MOD 5 BDAR (Appendix D). As noted, this water management system (including pit and sediment basin dewatering) is approved under the existing quarry consent. Reactivated operations following approval of MOD 5 will be consistent with currently approved operations.

The lowest point of the quarry pit is in the north-east of the quarry. As the pit is dewatered, the water level will retreat towards this lowest point. It is recommended that an ecologist is present during the removal of the final water from the depression and sump around the dewatering pipe inlet (about 10 m by 10 m). Any native animals captured would be moved to the adjacent Pond 2 or Pond 3 outside the quarry pit. This mitigation measure is proposed from an animal welfare perspective, to allow ecologists to capture large aquatic animals such as eels (if any are present), before all water is removed from the quarry pit.

vi Threatened ecological activities

The BDAR waiver request notes the site visit identified two threatened ecological communities (TECs) comprising Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and Cumberland Plain Woodland (CPW) in the Sydney Basin Bioregion (pages).

While the BDAR waiver request states the proposed modification will not result in direct impacts to native vegetation of the site, comparing Figure 2.2 (indicative concept masterplan) in the Final Land Use report with Figure 1.2 in the BDAR waiver request shows CPW and Swamp Oak Floodplain Forest are proposed to be removed and replaced with warehouses and hardstand areas as part of the final land use.

Swamp Pak Floodplain Forest is endangered and CPW is a critically endangered ecological community which means it is facing an extremely high risk of extinction in NSW in the immediate future. It is recommended the proposed concept masterplan is amended to avoid an impact on CPW and Swamp Oak Floodplain Forest.

MOD 5 does not propose additional clearing of native vegetation beyond the currently approved footprint. As noted, rehabilitation of the quarry void by infilling will be subject to a future modification of the quarry consent, while the final land use of the quarry site will be subject to future development consent and biodiversity assessment.

It is noted, that the new Aerotropolis SEPP, zones the riparian corridor of Oaky Creek as Environment and Recreation and accordingly the final land use of the site will avoid this corridor.

The existing Development Consent for DA No. 315-7-2003 as modified (MOD 1-3) includes Condition 34 that a Vegetation Management Plan (VMP) shall include revegetation of the riparian zone of Oaky Creek. The Final Land Use report accompanying the Mod 5 proposal states the ‘rehabilitation of the Oaky Creek riparian zone was completed by the previous site operators and no further rehabilitation activities are required or proposed’ and the VMP will be updated to reflect this rehabilitation status and to indicate that future works will be limited to maintenance programs only.

The updated mitigation measures for the Mod 5 proposal include a measure to revise the VMP under the existing quarry consent prior to the recommencement of operations and include measures to maintain the Oaky Creek Riparian corridor.

The updated VMP should address the ongoing protection and maintenance of the riparian corridor along Oaky Creek and provide details on the rehabilitated corridor.

The Final Land Use report includes an Indicative Commercial Concept Masterplan for the site. The Concept Masterplan appears to show the top of bank located immediately adjacent to the development footprint which means the associated riparian corridor would be located in the development footprint. The EIS for the Mod 3 proposal indicates a mitigation measure to be implemented on the site includes the maintenance of a riparian corridor of over 40 m in width along Oaky Creek.

The existing Development Consent defines the riparian corridor as “a 40 m wide strip of land adjacent to a local watercourse, measured horizontally from the top of the bank of the watercourse”, so it is not clear why the top of bank appears to be located immediately adjacent to the proposed conceptual development footprint. Further details need to be provided on this.

The updated VMP should include but not be limited to the following:

- a scale plan which clearly locates:
 - Oaky Creek;
 - top of bank;
 - the riparian corridor width (measured from top of bank);
 - existing remnant native vegetation along the creek;
 - rehabilitated areas along the creek;
 - the boundary of the site and development footprint;
 - Asset Protection Zone;
- details on the rehabilitation that has been undertaken to date in the riparian corridor, including the location of plantings, plant species, species type, number of species, etc;
- details on any further proposed planting in the riparian corridor, including the location, species, species type, number of species – the plant species should consist of a diversity of local native provenance plant species (trees, shrubs and groundcovers) from the relevant native vegetation community that occurs along the creek at this location to ensure genetic integrity;
- a series of photographs of the rehabilitated riparian corridor in an Appendix to the VMP, and include details of the photo point location, direction of photo, the date of photo, etc.

A VMP (UBM Ecological Consultants 2009) has been prepared for the quarry. As outlined in Section 6.8.5 of the Modification Report, the VMP will be revised prior to the restart of quarry operations, ensuring that it meets the requirements listed above.

The Aerotropolis SEPP defines an Environmental and Recreation Zone along Oaky Creek. Detailed design of the final land use will ensure that the requirements of this zone are met, and the riparian corridor protected.

The Mod 5 report notes no disturbance is proposed to native vegetation as part of this proposal apart from that currently approved (Section 6.8.4, page 96). It also states in Section 2.9.3 on page 30 “There are two native trees that are within the approved disturbance footprint. These may need to be cleared. No other clearing of native vegetation is required (see Section 6.8)”. However, the locations of these trees are not made clear in this waiver application or in the modification report.

The BDAR waiver report also notes the potential impact on these trees has been approved by an existing consent. If the two trees are immediately adjacent to the “tin shed” then:

- the applicant may want to remove them for the construction of the new workshop and equipment laydown area (Figure 1.1 of the waiver request) and
- the two trees have been mapped as PCT 1800 (which is the endangered Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions) (Figure 1.2 of the waiver request).

It is not clear from the documents provided if the existing consent covers the removal of vegetation, ie compare Figure 1.1 and 1.2 of the BDAR waiver request, with Figures 1.3 and 2.1 of the modification report.

Furthermore, the EA for the original DA has not been uploaded to the major projects register so EES has been unable to check this against the original DA documentation.

The “two trees” have likely been mapped as part of a TEC (probably PCT 1800). If this is the case, it follows that their proposed removal needs to be assessed for this Mod application.

In addition to the two trees potentially needing to be assessed as part of the Mod 5 application, if the two trees are to be removed it is recommended the following additional mitigation measures are added to those included in Section 6.8.5 of the Mod 5 report:

- seeds from the two native trees to be removed shall be collected and used in the rehabilitation of the site in areas where the relevant PCT occurs or once occurred;
- the native trees required to be cleared from the site shall be salvaged (for example tree hollows and tree trunks which are greater than approximately 25-30 cm in diameter and 3 m in length) and placed in the riparian corridor to enhance habitat.

Two trees mapped as poor condition PCT 1800 within the approved quarry extraction and stockpile area to the west of the quarry pit will be removed as part of MOD 5 as shown in Figure 4.1 of the MOD 5 BDAR. As these trees are within the approved footprints of the existing consent, they are approved to be removed and therefore their removal does not need to be considered in the MOD 5 BDAR. The trees adjacent to the disused farm shed will not be removed having been specifically avoided in the design of the modification footprint. When the two trees within the currently approved footprint are removed, native tree trunks greater than approximately 25 cm in diameter and 3 m in length will be placed within the Oaky Creek riparian corridor to enhance habitat.

4.8.2 Rehabilitation and final land use

i Final land use

The proposed Final Land Use would appear to result in additional direct and indirect impacts on biodiversity values. EES has also reviewed the Final Land Use report including the concept masterplan. It is noted the Final Land Use report was required to be submitted but not as part of the modification report. It is important that potential impacts on biodiversity values associated with the final land use are avoided. Avoidance of these impacts, a primary objective of the BC Act in relation to assessment of development, does not appear to have been considered in the proposed concept plan for the final land use. EES considers that avoidance of impacts is feasible, and the proposed concept plan for the final land use. EES considers that avoidance of impacts is feasible, and the proposed concept masterplan needs to be amended.

EES recommends the development footprint as shown on the concept plan is amended so that the future development will not increase the impact on biodiversity values. The concept plan should avoid the need to clear TECs.

The EIS for the Mod 3 proposal (dated 18 November 2014) recommends that when extraction ceases and the area is decommissioned, the ecological improvement of the site should form part of the remediation strategy. EES considers the recommendation made in the Mod 3 EIS for decommissioning the site should apply to the current proposed concept plan. That is, ecological improvement of the site should form part of the remediation strategy.

As noted in Section 1.3, the infilling of the quarry void will be subject to a separate modification application.

The concept master plan presented in the Final Land Use Plan (EMM 2020g) was developed specifically to avoid the Oaky Creek riparian corridor. It is acknowledged that with the commencement of the Aerotropolis SEPP, an area within the existing quarry footprint which the concept master plan envisaged would form part of the future warehouse development, has now been zoned Environment and Recreation. Accordingly, as part of the application process for the final development of the site, the site and building designs will not intrude into this zone.

Future applications will involve detailed biodiversity assessments.

ii Species selection as part of rehabilitation and final land use

Species selection for any future plantings on the site should be based on the proposed location (Riparian corridor or shale plain) and the ecological communities associated with them (Cumberland Plain Riparian Woodland or shale plain woodland) (Section 7.2.4, page 80).

Also, the species selection for any future plantings on the site should comprise local native provenance species from the relevant vegetation community that occurs or once occurred on the site.

The submission is noted and will be considered in the update of the VMP.

4.9 Heritage NSW

4.9.1 Aboriginal cultural heritage

Heritage NSW has reviewed the modification report and notes the proposed area for development has previously been subject to a range of ground disturbance as part of previous clearing, quarrying and farming activities. One Aboriginal site has previously been recorded within the study area but is outside the proposed activity areas. However, there has been no consultation undertaken with the Aboriginal community which may have provided more information about cultural values of the land for the modification.

Aboriginal consultation was undertaken as part of the ACHA prepared for the ARRC EIS. The survey for the ARRC encompassed the Mod 5 project area. As a result of the Aboriginal consultation undertaken for the ARRC project it was agreed that test excavations to be conducted to characterise the subsurface potential for Aboriginal artefacts. Test excavations were proposed not only in the areas of moderate significance but also within the areas of low significance. A small portion of the low significance area from the ARRC project overlaps with the Mod 5 project.

Mitigation measures for Aboriginal cultural heritage are outlined in Section 6.11.5 of the modification report (pages 110-111). These mitigation measures have been taken from the recommendations listed in Section 5.3, on pages 31-32 of the EMM Due diligence assessment (August 2020b).

Considering the assessments and Aboriginal consultation undertaken for the adjacent ARRC, the following additional mitigation measures are proposed by Heritage NSW:

- a small program of test excavation be undertaken in the proposed new office and weighbridge locations in the north-west corner of the study area if they have not been completed as part of the ARRC testing program;
- the mitigation measures outlined by EMM need to be reviewed after the results of the small program of test excavation and/or the ARRC test excavations have been completed.

A test excavation program was undertaken at the subject property over three days as part of the ACHA prepared for the ARRC EIS. Results of the test excavation demonstrated that there is a low-density artefact scatter across the ARRC site. The site has been recorded in AHIMS as LQ1 (# TBC). In total, seven artefacts were recovered from seven of 42 50 cm x 50 cm test pits. This represents an average artefact density of 0.7 artefacts per 1 m². Although there were no clear clusters of artefacts across the test area, five of the seven artefacts were retrieved from at the southern edge of the tested ARRC site. No artefacts were recovered within 100 m of the MOD 5 proposed new office and weighbridge. The results of the test excavation are in Figure 4.9.

Archaeological survey of the MOD 5 and ARRC areas initially identified areas of moderate and low archaeological potential across the proposed development areas. Therefore, the test excavation program aimed to test areas of both moderate and low densities. The tested area within the project area, between 100–200 m from Oaky Creek, that was originally anticipated to have moderate potential was found to contain low artefact densities (0.7 artefacts per 1 m²) to a level that would commonly be considered low archaeological potential. As such, the characterisation of areas of low potential was achieved through the tested areas and it is predicted that further archaeological material, traceable through test excavation, would be even less likely as the distance increases beyond 200 m from Oaky Creek. The sparse and random distribution of artefacts across the project area suggests that the ARRC site and broader subject property including the MOD 5 disturbance footprint and beyond was occupied occasionally, possibly because the foci of activity was within 100 m of the creek as regional models indicate.

The low-density artefact scatter is also attributable to previous disturbance, particularly the top 20–30 cm of soil, from roads, earthworks, historic land clearance and subsequent pastoral use. This assessment applies to both the MOD 5 disturbance area and ARRC site.

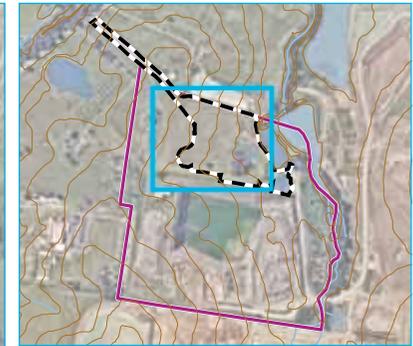
During the test excavation, discussions with representatives of the registered Aboriginal parties (RAPs) who were participating in the dig, determined that they were satisfied that the very low densities of artefacts did not warrant further subsurface testing or post-approval mitigation measures to be employed.

Overall, the test excavation program was sufficient to characterise the nature of, and potential for, Aboriginal artefacts in the project area and in the adjoining MOD 5 area, including the proposed weighbridge and office area. It is unlikely that Aboriginal objects will occur in the MOD 5 area in densities equal to, or greater than, than those uncovered during the test excavation for the AARC.

Applying the principles and requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (the Code) (DECCW 2010), test excavation is necessary when it can be demonstrated through background research and survey that sub-surface Aboriginal objects with potential conservation value have a high probability of being present in an area, and the area cannot be substantially avoided. Considering these prerequisites, the Mod 5 area does not feature areas with a high probability of containing Aboriginal objects, nor with potential conservation value. Test excavation within the nearby AARC area featured a very sparse and common stone artefact assemblage where neither conservation nor salvage is warranted, and these recommendations extend to the MOD 5 area. It is considered that the extensive investigations and salvages at the nearby Aerotropolis would provide far more significant examples of Aboriginal cultural heritage values in the local area.

Overall, EMM has gathered additional information from the outcomes of a test excavation program since the Heritage NSW submission for MOD 5. Considering this new information, it is not considered further excavation is necessary for MOD 5.

\\E:\msvr1\emmm\Jobs\2019\J1907.49 - GPG Luddenhams Quarry\GIS\02_Maps\SSD_Recycling_Facility\Heritage\HA008_ExcavationResults_20201126_02.mxd 1/12/2020



KEY

- Subject property
- ARRC site (project area)
- Waterbody
- Contour (2m)

Artefact frequency in 50 x 50cm test pits

-) 0
-) 1

Results of test excavation

Luddenhams Quarry - Modification 5
Submissions report
Figure 4.9



4.9.2 Heritage Council of NSW

The subject site is not listed on the State Heritage Register (SHR), nor is it in the immediate vicinity of any SHR item. Further, the site does not contain any known historical archaeological deposits. Therefore, no referral to the Heritage Council of NSW is required. The Department does not need to refer subsequent stages of this proposal to the Heritage Council of NSW.

This submission is noted.

4.10 Liverpool City Council

4.10.1 Traffic and transport

i Council requirements regarding new access and route arrangements

On 25 August 2020, Council provided detailed comments on SSD 10446 regarding revised site access via Adams Road and required intersection treatments. Adams Road is currently a local road under the care and control of Council. To accommodate the revised access arrangement including heavy vehicle movements along Adams Road and removal of the existing 3 tonnes load limit, the following Council requirements are to be imposed as consent conditions:

- the section of Adams Road between Elizabeth Drive and the site access shall be upgraded to Council's satisfaction;
- the proposed B-double route along the section of Adams Road between Elizabeth Drive and the proposed access road is to be approved by NHVR (in consultation with Council);
- application for the removal of 3 tonnes load limit along Adams Road is to be submitted to and supported by Council's Pedestrian, Active Transport and Traffic Committee.

This submission is noted. As outlined in Section 3.1.1, at the request of LCC, a pavement investigation has been carried out. The results indicate that Section 2 commencing 250 m south of the Elizabeth Drive/Adams Road intersection extending to 340 m south of the Elizabeth Drive/Adams Road intersection, immediately south of the proposed quarry intersection of Adams Road is considered to have reached the end of its structural life and will require upgrading regardless of whether MOD 5 is approved. Section 1 of Adams Road has a lifespan of approximately 20 years under existing traffic loading and of 11 years based on the predicted traffic heavy vehicle traffic volumes associated with MOD 5.

Council has requested additional information to assist in their assessment of the proposed upgrade approach. Accordingly, an assessment of road surface condition, topographic survey and a conceptual road design will be prepared prior to determination of the modification. Consultation with Council will be ongoing as part of the Section 138 (of the *Roads Act 1993*) application and the application to lift the load limit on the northern section of Adams Road.

ii Sealing the site

Unsealed roads and driveways may result in environmental impacts associated with the emission of airborne particulate matter and/or erosion, transportation and deposition of sediment off-site.

Given the expected significant vehicle movements on-site, high traffic volume areas must be sealed using either bitumen, concrete, or other similar materials and drained appropriately.

The proposed modification does not seek to increase the approved extraction rate or peak heavy vehicle movements within the quarry site. As outlined in the Modification Report, the site access road will be sealed from Adams Road to the weighbridge. Mitigation measures to minimise dust emissions include the operation of a water cart on the internal unsealed road as required and site wide vehicle speed limits.

iii Construction Traffic Management Plan

Prior to commencement of any works within the public road reservation, a Construction Traffic Management Plan including traffic control plans details for vehicular and pedestrian management, shall be prepared in accordance with AS1742.3 "Traffic Control Devices for Works on Roads" and the Roads and Maritime Services publication "Traffic Control at Worksites" and certified by an appropriately accredited Roads and Maritime Services Traffic Controller, and submitted to Council and the PCA for approval.

Traffic control measures shall be implemented during the construction phase of the development in accordance with the certified plan. A copy of the plan shall be available on site at all times.

Note: A copy of the Traffic Control Plan shall accompany the Notice of Commencement to Liverpool City Council.

This submission is noted. A construction traffic management plan will be prepared and submitted to LCC prior to road upgrade works on Adams Road.

iv Operational Traffic Management Plan

An operational traffic management plan which outlines haulage times and routes and indicates that heavy vehicles from/to the subject site should only travel along the northern section of Adams Road between Elizabeth Drive and the site access, has been prepared and submitted to Council for endorsement.

The plan is to include a map showing the northern section of Adams Road to be used for heavy vehicle movements and B-double route, which requires the removal of 3 tonnes load limit.

An endorsed operational traffic management plan is to be implemented to Council's satisfaction.

The quarry has an approved Road Transport Protocol (Epic Mining 2017). A revised road transport protocol will be prepared in following the approval of the modification as required by the Schedule 5, Condition 9 of the consent. The applicants will consult with Liverpool City Council during the revision of this protocol.

Prior to issue of construction certificate:

The applicant is to submit a Section 138 Roads Act application to Council for any road works in, on or over a public road including payment of application and inspection fees, to Council's Land Development and Traffic & Transport Sections for approval.

1. The application is to be accompanied by detailed design drawings for upgrade of the section of Adams Road between Elizabeth Drive and the site access, including design report, swept path analysis, signs and linemarking scheme prepared in accordance with Austroads Design Guide. The engineering plans are to be prepared in accordance with Liverpool City Council's Design Guidelines and Construction Specification for Civil Works, Austroads Guidelines and best engineering practice. All works shall be carried out in accordance with the Roads Act approval, the development consent including the stamped approved plans, and Liverpool City Council's specifications. Note: Approvals may also be required from Transport for NSW (RMS) for classified roads.
2. Detailed design information indicating the layout of the proposed car parking areas and internal access road associated with the subject development (including, driveways, grades, turn paths, sight distance requirements in relation to landscaping and/or fencing, aisle widths, aisle lengths, and parking bay dimensions) should be in accordance with AS 2890.1-2004, A52890.6-2009 and AS 1890.2-2002 for heavy vehicle usage.
3. A Construction Traffic Management Plan (CTMP) prepared by a qualified traffic and transport practitioner detailing construction and vehicle routes, number of trucks, hours of operation, access arrangements and traffic control should be submitted to Council for approval prior to the issue of a Construction Certificate.
4. A road occupancy permit is to be submitted to Council Traffic and Transport Section or Transport Management Centre (TMC) for any works within the public road reserve.

During construction:

6. Construction work/civil work/demolition work, including the delivery of materials, is only permitted on the site between the hours of 7:00am to 6:00pm Monday to Friday 8:00am to 1:00pm Saturday. No work will be permitted on Sundays or Public Holidays, unless otherwise approved by Council.
7. All Council approved road works within the public road reserve including for upgrade of the section of Adams Road between Elizabeth Drive and the site access, are to be carried out at full cost to the applicant.
8. Applications must be made to Council's Traffic and Transport Section for any record closures. The applications are to include a Traffic Control Plan, prepared by a suitably qualified person (application on Council website).

Prior to issue of the Occupation Certificate

9. Prior to the issue of an Occupation Certificate, the Principal Certifying Authority shall ensure that all approved Section 138 of the Roads Act roads works, or S68 LGA works have been completed, inspected and signed off by Liverpool City Council. The road works include upgrade of section of Adams Road between Elizabeth Drive and the site access.
10. All approved roadworks, signposting and street lighting are to be completed to Liverpool Council requirements, at full cost to the applicant.
11. Council's on-street assets including streetscapes should be protected at all times. Any damaged should be rectified to Council satisfaction.
12. The proposed B-double route along the section of Adams Road between Elizabeth Drive and the proposed access road has been approved by NHVR (in consultation with Liverpool City Council).

This submission is noted. Discussions are ongoing and will continue with Liverpool City Council regarding the relevant road works.

4.10.2 Surface water

i Flooding

Stormwater runoff from the disturbed area of the site is to be collected within the quarry pit and the Water Management Dam. Only excess water during large storm events are to be discharged to Oaky Creek.

The proposed water management strategy presented in the SWA is considered satisfactory.

It is recommended that:

- the disturbed area of the development site shall not encroach PMF extent as indicated in the SWA;
- design, install, operate and maintain stormwater management system of the site in accordance with the Water management strategy presented in the SWA;
- a general plan of water management shall be developed including but not limited to the following:
 - baseline monitoring data results;
 - objective and performance criteria including trigger levels for investigating and potential adverse impacts associated with water management;
 - details of monitoring, inspection and maintenance program;
 - reporting procedure for the results of the monitoring program; and
 - plans to respond to any exceedance of the performance criteria;
- divert stormwater away from disturbed land surface. All diversion banks, channels and point of discharge shall be constructed or stabilised so as to minimise erosion and scouring;
- continue surface water monitoring within Oaky Creek, upstream and downstream of the site and within the quarry pit and Water Management Dam.

Council's recommendations are consistent with those contained in the MOD 5 Surface Water Management Assessment.

The quarry has an Erosion and Sediment Control Plan (Epic Mining, undated). A water management plan, incorporating the relevant sections of the current erosion and sediment control plan, addressing the Council's recommendations above and meeting the requirements of Schedule 4, Condition 24 of the consent will be prepared in following the approval of the modification.

ii Soil and water management plan

A soil and water management plan shall be prepared by a suitably qualified consultant.

An endorsed soil and water management plan is to be implemented during construction.

As noted above, a water management plan, including an erosion and sediment control plan, will be prepared following the approval of the modification.

4.10.3 Vehicle refuelling and maintenance and chemical storage

If vehicle refuelling facilities are proposed on-site, detailed site plans are required to demonstrate compliance with the 'Practice Note Managing Run-Off from Service Station Forecourts' published by the NSW EPA dated June 2019. Detailed plans for the forecourt and chemical storage areas shall identify bunding, spill kit locations and drainage infrastructure. All work and storage areas where spillage may occur shall be bunded. The capacity of the bunded area shall be calculated as being equal to 110% of the largest storage or process vessel/container in the area or 10% of the total volume of vessels/container accommodated in the area, whichever is greater. Drainage within any fuel dispensing area may need to be connected to a pre-treatment device. The canopy covering the fuel dispensing and chemical storage areas shall have an overhang by 10° to prevent rainwater intrusion.

As outlined in the Modification Report, a small amount of fuel and chemicals required for site operations (including petrol, grease and flocculant) will be stored in a dedicated area within the site shed in accordance with the relevant Australian Standards. Maintenance of mobile plant will occur offsite. The quarry equipment fleet will be refuelled by a mobile refuelling vehicle with no fixed refuelling facilities proposed. There will be no vehicle wash bay onsite, however an outgoing wheel wash will be accommodated in the site entry infrastructure area.

4.10.4 Waste

i On-site sewage management system

The applicant indicates that wastewater generated by on-site amenities would be discharged to a septic tank for pump out by a licensed contractor. Under Section 68 of the *Local Government Act 1993* (LGA 1993), approval is required to install, construct or alter a waste treatment device and operate a system of sewage management at the premises. Therefore, separate approval is required under Section 68 of the LGA 1993 if the proposal includes an on-site sewage management system or any other infrastructure to hold or process, or re-use or discharge, sewage or by-products or sewage.

In accordance with the Liverpool DCP 2008, a new system must be installed where the existing system does not have adequate treatment capacity for all potential flows. It should be noted that sewage pump-put facilities are not supported by Council.

The application is to be supported by a wastewater report prepared by a suitably qualified and experienced environmental or wastewater consultant. The report shall identify the site area available for development and determine if on-site effluent disposal is feasible when considering potential risks to public health and the environment. The report must consider all potential wastewater flows (proposed and existing flows) and include minimum information specified in the submission.

Section 6.4.6 of the modification report states that wastewater generated by on-site amenities will be discharged to a septic holding tank, which will be pumped out by an approved licensed contractor when required.

The applicant acknowledges that an approval is required to construct or alter a waste treatment device under Section 68 of the *Local Government Act 1993* (LG Act 1993) and will do so following the approval of the proposed modification. The application will be prepared by a suitably qualified and experienced environmental or wastewater consultant and will consider the minimum information specified in LCC's submission.

ii Waste storage areas

The waste storage area to be clearly identified in the site plans. The designated waste storage areas shall comply with the following requirements:

- fully enclosed and provided with a concrete floor, and with concrete or cement rendered walls covered to the floor;
- a floor which consists of a removable basket within a fixed basket arrestor and is to comply with Sydney Water requirements;
- a tight-fitting, self-closing door and mechanical ventilation.

All containment measures including trafficable bunds shall be designed, installed and constructed in a manner which, permits the safe passage of personnel and vehicles, maintains effective containment capacity and minimises intrusive/offensive noise impacts arising from vehicle operation.

As outlined in Section 6.14 of the Modification Report, the quarry will produce only produce minor quantities of construction waste during construction of new site components and minor quantities of waste during continued quarry operations:

- cardboard packaging, plastic wrapping, plastic ties, wood pallets and other timber offcuts;
- general waste, including putrescible waste such as minimal food scraps;
- comingled recycling (from office activities and site employees);
- oily rags, filters and drums;
- waste batteries;
- confidential documents; and
- building and construction waste generated by construction.

These will be stored in a small, designated waste storage area within the site entry area. With the exception of bulky inert construction waste (eg timber offcuts), wastes will be stored in bins with a lid. Oily rags, filters, drums and waste batteries will be stored on a self-bunded pallet or similar. As such, it is not proposed to build a fully enclosed waste storage area.

4.10.5 Management measures

i Construction environmental management plan

A CEMP is to be prepared by a suitably qualified environmental consultant for the proposed development. An endorsed Construction Environmental Management Plan is to be implemented during construction.

A construction environmental management plan (CEMP) will be prepared by a suitably qualified environmental consultant and will be implemented during construction.

ii Operational environmental management plan

An OEMP shall be prepared by a suitably qualified and experienced environmental consultant and submitted to the consent authority for review. The OEMP is to include means by which the commitment in the environmental assessment reports will be fully implemented. proposed in the submitted technical reports whilst also addressing other risks to the environment including but not limited to material storage, dust/odour management, protection of watercourses, wet areas, water management and facility design.

The OEMP shall be prepared to meet the requirements of ISO 14001 and as a minimum address the following requirements:

- provide the strategic context for the management of the development;
- identify all the statutory requirements of the development and any specific environmental standards;
- detail mitigation measures to minimise acoustic impacts;
- specify mitigation requirements to maintain air quality;
- outline mitigation measures to maintain to maintain water quality;
- address sediment and erosion control during operation; and
- include community consultation and complaints management procedures.

In this regard, the OEMP must include at least the following information: introduction, project description, environmental policy, EMP context, objectives, responsibilities, statutory and reporting requirements, environmental management activities, environmental training, emergency contacts, risk assessment and monitoring and review procedures, OEMP auditing and appendices. Individual sub-plans may be incorporated into a single comprehensive OEMP.

In addition, a Noise Management Plan is required to mitigate acoustic impacts. Further advice should be sought from an environmental consultant who is suitably qualified and experienced in the preparation of OEMPs.

The LCC's comments above are generally covered by the quarry's SSD consent. The quarry's environmental management plans, including the noise management plan, will be updated to address the modified quarry operations and to ensure that they comply with the conditions of the consent.

4.10.6 Regulatory requirements

i Land use zoning and permissibility

Council notes that the development site is currently zoned RU1 Primary Production under the Liverpool LEP 2008, and Extractive Industries are permitted with consent under this zone. In addition, Extractive Industries are permitted with consent under this zone. In addition, Extractive Industries are also permissible under the Mining SEPP, on land where development for the purposes of agriculture may be carried out.

The development site is within the Western Sydney Aerotropolis boundary, and is subject to draft plans released by the Western Sydney Planning Partnership in December 2019. It is anticipated that the site will be rezoned to the 'Agribusiness' and 'Environment and Recreation' flexible land use zones in September 2020, once SEPP (Western Sydney Aerotropolis) 2020 has been gazetted.

Under the current Draft Plans, the proposed development would not be permissible. At this point in time, it is also not clear whether the permissibility for this land use under the Mining SEPP will continue to apply once the Aerotropolis SEPP is gazetted.

The above land use zoning and permissibility of the quarry activation is to be considered as part of the assessment of the application.

This is not correct in regard to the modification as the quarry is already approved. Where an activity becomes not permissible as a result of a zoning change, a consent for the activity may still be modified.

The modification application indicates that a new equipment area would be established to the north of the extended western stockpile. This area would include a demountable shed containing a quantity of fuel and chemicals required for site operations. Quarry equipment will be refuelled by a mobile refuelling vehicle. To address the requirements of State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33 Hazardous and Offensive Development), the Applicant may be required to prepare a preliminary screening procedure and/or Preliminary Hazard Analysis for the proposal. This matter is brought to the attention of the Department for their consideration.

As noted above, small quantities of fuel and chemicals required for site operations (including petrol, grease and flocculant) will be stored in a dedicated area within the site shed in accordance with the relevant Australian Standards. The storage and use of this material is considered consistent with the approved quarry operations and as such, consideration of State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) is not required.

4.11 Regional NSW – Mining, Exploration & Geoscience

Clay/shale and Structural Clay are prescribed minerals under the Mining Act 1992. The Proponent is required to hold an appropriate mining authority allowing for mineral extraction, such as a mining lease, from MEG to undertake mining. Based on current title information, MEG advises that the Proponent does not hold the appropriate titles as required for mineral extraction in order to satisfy the requirements of sections 5 and 73 of the Act. It is noted that the Proponent currently has an application for mining lease against the Project area with MEG for assessment.

- A development application under the EP&A Act must be approved before a mining lease can be granted. A mining lease will only be granted for activities specified in the development consent. MEG notes that a BDAR waiver application is pending. MEG requests that the Proponent advise the Geological Survey of NSW – Land Use team of any changes to the BDAR waiver application.
- MEG has determined that should the project be approved, efficient and optimised resource outcomes can be achieved, and any identified risks or opportunities can be effectively regulated through the conditions of mining authorities issued under the Mining Act 1992.

The quarry is currently approved. A mining lease application (“MLA 592”) has been submitted to Mining, Exploration & Geoscience (MEG). As noted in Section 4.8.1, EES requested that a full BDAR be prepared. The BDAR is provided in Appendix D and discussed in relation to the EES comments in Section 4.8.1. The BDAR found that no direct or indirect impacts on threatened species are predicted as a result of the proposed modification.

4.12 NSW Rural Fire Service

i Access for emergency vehicles and static water supply

The intent of measures is to minimise the risk of bush fire attack and provide protection for emergency services personnel, residents and others assisting firefighting activities. To achieve this, the following conditions shall apply:

1. Property access roads must comply with the following requirements of Table 7.4a of Planning for Bush Fire Protection 2019:

- property access roads are minimum 4 m carriageway width: two-wheel drive, all weather roads;
- a minimum vertical clearance of 4 m to any overhanging obstructions, including tree branches;
- the capacity of road surfaces and any bridges/causeways is sufficient to carry fully loaded firefighting vehicles, bridges and causeways are to be clearly indicate load rating;
- hydrants are provided in accordance with the relevant clauses of AS 2419.1.2005:
- there is a suitable access for a Category 1 fire appliance within 4 m of the static water supply where no reticulated supply is available;
- property access must provide a suitable turning area in accordance with Appendix 3;
- curves have a minimum inner radius of 6 m and are minimal in number to allow for rapid access and egress;
- the minimum distance between inner and outer curves is 6 m;
- the crossfall is not more than 10 degrees; and
- maximum grades for sealed roads do not exceed 15 degrees and not more than 10 degrees for unsealed roads.

The quarry site generally complies with the above requirements for Planning for Bushfire Protection (RFS 2019), meeting the required property access, road requirements and static water supply requirements. While there is no reticulated water supply at the subject property, fire appliances can access within 4 m of a static water supply (Water Management Dam).

ii Emergency and evacuation planning

To aid in the fire fighting activities, an unobstructed pedestrian access to the rear of the property must be provided and maintained at all times.

The intent of measures is to provide suitable emergency and evacuation arrangements for occupants of SFPP developments. To achieve this, the following conditions shall apply:

- an Emergency/Evacuation Plan must be prepared consistent with the NSW RFS document Guidelines for the Preparation of Emergency/Evacuation Plan.

An Emergency/Evacuation Plan will be prepared for reactivated quarry operations consistent with the NSW RFS document Guidelines for the Preparation of Emergency/Evacuation Plan.

The site is surrounded by a chainmesh security fence to prevent unauthorised access, particularly to the quarry pit.

4.13 Airservices Australia

Airservices view is that the proposed development would not have an impact on the safety, efficiency or regularity of existing, or future air transport operations into or out of Sydney, Bankstown, Camden and Richmond aerodromes or Westmead Hospital heliport.

This submission is noted.

5 Updated evaluation merits

An evaluation of merits outlining the need and justification of the proposed modification is provided in Chapter 7 of the Modification Report. The need for the proposed modification is heightened with the passing of time with an increasingly narrow window of time to extract an approved regionally significant resource identified in the SREP No. 9 – Extractive Industry (No. 2), prior to the end of the currently approved quarry operations period (31 December 2024).

A 2019 resource appraisal estimated that approximately 2 million tonnes of shale and clay resource remains within the approved extraction footprint. This material shale is worth about \$7/tonne, so the total resource has a value of about \$14 million.

The resource cannot currently be extracted as the approved site access on Commonwealth land can no longer be used by the quarry. This modification application proposes that quarry vehicles use the site access from Adams Road to allow resource extraction to resume. Quarry operations will be reactivated as soon as this modification is approved, all applicable consent conditions met and all other legislative requirements are met, eg an EPL and Mining Lease are granted. This will maximise the amount of clay and shale that can be recovered prior to the end of quarry operations. At an extraction rate of 300,000 tpa, up to about 1 million tonnes of the resource could be extracted prior to the end of quarrying operations on 31 December 2024.

As outlined in the Modification Report's evaluation of merits, given that the quarry will be reactivated as soon as all legislative requirements are met, reactivation will provide immediate economic benefits, including:

- it will provide employment for up to 15 quarry workers and 10 to 12 truck drivers;
- it will provide clay and shale for the production of approximately 80 million standard bricks per year, worth approximately \$76 million – enough to construct around 8,000 houses per year; and
- it will support the employment of around 200 brick manufacturing employees.

On a broader scale, there is a renewed demand for quarry products due to NSW Government's investment in infrastructure, building and development in the Greater Western Sydney region:

- the quarry will supply clay and shale for brick making, an essential building material required in the Western Sydney Priority Growth Area and South West Growth Area including the Western Sydney Aerotropolis;
- the quarry is ideally located to supply clay and shale to brick manufacturers in Western Sydney, minimising quarry truck travel times and transport impacts on the road network compared to more distantly located resources;
- reactivation of the quarry is aligned with the *Greater Sydney Region Plan* and the *Western City District Plan* which both include provisions to safeguard the continued economic contribution made by resource extraction; and
- the jobs created by the reactivation of the quarry will be in Western Sydney minimising commuting distances for employees living locally (importantly, the applicants are ready, willing and able to recommence quarrying activities on-site promptly after being granted the necessary consents).

The proposed modification will not result in significant biophysical, social or economic impacts and the modification report identified that any residual impacts can be appropriately managed.

As described in Section 2.4 of the Aerotropolis Plan and acknowledged in the submission from WSPP, land uses and urban forms will evolve as the Aerotropolis changes. This will require flexibility given the uncertain nature of future land uses, especially in non-residential areas. Land uses, buildings and structures will change from short- to medium-term uses to longer-term advanced and agribusiness industry uses. The Aerotropolis Plan recognises that new enabling industries such as building materials production, to facilitate construction of the Aerotropolis, may be permitted subject to interface mitigation treatments and an ability for the site to transition to higher order uses compatible with airport operations over time.

The continued operation of the quarry represents an existing “enabling” industry providing an economic basis on which the site can be developed to provide innovative resource recovery solutions in the medium- to long-term, and long-term agribusiness uses.

With the quarry inactive for well over 12 months, water has accumulated in the base of the quarry which can increase bird activity in the area. This highlights the benefits of reactivating the quarry to allow active management of the subject property.

As the potential environmental impacts can be managed and mitigated with few residual impacts and there are a range of immediate and longer-term economic benefits from reactivating the quarry through the proposed modification, we are confident that the proposed modification is in the public interest. The proposed modification allows the best use of the approved quarry and the site, and contributes to an economically viable pathway to the rehabilitation of the void to a final landform that can be fully developed for uses in keeping with the vision for the Aerotropolis.

References

Austrroads (2017a) *Guide to Road Design (Part 4A)*.

Austrroads 2016) *Austrroads Guide to Road Design Part 3 (Geometric Design)*

Benbow Environmental 2014, *Environmental Assessment Report for Epic Mining Pty Ltd*, 275 Adams Road, Luddenham, NSW.

Buonicore and Davis 1992, *Air Pollution Engineering Manual*, Air and Waste Management Association.

Connacher Environmental Group 2009, *Luddenham Quarry, Site Rehabilitation Plan*. Report prepared for Epic Mining.

DECC 2008, *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries*, NSW Department of Environment and Climate Change.

Douglas Nicolaisen & Associates Pty Ltd, 2003, *Environmental Impact Statement – Proposed Clay/Shale Extraction Operation – Lot 3 - 272 Adams Road Luddenham NSW*, prepared for Badger Mining Company Pty Limited 275 Adams Road Luddenham NSW.

Durkin 2020, *Pavement Investigation, Adams Road, Luddenham NSW 2745*. Report prepared for EMM Consulting Pty Limited by Durkin Construction Pty Ltd.

EMM 2020, *Luddenham Quarry Scoping Report MOD5, DA 315-7-2003*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020a, *Luddenham Quarry Modification 5 - Air quality impact assessment*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020b, *Luddenham Quarry Modification 5 – Noise and vibration impact assessment*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020c, *Luddenham Quarry Modification 5 - Surface water assessment*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020d, *Luddenham Quarry Modification 5 - Qualitative groundwater assessment*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020e, *Luddenham Quarry Modification 5 - Traffic impact assessment*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020f, *Biodiversity Development Assessment Report (BDAR) for modification of Luddenham Quarry operations*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020g, *Luddenham Quarry Modification 5 - Final land use report*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020h, *Luddenham Quarry Modification 5 - Aboriginal heritage due diligence assessment*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020i, *Luddenham Advanced Resource Recover Centre, Wildlife Strike and Birdstrike Risk Review*. Prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020j, *Luddenham Quarry Modification 5 - Aboriginal heritage due diligence assessment*. Report prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EMM 2020k, *Luddenham Advanced Resource Recover Centre, Environmental Impact Statement*. Prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Limited.

EPA 2000, *NSW Industrial Noise Policy (INP)*, NSW Environment Protection Authority.

EPA 2009, *The Interim Construction Noise Guideline (ICNG)*, NSW Environment Protection Authority.

Epic Mining 2017, *Road Transport Protocol, Luddenham Quarry, 275 Adams Road Luddenham*.

Epic Mining 2017, *275 Adams Road Luddenham Erosion and Sediment Control Plan*.

Insitu Advisory 2020, *Concept design and filling strategy, Luddenham Quarry 275 Adams Road Luddenham, NSW*. Report prepared for CFT No.13 Pty Ltd & KLF Holdings Pty Ltd.

Landcom 2004, *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition March 2004*. Government of NSW.

UBM Ecological Consultants 2009, *Vegetation Management Plan for a Clay Shale Quarry, Adams Road, Luddenham*. Prepared for Blue Sky Mining Pty Ltd by UBM Ecological Consultants Pty Ltd.

US EPA 2006, *Compilation of Air Pollutant Emission Factors, AP-42, Fourth Edition*. United States Environment Protection Agency (2006).



APPENDIX A –
Submissions summary





APPENDIX B –
Update mitigation measures



B.1 Appendix Heading

A summary of the environmental management and mitigation measures for the proposed modification is provided in Table B.1.

Table B.1 Management and mitigation measures

Aspect	Measures
Key environmental aspects	
Air quality	<p>Preparation and implementation of an air quality management plan, prepared following approval for the reactivation of the quarry, and including the below management and mitigation measures</p> <p>Water cart to operate on the internal unsealed haulage routes and sealing of the access road between Adams Road and the weighbridge</p> <p>Minimising drop heights when unloading from trucks</p> <p>Watering applied to the crushing plant as required to minimise dust emissions</p> <p>Sheltering factor applied for wind erosion within the established pit</p> <p>Avoiding the double handling of material wherever possible</p> <p>Site-wide vehicle speed limits will be applied (40 km/h limit on sealed and 20 km/h limit on unsealed roads);</p> <p>Avoiding disturbance of stabilised ground cover where possible</p> <p>Use of meteorological forecasts to predict when the risk of dust emissions may be high (due to adverse wind conditions), allowing procedures and preparatory measures to be implemented, as follows:</p> <ul style="list-style-type: none">• aim to have surfaces moist prior to the on-set of hot and windy conditions;• plan for additional water spraying during the day;• cease certain activities or reduce activity levels; and• re-schedule deliveries or product dispatch.
Noise	<p>Construction – work practice methods:</p> <p>Noise monitoring during the initial stages of construction will be undertaken to determine if actual construction noise levels are above NMLs. Construction noise levels will be managed where exceedances of NMLs may occur as detailed in a construction noise management plan.</p> <ul style="list-style-type: none">• regular reinforcement of the need to minimise noise and vibration, such as through toolbox talks;• review and implementation of feasible and reasonable mitigation measures that reduce construction noise levels;• avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;• develop routes for the delivery of materials and parking of vehicles to minimise noise;• where possible, avoid the use of equipment that generates impulsive noise; and• notify residents prior to the commencement of intensive works. <p>Construction – plant and equipment:</p> <ul style="list-style-type: none">• where possible, choose quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;• operate plant and equipment in the quietest and most efficient manner; and

Table B.1 Management and mitigation measures

Aspect	Measures
	<ul style="list-style-type: none"> • regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively. <p>The safe working distances for cosmetic damage from vibrations will be monitored throughout the construction process. If safe working distances need to be encroached, real time vibration monitoring with audible and visual alarms will be installed at vibration sensitive structures so actual vibration levels can be monitored and managed appropriately in real-time.</p> <p>Operation</p> <p>The quarry will be operated generally in accordance with the quarry as previously assessed and approved including:</p> <ul style="list-style-type: none"> • hours of operation; • traffic movements (with a small increase); and • existing noise bunds. <p>Following approval of the proposed modification, the quarry’s noise management plan will be reviewed and updated if necessary.</p>
Surface water	<p>Following approval of the proposed modification, the water management plan for the site will be updated to include the new water management strategy for the quarry and to address any specific development consent or licence conditions. It will also include the following:</p> <ul style="list-style-type: none"> • baseline monitoring data results; • objectives and performance criteria including trigger levels for investigating any potential adverse impacts associated with water management; • details of the monitoring, inspection and maintenance programs; • reporting procedures for the results of the monitoring program; and • plans to respond to any exceedances of the performance criteria. <ul style="list-style-type: none"> • Surface water quality monitoring will continue within Oaky Creek, upstream and downstream of the site, and within the quarry pit and Water Management Dam. <p>All monitoring will be undertaken in accordance with Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales (DEC 2004).</p> <p>Inspections of the water management system will be undertaken informally on a regular basis and formally on a quarterly basis. The water management structures will be visually inspected for capacity, structural integrity and effectiveness. Maintenance, such as the removal of excessive sediment accumulation or macrophyte growth from the Water Management Dam and drainage lines, will be implemented as required.</p> <p>A discharge characterisation assessment will be undertaken post-approval (within 12 months of commencement of operations - providing discharges occur).</p>
Groundwater	<p>No additional groundwater mitigation measures are required as a result of the proposed modification. The quarry’s water management plan will be updated to include the new water management strategy for the site and to address any specific development consent or licence conditions.</p>
Land and soil	<p>Existing management plans (including the site water management plan and relevant subplans including erosion and sediment control plan required under Condition 24 of the consent will also be updated to account for the proposed modification.</p>
Traffic and transport	<p>The northern section of Adams Road, between the subject property access road and Elizabeth Drive, will be upgraded by the applicant so that the pavement is suitable for use by heavy vehicles, up to B-doubles, and so that the lane and shoulder widths meet Austroads Guidelines. Upgrades to the northern section of Adams</p>

Table B.1 Management and mitigation measures

Aspect	Measures
	<p>Road will include upgrades to the Adams Road/site access road intersection and the Elizabeth Drive/Adams Road intersection so that it is suitable for B-doubles.</p> <p>Quarry trucks will only travel on the section of Adams Road between Elizabeth Drive and the site access road. No quarry trucks will travel on Adams Road south of the quarry access road.</p> <p>The Road Transport Protocol, required by Schedule 4, Condition 42 of the consent, will be revised to reflect site access changes and new infrastructure layout.</p> <p>Existing quarry roads will be used. These tracks may receive improvements but will not encroach on areas of native vegetation.</p> <p>WSA will be notified, prior to the start of road upgrade work on Adams Road.</p>
Biodiversity	<p>The proposed mitigation measures to mitigate indirect impacts to the biodiversity values on site will include:</p> <ul style="list-style-type: none"> • operations will be carried out in accordance with the vegetation management plan which will be revised prior to the restart of quarrying operations; • a speed limit of 40 kilometres per hour (km/h) will apply on the sealed site access road and 20 km/h on unsealed internal roads; • roads will be regularly be maintained by managing vegetation on the shoulder to main visibility to prevent vehicle strike; and • an ecologist will be present during the removal of the final water from the depression and sump around the dewatering pipe inlet (about 10 m by 10 m). Any native animals captured would be moved to the adjacent Pond 2 or Pond 3 outside the quarry pit.
Rehabilitation	<p>The Site Rehabilitation Plan (Connacher Environmental Group 2009) will be updated to include the changes relevant to the proposed modification and subsequently implemented in accordance with Schedule 4 Condition 33 of the consent.</p>
Visual	<p>The site vegetation management plan will be updated prior the restart of quarrying operations. This update will consider opportunities for further vegetation screening.</p>
Heritage	<p>The following mitigation measures will be applied:</p> <ul style="list-style-type: none"> • AHIMS site #45-5-2280 will continue to be avoided and protected by fencing. • The corrected coordinates for AHIMS site #45-5-2280 will be entered in the AHIMS database. • The riparian corridor along the western bank of Oaky Creek will continue to be avoided by quarrying activities. • The work will proceed with caution and the following actions will be taken in accordance with the AHDD recommendations: <ul style="list-style-type: none"> – In the event that unexpected Aboriginal objects, sites or places are discovered, DPIE will be notified as soon as practicable after they are first identified. – In the event that known or suspected human skeletal remains are encountered, the following procedure will be followed: <ul style="list-style-type: none"> ▪ the immediate vicinity will be secured to protect the find and the find will be immediately reported to the work supervisor who will immediately advise the site supervisor or other nominated senior staff member; ▪ the environmental manager or other nominated senior staff member will notify the police and the state coroner on the same day of the find (as required for all human remains discoveries); ▪ the environmental manager or other nominated senior staff member will contact DPIE for advice on identification of the skeletal material as Aboriginal and if so, management of the material;

Table B.1 Management and mitigation measures

Aspect	Measures
	<ul style="list-style-type: none"> ▪ if it is determined that the skeletal material is ancestral Aboriginal remains, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains; ▪ the site will be recorded in accordance with the NPW Act and DPIE guidelines; and ▪ if the remains are historical and not of Aboriginal origin, the Heritage Division of DPIE will be notified for further instruction.
Hazards	<p>Oils and lubricants and any other hazardous materials (eg cleaning products) will be stored in designated bunded areas in accordance with the following Australian Standards:</p> <ul style="list-style-type: none"> • Australian Standard 1940: 2004 The Storage and Handling of Flammable and Combustible Liquids; and • Australian Standard 1596: 2008 The Storage and Handling of LP Gas. <p>Site management processes will periodically review conformance with these controls and standards.</p> <p>An Emergency/Evacuation Plan will be prepared for reactivated quarry operations consistent with the NSW RFS document Guidelines for the Preparation of Emergency/Evacuation Plan.</p>
Waste	<p>To encourage the efficient use of resources and reduce potential environmental impacts from the quarry, all waste will be managed in accordance with the waste hierarchy:</p> <ul style="list-style-type: none"> • reduce waste production; • recover resources; and • dispose of waste appropriately. <p>General waste management measures on site will include:</p> <ul style="list-style-type: none"> • working with suppliers to reduce overall packaging as much as possible; • storing cardboard packaging and recyclable containers until collection by a licensed recycling contractor, or dispatch to an appropriately licensed facility; and • storing general waste in vermin proof bins until a scheduled collection from a licensed contractor. <p>General waste management measures on site will include:</p> <ul style="list-style-type: none"> • working with suppliers to reduce overall packaging as much as possible; • storing cardboard packaging and recyclable containers until collection by a licensed recycling contractor or dispatch to an appropriately licensed facility; and • storage of general waste in vermin proof bins until a scheduled collection from a licensed contractor.



APPENDIX C –
Pavement investigation report





Pavement Investigation

Adams Road, Luddenham NSW 2745

Prepared for:
EMM Consulting
20 Chandos Street, St Leonards NSW 2065



Prepared by:
Durkin Construction Pty Ltd

Report ID: D18219-PIR001
Revision: D
Date Issued: 18/11/2020



Table of Content

1.0	Introduction.....	2
2.0	Field Investigation.....	3
2.1	Borehole Investigation	3
2.2	Borehole Investigation Photos	4
2.3	Falling Weight Deflectometer Testing	12
3.0	Laboratory Testing.....	13
4.0	Existing Pavement Analysis	14

Appendix A – Borehole Location Map

Appendix B – Borehole Logs

Appendix C – DCP Test Reports

Appendix D – FWD Test Reports

Appendix E – Laboratory Test Reports

Document Control

REPORT ID	REV NO.	DATE	AUTHOR	REVIEWER	VERSION
D18219-PIR001	A	07/09/2020	J. Zhang	J. Loney	For Review
D18219-PIR001	B	24/09/2020	J. Zhang	J. Loney	Added FWD data and analysis
D18219-PIR001	C	02/10/2020	J. Zhang	J. Loney	Added additional FWD data and analysis
D18219-PIR001	D	18/11/2020	J. Zhang	J. Loney	Updated the pavement analysis based on the new traffic data provided by EMM Consulting

Reference Documents

Austrroads Guide to Pavement Technology Part 2: Pavement Structural Design, 2017, Austrroads, NSW (AGPT02-17)

Austrroads Guide to Pavement Technology Part 5: Pavement Evaluation and Treatment Design, 2019, Austrroads, NSW (AGPT05-19)

1.0 Introduction

At the request of **EMM Consulting**, a project level pavement investigation was conducted by **Durkin Construction (DC)** on Adams Road, Luddenham. The scope covers the section of road within 340 metres from Elizabeth Drive. The objective of the investigation was to investigate the existing condition of the pavement and provide an estimate on remaining structural life.

This pavement investigation comprised of shallow borehole investigation, Falling Weight Deflectometer (FWD) testing, Dynamic Cone Penetrometer (DCP) testing and sampling of pavement material for laboratory testing. The borehole locations are highlighted below in Figure 1.0.1. Detailed borehole location map is attached in Appendix A.



Figure 1.0.1 – Scope of Works (Overview)

2.0 Field Investigation

2.1 Borehole Investigation

The fieldwork consisted of drilling five (5) no. 150mm diameter shallow pavement boreholes to 1.5m depth. The borehole locations were selected in staggered locations within the scope given by **EMM Consulting**. All materials were logged as per guidelines in AS1726-2017 using the field tactile method.

Dynamic Cone Penetrometer (DCP) Tests were carried out as per AS1289.6.3.2 from the top of the subgrade to 1.5m depth or refusal at each borehole location to determine the in-situ subgrade CBR.

A summary of the findings from each borehole is shown below in Table 2.1.1. Detailed borehole logs are attached in Appendix B.

BOREHOLE LOCATION	DEPTH OF PAVEMENT MATERIAL (mm)	PAVEMENT MATERIAL DESCRIPTION	CBR FIELD DCP TESTS [%]
BH1	0-65	ASPHALT	-
	65-270	SANDY GRAVEL (CEMENT TREATED)	-
	270-1500	SILTY CLAY	4
BH2	0-20	SPRAYED SEAL	-
	20-225	GRAVELLY SAND (CEMENT TREATED)	-
	225-1500	SILTY CLAY	6
BH3	0-25	SPRAYED SEAL	-
	25-245	GRAVELLY SAND (CEMENT TREATED)	-
	245-1500	SANDY CLAY	8
BH4	0-20	SPRAYED SEAL	-
	20-160	GRAVELLY SAND (CEMENT TREATED)	-
	160-1500	SANDY CLAY	19
BH5	0-15	SPRAYED SEAL	-
	15-260	GRAVELLY SAND (CEMENT TREATED)	-
	260-490	GRAVELLY SAND	-
	490-1500	SANDY CLAY	8

Table 2.1.1 – Summary of Field Investigations

See Appendix C for DCP test reports.

2.2 Borehole Investigation Photos



Figure 2.2.1 – BH1: Pavement Surface Condition



Figure 2.2.2 – BH1: Existing Pavement Structure



Figure 2.2.3 – BH1: Existing Pavement Materials (Top to Bottom)



Figure 2.2.4 – BH2: Pavement Surface Condition



Figure 2.2.5 – BH2: Existing Pavement Structure



Figure 2.2.6 – BH3: Existing Pavement Materials (Top to Bottom)



Figure 2.2.7 – BH3: Pavement Surface Condition



Figure 2.2.8 – BH3: Existing Pavement Structure



Figure 2.2.9 – BH3: Existing Pavement Materials (Top to Bottom)



Figure 2.2.10 – BH4: Pavement Surface Condition



Figure 2.2.11 – BH4: Existing Pavement Structure



Figure 2.2.12 – BH4: Existing Pavement Materials (Top to Bottom)



Figure 2.2.13 – BH5: Pavement Surface Condition



Figure 2.2.14 – BH5: Existing Pavement Structure



Figure 2.2.15 – BH5: Existing Pavement Materials (Top to Bottom)

2.3 Falling Weight Deflectometer Testing

Falling Weight Deflectometer (FWD) Testing was carried out on 22nd September and 1st October 2020 during day shift to investigate the existing pavement condition and to estimate the pavement remaining life. A 40kN (566kPa) plate loading was used as per AGPT05-19 recommendations. A test was carried out every 10m along both outer wheel paths (OWP), and along the Northbound Inner Wheel Path (IWP).

The maximum deflections at each test point are plotted in Figure 2.3.1 below. Based on the findings from the field boreholes, the base material is believed to be cement modified but not in a bound state. For FWD testing and analysis this pavement material has been treated as unbound granular with thin bituminous surfacing (AGPT05-19).

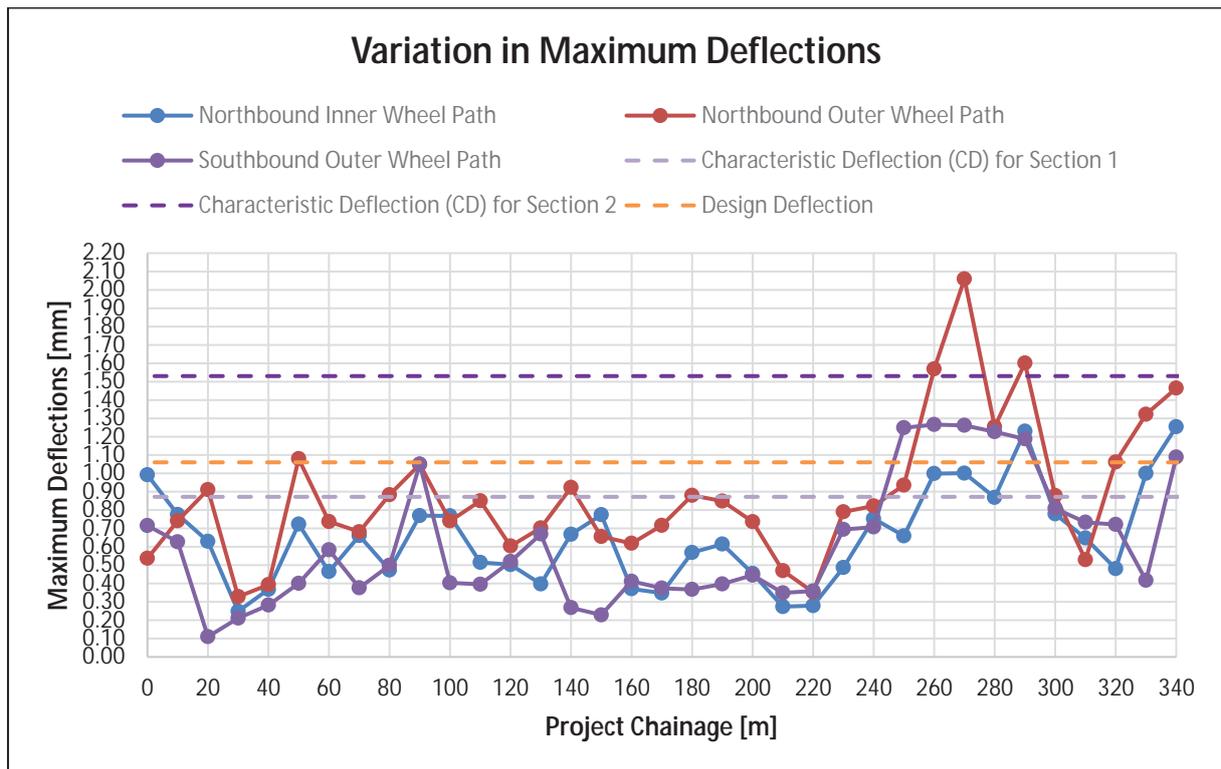


Figure 2.3.1 – Variation in Maximum Deflection along project

As seen in Figure 2.3.1, the maximum deflections are generally consistent between wheel paths along the length of the scope with a clear step change in maximum deflections at CH250. CH0 was taken from Elizabeth Drive end of the scope. The section with high deflections are in the area which is next to the development site access between CH250-290m. A design deflection based on 20 years of existing traffic loading has been calculated as per AGPT05-19 which has been used as a reference for the existing pavement performance.

The pavement is recommended to be divided into 2 sub-sections based on the FWD data. Section 1 is between Chainage 0 and 250m and Section 2 is between Chainage 250m and 340m. A corrected characteristic deflection (CD) for each sub-section of pavement has been calculated for analysis. For each sub section, this has been calculated as the average maximum deflection plus 1.3 times the standard deviation. Seasonal and temperature correction factors have also been added based on AGPT05 recommendations.

The CD for section 1 is below the design deflection which indicates an adequate pavement structural performance (Remaining structural life is greater than the 20 year design loading) . In contrast to section 1, the CD for section 2 exceeds the design traffic by 0.47mm which indicates the pavement has already reached the end of its structural deisgn life.

	Section Start	Section End	Average Maximum Deflection [mm]	Standard Deviation	Corrected Characterisitic Deflection [mm]
Section 1	0	250	0.41	0.16	0.87
Section 2	250	290	0.75	0.26	1.53

Figure 2.3.2 – Characterisitic deflection of each sub-section

See Appendix D for detailed FWD reports.

3.0 Laboratory Testing

Laboratory soaked CBR tests were requested for each subgrade sample collected from site. A summary of the laboratory testing results is shown below in Figure 3.1. All testings were carried out by Durkin's NATA accredited laboratory to Australian Standard.

BOREHOLE LOCATION	DEPTH OF SAMPLE (mm)	SAMPLE DESCRIPTION	CBR LAB 4-DAY SOAKED [%]
BH1	270-1500	Silty CLAY	12.0
BH2	225-1500	Silty CLAY	14.0
BH3	245-1500	Sandy CLAY	7.0
BH4	160-1500	Sandy CLAY	6.0
BH5	490-1500	Sandy CLAY	16.0

Figure 3.1 – Summary of Laboratory Testing Results

A design subgrade CBR of 6.0% is recommended for this project. See Appendix E for the detailed laboratory test reports.

4.0 Existing Pavement Analysis

A traffic volume survey was undertaken by EMM Consulting on Adams Road between 27th November and 3rd December 2019. This data shows an Annual Average Daily Traffic (AADT) of 2099 with 7.2% heavy vehicles (HV%) – 151 heavy vehicles per day. All the parameters in Table 4.1 below have been adopted for the estimation of the remaining life of the existing pavement (in years).

Design Parameter	Value
Annual Average Daily Traffic (AADT)	2,099
Average Percentage of Heavily Vehicles (HV%)	7.2
Direction Factor (DF)	0.5
Lane Distribution Factor (LDF)	1.0
Average Number of Axle Groups Per Heavy Vehicle (H _{HVAG})	2.5
Average Number of Equivalent Standard Axles Per Heavy Vehicle Axle Group (ESA/HVAG)	1.0
Growth Rate [%]	2.0

Table 4.1 – Traffic Loading Parameters

The additional traffic given by EMM Consulting has been used for analysis for the estimate of the reduction of pavement remaining life in both scenarios. The existing pavement traffic has 151 heavy vehicles per day. The Modification 5 scenario would increase this by 100 to 251 and the State Significant Development (SSD) scenario would increase this by 559 to 710. The load distribution of each additional heavy vehicle is assumed to be similar to that assumed for the existing heavy vehicles for this analysis.

A summary of estimated remaining life for each scenario is shown below in Table 4.2. The estimated remaining life has been capped at 20 years for this analysis. Figure 9.2 of AGPT05-19 has been used to estimate remaining life based on the FWD deflections.

Scenario for Analysis	Design Traffic Loading over 20 years (ESA)	Section 1 (CH0-250m) – Estimated Remaining Life (Years)	Section 2 (CH250-340m) – Estimated Remaining Life (Years)
Existing Traffic Loading	1.7 x 10 ⁶	20	0
Modification 5 (MOD 5)	2.8 x 10 ⁶	11	0
State Significant Development (SSD)	7.9 x 10 ⁶	2	0

Table 4.2 – Summary of Estimated Pavement Remaining Life



APPENDIX A

Borehole Locating Map

Adams Road, Luddenham (From Elizabeth Drive + 300m)





APPENDIX B

Borehole Logs

Engineering Log - Borehole

Project No.: D18219

Client: EMM Consulting	Commenced: 26/08/2020
Project Name: Adams Road, Luddenham	Completed: 26/08/2020
Hole Location: Adams Road, Luddenham	Logged By: JZ
Hole Position: CH 20.5m O/S 3.6m SCL	Checked By: JL

Drill Model and Mounting: Mechanical Auger	Inclination: -90°	RL Surface: No survey
Hole Diameter: 150 mm	Bearing: 270°	Datum: AHD Operator: SC/TN

Drilling Information				Soil Description						Observations				
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Hand Penetrometer UCS (kPa)	Structure and Additional Observations
							0.0			ASPHALT: AC14	D			
							0.1		GP	Sandy GRAVEL: Non Plastic, 20mm NS, Poorly Graded, Sub Rounded, Brown, Dry	D			0.07: Cement treated material
				SA101 B 0.27-1.50 m			0.2							
				DCP Test Started 0.38 m			0.3		CI	Silty CLAY: Medium Plasticity, Brown, Moist, Soft				0.27: Organic material
			Not Encountered				0.4							
							0.5							
							0.6							
							0.7							
							0.8							
							0.9				M	S		
							1.0							
							1.1							
							1.2							
							1.3							
							1.4							
							1.5			Hole Terminated at 1.50 m Target depth				
							1.6							

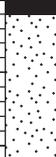
Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration No resistance ranging to refusal	Water Level (Date) Inflow Partial Loss Complete Loss	Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test	Moisture Condition D - Dry M - Moist W - Wet	Consistency/Relative Density VS - Very Soft S - Soft F - Firm VSt - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense
Support C - Casing	Graphic Log/Core Loss Core recovered (hatching indicates material) Core loss	Classification Symbols and Soil Descriptions Based on Unified Soil Classification System	Plastic Limit < PL = PL < PL		

Engineering Log - Borehole

Project No.: D18219

Client: EMM Consulting	Commenced: 26/08/2020
Project Name: Adams Road, Luddenham	Completed: 26/08/2020
Hole Location: Adams Road, Luddenham	Logged By: JZ
Hole Position: CH 95.5m O/S 1.8m NCL	Checked By: JL

Drill Model and Mounting: Mechanical Auger	Inclination: -90°	RL Surface: No survey
Hole Diameter: 150 mm	Bearing: 270°	Datum: AHD Operator: SC/TN

Drilling Information				Soil Description						Observations				
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Hand Penetrometer UCS (kPa)	Structure and Additional Observations
							0.02		SP	SPRAYED SEAL: 14mm Gravelly SAND: Non Plastic, 14mm NS, Poorly Graded, Sub Rounded, Brown, Dry	D		100 200 300 400 500	0.02: Cement treated material
				SA201 B 0.23-1.50 m DCP Test Started 0.33 m			0.23		CI	Silty CLAY: Medium Plasticity, Brown, Moist, Soft				0.23: Organic material
			Not Encountered				1.5			Hole Terminated at 1.50 m Target depth				

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration  No resistance ranging to refusal	Water  Level (Date)  Inflow  Partial Loss  Complete Loss	Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test	Moisture Condition D - Dry M - Moist W - Wet	Consistency/Relative Density VS - Very Soft S - Soft F - Firm VSt - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense
Support C - Casing	Graphic Log/Core Loss  Core recovered (hatching indicates material)  Core loss	Classification Symbols and Soil Descriptions Based on Unified Soil Classification System	Plastic Limit < PL = PL < PL		

Engineering Log - Borehole

Project No.: D18219

Client: EMM Consulting	Commenced: 26/08/2020
Project Name: Adams Road, Luddenham	Completed: 26/08/2020
Hole Location: Adams Road, Luddenham	Logged By: JZ
Hole Position: CH 170.5m O/S 1.8m SCL	Checked By: JL

Drill Model and Mounting: Mechanical Auger	Inclination: -90°	RL Surface: No survey
Hole Diameter: 150 mm	Bearing: 270°	Datum: AHD Operator: SC/TN

Drilling Information				Soil Description						Observations				
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Hand Penetrometer UCS (kPa)	Structure and Additional Observations
							0.1		SP	SPRAYED SEAL: 14mm Gravelly SAND: Non Plastic, 14mm NS, Poorly Graded, Sub Rounded, Brown, Dry	D			0.00: Polishing in wheelpaths and minor longitudinal cracking 0.03: Cement treated material
				SA301 B 0.25-1.50 m DCP Test Started 0.29 m			0.2							
			Not Encountered				0.3		CI	Sandy CLAY: Medium Plasticity, Brown-Red, Moist, Firm				
							0.4							
							0.5							
							0.6							
							0.7							
							0.8							
							0.9				M	F		
							1.0							
							1.1							
							1.2							
							1.3							
							1.4							
							1.5			Hole Terminated at 1.50 m Target depth				
							1.6							

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration No resistance ranging to refusal	Water Level (Date) Inflow Partial Loss Complete Loss	Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test	Moisture Condition D - Dry M - Moist W - Wet	Consistency/Relative Density VS - Very Soft S - Soft F - Firm VSt - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense
Support C - Casing	Graphic Log/Core Loss Core recovered (hatching indicates material) Core loss	Classification Symbols and Soil Descriptions Based on Unified Soil Classification System	Plastic Limit < PL = PL > PL		

Engineering Log - Borehole

Project No.: D18219

Client: EMM Consulting	Commenced: 26/08/2020
Project Name: Adams Road, Luddenham	Completed: 26/08/2020
Hole Location: Adams Road, Luddenham	Logged By: JZ
Hole Position: CH 245.5m O/S 1.8m NCL	Checked By: JL

Drill Model and Mounting: Mechanical Auger	Inclination: -90°	RL Surface: No survey
Hole Diameter: 150 mm	Bearing: 270°	Datum: AHD Operator: SC/TN

Drilling Information				Soil Description						Observations				
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Hand Penetrometer UCS (kPa)	Structure and Additional Observations
				SA401 B 0.16-1.50 m DCP Test Started 0.23 m			0.1		SP	SPRAYED SEAL: 14mm Gravelly SAND: Non Plastic, 14mm NS, Poorly Graded, Sub Rounded, Brown, Dry	D			0.00: Polishing in wheelpaths 0.02: Cement treated material
							0.2		CL	Sandy CLAY: Low Plasticity, Brown-Yellow, Dry, Firm				
			Not Encountered				0.3							
							0.4							
							0.5							
							0.6							
							0.7							
							0.8							
							0.9							
							1.0							
							1.1							
							1.2							
							1.3							
							1.4							
							1.5			Hole Terminated at 1.50 m Target depth				
							1.6							

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration No resistance ranging to refusal	Water Level (Date) Inflow Partial Loss Complete Loss	Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test	Moisture Condition D - Dry M - Moist W - Wet	Consistency/Relative Density VS - Very Soft S - Soft F - Firm VSt - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense
Support C - Casing	Graphic Log/Core Loss Core recovered (hatching indicates material) Core loss	Classification Symbols and Soil Descriptions Based on Unified Soil Classification System	Plastic Limit < PL = PL > PL		

Engineering Log - Borehole

Project No.: D18219

Client: EMM Consulting	Commenced: 26/08/2020
Project Name: Adams Road, Luddenham	Completed: 26/08/2020
Hole Location: Adams Road, Luddenham	Logged By: JZ
Hole Position: CH 320.5m O/S 2.0m SCL	Checked By: JL

Drill Model and Mounting: Mechanical Auger	Inclination: -90°	RL Surface: No survey
Hole Diameter: 150 mm	Bearing: 270°	Datum: AHD Operator: SC/TN

Drilling Information				Soil Description						Observations				
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Hand Penetrometer UCS (kPa)	Structure and Additional Observations
							0.0		SP	SPRAYED SEAL: 14mm	D			0.00: Polishing in wheelpaths 0.02: Cement treated material
							0.1		SP	Gravelly SAND: Non Plastic, 14mm NS, Poorly Graded, Sub Rounded, Brown, Dry	D			
							0.2		SP	Gravelly SAND: Non Plastic, 14mm NS, Poorly Graded, Sub Rounded, Brown, Moist	M			
				SA501 B 0.49-1.50 m DCP Test Started 0.54 m			0.3		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
			Not Encountered				0.4		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							0.5		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							0.6		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							0.7		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							0.8		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							0.9		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							1.0		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm	D	F		
							1.1		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							1.2		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							1.3		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							1.4		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							1.5		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
							1.6		CL	Sandy CLAY: Low Plasticity, Brown-Red, Dry, Firm				
										Hole Terminated at 1.50 m Target depth				

Method AS - Auger Screwing RR - Rock Roller WB - Washbore	Penetration 	Water 	Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test	Moisture Condition D - Dry M - Moist W - Wet	Consistency/Relative Density VS - Very Soft S - Soft F - Firm VSt - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense
Support C - Casing	Graphic Log/Core Loss 	Classification Symbols and Soil Descriptions Based on Unified Soil Classification System	Plastic Limit < PL = PL > PL		



APPENDIX C

DCP Test Report



APPENDIX D

FWD Test Reports

FWD/HWD Report



Durkin Construction Pty Ltd

Silverwater Laboratory

Unit 3, 50-52 Derby Street Silverwater NSW 1811

Phone: (02) 9712 0308

Fax: (02) 9647 1984

Email: info@durkinconstruction.com.au

Job Number: D18219 **Report Number:** D18219-Adams

Project Name: Adams Road, Luddenham

Date Tested: 22/09/2020 **Client:** EMM Consulting

Filters Applied: None

Time Tested: 10:09-11:08 **Contact:** Abdullah Uddin

Operator: D. Carollo

Target Load: 40kN / 566kPa **GPS Model / Datum:** BX982 / GDA

Test Equipment: HWD-175

Chainage	Lane	Wheel Path	GPS Location		Peak Load [kPa]	FWD Deflection Results [µm]													Normalised Deflection Results [µm]										Temperature [°C]		FWD/HWD [mm]			Remaining Life [Years]	Pavement Condition
						Offset from Load [mm]													Offset from Load [mm]										Surface	Air	D _{max}				
						0	200	300	450	600	750	900	1200	1500	0	200	300	450	600	750	900	1200	1500	D _{MAX}	Corrected	CF									
Lat	Long																																		
0	NB	IWP	-33.86906	150.71818	544	680	502	394	267	182	136	96	67	51	708	522	410	278	189	142	100	70	53	34.2	25.8	0.71	0.99	0.19	20						
10	NB	IWP	-33.86913	150.71822	524	513	368	292	212	162	135	100	66	47	554	397	316	229	174	145	108	71	51	34.8	26.4	0.55	0.78	0.16	20						
20	NB	IWP	-33.86921	150.71819	539	428	370	321	256	204	169	124	78	53	449	389	337	269	214	177	130	82	56	35.3	26.1	0.45	0.63	0.06	20						
30	NB	IWP	-33.86928	150.71812	510	160	144	136	121	110	100	84	64	50	177	159	151	134	122	111	93	71	55	36.7	26.0	0.18	0.25	0.02	20						
40	NB	IWP	-33.86933	150.71803	529	245	223	206	172	140	119	92	66	49	262	239	221	184	149	127	99	71	52	37.0	25.1	0.26	0.37	0.02	20						
50	NB	IWP	-33.86939	150.71794	571	521	394	332	255	208	182	146	101	69	516	390	329	253	206	180	145	100	69	36.3	24.8	0.52	0.72	0.13	20						
60	NB	IWP	-33.86944	150.71786	549	322	270	242	198	165	139	106	69	47	332	279	249	205	170	144	109	71	48	35.4	24.8	0.33	0.47	0.05	20						
70	NB	IWP	-33.86950	150.71778	560	466	409	349	297	237	207	168	111	70	471	414	353	300	240	209	170	112	70	36.3	24.8	0.47	0.66	0.06	20						
80	NB	IWP	-33.86955	150.71769	545	325	292	272	236	208	184	147	102	68	338	303	282	245	216	191	152	106	71	25.8	25.1	0.34	0.47	0.03	20						
90	NB	IWP	-33.86960	150.71761	577	560	399	321	241	190	158	123	85	64	549	392	315	236	187	155	120	83	63	38.5	26.4	0.55	0.77	0.16	20						
100	NB	IWP	-33.86965	150.71751	562	544	454	413	342	281	234	173	110	70	548	457	415	344	283	235	174	111	70	38.4	24.6	0.55	0.77	0.09	20						
110	NB	IWP	-33.86970	150.71743	559	363	329	301	261	221	187	143	90	52	367	333	304	264	224	190	144	91	53	27.6	25.0	0.37	0.51	0.03	20						
120	NB	IWP	-33.86975	150.71735	546	346	308	281	240	207	181	142	92	63	359	319	291	248	214	188	147	95	65	35.3	25.7	0.36	0.50	0.04	20						
130	NB	IWP	-33.86980	150.71726	541	271	238	220	190	168	147	118	78	55	284	249	230	199	176	154	123	82	58	36.0	25.1	0.28	0.40	0.03	20						
140	NB	IWP	-33.86986	150.71718	593	499	407	327	233	165	126	80	48	35	477	388	312	222	157	120	77	46	34	35.5	25.5	0.48	0.67	0.09	20						
150	NB	IWP	-33.86991	150.71709	567	554	450	394	315	271	246	200	131	83	553	449	393	315	271	246	199	131	83	35.8	25.6	0.55	0.77	0.10	20						
160	NB	IWP	-33.86996	150.71701	555	260	223	202	167	136	114	83	53	35	265	227	205	170	138	116	85	54	36	36.0	25.6	0.26	0.37	0.04	20						
170	NB	IWP	-33.87002	150.71692	552	242	208	187	151	123	103	76	47	30	248	213	191	154	126	106	77	48	31	36.1	25.5	0.25	0.35	0.03	20						
180	NB	IWP	-33.87007	150.71683	557	400	365	343	291	248	210	157	90	55	406	371	349	296	252	213	159	91	56	35.8	26.0	0.41	0.57	0.04	20						
190	NB	IWP	-33.87012	150.71674	560	434	360	322	264	207	168	121	71	41	438	364	325	267	209	169	123	72	41	37.1	25.9	0.44	0.61	0.07	20						
200	NB	IWP	-33.87017	150.71666	556	319	288	258	213	176	148	111	68	42	325	293	263	217	179	150	113	69	43	33.7	25.5	0.32	0.46	0.03	20						

210	NB	IWP	-33.87023	150.71657	571	197	155	139	115	97	82	65	40	30	195	154	137	114	96	81	64	40	30	29.8	25.7	0.20	0.27	0.04	20
220	NB	IWP	-33.87028	150.71649	557	196	160	146	123	106	91	73	48	33	199	162	148	125	108	92	74	49	34	36.2	25.9	0.20	0.28	0.04	20
230	NB	IWP	-33.87033	150.71640	541	332	269	243	203	167	142	107	67	45	347	282	254	212	174	149	112	70	47	37.4	25.6	0.35	0.49	0.07	20
240	NB	IWP	-33.87038	150.71632	572	543	412	328	249	199	163	121	75	49	538	408	324	247	197	162	120	74	48	36.9	24.8	0.54	0.75	0.13	20
250	NB	IWP	-33.87044	150.71623	596	495	369	300	225	164	129	85	51	34	470	351	284	214	155	123	81	48	32	36.3	25.6	0.47	0.66	0.12	20
260	NB	IWP	-33.87049	150.71615	593	747	552	449	340	268	223	166	108	70	713	526	428	325	256	213	158	103	67	36.2	24.8	0.71	1.00	0.19	20
270	NB	IWP	-33.87054	150.71607	582	734	522	406	290	224	183	137	87	59	714	508	394	282	218	178	133	85	57	36.2	25.1	0.71	1.00	0.21	20
280	NB	IWP	-33.87059	150.71598	579	634	493	403	296	221	175	124	77	53	620	482	394	289	216	171	121	76	51	36.3	24.6	0.62	0.87	0.14	20
290	NB	IWP	-33.87064	150.71590	595	922	647	519	378	288	230	163	102	67	877	615	493	360	274	218	155	97	63	24.9	23.5	0.88	1.23	0.26	8
300	NB	IWP	-33.87069	150.71581	557	547	450	392	301	237	191	137	83	54	556	457	398	306	241	194	139	85	54	36.2	23.8	0.56	0.78	0.10	20
310	NB	IWP	-33.87074	150.71572	577	471	351	299	237	190	157	116	70	47	462	345	293	232	186	154	114	69	46	30.3	23.6	0.46	0.65	0.12	20
320	NB	IWP	-33.87080	150.71564	566	343	253	216	177	145	125	97	65	47	343	253	216	177	145	125	97	65	47	28.4	23.7	0.34	0.48	0.09	20
330	NB	IWP	-33.87085	150.71555	598	754	473	367	256	194	158	110	72	50	713	447	347	242	183	150	104	68	47	34.9	24.0	0.71	1.00	0.27	20
340	NB	IWP	-33.87090	150.71547	601	950	673	543	401	281	216	146	92	65	895	634	511	378	265	204	138	87	62	33.2	24.5	0.89	1.25	0.26	7
0	NB	OWP	-33.86905	150.71815	538	364	318	279	220	176	146	108	75	55	383	335	293	231	185	153	114	78	58	34.0	24.2	0.38	0.54	0.05	20
10	NB	OWP	-33.86911	150.71821	541	506	424	362	272	205	166	116	71	48	529	443	378	284	214	174	121	74	51	35.3	24.3	0.53	0.74	0.09	20
20	NB	OWP	-33.86918	150.71819	562	646	480	390	268	189	151	102	67	50	650	483	393	270	190	152	103	67	50	35.5	23.9	0.65	0.91	0.17	20
30	NB	OWP	-33.86925	150.71812	540	224	195	177	151	130	114	93	67	50	234	205	186	158	136	119	98	71	53	34.8	23.5	0.23	0.33	0.03	20
40	NB	OWP	-33.86930	150.71804	537	267	239	200	154	134	122	96	70	56	281	251	211	163	141	129	101	74	59	35.8	23.6	0.28	0.39	0.03	20
50	NB	OWP	-33.86936	150.71796	553	753	584	479	358	287	241	175	102	66	770	597	490	366	294	246	179	104	68	35.1	23.6	0.77	1.08	0.17	18
60	NB	OWP	-33.86942	150.71787	575	535	422	357	265	199	162	117	84	59	526	416	352	261	196	159	115	82	58	31.9	23.9	0.53	0.74	0.11	20
70	NB	OWP	-33.86946	150.71779	556	478	443	403	314	267	228	176	104	65	487	451	410	319	271	232	179	106	66	35.3	23.7	0.49	0.68	0.04	20
80	NB	OWP	-33.86951	150.71769	564	628	489	398	308	245	202	144	89	67	631	490	399	309	246	202	144	89	67	23.1	24.9	0.63	0.88	0.14	20
90	NB	OWP	-33.86957	150.71761	584	772	650	507	344	239	183	132	81	59	748	630	491	333	232	177	128	78	57	36.2	25.3	0.75	1.05	0.12	20
100	NB	OWP	-33.86962	150.71752	550	514	432	358	255	195	158	116	75	54	528	445	368	263	201	163	119	77	56	35.7	23.6	0.53	0.74	0.08	20
110	NB	OWP	-33.86968	150.71744	569	610	456	381	267	202	160	110	65	46	607	453	378	265	201	159	109	65	45	26.0	23.6	0.61	0.85	0.15	20
120	NB	OWP	-33.86972	150.71735	561	427	362	319	257	207	175	127	79	50	431	365	322	259	209	177	128	79	50	34.6	24.7	0.43	0.60	0.07	20
130	NB	OWP	-33.86978	150.71727	568	503	408	365	328	285	249	198	129	94	501	406	363	327	284	248	197	128	94	35.6	24.0	0.50	0.70	0.09	20
140	NB	OWP	-33.86983	150.71718	575	669	574	494	362	263	214	134	81	54	659	565	486	356	259	211	132	79	53	34.5	23.7	0.66	0.92	0.09	20
150	NB	OWP	-33.86988	150.71709	580	480	372	287	208	160	127	91	56	39	468	363	280	203	156	124	89	55	38	35.1	23.6	0.47	0.66	0.10	20
160	NB	OWP	-33.86993	150.71701	584	456	418	391	333	259	215	163	98	47	441	405	379	323	251	208	158	95	46	36.0	23.8	0.44	0.62	0.04	20
170	NB	OWP	-33.86999	150.71692	568	513	417	333	250	186	148	99	56	35	511	415	332	250	186	147	99	55	35	27.8	23.9	0.51	0.72	0.10	20
180	NB	OWP	-33.87004	150.71684	569	632	540	461	358	260	197	123	60	39	628	537	458	356	258	196	122	60	38	35.8	23.7	0.63	0.88	0.09	20
190	NB	OWP	-33.87009	150.71675	579	620	481	380	255	179	144	102	61	41	606	471	372	249	175	141	100	60	40	35.9	24.1	0.61	0.85	0.13	20
200	NB	OWP	-33.87016	150.71666	603	560	458	363	276	204	154	108	64	45	526	430	341	259	191	145	101	60	43	33.8	24.5	0.53	0.74	0.10	20
210	NB	OWP	-33.87020	150.71658	560	332	281	228	180	149	127	94	58	38	335	284	231	182	151	128	95	59	39	30.1	24.5	0.34	0.47	0.05	20

220	NB	OWP	-33.87025	150.71649	565	252	202	173	147	122	107	83	57	40	252	202	173	147	122	107	83	57	40	34.6	25.0	0.25	0.35	0.05	20
230	NB	OWP	-33.87030	150.71640	564	562	438	335	240	178	142	105	65	43	564	439	337	241	179	142	106	65	43	36.2	24.4	0.56	0.79	0.12	20
240	NB	OWP	-33.87036	150.71632	572	593	458	346	240	176	137	92	66	44	587	453	342	238	174	136	91	65	43	34.5	24.6	0.59	0.82	0.13	20
250	NB	OWP	-33.87041	150.71623	599	707	526	398	255	164	120	74	41	32	668	497	376	241	155	113	70	39	31	34.3	24.2	0.67	0.94	0.17	20
260	NB	OWP	-33.87047	150.71614	594	1175	833	656	474	356	286	201	113	75	1120	794	625	452	339	272	192	108	72	34.1	23.7	1.12	1.57	0.33	1
270	NB	OWP	-33.87052	150.71606	600	1558	1132	853	586	431	337	232	141	95	1469	1068	805	553	406	318	219	133	90	32.5	23.6	1.47	2.06	0.40	0
280	NB	OWP	-33.87057	150.71597	598	946	724	541	353	230	173	121	76	52	895	686	512	334	217	164	114	72	49	34.3	24.5	0.89	1.25	0.21	7
290	NB	OWP	-33.87062	150.71588	586	1183	841	644	429	303	228	160	102	72	1142	812	622	414	293	220	154	98	69	22.8	24.2	1.14	1.60	0.33	1
300	NB	OWP	-33.87068	150.71580	577	640	520	434	328	245	200	141	87	58	627	510	426	321	241	196	138	86	57	34.9	23.9	0.63	0.88	0.12	20
310	NB	OWP	-33.87073	150.71571	559	373	335	305	254	209	177	134	83	53	378	339	309	257	212	179	135	84	54	28.0	23.0	0.38	0.53	0.04	20
320	NB	OWP	-33.87078	150.71563	616	825	534	385	253	183	148	105	72	50	758	490	354	233	168	136	96	66	46	25.0	22.9	0.76	1.06	0.27	20
330	NB	OWP	-33.87084	150.71554	641	1068	676	495	324	237	181	125	80	55	943	597	437	286	209	160	111	71	49	34.4	23.1	0.94	1.32	0.35	5
340	NB	OWP	-33.87089	150.71546	594	1097	840	687	510	394	309	223	139	93	1045	800	654	486	375	295	212	133	89	31.2	23.0	1.04	1.46	0.24	2
0	SB	OWP	-33.86912	150.71841	530	478	325	247	160	104	75	51	35	26	510	347	263	170	111	80	55	37	28	34.1	26.1	0.51	0.72	0.16	20
10	SB	OWP	-33.86917	150.71832	521	412	313	251	175	131	105	79	55	41	448	340	273	190	142	114	86	60	44	36.7	26.1	0.45	0.63	0.11	20
20	SB	OWP	-33.86923	150.71824	533	74	65	61	56	53	50	45	38	31	79	69	65	60	56	53	47	40	33	37.0	25.9	0.08	0.11	0.01	20
30	SB	OWP	-33.86928	150.71816	542	144	121	112	101	93	85	74	58	46	151	127	117	106	97	89	77	61	48	37.7	26.2	0.15	0.21	0.02	20
40	SB	OWP	-33.86933	150.71807	533	190	163	149	131	118	107	88	69	53	202	173	159	140	126	114	93	74	56	38.7	26.5	0.20	0.28	0.03	20
50	SB	OWP	-33.86939	150.71799	539	273	227	203	175	157	142	117	86	64	286	239	214	183	165	149	123	90	67	41.2	26.7	0.29	0.40	0.05	20
60	SB	OWP	-33.86944	150.71790	531	391	317	275	229	184	143	116	84	60	417	337	293	244	197	152	124	89	64	40.3	26.3	0.42	0.58	0.08	20
70	SB	OWP	-33.86950	150.71781	557	264	243	223	186	154	130	101	69	48	269	247	226	189	156	132	102	70	49	40.0	26.1	0.27	0.38	0.02	20
80	SB	OWP	-33.86955	150.71773	548	345	275	246	203	170	146	113	72	49	356	284	254	210	175	151	116	75	51	40.1	26.0	0.36	0.50	0.07	20
90	SB	OWP	-33.86960	150.71764	562	744	630	562	444	351	280	181	118	72	749	634	566	447	354	282	182	118	73	38.5	26.3	0.75	1.05	0.12	20
100	SB	OWP	-33.86965	150.71755	546	278	237	211	174	149	134	109	81	56	288	245	218	180	154	139	113	84	58	37.3	26.6	0.29	0.40	0.04	20
110	SB	OWP	-33.86971	150.71747	558	279	251	229	198	170	149	120	84	58	282	255	232	200	172	151	122	85	59	39.0	26.3	0.28	0.40	0.03	20
120	SB	OWP	-33.86976	150.71738	550	361	324	295	247	210	182	143	95	60	371	333	303	254	216	188	148	97	61	38.1	26.5	0.37	0.52	0.04	20
130	SB	OWP	-33.86981	150.71729	576	486	394	344	281	229	189	140	85	52	478	387	338	277	225	186	138	84	51	38.5	26.2	0.48	0.67	0.09	20
140	SB	OWP	-33.86987	150.71721	547	185	172	160	141	124	110	89	62	43	192	178	166	146	128	114	92	64	44	39.2	26.2	0.19	0.27	0.01	20
150	SB	OWP	-33.86992	150.71712	557	161	148	138	121	107	96	78	56	41	163	150	140	123	109	97	79	57	41	39.7	26.0	0.16	0.23	0.01	20
160	SB	OWP	-33.86997	150.71704	542	282	270	242	205	174	152	122	88	63	294	282	253	214	181	159	127	92	66	38.8	26.2	0.29	0.41	0.01	20
170	SB	OWP	-33.87003	150.71695	542	256	241	226	196	174	154	121	84	54	267	251	236	205	182	161	126	88	56	39.3	26.7	0.27	0.37	0.02	20
180	SB	OWP	-33.87008	150.71686	557	258	227	209	178	152	131	100	64	41	262	230	213	181	155	133	101	65	42	39.9	26.7	0.26	0.37	0.03	20
190	SB	OWP	-33.87014	150.71677	555	278	248	226	194	163	140	110	74	52	284	253	230	198	166	143	112	76	53	40.5	26.6	0.28	0.40	0.03	20
200	SB	OWP	-33.87019	150.71669	544	305	282	259	225	194	168	129	82	49	318	293	269	234	202	175	135	85	51	40.1	26.1	0.32	0.45	0.02	20
210	SB	OWP	-33.87024	150.71660	541	238	202	179	144	118	99	74	47	31	249	211	187	151	123	104	77	49	33	40.8	26.0	0.25	0.35	0.04	20
220	SB	OWP	-33.87030	150.71651	558	253	233	216	180	152	131	105	69	50	256	236	219	183	154	133	107	70	51	41.4	26.0	0.26	0.36	0.02	20

230	SB	OWP	-33.87035	150.71643	551	483	413	367	301	248	210	158	98	59	496	424	377	309	254	216	162	101	60	39.1	26.2	0.50	0.69	0.07	20
240	SB	OWP	-33.87040	150.71634	573	511	432	381	304	244	199	143	84	49	505	427	377	301	241	197	142	83	49	40.0	26.4	0.50	0.71	0.08	20
250	SB	OWP	-33.87045	150.71625	586	923	793	678	531	417	337	242	142	84	891	766	655	513	403	325	234	138	81	40.0	26.7	0.89	1.25	0.13	7
260	SB	OWP	-33.87051	150.71617	555	886	745	611	437	308	232	144	79	51	903	760	623	445	314	236	147	81	52	39.9	27.4	0.90	1.27	0.14	7
270	SB	OWP	-33.87056	150.71608	566	900	749	597	396	276	211	144	85	55	900	749	597	396	276	211	144	85	55	39.1	27.1	0.90	1.26	0.15	7
280	SB	OWP	-33.87061	150.71599	543	840	711	610	475	357	285	194	113	72	875	741	636	495	372	297	203	118	75	38.1	26.6	0.88	1.23	0.13	8
290	SB	OWP	-33.87066	150.71590	572	856	652	520	356	244	182	117	72	51	847	645	514	352	241	180	115	71	50	38.5	26.5	0.85	1.19	0.20	10
300	SB	OWP	-33.87071	150.71582	558	569	492	421	326	252	204	143	83	54	578	499	427	330	255	207	145	84	55	38.7	26.5	0.58	0.81	0.08	20
310	SB	OWP	-33.87077	150.71573	580	537	405	296	195	137	105	70	42	33	524	395	289	190	134	103	69	40	32	38.9	26.2	0.52	0.73	0.13	20
320	SB	OWP	-33.87082	150.71565	601	547	439	386	305	239	196	135	76	42	515	414	364	287	225	184	127	72	40	39.1	26.0	0.51	0.72	0.10	20
330	SB	OWP	-33.87088	150.71556	569	299	255	223	175	141	118	89	58	46	298	253	222	174	140	118	88	57	45	38.6	26.1	0.30	0.42	0.04	20
340	SB	OWP	-33.87093	150.71548	577	792	600	489	342	241	198	148	94	70	777	589	480	335	237	194	145	92	69	37.5	26.6	0.78	1.09	0.19	17

Average	35.5	25.2	0.51	0.71	0.10
Standard Deviation	4.0	1.1	0.25	0.35	0.08
CV	0.11	0.05	0.48	0.48	0.78

Seasonal Correction Factor	Temperature Deflection Correction Factor	Deflection Standardisation Factor	Design Traffic
1.3	0.98	1.1	1.68E+06

Corrected Characteristic Deflection [mm] - Section 1	0.87
Corrected Characteristic Deflection [mm] - Section 2	1.53
Design Deflection [mm]	1.06

Notes:

COL - Centre of Lane, IWP - Inner Wheelpath, OWP - Outer Wheelpath, NB - North Bound, SB - South Bound, EB - East Bound, WB - West Bound, PL - Left Parking Lane, PR - Right Parking Lane, TL - Left Traffic Lane, TR - Right Traffic Lane, OS - Outer Shoulder, IS - Inner Shoulder, FL - Fast Lane, SL - Slow Lane, CR - Crocodile Cracking, HO - Pothole, SR - Ravelling, DR - Rutting, SS - Stripping, PA - Patching

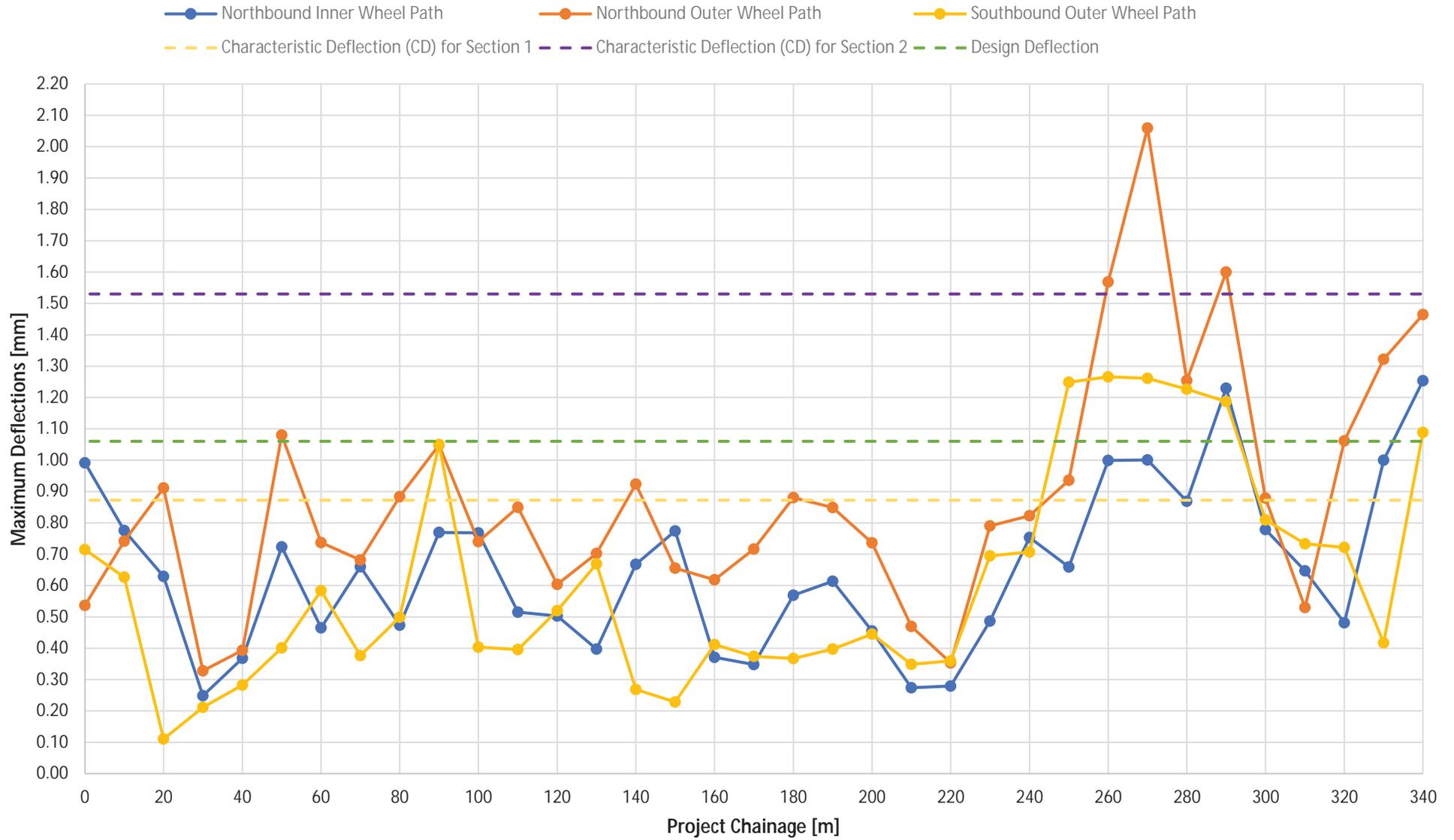
Chainage 0 is taken from North end

The estimated remaining life is only applicable to granular pavements with thin bituminous surfacing [AGPT05-19]

Report By:  Jack Zhang
Pavement Engineer

Approved By:  James Loney
Pavement Technology Manager / Senior Pavement Engineer

Variation in Maximum Deflections





APPENDIX E

Laboratory Test Reports

Material Test Report



Report Number: D18219-1
Issue Number: 1
Date Issued: 07/09/2020
Client: EMM Consulting
 Ground floor, 20 Chandos Street, St Leonards NSW 2065
Contact: Abdullah Uddin
Project Number: D18219
Project Name: Adams Road, Luddenham, NSW
Project Location: Adams Road, Luddenham, NSW
Client Reference: D18219 - D18219
Work Request: 942
Sample Number: 20-942A
Date Sampled: 25/08/2020
Dates Tested: 27/08/2020 - 31/08/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: BH1 , Depth: 270-1500mm
Lot No: BH1
Material: Silty Clay
Material Source: BH

Durkin Construction Pty Ltd
 Silverwater Laboratory
 Unit 3, 50-52 Derby Street Silverwater NSW 1811
 Phone: (02) 9712 0308
 Fax: (02) 9647 1984
 Email: jack@durkinconstruction.com.au

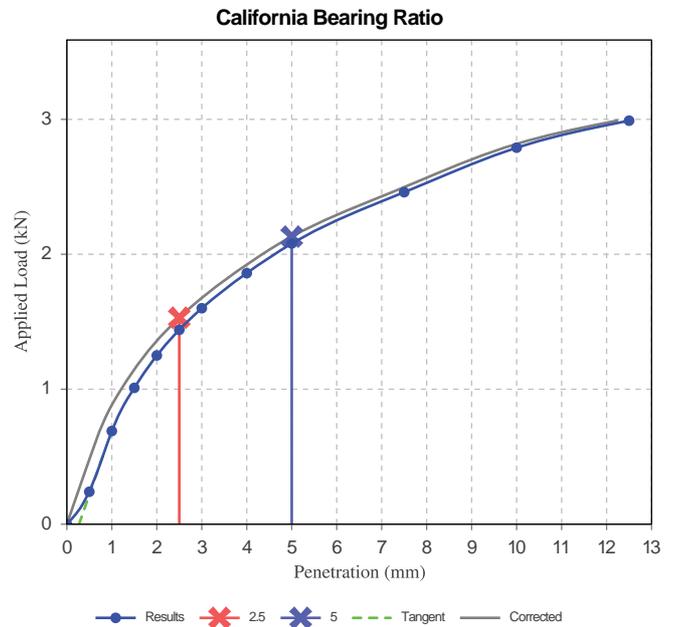


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jack Zhang

NATA Accredited Laboratory Number: 18612

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	12		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m ³)	1.85		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	98.0		
Moisture Content at Placement (%)	14.2		
Moisture Content Top 30mm (%)	17.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report



Report Number: D18219-1
Issue Number: 1
Date Issued: 07/09/2020
Client: EMM Consulting
 Ground floor, 20 Chandos Street, St Leonards NSW 2065
Contact: Abdullah Uddin
Project Number: D18219
Project Name: Adams Road, Luddenham, NSW
Project Location: Adams Road, Luddenham, NSW
Client Reference: D18219 - D18219
Work Request: 942
Sample Number: 20-942B
Date Sampled: 25/08/2020
Dates Tested: 27/08/2020 - 31/08/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: BH2 , Depth: 225-1500mm
Lot No: BH2
Material: Silty Clay
Material Source: BH

Durkin Construction Pty Ltd
 Silverwater Laboratory
 Unit 3, 50-52 Derby Street Silverwater NSW 1811
 Phone: (02) 9712 0308
 Fax: (02) 9647 1984
 Email: jack@durkinconstruction.com.au

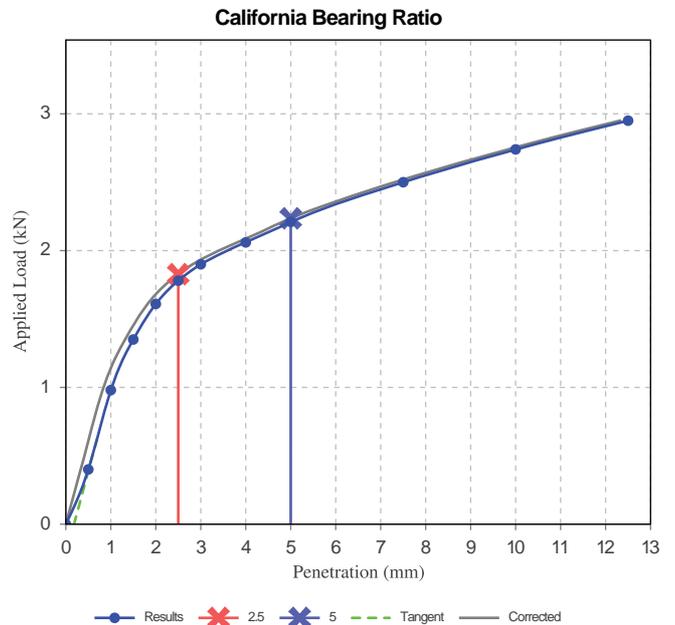


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jack Zhang

NATA Accredited Laboratory Number: 18612

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	14		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m ³)	1.77		
Optimum Moisture Content (%)	16.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	99.5		
Moisture Content at Placement (%)	16.1		
Moisture Content Top 30mm (%)	19.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report



Report Number: D18219-1
Issue Number: 1
Date Issued: 07/09/2020
Client: EMM Consulting
 Ground floor, 20 Chandos Street, St Leonards NSW 2065
Contact: Abdullah Uddin
Project Number: D18219
Project Name: Adams Road, Luddenham, NSW
Project Location: Adams Road, Luddenham, NSW
Client Reference: D18219 - D18219
Work Request: 942
Sample Number: 20-942C
Date Sampled: 25/08/2020
Dates Tested: 27/08/2020 - 31/08/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: BH3 , Depth: 245-1500mm
Lot No: BH3
Material: Sandy Clay
Material Source: BH

Durkin Construction Pty Ltd
 Silverwater Laboratory
 Unit 3, 50-52 Derby Street Silverwater NSW 1811
 Phone: (02) 9712 0308
 Fax: (02) 9647 1984
 Email: jack@durkinconstruction.com.au

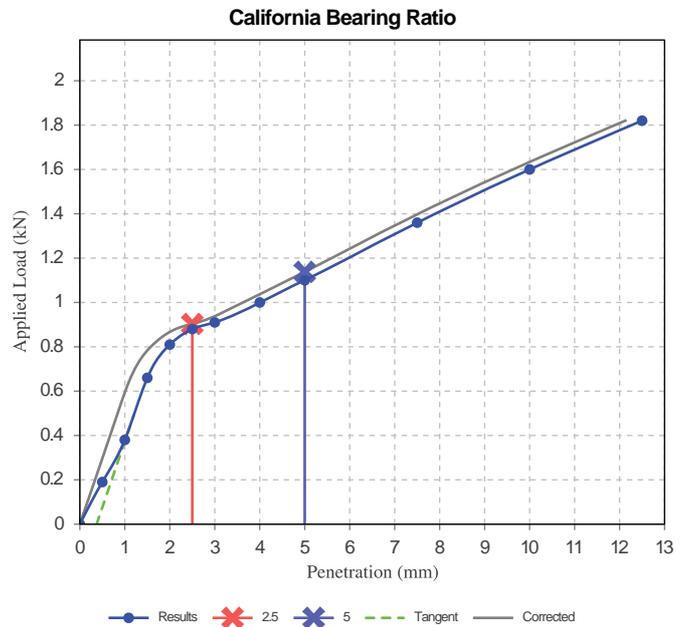


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jack Zhang

NATA Accredited Laboratory Number: 18612

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	7		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m ³)	1.78		
Optimum Moisture Content (%)	19.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.0		
Moisture Content at Placement (%)	19.2		
Moisture Content Top 30mm (%)	23.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report



Report Number: D18219-1
Issue Number: 1
Date Issued: 07/09/2020
Client: EMM Consulting
 Ground floor, 20 Chandos Street, St Leonards NSW 2065
Contact: Abdullah Uddin
Project Number: D18219
Project Name: Adams Road, Luddenham, NSW
Project Location: Adams Road, Luddenham, NSW
Client Reference: D18219 - D18219
Work Request: 942
Sample Number: 20-942D
Date Sampled: 25/08/2020
Dates Tested: 27/08/2020 - 31/08/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: BH4 , Depth: 160-1500mm
Lot No: BH4
Material: Sandy Clay
Material Source: BH

Durkin Construction Pty Ltd
 Silverwater Laboratory
 Unit 3, 50-52 Derby Street Silverwater NSW 1811
 Phone: (02) 9712 0308
 Fax: (02) 9647 1984
 Email: jack@durkinconstruction.com.au

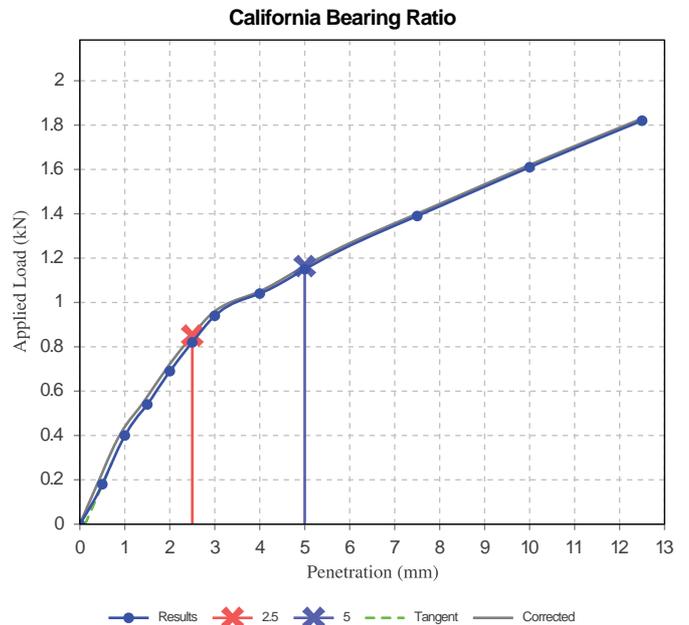


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jack Zhang

NATA Accredited Laboratory Number: 18612

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	6		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m ³)	1.78		
Optimum Moisture Content (%)	16.0		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	100.5		
Moisture Content at Placement (%)	16.0		
Moisture Content Top 30mm (%)	21.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report



Report Number: D18219-1
Issue Number: 1
Date Issued: 07/09/2020
Client: EMM Consulting
 Ground floor, 20 Chandos Street, St Leonards NSW 2065
Contact: Abdullah Uddin
Project Number: D18219
Project Name: Adams Road, Luddenham, NSW
Project Location: Adams Road, Luddenham, NSW
Client Reference: D18219 - D18219
Work Request: 942
Sample Number: 20-942E
Date Sampled: 25/08/2020
Dates Tested: 27/08/2020 - 31/08/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: BH5 , Depth: 490-1500mm
Lot No: BH5
Material: Sandy Clay
Material Source: BH

Durkin Construction Pty Ltd
 Silverwater Laboratory
 Unit 3, 50-52 Derby Street Silverwater NSW 1811
 Phone: (02) 9712 0308
 Fax: (02) 9647 1984
 Email: jack@durkinconstruction.com.au

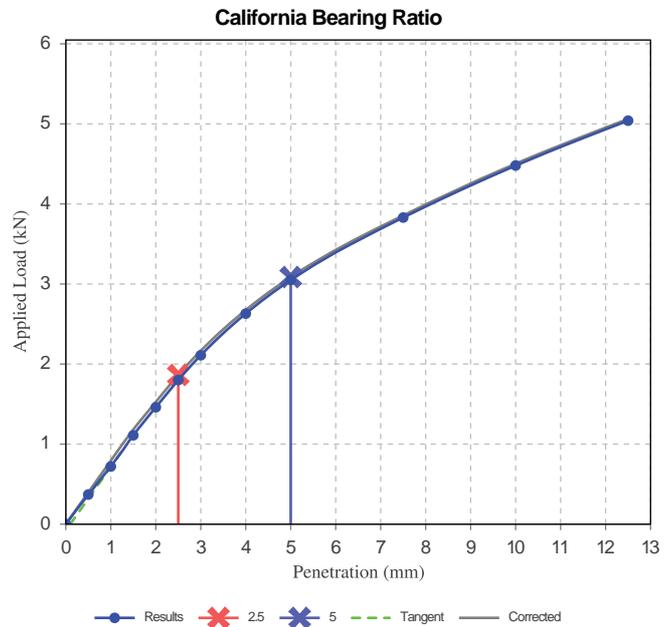


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jack Zhang

NATA Accredited Laboratory Number: 18612

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	16		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m ³)	1.90		
Optimum Moisture Content (%)	11.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Moisture Content at Placement (%)	11.6		
Moisture Content Top 30mm (%)	13.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report



Report Number: D18219-1
Issue Number: 1
Date Issued: 07/09/2020
Client: EMM Consulting
Ground floor, 20 Chandos Street, St Leonards NSW 2065
Contact: Abdullah Uddin
Project Number: D18219
Project Name: Adams Road, Luddenham, NSW
Project Location: Adams Road, Luddenham, NSW
Client Reference: D18219 - D18219
Work Request: 942
Dates Tested: 27/08/2020 - 27/08/2020

Durkin Construction Pty Ltd
Silverwater Laboratory
Unit 3, 50-52 Derby Street Silverwater NSW 1811
Phone: (02) 9712 0308
Fax: (02) 9647 1984
Email: jack@durkinconstruction.com.au



Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jack Zhang

NATA Accredited Laboratory Number: 18612

Moisture Content AS 1289 2.1.1			
Sample Number	Sample Location	Moisture Content	Material
20-942A	BH1 , Depth: 270-1500mm	19.1 %	Silty Clay
20-942B	BH2 , Depth: 225-1500mm	21.5 %	Silty Clay
20-942C	BH3 , Depth: 245-1500mm	18.7 %	Sandy Clay
20-942D	BH4 , Depth: 160-1500mm	13.7 %	Sandy Clay
20-942E	BH5 , Depth: 490-1500mm	8.7 %	Sandy Clay



APPENDIX D –
Biodiversity Development Assessment Report





Luddenham Quarry – Modification 5

Biodiversity Development Assessment Report

Prepared for Coombes Property Group and KLF Holding Pty Ltd
December 2020



Servicing projects throughout Australia and internationally

SYDNEY

Ground Floor, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE

Level 3, 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE

Level 1, 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

ADELAIDE

Level 4, 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE

Ground Floor, 188 Normanby Road
Southbank VIC 3006
T 03 9993 1905

PERTH

Suite 9.02, Level 9, 109 St Georges Terrace
Perth WA 6000
T 02 9339 3184

CANBERRA

PO Box 9148
Deakin ACT 2600

Luddenham Quarry – Modification 5

Biodiversity Development Assessment Report

Report Number

J190749 RP40

Client

Coombes Property Group and KLF Holding Pty Ltd

Date

1 December 2020

Version

v2 Final

Prepared by

Approved by



Jason Brown

Senior Ecologist

1 December 2020

Steven Ward

Associate Ecologist

1 December 2020

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public. © Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

Executive Summary

ES1 Background

CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), acquired in late 2019 the property at 275 Adams Road, Luddenham New South Wales (NSW) (Lot 3 in DP 623799, 'the subject property') within the Liverpool City Council municipality. The subject property is host to an existing shale/clay quarry (the quarry site).

CPG in partnership with KLF (the applicants) are seeking to reactivate quarrying operations at the site, an existing clay/shale quarry in the Greater Western Sydney region of NSW.

Quarrying operations were originally approved under consent DA No. 315-7-2003 (the consent, and now classified as State significant development (SSD)) issued by the Minister for Infrastructure, Planning and Natural Resources on 23 May 2004. The existing consent has been modified three times (MOD1 to MOD3). A fourth modification (MOD4) was withdrawn. The quarry is currently approved to produce and transport up to 300,000 tonnes per annum (tpa) of clay and shale product, with quarry operations approved until 31 December 2024, although rehabilitation and some other activities may continue past this date.

CPG and KLF are seeking to reactivate quarrying operations through an approved modification (MOD 5) of the consent (the proposed modification) to avoid sterilisation of a regionally significant resource that is identified in Schedule 1 of the Sydney Regional Environmental Plan No 9 – Extractive Industry (No 2 – 1995).

As the proposed modification will not result in clearance of native vegetation outside of the approved quarry footprint or significantly impact on biodiversity values, a Biodiversity Development Assessment Report (BDAR) waiver application was lodged with the Scoping Report (EMM 2020d) and subsequently appended to the Modification Report (EMM 2020e). Notwithstanding, the Department of Planning, Infrastructure and Environment; Environment, Energy and Science group (EES), requested in its response to the Modification Report, that a BDAR be prepared.

This BDAR has therefore been prepared by EMM Consulting Pty Limited (EMM) in the response to submissions phase of the MOD 5 application to address the EES submission and provide further information regarding the biodiversity values at the subject property and the level of direct and indirect impacts on these values.

In parallel to the proposed modification, the applicants are progressing a new SSD application to establish a construction and demolition waste advanced resource recovery centre (ARRC) on the subject property to the north of the quarry site. A BDAR has been submitted to address the environmental and planning obligations for the ARRC and will be updated to address comments received from EES.

Given that the existing quarry site and proposed ARRC are located within the same landholding, information on survey and results across the subject property as a whole is presented in both BDARs. Impacts associated with MOD 5 are assessed in this report, whilst impacts associated with the proposal for the ARRC are assessed in a separate BDAR.

ES2 Overview of the proposed modification

The scope of the proposed modification is described in detail in Chapter 2 of the Modification Report (EMM 2020e) and is summarised as follows:

- the use of the existing site access from Adams Road by quarry vehicles;
- upgrade (including sealing) of the site access road and its intersection with Adams Road as required, and upgrades to the existing internal road network;
- new stockpiling area, weighbridge and other site infrastructure within Lot 3 DP 623799;
- the operation of some additional quarry equipment and a small increase to the daily maximum number of trucks;
- removal of references to activities on Commonwealth-owned land previously known as Lot 1 DP 838361 (now a part of Lot 101 DP 1236319) from the consent;
- update of the existing surface water management system;
- removal of the northern noise bund during construction of the ARRC; and
- administrative modification of some other conditions of consent to align with current government policy and/or site conditions (ie reduced development footprint).

The proposed modification does not seek to increase the quarry void footprint, production rate or hours of operation. It is not proposed to extend the quarry life beyond 2024.

The northern section of Adams Road, between the subject property access road and Elizabeth Drive, will be upgraded by the applicant so that the pavement is suitable for use by heavy vehicles up to 19 m in length. This will consist of pavement upgrades (resealing to improve strength of pavement). No road widening or drainage works will occur as part of the proposed works.

ES3 Landscape

The development occurs within the Sydney Basin Interim Biogeographic Regionalisation of Australia (IBRA) region, and Cumberland subregion. The subject property is located within the upper reaches of the Hawkesbury River catchment, with Oaky Creek running along the eastern boundary.

The locality is considered highly cleared and fragmented with native vegetation often occurring in isolated patches surrounded by a matrix of agricultural land. The subject property itself has previously been utilised for quarrying and agricultural land uses. The Western Sydney International (Nancy-Bird Walton) Airport (WSA) occurs immediately to the east and south of the subject property, and has, or will, remove native vegetation across the footprint of the WSA during the course of that project.

There are no areas of outstanding biodiversity value, as defined in Part 3 of the *Biodiversity Conservation Act 2016* (BC Act) within a 1,500 m buffer of the subject property.

ES4 Native vegetation

Survey identified that most of the subject property is dominated by open grasslands of varying condition and quality. Most of these areas have been heavily impacted by pastoral activities, particularly grazing and previous quarry activities, and are dominated by exotic plant species. The following native plant community types (PCTs) were recorded within the subject property:

- PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain with is associated with the BC Act listed *Cumberland Plain Woodland in the Sydney Basin Bioregion Critically Endangered Ecological Community* (Cumberland Plain Woodland CEEC); and
- PCT 1800 – Cumberland Swamp Oak riparian forest, and is associated with the BC Act listed *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community* (Swamp Oak Floodplain Forest EEC), and a portion along Oaky Creek with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland Endangered Ecological Community* listed under the BC Act.

PCT 849 is located outside of the impact area for MOD 5, and therefore is not assessed as being impacted as part of MOD 5.

PCT 1800 and the BC Act listed Swamp Oak Floodplain Forest EEC occurs within the existing approved DA NO. 315-7-2003 (as modified), with impacts limited to two trees. These impacts are already approved under the existing consent DA No. 315-7-2003. No new native vegetation removal will occur as a result of MOD 5.

ES5 Threatened species

No native vegetation additional to that approved will be removed as a result of the proposal. No threatened flora species were recorded across the subject property.

One candidate species credit species, Southern Myotis (*Myotis macropus*) was recorded within the subject property, foraging over ponds along Oaky Creek. In addition, Southern Myotis was recorded roosting within a culvert over Oaky Creek, underneath an old eastern access road. This culvert sits within Commonwealth land that is part of the WSA. None of the proposed activities on the subject property propose changes to the culvert, and the old access road has been fenced off and will no longer be utilised due to the WSA development. Outcomes for the culvert itself will be subject to the WSA development activities.

No changes are proposed to the ponds utilised for foraging as part of the MOD 5. Some changes are proposed as part of the ARRC SSD and will be addressed under that BDAR. It is possible that Southern Myotis may forage over the water within the current quarry pit, though it is unknown whether this occurs. The quarry currently has approval to dewater the pit and therefore this is not considered to be an impact arising from the MOD 5 application.

Target survey was undertaken for Green and Golden Bell Frog targeting the ponds, exotic grasslands, and current quarry pit, but was not detected.

ES6 Impact avoidance, minimisation and mitigation

The proposed modification has been designed, to avoid sensitive biodiversity areas. The MOD 5 footprint has been designed to avoid new impacts to the Swamp Oak Floodplain Forest EEC listed under the BC Act (PCT 1800) along the eastern boundary (some vegetation in this area also meeting the listing under the EPBC Act as *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland EEC*) and around a disused farm shed, and Cumberland Plain Woodland CEEC listed under the BC Act (PCT 849) that is present between the access road and the western boundary.

Key avoidance measures to be implemented by the proponent comprise:

- avoidance of direct impacts to Oaky Creek;
- no impacts to PCT 849; and
- minimisation of impacts to PCT 1800, by only impacting habitat within the existing DA NO. 315-7-2003 impact area (consisting of up to 0.08 ha in poor condition).

ES7 Biodiversity impacts and offsets

Following the implementation of avoidance and minimisation measures, the proposed modification will result in no direct or indirect impacts to native vegetation or threatened species habitat outside the existing development application approval.

The proposed modification will remove 0.08 hectares of native vegetation within the existing DA NO. 315-7-2003 impact area.

The current quarry pit has water within it and will be dewatered as part of the works. Dewatering is permitted under the current approval (DA NO. 315-7-2003 as modified).

Southern Myotis were recorded roosting in a culvert beneath the former approved access for the quarry. The access road will no longer be used (due to the WSA development). The culvert is located on Commonwealth land and is not proposed to be removed or otherwise altered as part of MOD 5.

Table of Contents

Executive Summary	ES.1
Table of Contents	vi
Abbreviations	xi
STAGE 1: BIODIVERSITY ASSESSMENT	1
1 Introduction	2
1.1 Overview	2
1.2 Background	2
1.3 Overview of proposed modification	3
1.4 Purpose of this report	4
1.5 Site context	5
1.6 Project area, survey area, disturbance and avoidance footprint definitions	5
1.7 Assessment guidelines and requirements	5
1.8 Information sources	9
1.8.1 Publications and databases	9
1.8.2 Spatial data	9
1.8.3 Limitations	10
2 Legislative context	11
2.1 Commonwealth	11
2.1.1 Environment Protection and Biodiversity Conservation Act 1999	11
2.2 State	11
2.2.1 Environmental Planning and Assessment Act 1979	11
2.2.2 Biodiversity Conservation Act 2016	12
2.2.3 Fisheries Management Act 1994	12
2.2.4 Biosecurity Act 2015	13
3 Landscape features	14
3.1 Landscape features	14
3.1.1 Bioregions and landscapes	14
3.1.2 Watercourses and wetlands	14
3.1.3 Connectivity	14
3.1.4 Areas of geological significance and soil hazard features	14
3.1.5 Areas of outstanding biodiversity value	14

3.2	Assessment of site context	14
3.2.1	Native vegetation cover	14
3.2.2	Assessment of patch size	15
4	Native vegetation	18
4.1	Background review	18
4.2	Methods	18
4.2.1	Detailed vegetation mapping and habitat assessment	18
4.2.2	Vegetation integrity assessment	19
4.3	Results	19
4.3.1	Vegetation description	19
4.3.2	Plant community type descriptions	22
4.3.3	Vegetation integrity score	29
4.4	Groundwater dependent ecosystems	29
4.4.1	Identification of potential GDEs	29
4.4.2	Potential GDEs	30
5	Threatened species	31
5.1	Fauna habitat assessment	31
5.2	Ecosystem credit species assessment (step 1)	35
5.3	Species credit species assessment (step 1)	40
5.3.1	Habitat constraints assessment (Step 2)	40
5.3.2	Identifying candidate species credit species for further assessment (Step 3)	45
5.3.3	Targeted survey methods	56
5.3.4	Targeted survey results	66
5.3.5	Species credit species	72
	STAGE 2: IMPACT ASSESSMENT	75
6	Impact assessment (biodiversity values)	76
6.1	Potential direct, indirect and prescribed impacts	76
6.1.1	Direct impacts	76
6.1.2	Indirect impacts	76
6.1.3	Prescribed impacts	76
6.2	Measures to avoid, minimise and mitigate impacts	83
6.2.1	Avoidance measures	83
6.2.2	Mitigation measures	83

6.2.3	Summary of measures to avoid, minimise and mitigate impacts	86
6.3	Impact summary	89
6.3.1	Serious and irreversible impacts (SAIL)	89
6.3.2	Impacts requiring offsets	89
6.3.3	Impacts not requiring offsets	89
7	Impacts to MNES	90
7.1	Desktop assessment to identify candidate species and communities	90
7.1.1	Candidate species assessment	90
7.2	Significant impact assessments	91
8	References	93

Appendices

Appendix A Vegetation integrity assessment – datasheets

Appendix B Vegetation integrity assessment – plot data

Appendix C Fauna survey effort summary

Appendix D Targeted survey weather conditions

Appendix E EPBC PMST Report

Appendix F EPBC Act protected matters likelihood of occurrence assessment

Appendix G EPBC Act significant impact criteria assessments

Appendix H Acoustic detection survey results

Tables

Table 1.1	Naming of areas referred to in this BDAR	5
Table 3.1	Percentage of native vegetation cover	15
Table 4.1	Definitions used in delineation of vegetation zones	18
Table 4.2	Vegetation zone identified along with broad condition state	20
Table 4.3	PCT 1800 – Cumberland Swamp Oak riparian forest description	22
Table 4.4	PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion description	26
Table 4.5	Vegetation zones mapped within the subject property	29
Table 5.1	Assessment of ecosystem credit species within the subject property footprint	36
Table 5.2	Assessment of geographic and habitat constraint features within the subject property	41
Table 5.3	Species excluded from further assessment	45

Table 5.4	Species credit species and status and habitat suitability assessment (across subject property as a whole)	46
Table 5.5	Candidate species	56
Table 5.6	Targeted threaten flora searches within the subject property.	57
Table 5.7	Stratification units and survey area – nocturnal bids	59
Table 5.8	Methods and survey effort – nocturnal birds	59
Table 5.9	Methods and survey effort - Microchiropteran bats	60
Table 5.10	Waterbody areas	62
Table 5.11	Methods and survey effort - amphibians	63
Table 5.12	Stratification units and survey area – terrestrial invertebrates	64
Table 5.13	Methods and survey effort – terrestrial invertebrates	64
Table 5.14	Species impact (ha)	72
Table 5.15	Species credit species, habitat suitability and targeted survey results	73
Table 6.1	Prescribed biodiversity impacts relevant to the proposed modification	77
Table 6.2	Prescribed biodiversity impacts assessment: impacts of development on the habitat of threatened species or ecological communities associated with human made structures	78
Table 6.3	Prescribed biodiversity impacts assessment: impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation	80
Table 6.4	Prescribed biodiversity impacts assessment: water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	81
Table 6.5	Summary of impacts, and measures to avoid, minimise and mitigate	87
Table 7.1	Threatened and migratory species with potential to occur in the subject property based on the desktop assessment	90
Table 7.2	Threatened and migratory species further assessment or presumed presence	91
Table B.1	Vegetation integrity data	B.2
Table C.1	Fauna survey effort	C.2
Table D.1	Weather conditions during fauna surveys	D.1
Table F.1	Likelihood of occurrence assessment – threatened ecological communities	F.2
Table F.2	Likelihood of occurrence assessment – threatened flora	F.3
Table F.3	Likelihood of occurrence assessment – fauna species	F.7
Table F.4	Likelihood of occurrence assessment – migratory species	F.14
Table G.1	Significant impact criteria assessment – Large-eared Pied Bat	G.2
Table G.2	Significant impact criteria assessment – Grey-headed Flying-fox	G.4
Table G.3	Significant impact criteria assessment – Horsfield’s Bronze-cuckoo	G.6
Table G.4	Significant impact criteria assessment – Sharp-tailed Sandpiper	G.7

Table G.5	Significant impact criteria assessment – Latham’s Snipe	G.8
Table G.6	Significant impact criteria assessment – Common Greenshank	G.9

Figures

Figure 1.1	Regional context	6
Figure 1.2	Proposed modification overview	7
Figure 1.3	Vegetation Management Plan areas (UBM Ecological 2009)	8
Figure 3.1	Regional ecological context	16
Figure 3.2	Site context	17
Figure 4.1	Plant community types and plot locations	21
Figure 5.1	Flora survey locations	58
Figure 5.2	Fauna survey locations	65
Figure 5.3	Threatened fauna species credit species recorded	71

Abbreviations

ARRC	Advanced Resource Recovery Centre
BAM	Biodiversity Assessment Method
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BCD	Biodiversity Conservation Division
BDAR	Biodiversity Development Assessment Report
BioNet	NSW BioNet
Biosecurity Act	NSW <i>Biosecurity Act 2015</i>
BOS	Biodiversity Offsets Scheme
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CHM	Canopy Height Model
CPG	Coombes Property Group
DAWE	Commonwealth Department of Agriculture, Water and Environment
DFSI	NSW Department of Finance, Services and Innovation
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Limited
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESCP	Erosion and sediment control plan
FM Act	NSW <i>Fisheries Management Act 1994</i>
GDE	Groundwater-dependent ecosystem
GPS	Geographic Positioning System
IBRA	Interim Biogeographic Regionalisation of Australia
KFH	Key Fish Habitats
KLF	KLF Holding Pty Ltd
KTP	Key Threatening Process
LGA	Local Government Area
LiDAR	Light Detection and Ranging
MNES	Matters of National Environmental Significance
MOD 5	Modification 5 of DA NO. 315-7-2003
NSW	New South Wales
OEH	Office of Environment and Heritage (now BCD)
PCT	NSW Plant Community Type

PMST	Protected Matters Search Tool
RVA	Rapid Vegetation Assessment
SEARs	Secretary’s Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SRD	State and Regional Development
SSD	State Significant Development
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
tpa	tonnes per annum
TPZ	Tree Protection Zone
VIS	Vegetation Information System
WSA	Western Sydney International (Nancy-Bird Walton) Airport

STAGE 1: BIODIVERSITY ASSESSMENT

1 Introduction

1.1 Overview

CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), has recently acquired the property at 275 Adams Road, Luddenham NSW (Lot 3 in DP 623799, 'the site') within the Liverpool City Council municipality. The site is host to an existing shale/clay quarry. The site shares its southern and eastern boundaries with the WSA development site (Figure 1.1).

CPG owns, develops, and manages a national portfolio of office, retail, entertainment, land, and other assets. The company's business model is to retain long-term ownership and control of all its assets. CPG has the following staged vision to the long-term development of the site:

- **Stage 1 Quarry Reactivation: Solving a problem.** CPG intends to responsibly avoid the sterilisation of the remaining natural resource by completing the extraction of shale which is important to the local construction industry as raw material used by brick manufacturers in Western Sydney. Following the completion of approved extraction activities, the void will be prepared for rehabilitation.
- **Stage 2 Advanced Resource Recovery Centre and Quarry Rehabilitation: A smart way to fill the void:** CPG in partnership with KLF Holdings Pty Ltd (KLF) and in collaboration between the circular economy industry and the material science research sector, intends to establish a technology-led approach to resource recovery, management, and reuse of Western Sydney's construction waste, and repurposing those materials that cannot be recovered for use to rehabilitate the void. This will provide a sustainable and economically viable method of rehabilitating the void for development.
- **Stage 3 High Value Employment Generating Development: Transform the land to deliver high value agribusiness jobs.** CPG intends to develop the rehabilitated site into a sustainable and high-tech agribusiness hub supporting food production, processing, freight transport, warehousing, and distribution, whilst continuing to invest in the resource recovery research and development (R&D) initiatives. This will deliver the vision of a technology-led agribusiness precinct as part of the Aerotropolis that balances its valuable assets including proximity to the future WSA and Outer Sydney Orbital.

This report relates to MOD5 of the DA NO. 315-7-2003 (as modified) relating to the delivery of Stage 1 above.

KLF is an Australian-owned and operated waste management company that operates two strategically located resource recovery and recycling facilities in Sydney; one at Camellia and another at Asquith. KLF has 20 years' experience in the waste recycling and resource recovery industry. KLF facilities are licensed by the NSW Environment Protection Authority (EPA) and have full International Organisation for Standardisation (ISO) accreditation.

1.2 Background

CPG in partnership with KLF (the applicants) are seeking to reactivate quarrying operations at the site, an existing clay/shale quarry in the Greater Western Sydney region of New South Wales (NSW).

Quarrying operations were originally approved under State significant development (SSD) consent DA No. 315-7-2003 (the consent) issued by the Minister for Infrastructure, Planning and Natural Resources on 23 May 2004. The existing consent has been modified three times (MOD 1 to MOD 3). A fourth modification (MOD 4) was withdrawn. The quarry is currently approved to produce and transport up to 300,000 tonnes per annum (tpa) of clay and shale product up to 31 December 2024.

The consent includes quarry components that are on Commonwealth-owned land, which was leased by the previous operator, including the site access road, quarry support facilities and stockpiling areas. These quarry components on Commonwealth-owned land, including the approved site access off Elizabeth Drive, are no longer available for use by the quarry. The quarrying operations ceased under the previous owners/operators approximately 2 years ago. CPG/KLF have no relationship to the previous site owners/operators.

The approved water management system includes a quarry sump to dewater the quarry void to two sedimentation dams. Water collected in the surface water management system is used for dust suppression or irrigation or is discharged to Oaky Creek. Dewatering of the quarry pit is permitted under DA 315-7-2003.

A Vegetation Management Plan (VMP), as required by condition 34 of the consent was prepared in 2009 (UBM Ecological 2009). Vegetation west of the site was identified as “Western Eucalypt Woodland” consistent with Cumberland Plain Woodland. Vegetation along the eastern roughly 40 m edge of the property was identified as “Riparian Zone” (Figure 1.3).

CPG and KLF are seeking to reactivate quarrying operations through an application for modification (MOD 5) of the consent (as modified) (the proposed modification) to avoid sterilisation of a regionally significant resource that is identified in Schedule 1 of the Sydney Regional Environmental Plan No 9 – Extractive Industry (No 2 – 1995) (SREP No 9 – Extractive Industries). Reactivation of the quarry will provide for the continued economic contribution of an approved resource extraction activity.

In parallel to the proposed modification, the applicants are progressing a new SSD application to establish a construction and demolition waste advanced resource recovery centre (ARRC) on the site (Stage 2), with the intention of making a future application to fill the quarry void with unrecyclable materials to provide a sustainable and economically viable method of rehabilitating the void.

For clarity, no application has yet been submitted for the infilling of the quarry void component of Stage 2 or Stage 3 for Employment Generating Development. These applications will be subject to relevant additional assessment at the time of application, and therefore are not discussed within this BDAR.

This report has been prepared by EMM Consulting Pty Ltd (EMM) on behalf of the applicants.

1.3 Overview of proposed modification

The scope of the proposed modification is described in detail in Chapter 2 of the Modification Report (EMM 2020e) and is summarised as follows:

- the use of the existing site access from Adams Road by quarry vehicles;
- upgrade (including sealing) of the site access road and its intersection with Adams Road as required, and upgrades to the existing internal road network;
- new stockpiling area, weighbridge and other site infrastructure within Lot 3 DP 623799;
- the operation of some additional quarry equipment and a small increase to the daily maximum number of trucks;
- removal of references to activities on Commonwealth-owned land previously known as Lot 1 DP 838361 (now a part of Lot 101 DP 1236319) from the consent;
- update of the existing surface water management system;
- removal of the northern noise bund during construction of the ARRC; and
- administrative modification of some other conditions of consent to align with current government policy and/or site conditions (ie reduced development footprint).

The proposed modification does not seek to increase the quarry void footprint, production rate or hours of operation. It is not proposed to extend the quarry life beyond 2024.

The northern section of Adams Road, between the subject property access road and Elizabeth Drive, will be upgraded by the applicant so that the pavement is suitable for use by heavy vehicles up to 19 m in length. This will consist of pavement upgrades (resealing to improve strength of pavement). No road widening or drainage works will occur as part of the proposed works.

The proposed MOD 5 layout is shown in Figure 1.2.

1.4 Purpose of this report

As the proposed modification will not result in clearance of native vegetation outside of the approved quarry footprint or significantly impact on biodiversity values, a Biodiversity Development Assessment Report (BDAR) waiver application was lodged with the Scoping Report (EMM 2020d) and subsequently appended to the Modification Report (EMM 2020e). Notwithstanding, the Department of Planning, Infrastructure and Environment; Environment, Energy and Science group (EES), requested in its response to the Modification Report, that a BDAR be prepared. Responses to submissions, including to EES submissions, are provided in a separate document (EMM 2020f).

This BDAR has therefore been prepared by EMM in the response to submissions phase of the MOD 5 application to address the EES submission and provides further information regarding the biodiversity values at the subject property. It documents the terrestrial biodiversity assessment methods and results, the initiatives built into the MOD 5 design to avoid and minimise impacts to terrestrial biodiversity, and the mitigation and management measures.

The specific objectives of this assessment are to:

- describe the existing biodiversity values and existing environment;
- identify and assess the potential for presence of biodiversity values, including threatened species and communities under relevant legislation including the NSW *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- identify ecological constraints within and impacts arising from the modification;
- provide mitigation measures to reduce the impacts from the MOD 5 on biodiversity wherever possible; and
- where impacts are unavoidable, consider compensatory measures that are appropriate.

A separate BDAR has been prepared to support the Environmental Impact Statement (EIS) for the ARRC. While the two separate applications pertain to different footprints within the subject property, they share the same study area which encompasses the entire subject property. The two reports utilise and present the stronger data set from the overall subject property to inform the assessments.

1.5 Site context

The quarry site is within 275 Adams Road, Luddenham NSW (described as Lot 3 in DP 623799) in the Liverpool City Council local government area in the Greater Western Sydney region of New South Wales (NSW). The subject property is approximately 19 kilometres (km) north-west of the city of Liverpool, 25 km south-west of the city of Parramatta and approximately 43 km south-west of the city of Sydney.

The subject property is approximately 19 hectares (ha) and is bordered to the east and south by the Commonwealth-owned WSA site. The WSA has been approved and construction, including bulk earthworks and road infrastructure upgrades, are currently underway. In addition to WSA, surrounding land uses include a mix of agricultural, rural industrial and commercial, and residential development. Oaky Creek forms the eastern boundary of the site.

Oaky Creek runs along the eastern border of the subject property. A strip of land along the eastern side of Oaky Creek is zoned as Environment and Recreation under the Western Sydney Aerotropolis State Environmental Planning Policy.

The property is included within the Draft Cumberland Plain Conservation Plan (DPIE 2020), which if approved would result in most of the vegetation in the western part of the site being granted biodiversity certification as it is identified as being 'Certified – Urban Capable'.

1.6 Project area, survey area, disturbance and avoidance footprint definitions

Table 1.1 defines the areas discussed in the BDAR. The MOD 5 area and subject property boundary are illustrated in Figure 1.2 and cover the development application area for MOD 5.

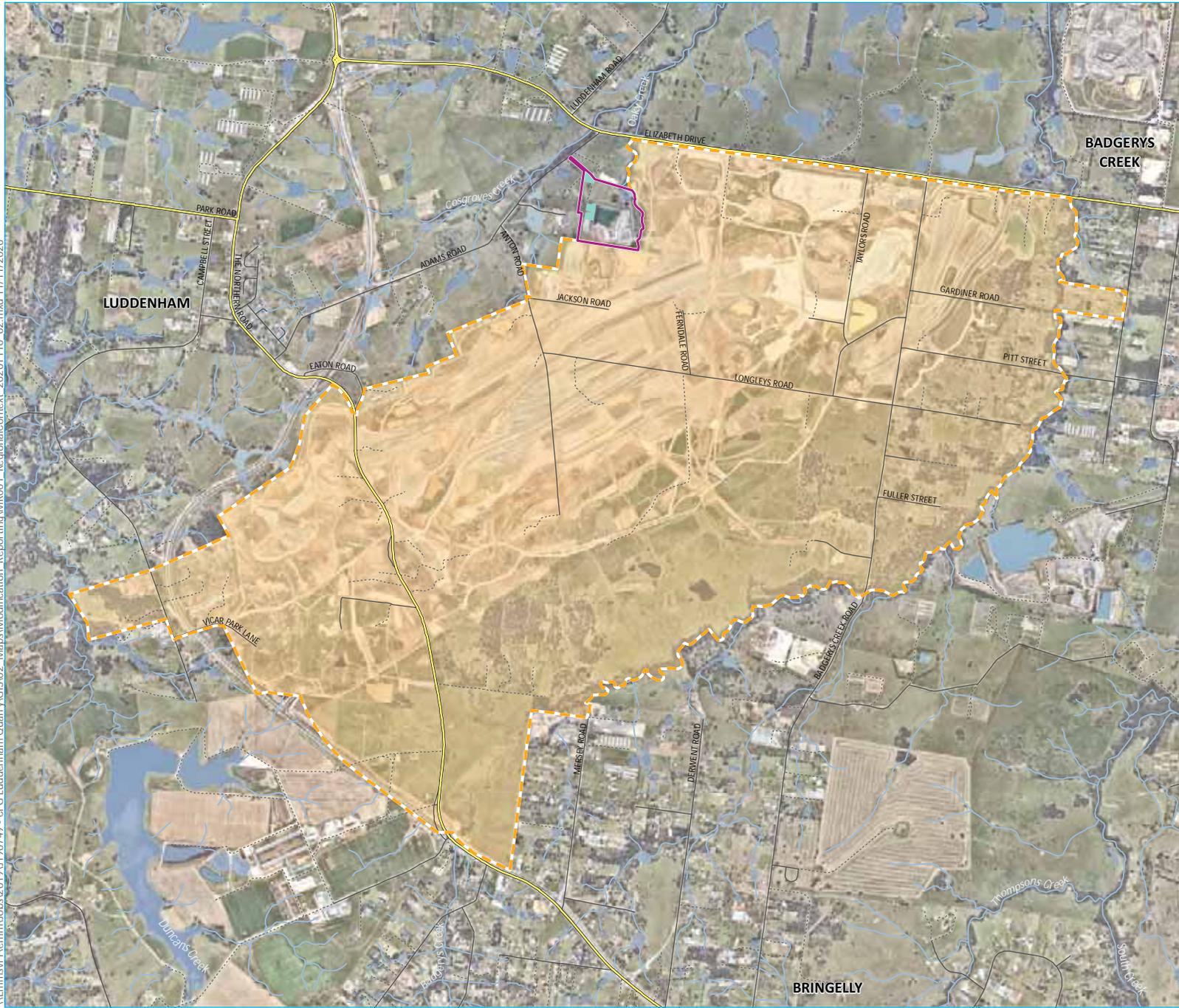
Table 1.1 Naming of areas referred to in this BDAR

Project elements	Definition
Native vegetation assessment area	Subject property plus 1,500 m buffer
Study area/subject property	Area which was surveyed for ecological values. For MOD 5 this was the subject property boundary (Figure 1.2). The term 'subject property' is used within this report instead of study area
Project area/Modification 5 (MOD 5) site	Area subject to proposed direct impacts. The terms 'MOD 5' or 'MOD 5 area' are used in this report instead of project area or project footprint. It is noted that Development Consent DA NO. 315-7-2003 remains in force, and thus much of the footprint is covered by the current quarry extraction approval.
Indirect impact area	Area subject to anticipated indirect impacts, which was delineated as 20 m buffer from the MOD 5 area.
Impact area	Combined direct impact and indirect impact areas

1.7 Assessment guidelines and requirements

This BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM; OEH 2017) and the legislative framework outlined in Chapter 2. It is noted that whilst an updated BAM has been adopted and released (DPIE 2020), that Section 6.31 of the Biodiversity Conservation Regulation allows the use of the previous method for a 12 month period for SSD, SSI and Biodiversity Certification projects, and 6 months for any other type of assessment. This BDAR has been prepared in accordance with, and utilises, BAM 2017 (OEH 2017).

\\Emsvr1\emms\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02_Maps\Modification_Reporting\WR001_RegionalContext_20201110_02.mxd 11/11/2020

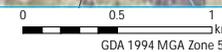


- KEY**
- Subject property
 - MOD 5 footprint
 - Western Sydney International (Nancy-Bird Walton) Airport
 - Major road
 - Minor road
 - Vehicular track
 - Watercourse/drainage line
 - NPWS reserve (see inset)
 - State forest (see inset)

Regional context

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 1.1

Source: EMM (2020); DFSI (2017); Nearmap (2020)



\\Ems\svr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02 - Maps\Modification - Reporting\BDAR\MBDR001 - ModificationActivity_20201123_05.mxd 26/11/2020



- KEY**
- Study area
 - Modification footprint
 - Cadastral boundary
- Proposed site modifications
- Approved site activity
 - Proposed site modification area

Proposed modification overview

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 1.2



Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)



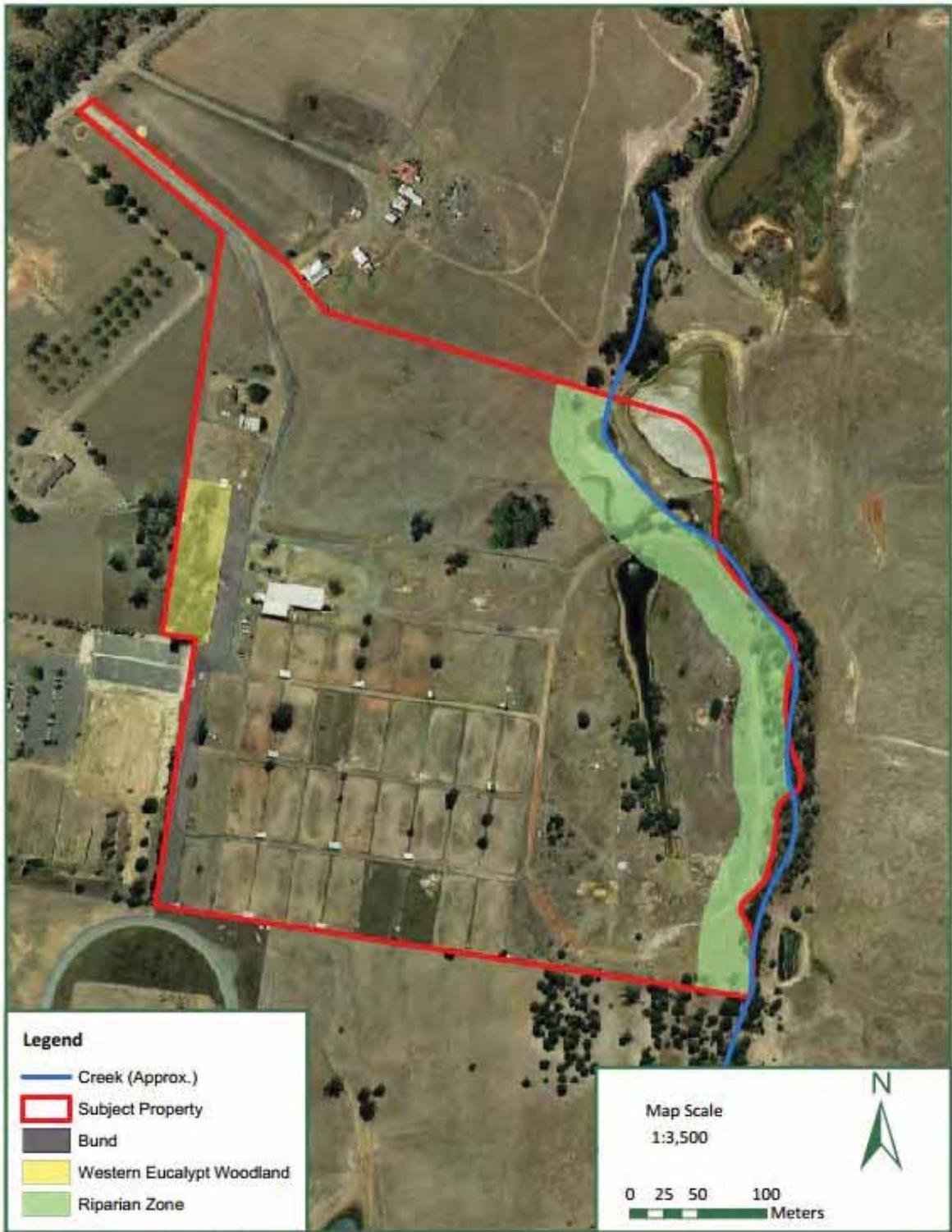


Figure 1.3 Areas to which this VMP Applies

Figure 1.3 Vegetation Management Plan areas (UBM Ecological 2009)

1.8 Information sources

1.8.1 Publications and databases

In order to provide a context for the BDAR, information about flora and fauna within 10 km of the subject property was obtained from relevant public databases. The centre point of the subject property was taken as Latitude -33.87, Longitude 150.72. Records from the following databases were collated and reviewed:

- BioNet Atlas of NSW Wildlife for previous threatened species records;
- Commonwealth Department of the Agriculture, Water and the Environment (DAWE) *Protected Matters Search Tool* (PMST) for Matters of National Environmental Significance (MNES) likely to occur within the subject property; and
- the NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Information System database.

The following studies and reports were also reviewed:

- Development Consent, DA No. 315-7-2003, for Badger Mining Company Pty Limited;
- Phillips C 2004, *Assessment report: Proposed clay/shale extraction operation, Lot 3 – 275 Adams Road, Luddenham*, prepared for Badger Mining Company Pty Limited;
- Douglas Nicolaisen & Associates Pty Ltd 2003, *Environmental Impact Statement – Proposed Clay/Shale Extraction Operation – Lot 3 - 272 Adams Road Luddenham NSW*, prepared for Badger Mining Company Pty Limited 275 Adams Road Luddenham NSW;
- Department of Infrastructure and Regional Development (DIRB) 2016, *Western Sydney Airport EIS Biodiversity Assessment*, prepared for Western Sydney Unit – Western Sydney Airport EIS, 21/24265; and
- UBM Ecological 2009 *Vegetation Management Plan for a clay shale quarry, Adams Road, Luddenham*, Prepared for Blue Sky Mining P/L.

1.8.2 Spatial data

Mapping has been produced using a Geographic Information System (GIS). The following spatial datasets were utilised during the development of this report:

- site plans supplied by CPG Stage 01 Masterplan Rev. E;
- *Remnant Vegetation of the western Cumberland subregion, 2013 Update. VIS_ID 4207* (OEH 2015);
- *Mitchell Landscapes Version V3.1* (OEH 2016a);
- *Interim Biogeographic Regionalisation of Australia (IBRA) Version 7* (DoEE 2017a);
- Directory of important wetlands (DoEE 2018b);
- NSW Wetlands (OEH 2010);
- base map data for the subject property was obtained from Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFSI digital cadastral database; and
- mapping for stream orders was obtained from the Water Management (General) Regulation 2018 hydroline spatial data 1.0.

1.8.3 Limitations

Vegetation mapping was conducted using a mobile phone running Collector for ArcGIS™ and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Surveys were completed during Summer 2020, when field conditions were conducive to detecting many of the flora and fauna species known to occur in the area. Surveys were undertaken in accordance with relevant NSW and Commonwealth survey guidelines for threatened species and the requirements of the *Framework for Biodiversity Assessment* (OEH 2018). Some flora species may be missed in surveys for a variety of reasons, for example: biannual flowering, poor flowering conditions, herbivory, heavy grazing pressures and drought conditions.

During the flora and fauna surveys the following limitation occurred:

- the south-eastern corner was surrounded by a security fence, so threatened flora and habitat assessments were undertaken from the other side of the fence;
- portions of vegetation communities were flooded at the time of survey (outside of the MOD 5 and approved quarry footprint) limiting the locations where plots could be performed, as the water prevented identification of the groundlayer species and cover;
- no targeted flora or snail surveys were completed within the quarry pit, in fenced areas or in flooded areas; and
- most of the mapped vegetation and all BAM plots occur outside the approved quarry and MOD 5 disturbance footprints.

2 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation. The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matters of National Environmental Significance (MNES) protected under the Act.

Nine MNES are identified under the EPBC Act:

- world heritage properties;
- national heritage places;
- wetlands of international importance (also known as 'Ramsar' wetlands);
- nationally threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, activities that have potential to result in significant impacts on MNES must be referred to the Commonwealth Minister for the Environment for assessment. Assessment of MNES is provided in Chapter 7.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) was enacted to encourage the proper consideration and management of impacts of proposed development or land-use changes on the environment (both natural and built) and the community. The EP&A Act is administered by the NSW Department of Planning, Industry and Environment (DPIE).

As specified in DA 315-7-2003, the quarry is classified as SSD. The consent is proposed to be modified under Section 4.55(1A) of the EP&A Act as it will have minimal environmental impacts which are generally restricted to the proposed change in site access and minor changes to quarry operations.

i State Environmental Planning Policy (Koala Habitat Protection) 2019

The State Environmental Planning Policy (SEPP) Koala Habitat Protection replaces SEPP 44. This SEPP does not apply to SSD and State Significant Infrastructure projects, but nonetheless consideration has been given to the potential of the Koala to occur within this report.

2.2.2 Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 (BC Act) details mechanisms for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the NSW Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the Biodiversity Assessment Method (BAM, OEH 2017) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities (TECs) and their habitats and determine offset requirements.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values in order to:

- identify the biodiversity values on land subject to proposed development area;
- determine the residual impacts of a proposed development following all measures to avoid, minimise and mitigate impacts; and
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

This biodiversity assessment has been prepared in accordance with the BAM and addresses the requirements of the BC Act.

2.2.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994 (FM Act)* contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in section 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve key fish habitats (KFH). These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in sections 3.2.1 and 3.2.2 of the *Policy and Guidelines for Fish Conservation and Management* (DPI 2013).

The subject property is not mapped as a KFH in the Key Fish Habitat map. MOD 5 will not impact on any threatened aquatic species, populations, communities, habitats and KFH.

2.2.4 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) replaced the *Noxious Weeds Act 1993* on 1 July 2017. The Biosecurity Act aims broadly to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, carriers and other activities. The Act is administered by the Department of Primary Industries.

Weeds of National Significance identified and recorded during the flora survey include:

- Alligator Weed (*Alternanthera philoxeroides*);
- African Boxthorn (*Lycium ferocissimum*);
- Blackberry (*Rubus fruticosus*); and
- Bridal Creeper (*Asparagus asparagoides*).

3 Landscape features

The identification of landscape features in the subject property was determined using Section 4 of the BAM (OEH 2017), as summarised within this chapter.

3.1 Landscape features

3.1.1 Bioregions and landscapes

The subject property is confined to the Cumberland Interim Biogeographic Regionalisation of Australia (IBRA) subregion, within the Sydney Basin bioregion (Figure 3.1). The Bionet landscape is entirely Cumberland Plain.

The majority of the site is within the Mitchell Landscape “Hawkesbury - Nepean Channels and Floodplains”, with part of the southern portion of the site within “Cumberland Plain” Mitchell landscape. As the site is predominately “Hawkesbury - Nepean Channels and Floodplains” this was utilised in the BAM calculator.

3.1.2 Watercourses and wetlands

One mapped watercourse, Oaky Creek, and two dams intersect the subject property (Figure 3.2). Oaky Creek flows into Cosgroves Creek north of Elizabeth Drive.

3.1.3 Connectivity

The locality is considered highly fragmented with native vegetation often occurring in isolated patches surrounded by a matrix of agricultural land. This is also consistent with the remaining vegetation within and adjoining the subject property.

3.1.4 Areas of geological significance and soil hazard features

The subject property does not contain karsts, caves, crevices, cliffs or other areas of geological significance. Similarly, there are no soil hazard features that occur within the subject property.

3.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value within the subject property, or the 1,500 m buffer.

3.2 Assessment of site context

The site context has been assessed in accordance with Section 4.3 of BAM (OEH 2017) for site-based developments.

3.2.1 Native vegetation cover

Native vegetation cover within the buffer area (including the subject property) was determined as the sum of the areas of native vegetation map, divided by the entire buffer area (Table 3.1). It is noted that a significant proportion of the vegetation within the 1,500 m buffer is approved for clearing (or has been cleared) associated with the Stage 1 development of the Western Sydney International (Nancy-Bird Walton) Airport.

Table 3.1 **Percentage of native vegetation cover**

Native vegetation in buffer area (ha)	Buffer area (ha)	Percentage of native vegetation in buffer area
48.7	828.5	5.9%

3.2.2 Assessment of patch size

For each vegetation zone within the impact area, patch size was assessed using a select process in ArcGIS, using existing vegetation mapping and aerial imagery. All intact native vegetation (for the subject property) was separated by a distance of less than 100 m (woody vegetation ecosystems) or 30 m (non-woody vegetation ecosystems) was mapped sequentially.

This process showed that all vegetation zones within the subject property are part of a patch of connecting vegetation of a size of >100 ha. A patch size of 101 ha is considered to apply to all native vegetation areas.

\\lemmsvr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02_Maps\Modification_Report\BDMAR\BDMAR002_EcologicalContext_20201118_03.mxd 18/11/2020



- KEY**
- Subject property
 - Modification footprint 1500 m BDAR buffer
 - Modification footprint
 - Major road
 - NSW Mitchell landscape
 - Cumberland plain
 - Hawkesbury - nepean channels and floodplains
- IBRA region: Sydney Basin
IBRA subregion: Cumberland

Regional ecological context

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 3.1



\\Emmsvr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02_Maps\Modification_Reporting\BDAR\MBDAR003_SiteEcoContext_20201123_05.mxd 26/11/2020



- KEY**
- Subject
 - Modification footprint
 - Modification footprint 1500 m BDAR
 - Strahler stream
 - 1st
 - 2nd
 - 3rd
 - 4th
 - 1,500 m native vegetation
 - PCT 850 - Shale Hills
 - PCT 849 - Shale Plains
 - PCT 835 - Alluvial
 - Unidentified vegetation (added by EMM consulting)
 - Existing environment
 - Waterbody
 - Major
 - Minor
 - Vehicular

Site context

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 3.2

Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)



4 Native vegetation

The extent of native vegetation within the subject property was determined using Section 5 of the BAM (OEH 2017), as summarised within this chapter.

4.1 Background review

A review of regional vegetation mapping was undertaken to inform the survey. OEH (2015) identified the following PCTs within the subject property (Figure 4.1);

- Alluvial Woodland which is equivalent to: PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion; and
- Shale Plains Woodland which is equivalent to: PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.

DIRD (2016) identified and mapped HN526 Forest Red Gum – Rough-barked Apple grassy woodland on floodplains, Sydney Basin, as being present on the eastern side of Oaky Creek. This community corresponds to River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (EEC) under the BC Act.

4.2 Methods

The following sections outline the methods employed to map vegetation, and to assess the vegetation integrity of native vegetation within the impact area.

4.2.1 Detailed vegetation mapping and habitat assessment

Native vegetation was assessed in the field by EMM on the following dates:

- 30 January 2020; and
- 24 February 2020.

Field surveys on 30 January stratified the subject property by air photo interpretation and on-ground validation into PCTs. Mapping of vegetation communities was conducted using hand-held tablet computers using the ArcGIS Collector application and aerial photo interpretation.

PCTs were stratified into vegetation zones based on broad condition state. Depending on the condition of these PCTs, they were allocated to a condition class of Medium or Poor was attributed depending on the condition of vegetation. PCTs were stratified into vegetation zones based on broad condition state using the definitions in Table 4.1.

Table 4.1 Definitions used in delineation of vegetation zones

Condition class	Description
Medium	Some elements or stratum missing or immature, but minimal disturbance.
Poor	Tree stratum present, but understorey vegetation degraded due to weeds or other major disturbance.

4.2.2 Vegetation integrity assessment

Following the stratification of vegetation zones within the subject property, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlined in Section 5 of the BAM (OEH 2017). A total of four plots were undertaken (Figure 4.1). At each plot location the following was undertaken:

- one 20 x 20 m plot, for assessment of composition and structure; and
- one 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1-5%) or estimated to the nearest 5% (5- 100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1000, 1500, 2000.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 4 of the BAM (OEH 2017). Datasheets are provided in Appendix A, while compiled plot data is provided in Appendix B.

Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined. Identification of PCTs within the subject property was confirmed with reference to the community profile descriptions (and diagnostic species tests) held within the NSW VIS: Classification Version 2.1 (OEH 2014).

Plots were undertaken on 24 February 2020. Plots were placed as close as possible to the impact area, and to thereby reflect the disturbed small areas of vegetation within impact zones for both the MOD 5 and ARRC. Three plots (2, 3, and 4) were located partially outside of their respective mapped PCTs due to limited vegetation extent. Constraints to choosing plot locations were:

- parts of the PCTs occur near the edge of the quarry pit where it is unsafe to survey;
- ephemeral water flooding parts of the medium condition PCT 1800 in the subject property, preventing adequate survey of the ground layer (hence plots were moved to dry locations); and
- most of the vegetation mapped occurs outside the MOD 5 site area.

Surveys for flora and vegetation communities were completed under the authority of Scientific License (SL100409). A list of flora species was compiled for each plot and PCT. Records of all flora species will be submitted to Biodiversity Conservation Division (BCD) for incorporation into the Atlas of NSW Wildlife.

4.3 Results

4.3.1 Vegetation description

Most of the subject property is dominated by open grasslands of varying condition and quality. Most of these areas have been heavily impacted by pastoral activities, particularly grazing, and are dominated by exotic plant species. In some areas of grassland, native cover of species such as Kangaroo Grass (*Themeda triandra*), Red-anthered Wallaby Grass (*Joycea pallida*) and Weeping Grass (*Microlaena stipoides*) occurs, but is <10% of the cover, resulting in the areas still being mapped as exotic.

The remaining wooded habitat within the subject property is comprised of a highly degraded woodland in the western section, a narrow riparian corridor dominated by Swamp Oak (*Casuarina glauca*), and scattered Swamp Oak in some areas of the subject property.

Site investigations, including determination of vegetation communities using the methods described in Section 5.2 of the BAM (OEH 2017). The PCTs and vegetation zones are described within Table 4.2 and shown in Figure 4.1. The PCTs are described in further detail within Section 4.3.2.

Table 4.2 Vegetation zone identified along with broad condition state

PCT ID	PCT name	Condition	Association with BC Act TEC	Association with EPBC Act TEC	Subject property direct impact area (ha)	Area within approved DA impact area ¹ (ha)	Indirect impact area (ha)	
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Medium	Swamp	Oak	Portions of the PCT within the subject property align with the EPBC Act listing, North Coast, Sydney but none is within the Basin and South East Corner Bioregions EEC	0	0.002	0
		Poor	Floodplain Forest			0	0.082	0
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion ²	Poor	Cumberland Woodland Sydney Basin	Plain in the Basin	The PCT does not align with the EPBC Act listing	0	0.001	0

1. Vegetation within the DA 315-7-2003 (as modified) is approved for removal and is thus not assessed as an impact under this BDAR.

2. PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion in poor condition was recorded within the subject property and outside the impact area.

\\Emmsvr1\emms\Jobs\2019\190749 - GPG Luddenham Quarry\GIS\02_Maps\Modification_Reporting\BDAR\MBAR004_PCTs_20201123_06.mxd 26/11/2020

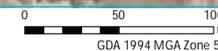


- Subject property
 - Modification footprint
 - Approved site activity
 - Waterbody
 - Cadastral boundary
 - Vegetation plot
- Plant community
- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley
 - Poor
 - Medium
 - PCT 849 - Grey Box Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
 - Poor
- Threatened ecological community
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin, South East Corner Bioregions (BC Act)
 - Cumberland Plain Woodland in the Sydney Basin Bioregion (BC Act)
 - Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (EPBC Act)

Plant community types and plot locations

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 4.1

Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020); DOE (2019)



4.3.2 Plant community type descriptions

Descriptions of the PCTs are provided in Table 4.3 and Table 4.4. PCTs and vegetation zones are mapped in Figure 4.1.

Table 4.3 PCT 1800 – Cumberland Swamp Oak riparian forest description

PCT 1800 – Cumberland Swamp Oak riparian forest

PCT ID	1800
Common name	Cumberland Swamp Oak riparian forest
Condition classes	Two vegetation zones were mapped within the subject property: <ul style="list-style-type: none"> • Medium • Poor
Extent within the subject property	Total area: 2.47 ha 1.24 ha (medium) 1.23 ha (poor)
Extent within MOD 5 site that will result in additional vegetation clearance (beyond the DA 315-7-2003 footprint)	Total area of additional impact: 0 ha
Extent within the approved DA 315-7-2003	0.084 ha (poor)
Description	<p>The below description relates to vegetation surveyed within the impact area. The poor vegetation zone inside the subject property – but outside the MOD 5 site – includes a greater variety of canopy and midstorey species, such as Cabbage Gum (<i>Eucalyptus amplifolia</i>), Woollybutt (<i>E. longifolia</i>) and an unknown Ironbark (<i>Eucalyptus</i> sp.). The greater diversity appears to have resulted from previous planting of native species within the ‘riparian zone’ as part of the Vegetation Management Plan prepared for the site (UBM Ecological 2009).</p> <p>The PCT comprises a canopy of Swamp Oak.</p> <p>The midstorey is sparse, comprising African Boxthorn (<i>Lycium ferocissimum</i>) and Moth Vine (<i>Araujia sericifera</i>).</p> <p>The groundlayer is dominated by exotic species. Exotic grass and grass-like species are: Kikuyu (<i>Cenchrus clandestinus</i>), Paspalum (<i>Paspalum dilatatum</i>) and Marsh Bristlegrass (<i>Setaria parviflora</i>).</p> <p>Exotic forb species are: Alligator Weed, Black-berry Nightshade (<i>Solanum nigrum</i>), Bridal Creeper (<i>Asparagus asparagoides</i>) and Paddy’s Lucerne (<i>Sida rhombifolia</i>).</p> <p>Native grasses and forbs comprise Common Couch (<i>Cynodon dactylon</i>), Oxalis (<i>Oxalis exilis</i>), Climbing Saltbush (<i>Einadia</i> spp.), Indian Pennywort (<i>Centella asiatica</i>), Kidney Weed (<i>Dichondra repens</i>), Red Grass (<i>Bothriochloa macra</i>), Slender Rat’s Tail Grass (<i>Sporobolus elongatus</i>), Variable Glycine (<i>Glycine tabacina</i>), Weeping Grass (<i>Microlaena stipoides</i>) and Wiry Spurge (<i>Phyllanthus virgatus</i>).</p>
Survey effort	Three plots/transects within the subject property (all outside the impact area): <ul style="list-style-type: none"> • Medium: 2 plots (numbers 3 and 4) • Poor: 1 plot (number 2)
Condition description	Within the subject property the community is in medium to poor condition with a high cover of introduced plant species due to past and current grazing activities. Vegetation zones were delineated largely based off whether the canopy was dense or sparse.

Table 4.3 PCT 1800 – Cumberland Swamp Oak riparian forest description

PCT 1800 – Cumberland Swamp Oak riparian forest

<p>Characteristic species used for identification of PCT</p>	<p>This PCT could align with PCT 1800 or PCT 835.</p> <p>According to the NSW VIS Classification (OEH 2014), PCT 1800 Cumberland Swamp Oak Riparian Forest (<i>Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley</i>) is found on the riverflats of the Cumberland Plain in western Sydney and in the Hunter Valley. The distinguishing feature is the prominent stands of Swamp Oak found along or near streams. This community features an open grassy and herbaceous understorey, as is typical of riverflat forests. It may be that this is a pioneering community that is re-establishing following clearing or disturbance. It is known that many creeklines in western Sydney are slightly saline, particularly during drought (Benson and Howell 1990).</p> <p>The NSW VIS Classification for PCT 835 Cumberland River-flat Forest (<i>Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion</i>) is found on broad alluvial flats of the Hawkesbury and Nepean river system. It also forms narrower ribbons alongside streams and creeks that drain the Cumberland Plain. Typically, the canopy includes one of either Rough-barked Apple (<i>Angophora floribunda</i>) or Broad-leaved Apple (<i>Angophora subvelutina</i>), and one or both of Forest Red Gum (<i>Eucalyptus tereticornis</i>) and Cabbage Gum (<i>Eucalyptus amplifolia</i>). The understorey within this riverflat forest is characterised by an occasional sparse to open small tree stratum of paperbark (<i>Melaleuca spp.</i>) and wattles (<i>Acacia spp.</i>).</p>
<p>Justification of evidence used to identify the PCT</p>	<p>PCT 1800 has been chosen because:</p> <ul style="list-style-type: none"> • the subject property is on the Cumberland Plain; • a canopy of Swamp Oak is characteristic of this PCT. The description of Cumberland Riverflat Forest in the Sydney Metro veg classification, lists Swamp Oak as an ‘uninformative’ (non-diagnostic) species sometimes found (22% frequency) in the community; • the area mapped is periodically inundated, providing periodic swamp-like conditions; • analysis of plot data against key characteristic species provides: <ul style="list-style-type: none"> – 20% (Canopy), 7% (Understorey) and 11% (Groundlayer), noting that VIS treats Swamp Oak as both a canopy and understorey species; otherwise the score for understorey would be 0%. <p>The description of PCT 1800 acknowledges that “It may be that this is a pioneering community that is re-establishing following clearing”.</p> <p>In conclusion, PCT 1800 has been chosen as the current best fit, based on landform subject to periodic inundation and species currently present, in particular because the vegetation is dominated by Swamp Oak. However, it is noted that the vegetation has likely colonised responding to past clearing; and could be vegetation in a transitional state between PCT 1800 and PCT 835.</p>

Table 4.3 PCT 1800 – Cumberland Swamp Oak riparian forest description

PCT 1800 – Cumberland Swamp Oak riparian forest

Status	<p>PCT 1800 Cumberland Swamp Oak riparian forest Bioregion is associated with the BC Act <i>Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community</i> listing and EPBC Act listing as <i>Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland Endangered Ecological Community</i>. The PCT aligns with the BC Act listing because:</p> <ul style="list-style-type: none"> • it occurs on the Cumberland plains; • it comprises a dense tree canopy; • it is periodically waterlogged; and • the canopy comprises Swamp Oak. <p>The PCT that is in medium and poor condition along Oaky Creek aligns with the EPBC Act listing as <i>Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland Endangered Ecological Community (EEC)</i> because:</p> <ul style="list-style-type: none"> • the patch along Oaky Creek is greater than 2 ha in size; • Overall, non-native species comprise less than 80% of total understorey vegetation cover in both vegetation zones (noting that the medium condition vegetation zone only plots together average to 79.1% non-native species cover; thus, the vegetation zones only just pass this threshold); and • Transformer species (eg. Bridal Creeper) comprise less than 50% of total understorey vegetation cover. <p>Non-native species understorey cover is based off floristics plots completed. It is noted that non-native understorey species cover is likely higher in some areas of the poor condition PCT 1800 on site. However, as we do not have plot data to support this claim, we are taking a precautionary approach by including the both the poor and medium quality PCT 1800 situated along Oaky Creek meeting the EPBC threatened ecological community condition thresholds.</p> <p>Vegetation areas outside of Oaky Creek are located further than 30 m from the vegetation along Oaky Creek, and thus are not part of the same 'patch' (DoEEa), and are less than 0.5 ha in size which is minimum size to meet the EPBC Act condition thresholds, and also contain higher levels of exotic cover based on site observations.</p>
Estimate of percent cleared value of PCT within NSW	60%

Table 4.3 **PCT 1800 – Cumberland Swamp Oak riparian forest description**

PCT 1800 – Cumberland Swamp Oak riparian forest



Photograph 4.1 **Cumberland Swamp Oak riparian forest within the impact area (Medium condition - plot ID P03).**

Table 4.4 PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion description

PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	
PCT ID	849
Common name	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Condition classes	Poor
Extent within the subject property	0.35 ha
Extent within MOD 5 site that will result in additional vegetation clearance (beyond the DA 315-7-2003 footprint)	Total area of additional impact: 0 ha
Extent within the approved DA 315-7-2003	0.001 ha
Description	<p>The canopy comprises dying Grey Box (<i>Eucalyptus moluccana</i>). It is assumed that they are dying from either drought conditions or from dieback, but the actual cause is unknown. Due to the absence of fruiting material, adult leaves or a healthy tree form, identification was based on juvenile leaves, bark, and the local species in the area. Trees inspected outside the subject property also lacked identification material.</p> <p>The midstorey is absent.</p> <p>The groundlayer is co-dominated by exotic grass and forb species. Exotic grass and grass-like species are: Kikuyu, Rhodes Grass (<i>Chloris gayana</i>), Paspalum and Marsh Bristlegrass. Other exotic species are Moth Vine, Turnip Weed (<i>Rapistrum rugosum</i>), Paddy's Lucerne (<i>Sida rhombifolia</i>), Small-flowered Mallow (<i>Malva parviflora</i>), Lamb's Tongues (<i>Plantago lanceolata</i>), Apple of Sodom (<i>Solanum linnaeanum</i>), Black-berry Nightshade and Shore Vervain (<i>Verbena caracasana</i>).</p> <p>The native grasses and grass-like species are Common Couch, Toad Rush (<i>Juncus bufonius</i>), Watercrown Grass (<i>Paspalidium distans</i>) and Early Spring Grass (<i>Eriochloa pseudoacrotricha</i>), which are all commonly associated with exotic grasslands and are often cultivated. The native forbs are Climbing Saltbush (<i>Einadia</i> spp.), Kidney Weed, Fireweed (<i>Senecio</i> spp.) and Dock (<i>Rumex</i> spp.).</p>
Survey effort	1 plot (number 1)
Condition description	<p>The community is in poor condition with a high cover of introduced or cultivated plant species, likely due to past grazing activities. Since grazing activities ceased, there is no evidence of mowing or regular grazing, given that the area is littered with rubbish and the large grass tussocks appear to be choking out the smaller species.</p> <p>The overstorey consists of dead and dying trees, where the healthier specimens are covered in large juvenile leaves, but no adult leaves are visible. The trees in the adjacent property are likewise in poor condition.</p> <p>The midstorey (shrub layer) is absent.</p>
Characteristic species used for identification of PCT	<p>The canopy comprises Grey Box, which is a dominant species of both PCT 849 and 850.</p> <p>The midstorey is absent. The groundlayer includes Kidney Weed (which is characteristic of PCT 849 and 850) and Watercrown (characteristic of PCT 849 only).</p>

Table 4.4 PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion description

PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	
Justification of evidence used to identify the PCT	<p>According to the NSW VIS Classification (Version 2.1.9), grassy woodlands in the Cumberland Plains are likely to fit one of two PCTs, which together are known as Cumberland Plain Woodland in the Sydney Basin Bioregion EEC: PCT 849 and 850. These PCTs are very similar. Both comprise a canopy of two to three dominant species, of which Grey Box is one. The elevation is 69 m, which could fit either PCT description.</p> <p>PCT 849 was chosen because:</p> <ul style="list-style-type: none"> • of the lack of Hickory Wattle (<i>Acacia implexa</i>) within the subject property (which the VIS specifically states is a characteristic distinction between the two PCTs); • two present groundlayer species align with PCT 849 (Kidney Weed and Watercrown) but only one species for PCT 850 (Kidney Weed); • analysis of plot data against key characteristic species fits PCT 849 best: <ul style="list-style-type: none"> – PCT 849: 50% (canopy), 0% (midstorey), 9% (groundlayer); and – PCT 850: 33% (canopy), 0% (midstorey), 7% (groundlayer).
Status	<p>PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion is associated with the BC Act listing <i>Cumberland Plain Woodland in the Sydney Basin Bioregion Critically Endangered Ecological Community</i> and the EPBC Act listing as <i>Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest Critically Endangered Ecological Community</i>. The PCT aligns with the BC Act listing because:</p> <ul style="list-style-type: none"> • it occurs on the Cumberland plains; • it comprises an open tree canopy; • it comprises a continuous groundcover dominated by grasses and herbs; and • the canopy is dominated by Grey Box. <p>The PCT does not align with the EPBC Act listing because it is less than 0.5 ha in size, is isolated from other patches of vegetation, and native midstorey is absent.</p>
Estimate of percent cleared value of PCT within NSW	93%

Table 4.4 **PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion description**

PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion



Photograph 4.2 **Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion within the subject property (Poor condition - plot ID P01).**

4.3.3 Vegetation integrity score

The vegetation integrity score for each vegetation zone within the subject property is presented in Table 4.5, noting that no native vegetation will be impacted as part of MOD 5.

As no native vegetation will be removed as part of MOD 5, and water management and other site activities will occur broadly consistent with the current approval, no indirect impacts are expected to occur, and therefore no indirect impact zones have been identified within this MOD 5 BDAR.

Table 4.5 Vegetation zones mapped within the subject property

Plant community type	Condition	Vegetation integrity score
PCT 849 – Cumberland shale plains woodland	Poor	26.7
PCT 1800 – Cumberland Swamp Oak riparian forest	Medium	43.7
	Poor	44.2

4.4 Groundwater dependent ecosystems

An assessment was completed to identify terrestrial ecosystems which potentially use and/or are reliant on groundwater in the subject property. It included reviewing the Groundwater Dependent Ecosystem (GDE) Atlas (BOM 2020a) and groundwater monitoring data.

4.4.1 Identification of potential GDEs

Ecosystems that could rely on either surface or subsurface expression of groundwater within or surrounding the subject property are those associated with:

- creeks where deep groundwater is discharging and provides baseflow;
- shallow (perched) groundwater systems;
- springs; and
- terrestrial vegetation overlaying shallow groundwater (within the vegetation roost zone).

These ecosystems have been classified into three categories according to their dependence on groundwater:

- non-dependent;
- facultative;
- entirely dependent/obligate:
 - opportunistic;
 - proportional; and
 - highly dependent.

Considerations in evaluating PCTs and their potential dependency on groundwater include:

- the physiology of plant species that occur in that community and their likely dependence on water availability;
- the PCTs location in the landscape; and
- if the rooting depth of vegetation would be able to take up groundwater based on likely depth of the aquifer and soil characteristics.

Access to the groundwater is dependent on a number of factors with the core factor being the depth to the water table. As terrestrial vegetation communities are composed of a range of vegetation types with a range of rooting depths and strategies there is a relationship between groundwater depth and the types and composition of the vegetation that is able to access it (Serov P 2012).

4.4.2 Potential GDEs

The GDE Atlas (BOM 2020a) does not show any terrestrial GDEs as occurring in the subject property. It is not considered that the MOD 5 site will have an impact on the water table. Draining the quarry pit is allowed under the current DA NO. 315-7-2003 (as modified). The quarry pit was regularly drained until operations ceased about two years ago, hence draining is unlikely to cause any additional impacts to GDEs or the water table.

5 Threatened species

5.1 Fauna habitat assessment

Fauna habitat primarily comprises the riparian corridor running along the eastern boundary of the subject property. The extensive history of use of the subject property for agricultural purposes and quarrying, has resulted in large areas of exotic grassland, a highly degraded woodland, and a narrow riparian corridor. Scattered native trees and some ephemeral dams also provide some habitat. As a result, the subject property provides limited refuge or habitat for fauna.

The exotic grassland comprises dense patches of pasture grasses, particularly Kikuyu. Habitat features, such as bare ground, inter-tussock-space, logs, and perching structures are virtually absent.

PCT 849 is comprised of trees in very poor condition. The area contains minimal areas of fallen timber, with some areas of scattered rubbish providing some habitat in the groundlayer. The canopy of the trees is limited to dense epicormic growth. No adult leaves were seen during the surveys in January and February 2020.

The riparian corridor comprises largely Swamp Oak with occasional juvenile planted native trees growing along Oaky Creek. Due to the young age of these trees, presence of habitat features (such as logs, hollow-bearing trees, etc) is very limited. During periods of low flow, Oaky creek consists of a series of disconnected pools with a muddy base and little aquatic vegetation.

The scattered trees comprise Swamp Oak, from regenerating trees to mature trees. No hollows were identified.

The bottom of the quarry pit has filled with water but lacks aquatic plants or vegetation (Photograph 5.1).

The ephemeral dams and swamps are dominated by exotic species. The groundlayer is either absent or dominated by wetland plants, depending on the frequency and duration of flooding events (Pond 1 Photograph 5.2, Pond Photograph 5.3, Pond 3 Photograph 5.4, and Pond 4 Photograph 5.5).

A shed associated with the quarry occurs in the MOD 5 site. This building is an open large tin shed, with no roof voids with no features considered to support fauna species. No guano or other signs of bat usage were observed.

A bridge crosses Oaky Creek on the south-eastern boundary of the subject property and is considered to provide microchiropteran habitat.

No threatened flora or fauna were recorded along the eastern side of Oaky Creek within the WSA (DIRD 2016).



Photograph 5.1 Quarry pit (views from the northeast and southeast respectively)



Photograph 5.2 Pond 1



Photograph 5.3 Pond 2



Photograph 5.4 **Pond 3**



Photograph 5.5 **Pond 4**

5.2 Ecosystem credit species assessment (step 1)

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (OEH 2017), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur. It is noted that no native vegetation additional to that approved will be removed as a result of the proposal. However, the species identified below are based on the PCTs occurring within the subject land.

A list of ecosystem credit species predicted to occur within the impact area, based on the PCTs present and generated by the calculator associated within the BAM (OEH 2017) is provided in Table 5.1.

The potential for these species to occur within the impact area was assessed in accordance with Section 6.2 of the BAM (OEH 2017).

Table 5.1 Assessment of ecosystem credit species within the subject property footprint

Common name	Scientific name	Justification for exclusion
<i>Anthochaera phrygia</i>	Regent Honeyeater (Foraging)	<p>Regent Honeyeater inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany.</p> <p>The impact area is dominated by Swamp Oak and lacks suitable numbers of eucalyptus species or abundance of mistletoes for foraging. The surrounding habitat has been cleared for farming and is highly isolated from larger patches of more suitable habitat.</p> <p>This species is excluded.</p>
<i>Artamus cyanopterus</i>	Dusky Woodswallow	Excluded from cleared vegetation zones and condition class Poor. No additional vegetation will be removed.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Foraging)	Excluded from cleared vegetation zones (condition class Poor or Derived grassland). Species associated with PCT 849 which is located outside of the impact area.
<i>Chthonicola sagittata</i>	Speckled Warbler	<p>The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.</p> <p>The impact area is dominated by Swamp Oak and lacks native tussock grasses. The surrounding habitat has been cleared for farming and is highly isolated from larger patches of more suitable habitat.</p> <p>This species is excluded.</p>
<i>Circus assimilis</i>	Spotted Harrier	<p>Not excluded.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>

Table 5.1 Assessment of ecosystem credit species within the subject property footprint

Common name	Scientific name	Justification for exclusion
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	<p>Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>), forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; fallen timber is an important habitat component for foraging. Hollows in standing dead or live trees and tree stumps are essential for nesting.</p> <p>The impact area is dominated by Swamp Oak and lacks suitable eucalypts species that this species is known to be associated with. The surrounding habitat has been cleared for farming and is highly isolated from larger patches of more suitable habitat.</p> <p>This species is excluded.</p>
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Excluded from cleared vegetation zones and condition class Poor. No additional vegetation will be removed.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	<p>Spotted-tailed Quoll use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites in areas containing rainforest, open forest woodland, coastal heath and inland riparian forest.</p> <p>The impact area lacks suitable den features. The surrounding habitat has been cleared for farming and is highly isolated from larger patches of more suitable habitat.</p> <p>This species is excluded.</p>
<i>Glossopsitta pusilla</i>	Little Lorikeet	Excluded from cleared vegetation zones and condition class Poor. No additional vegetation will be removed.
<i>Grantiella picta</i>	Painted Honeyeater	Excluded from cleared vegetation zones and condition class Poor. No additional vegetation will be removed.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Foraging)	Excluded from cleared vegetation zones and condition class Poor. No additional vegetation will be removed.
<i>Hieraaetus morphnoides</i>	Little Eagle (Foraging)	Excluded from cleared vegetation zones and condition class Poor. No additional vegetation will be removed.
<i>Ixobrychus flavicollis</i>	Black Bittern	Excluded from cleared vegetation zones and condition class Poor. No additional vegetation will be removed.

Table 5.1 Assessment of ecosystem credit species within the subject property footprint

Common name	Scientific name	Justification for exclusion
<i>Lathamus discolor</i>	Swift Parrot (Foraging)	Swift Parrot occur in areas where eucalypts are flowering profusely or where lerp (from sap-sucking bugs) infestations are abundant. Favoured feed trees include winter flowering species such as Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Bloodwood (<i>C. gummifera</i>), Forest Red Gum (<i>E. tereticornis</i>), Mugga Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>). The impact area is dominated by Swamp Oak and lacks suitable numbers of eucalyptus species for foraging. The surrounding habitat has been cleared for farming and is highly isolated from larger patches of more suitable habitat. This species is excluded.
<i>Lophoictinia isura</i>	Square-tailed Kite	Not excluded, however, no additional vegetation will be removed.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	Not excluded, however, no additional vegetation will be removed.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	Not excluded, however, no additional vegetation will be removed.
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Not excluded, however, no additional vegetation will be removed. This species was recorded within the impact area.
<i>Miniopterus australis</i>	Little Bent-winged Bat (foraging)	Not excluded, however, no additional vegetation will be removed. This species was recorded as having a probable pass during the acoustic detection survey.
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (foraging)	Not excluded, however, no additional vegetation will be removed. This species was recorded during the acoustic detection survey.
<i>Neophema pulchella</i>	Turquoise Parrot	Not excluded, however, no additional vegetation will be removed.
<i>Ninox connivens</i>	Barking Owl (Foraging)	Not excluded, however, no additional vegetation will be removed.
<i>Ninox strenua</i>	Powerful Owl (Foraging)	Excluded from cleared vegetation zones and condition class Poor, however, no additional vegetation will be removed.
<i>Pandion cristatus</i>	Eastern Osprey (Foraging)	Excluded from cleared vegetation zones and condition class Poor, however, no additional vegetation will be removed.
<i>Petroica boodang</i>	Scarlet Robin	Excluded from cleared vegetation zones and condition class Poor, however, no additional vegetation will be removed.

Table 5.1 Assessment of ecosystem credit species within the subject property footprint

Common name	Scientific name	Justification for exclusion
<i>Petroica phoenicea</i>	Flame Robin	Excluded from cleared vegetation zones and condition class Poor, however, no additional vegetation will be removed.
<i>Phascolarctos cinereus</i>	Koala (Foraging)	Excluded from cleared vegetation zones and condition class Poor, however, no additional vegetation will be removed.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Foraging)	Excluded from cleared vegetation zones and condition class Poor, however, no additional vegetation will be removed. This species was recorded within the impact area during nocturnal surveys.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	Not excluded, however, no additional vegetation will be removed. The species was heard foraging over the impact area during nocturnal surveys.
<i>Stagonopleura guttata</i>	Diamond Firetail	Not excluded, however, no additional vegetation will be removed.
<i>Tyto novaehollandiae</i>	Masked Owl (Foraging)	Not excluded, however, no additional vegetation will be removed.

5.3 Species credit species assessment (step 1)

Species credit species are threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. A list of species credit species predicted to occur within the impact area, based on the PCTs present and generated by the calculator associated within the BAM (OEH 2017) is provided in Table 5.2.

The potential for species credit species to occur within the impact area is assessed in Section 5.3.1 below, in accordance with Section 6.2 of the BAM (OEH 2017).

5.3.1 Habitat constraints assessment (Step 2)

For the purposes of the BAM (OEH 2017), species credit species require detailed assessment and, if present, additional offsets to ecosystem credits. An assessment of habitat constraints for threatened species credit species was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017). For those threatened species credit species predicted to occur, for which habitat constraints are listed, an assessment was undertaken of the presence of the habitat features within the subject property.

The species generated by the calculator with habitat constraints, as well as the results of the habitat constraints assessment, are shown in Table 5.2.

Table 5.2 Assessment of geographic and habitat constraint features within the subject property

Scientific name	Common name	Feature	Sensitivity to gain class	Habitat / geographic constraint present in the subject property	Justification
Flora					
<i>Gyrostemon thesioides</i>	-	<ul style="list-style-type: none"> Sandy, alluvial or colluvial soil within 50 m of a water course 	High	Yes	The subject property is within 50 m of a water course.
<i>Maundia triglochinooides</i>	-	<ul style="list-style-type: none"> Ephemerally and semi-permanently wet areas Wet areas up to 1 m deep Wet areas can be man-made or natural 	High	Yes	The subject property contains semi-permanent and ephemeral wet areas suitable to support this species.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	<ul style="list-style-type: none"> Those LGAs named in the population's listing 	High	Yes	The subject property is within Liverpool LGA.
<i>Persicaria elatior</i>	Tall Knotweed	<ul style="list-style-type: none"> Semi-permanent/ephemeral wet areas; or within 50 m swamps; or or within 50 m of waterbodies including Wetlands 	High	Yes	The subject property contains semi-permanent and ephemeral wet areas suitable to support this species.
Fauna					
<i>Anthochaera phrygia</i>	Regent Honeyeater (Breeding)	<ul style="list-style-type: none"> As per mapped areas 	High	No	The subject property is not mapped as containing known breeding habitat for this species.
<i>Burhinus grallarius</i>	Bush Stone-curlew	<ul style="list-style-type: none"> Fallen/standing dead timber including logs 	High	Yes	The subject property contains minimal features such as fallen and standing dead timber.

Table 5.2 Assessment of geographic and habitat constraint features within the subject property

Scientific name	Common name	Feature	Sensitivity to gain class	Habitat / geographic constraint present in the subject property	Justification
<i>Callocephalon Fimbriatum</i>	Gang-gang Cockatoo (Breeding)	<ul style="list-style-type: none"> Eucalypt tree species with hollows greater than 9 cm diameter. 	High	No	One dead standing tree that contained a small to medium size hollow was observed within the subject property. This hollow was less than 9 cm diameter and was being used by breeding Red-rumped parrots (<i>Psephotus haematonotus</i>).
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	<ul style="list-style-type: none"> Cliffs within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels. 	Very high	No	<p>The subject property does not contain cliffs nor within 2 km of rocky areas that could provide features to support this species.</p> <p>This species was recorded during the acoustic detection surveys, having just one pass over the site. It is assumed the riparian corridor may be used as commuting habitat for this species.</p>
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	<ul style="list-style-type: none"> Living or dead mature trees within suitable vegetation within 1 km of a river, lake, large dam or creeks, wetland and coastlines. 	High	Yes	The subject property contains living and dead mature trees located 1 km from large dams and wetlands.
<i>Hieraaetus morphnoides</i>	Little Eagle (Breeding)	<ul style="list-style-type: none"> Nest Trees – live (occasionally dead) large old trees within vegetation. 	Moderate	Yes	The subject property contains live mature trees; however, these trees are not considered to be large old trees.
<i>Lathamus discolor</i>	Swift Parrot	<ul style="list-style-type: none"> As per mapped areas 	Moderate	No	The subject property is not mapped as containing known breeding habitat for this species.
<i>Litoria aurea</i>	Green and Golden Bell Frog	<ul style="list-style-type: none"> Semi-permanent/ephemeral wet areas Within 1km of wet areas/swamps Within 1km of swamp/waterbodies Within 1km of waterbody 	High	Yes	The subject property contains semi-permanent and ephemeral wet areas suitable to support this species.

Table 5.2 Assessment of geographic and habitat constraint features within the subject property

Scientific name	Common name	Feature	Sensitivity to gain class	Habitat / geographic constraint present in the subject property	Justification
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)	<ul style="list-style-type: none"> Nest trees 	Moderate	No	No nest trees were observed that are been used by this species.
<i>Miniopterus australis</i>	Little Bent-winged Bat (Breeding)	<ul style="list-style-type: none"> Caves, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' Observation type code 'E nest-roost' With numbers of individuals >500 Or from the scientific literature 	Very High	No	The subject property does not contain caves or other structures that could provide breeding features to support this species.
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Breeding)	<ul style="list-style-type: none"> Caves, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' Observation type code 'E nest-roost' With numbers of individuals >500 	Very High	No	<p>The subject property does not contain caves or other structures that could provide breeding features to support this species.</p> <p>This species was recorded during the acoustic detection surveys. It is assumed the riparian corridor may be used as commuting habitat for this species.</p>
<i>Myotis macropus</i>	Southern Myotis	<ul style="list-style-type: none"> Hollow bearing trees. Within 200 m of riparian zone. Bridges, caves or artificial structures within 200 m of riparian zone / waterbodies. This includes rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200 m 	High	Yes	The subject property is within 200 m of a riparian zone and contains a number of dams and waterbodies.

Table 5.2 Assessment of geographic and habitat constraint features within the subject property

Scientific name	Common name	Feature	Sensitivity to gain class	Habitat / geographic constraint present in the subject property	Justification
<i>Ninox connivens</i>	Barking Owl (Breeding)	<ul style="list-style-type: none"> Hollow bearing trees Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground 	High	No	One dead standing tree that contained a small to medium size hollow was observed within the subject property. This hollow was less than 9 cm diameter, observed to be used by breeding Red-rumped parrots.
<i>Ninox strenua</i>	Powerful Owl (Breeding)	<ul style="list-style-type: none"> Living or dead trees with hollow greater than 20 cm diameter 	High	No	One dead standing tree that contained a small to medium size hollow was observed within the subject property. This hollow was less than 9 cm diameter, observed to be used by breeding Red-rumped parrots.
<i>Pandion cristatus</i>	Eastern Osprey (Breeding)	<ul style="list-style-type: none"> Presence of stick-nest in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting 	Moderate	No	The subject property did not contain any evidence of stick-nest in trees or artificial structures within 100 m of the waterbodies.
<i>Phascolarctos cinereus</i>	Koala (Breeding)	<ul style="list-style-type: none"> Areas identified via survey and important habitat 	High	Yes	The subject property primarily contains Swamp Oak, which is identified as a Koala use tree under the Koala Habitat Protection SEPP, though this tree species is not known to be used for food by the Koala.
<i>Pommerhelix duralensis</i>	Dural Land Snail	<ul style="list-style-type: none"> Leaf litter and shed bark or within 50 m of litter or bark Rocks or within 50 m of rocks 	High	Yes	The subject property contains leaf litter and shed bark but lacks any rocky habitat. Species associated with PCT 849 which is located outside of the impact area.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Breeding)	<ul style="list-style-type: none"> Breeding camps 	High	No	No breeding camps are located within or adjacent to the subject property.
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	<ul style="list-style-type: none"> Living or dead trees with hollows greater than 20 cm diameter 	High	No	One dead standing tree that contained a small to medium size hollow was observed within the subject property. This hollow was less than 9 cm diameter, observed to be used by breeding Red-rumped parrots.

Using the process outlined in Step 2 of Section 6.4 of the BAM (OEH 2017), the species that were excluded (Table 5.3) do not require further assessment as per section 6.4.1.13 of the BAM (OEH 2017). Species that have not been excluded on the basis of the identified geographic or habitat constraints above are given further consideration in Section 6.3.2.

Table 5.3 Species excluded from further assessment

Scientific name	Common name
<i>Anthochaera phrygia</i>	Regent Honeyeater (Breeding)
<i>Callocephalon Fimbriatum</i>	Gang-gang Cockatoo (Breeding)
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat
<i>Lathamus discolor</i>	Swift Parrot
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)
<i>Miniopterus australis</i>	Little Bent-winged Bat (Breeding)
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Breeding)
<i>Ninox connivens</i>	Barking Owl (Breeding)
<i>Ninox strenua</i>	Powerful Owl (Breeding)
<i>Pandion cristatus</i>	Eastern Osprey (Breeding)
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Breeding)
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)

5.3.2 Identifying candidate species credit species for further assessment (Step 3)

To develop a list of species credit species for further assessment, an assessment was undertaken in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017), as shown in Table 5.4.

It is again noted that the list of species credit species for assessment was developed from a precautionary perspective, as no additional native vegetation is impacted by the proposed MOD 5, and therefore from a technical perspective threatened species are not triggered for survey and assessment. However, as discussed under Section 1.4 data from across the subject property as a whole was utilised, and the assessment is presented in Table 5.4.

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
Flora			
<i>Acacia bynoeana</i>	Bynoe's Wattle	Yes	<p>Bynoe's Wattle is a semi-prostrate shrub to a metre high. It is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1-5 plants). Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>
<i>Acacia pubescens</i>	Downy Wattle	Yes	<p>Downy Wattle occurs in open woodland and forest, in a variety of plant communities. Hybridises with other wattle species (<i>A. baileyana</i>, <i>A. decurrens</i> and <i>A. jonesii</i>). High Sensitivity to loss (ie providing protection above the listing status) based on recent population decline.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	No (degraded habitat)	<p>Found in grassy sclerophyll woodland on clay loam or sandy soils. When not flowering, only a single leaf is visible above ground, and this leaf regrows each year.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 1800, as such this species is not considered to occur within the subject property. Furthermore PCT 1800 does not occur within the MOD 5 footprint.</p>

¹ The habitat suitability assessment was applied to the subject property as a whole. The MOD 5 footprint for additional works does not contain any mapped native vegetation.

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Yes	<p>The rare species is known in rainforest gullies scrub and scree slopes. Associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>) coastal scrub; Forest Red Gum (<i>Eucalyptus tereticornis</i>) aligned open forest and woodland; Spotted Gum (<i>Corymbia maculata</i>) aligned open forest and woodland; and Bracelet Honey Myrtle (<i>Melaleuca armillaris</i>) scrub to open scrub.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>
<i>Deyeuxia appressa</i>		No (degraded habitat)	<p>No records since 1942. Given that this species hasn't been seen in over 60 years, almost nothing is known about its habitat and ecology. The species requires moist conditions to grow. Ecology data is inferred from other species.</p> <p>This species hasn't been seen for over 60 years, the habitat within the subject property has undergone historical clearing and grazing, it may no longer be suitable to support this species. This species has been assumed to be extinct in the wild. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 1800, as such this species is not considered to occur within the subject property.</p>
<i>Dillwynia tenuifolia</i>		Yes	<p>Present in western Sydney, mainly in scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or lateraled clays. Will flower sporadically outside of official survey period in response to rain.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Eucalyptus benthamii</i>	Camden White Gum	Yes	<p>Occurs from 30 m up to as high as 750 m ASL in the Kedumba population in open forest. Most populations occur between 60 m and 300 m ASL. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment (ie. bare silt deposits in rivers and streams). Associated with <i>Eucalyptus elata</i>, <i>E. bauerina</i>, <i>E. amplifolia</i>, <i>E. deanei</i> and <i>Angophora subvelutina</i>. Understorey species include <i>Bursaria spinosa</i>, <i>Pteridium esculentum</i>, and a wide variety of agricultural weeds. The species is often associated with floodplains.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>
<i>Grevillea juniperina</i> <i>subsp. juniperina</i>	Juniper-leaved Grevillea	Yes	<p>Associated with Cumberland Plain Woodland, amongst other vegetation types common in western Sydney. Grows on reddish clay to sandy soils. Associated canopy species in Cumberland Plain Woodland includes Forest Red Gum (<i>Eucalyptus tereticornis</i>), Grey Box, Narrow-leaved Ironbark (<i>E. crebra</i>), Red ironbark (<i>E. fibrosa</i>) and Thin-leaved Stringybark (<i>E. eugenioides</i>).</p> <p>Understorey species include Blackthorn (<i>Bursaria spinosa</i>), Siebers Parrot-pea (<i>Dillwynia sieberi</i>), Rice Flower (<i>Ozothamnus diosmifolius</i>), Gorse Bitter Pea (<i>Daviesia ulicifolia</i>), Sickle Wattle (<i>Acacia falcata</i>), Parramatta Wattle (<i>A. parramattensis</i>), Kangaroo Grass (<i>Themeda australis</i>), Purple Wiregrass (<i>Aristida ramosa</i>), Barbed-wire Grass (<i>Cymbopogon refractus</i>), Browns Lovegrass (<i>Eragrostis brownii</i>), Rock Fern (<i>Cheilanthes sieberi</i>), Spreading Flax-lily (<i>Dianella revoluta</i>) and Ivy Goodenia (<i>Goodenia hederacea</i>). The species often colonises mechanically disturbed areas.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Gyrostemon thesioides</i>	Broom Wheelfruit	No	<p>Grows on hillsides and riverbanks and may be restricted to fine sandy soils. Surveys must occur within three years of fire and thereafter may only be present in the seedbank.</p> <p>Unable to survey due to lack of evidence of fire occurring within the last three years. The subject property is located in a rural landscape with patchy and fragmented native vegetation. PCT 1800 is regularly inundated with areas of standing water surrounded by waterbodies. It is considered rare that this habitat would be affected by fires regular enough to support germination for this species. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 1800, as such this species is not considered to occur within the subject property.</p>
<i>Maundia triglochinooides</i>	-	Yes	<p>Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30–60 cm deep on heavy clay and low nutrients. Fruit are required for identification. Associated with wetland species e.g. <i>Triglochin procerum</i>.; spreads vegetatively, with tufts of leaves arising along rhizome. Populations expand following flood events and contract to more permanent wetlands in times of low rainfall. Appears to be somewhat dependent on water quality so a population can go from prolific to nothing and back again over time. It can be absent for many years and then flourish.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 1800, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Potential to occur in PCT 1800 in areas where water occasionally/regularly reaches up to 1 m depth (noted that this PCT occurs outside of the MOD 5 impact area).</p>
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	-	Yes	<p>The subject property is located within the area mapped for this population. No previous recorded of this species/population are within the subject property. Presence cannot be discounted without survey.</p>
<i>Persicaria elatior</i>	Tall Knotweed	Yes	<p>This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 1800, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Potential to occur in PCT 1800 in areas either within 50 m of permanent water bodies, or within ephemerally wet areas (noted that this PCT occurs outside of the MOD 5 impact area).</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Persoonia bargoensis</i>	Bargo Geebung	Yes	<p>The Bargo Geebung occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravelly soils of the Wianamatta Shale and Hawkesbury Sandstone. It favours interface soil landscapes such as between the Blacktown Soil Landscape and the complex Mittagong Formation soils (Lucas Heights Soil Landscape) with the underlying sandstone (Hawkesbury Soil Landscape and Gynea Soil Landscape). Some of the vegetation the species occurs within would be recognised as the Shale/Sandstone Transition Forest, a listed community. This species seems to benefit from the reduced competition and increased light available on disturbance margins including roadsides.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Species associated with PCT 849 which is located outside of the impact area.</p>
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	No (degraded habitat)	<p>Austral Pillwort grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous. Most of the records in the Albury-Urana area were from table drains on the sides of roads. The ACT record was from a subalpine grassy plain. This species is probably ephemeral (especially in the drier parts of its range), appearing when soils are moistened by rain. Survey in drying mud after inundation.</p> <p>This species can be associated with highly disturbed areas, found in table drains on roadsides. Most recorded are known to occur within the Albury-Urana area. This species is only predicted to occur within the Cumberland IBRA sub region. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded, as such this habitat is only considered marginal to support this species within the subject property, and too degraded within the MOD 5 footprint to occur.</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Pimelea curviflora</i> var. <i>curviflora</i>		Yes	<p>Restricted to the coastal zone around Sydney occurring on ridge tops and upper slopes in open forest and woodland on sandy soil derived from sandstone on shaley/lateritic soils and shale/sandstone transition soils. It often grows among dense grasses and sedges.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>Due to the variable flowering and cryptic nature of the species, two surveys are generally required. However, given the highly disturbed nature of the groundlayer in the subject property, no potential habitat is available for the species. Therefore, one survey is considered adequate to assess presence.</p> <p>This is a species associated with PCT 849 which is located outside of the impact area.</p>
<i>Pimelea spicata</i>	Spiked Rice-flower	No (degraded habitat)	<p>In the Cumberland Plain this species is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) on well-structured clay soils. It is associated with Grey Box, Forest red gum (<i>E. tereticornis</i>) and narrow-leaved ironbark (<i>E. crebra</i>). Blackthorn (<i>Bursaria spinosa</i>) is often present at sites (and may be important in protection from grazing) and Kangaroo Grass (<i>Themeda australis</i>).</p> <p>Must survey 4 weeks after at least a 30 mm rainfall event. In drier times plants are often not visible above ground unless soil remain moist. Multiple surveys may be required. Survey at least 3 times, each at least a month apart unless found. Is associated with the highly disturbed areas with no or limited native vegetation. Given the density and height of exotic vegetation this species is cryptic.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included waterbody creation of dams. The habitat is highly degraded within PCT 849, as such this species is not considered to occur within the subject property.</p>
<i>Pomaderris brunnea</i>	Brown Pomaderris	Yes	<p>Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. It is associated with Cabbage Gum, Rough-barked Apple (<i>Angophora floribunda</i>), Parramatta Wattle (<i>Acacia parramattensis</i>), Blackthorn, and White Kunzea (<i>Kunzea ambigua</i>).</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included waterbody creation of dams. The habitat is highly degraded within PCT 1800, as such this habitat is only considered marginal to support this species within the subject property (noted that this PCT occurs outside of the MOD 5 impact area).</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	No (degraded habitat)	<p>Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. Habitat requires a native groundcover (ie. over 50% native species).</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included waterbody creation of dams. The habitat is highly degraded within the subject property, as such the subject property does not contain suitable habitat for this species.</p>
<i>Pultenaea pedunculata</i>	Matted Bush-pea	No (degraded habitat)	<p>The Matted Bush-pea occurs in a range of habitats. NSW populations are generally among woodland vegetation, but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area. Colonises bare ground very well.</p> <p>In the Cumberland Plain the species favours sites in clay or sandy-clay soils on Wianamatta Shale-derived soils, and (in the Liverpool area) it is usually close to patches of Tertiary Alluvium. In the Liverpool - Fairfield area the majority of occurrences are in lower-lying areas and often close to creek lines. Soils are moderately to poorly drained.</p> <p>Associated species in the Sydney area include Grey Box, Red Ironbark (<i>E. fibrosa</i>), Narrow-leaved Ironbark (<i>E. crebra</i>), Woollybutt (<i>E. longifolia</i>) and White Feather Honey Myrtle (<i>Melaleuca decora</i>). Understorey species include Blackthorn, Rice Flower (<i>Ozothamnus diosmifolius</i>), Parramatta Wattle, Hickory Wattle (<i>A. falcata</i>), Australian Indigo (<i>Indigofera australis</i>), Sieber's Parrot-pea (<i>Dillwynia sieberi</i>), Sticky Daisy Bush (<i>Olearia viscidula</i>), White Kunzea (<i>Kunzea ambigua</i>), a Stinkweed (<i>Opercularia diphylla</i>), Cranberry Heath (<i>Astroloma humifusum</i>), Variable Glycine (<i>Glycine tabacina</i>), False Sarsaparilla (<i>Hardenbergia violacea</i>), Sprawling Bluebell (<i>Wahlenbergia gracilis</i>), Threeawn Speargrass (<i>Aristida vagans</i>), Rough Saw-sedge (<i>Gahnia aspera</i>), Wattle Mat-rush (<i>Lomandra filiformis</i>), Rock Fern (<i>Cheilanthes sieberi</i>) and Kangaroo Grass (<i>Themeda australis</i>).</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. The habitat is highly degraded within PCT 849, as such this species is not considered to occur within the subject property.</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Thesium australe</i>	Austral Toadflax	Yes	<p>Austral Toadflax occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, often in association with Kangaroo Grass and often in wet areas. This species is a root parasite that takes water and some nutrients from other plants, especially Kangaroo Grass. This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands region.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included waterbody creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.</p> <p>This species is associated with PCT 849 which is located outside of the impact area.</p>
Fauna			
<i>Burhinus grallarius</i>	Bush Stone-curlew	Yes	<p>The Bush Stone-curlew inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber.</p> <p>The subject property contains marginal habitat to support this species.</p>
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	No (degraded habitat)	<p>The Eastern Pygmy-possum is found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collect from banksias, eucalypts and bottlebrushes. Also feeds on insects throughout the year. This feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation (eg grass-tree skirts). Nest-building appears to be restricted to breeding females. Tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.</p> <p>The subject property lacks suitable feed species to support suitable habitat for Eastern Pygmy-possums, the habitat is considered isolated from larger and more suitable habitat that could support this species, and as such is highly degraded.</p>
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	No (degraded habitat)	<p>Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass.</p> <p>This species was observed 1 km way from the subject property. No nests suitable for the species were observed during the habitat assessment. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the waterbody creation of dams. The habitat is highly degraded, as such breeding habitat unlikely to occur within the subject property.</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Hieraaetus morphnoides</i>	Little Eagle (Breeding)	No (degraded habitat)	<p>The Little Eagle occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. The species nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.</p> <p>No nests suitable for the species were observed during the habitat assessment. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded, as such breeding habitat unlikely to occur within the subject property.</p>
<i>Litoria aurea</i>	Green and Golden Bell Frog	Yes	<p>This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes waterbodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. This species can occur in highly disturbed areas.</p> <p>The subject property contains potentially suitable habitat to support this species.</p>
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	Yes	<p>Primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this species is not considered to occur within the subject property.</p> <p>This species is associated with PCT 849 which is located outside of the impact area. Nonetheless threatened snail survey was undertaken.</p>
<i>Myotis macropus</i>	Southern Myotis	Yes	<p>This species roost in groups close to water in caves, mine shafts, hollow-bearing trees, storm water channels, building, under bridges and in dense foliage. The Southern Myotis relies on waterways with pools of 3 m wide or greater for foraging, breeding and roosting.</p> <p>The subject property contains potentially suitable habitat to support this species, as defined in OEH (2018a).</p>

Table 5.4 Species credit species and status and habitat suitability assessment (across subject property as a whole)¹

Scientific name	Common name	Candidate species	Justification
<i>Petaurus norfolcensis</i>	Squirrel Glider	No (degraded habitat)	<p>The Squirrel Glider inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. The species prefers mixed species stands with a shrub or Acacia mid-storey. The species relies on large old trees with hollows for breeding and nesting; however, trees need to be less than 50 m apart.</p> <p>No suitable trees with hollows are within the subject property, the habitat is considered isolated from larger and more suitable habitat that could support this species. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded, as such suitable habitat is unlikely to occur within the subject property.</p>
<i>Phascolarctos cinereus</i>	Koala (Breeding)	No (degraded habitat)	<p>Koalas live in eucalypt woodlands and forests. Home range size varies according to quality of habitat, ranging from less than two to several hundred hectares. The trees within the subject property provide foraging or sheltering resources for Koala.</p> <p>The habitat is considered isolated from larger and more suitable habitat that could support this species. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded, as such suitable habitat is unlikely to occur within the subject property.</p>
<i>Pommerhelix duralensis</i>	Dural Land Snail	Yes	<p>The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.</p> <p>This species is associated with PCT 849 which is located outside of the impact area. Nonetheless threatened snail survey was undertaken across the subject property.</p>

Table 5.4 identified the following species for further consideration across the entire subject property. It is noted that additional native vegetation will not be removed as a result of the MOD 5 footprint.

Table 5.5 Candidate species

Scientific name	Common name	BC Act	EPBC Act
Flora			
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V
<i>Acacia pubescens</i>	Downy Wattle	V	V
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E
<i>Dillwynia tenuifolia</i>		V	-
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	V	-
<i>Maundia triglochinosoides</i>		V	-
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population		E	-
<i>Persicaria elatior</i>	Tall Knotweed	V	V
<i>Persoonia bargoensis</i>	Bargo Geebung	E	V
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V
<i>Pomaderris brunnea</i>	Brown Pomaderris	E	V
<i>Thesium australe</i>	Austral Toadflax	V	V
Fauna			
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-
<i>Myotis macropus</i>	Southern Myotis	V	-
<i>Pommerhelix duralensis</i>	Dural Land Snail	E	E

The presence or absence of these species in the impact area was determined in accordance with Section 6.4 of the BAM (OEH 2017). Survey methods and outcomes are discussed further below.

5.3.3 Targeted survey methods

ii Targeted flora surveys

Targeted surveys were completed on 30 January 2020. Surveys were undertaken by walking line transects in accordance with OEH *Guide to surveying threatened plants* (OEH 2016) using transects spaced at 10 m intervals across accessible areas of the subject property (ie. excluding the quarry, which is absent of vegetation). Table 5.6 shows the flora species that were able to be included as part of the flora searches, conducted 30 January 2020.

Table 5.6 Targeted threaten flora searches within the subject property.

Scientific name	Common name	Surveyed in survey guidance period
<i>Acacia bynoeana</i>	Bynoe's Wattle	Yes
<i>Acacia pubescens</i>	Downy Wattle	Yes
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Yes
<i>Dillwynia tenuifolia</i>	-	Although surveys did not occur during survey season, the shrub form was readily detectable because no native shrub species were present in the subject property.
<i>Eucalyptus benthamii</i>	Camden White Gum	Yes
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	Yes
<i>Maundia triglochinoides</i>	-	Yes
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	-	Yes
<i>Persicaria elatior</i>	Tall Knotweed	Yes
<i>Persoonia bargoensis</i>	Bargo Geebung	Yes
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	Yes
<i>Pomaderris brunnea</i>	Brown Pomaderris	Although surveys did not occur during survey season, the shrub form was readily detectable because no native shrub species were present in the subject property.
<i>Thesium australe</i>	Austral Toadflax	Yes

\\Emsrvr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02_Maps\Modification_Reporting\BDAR\MBDR005_FloraSurvey\Locations_20201123_05.mxd 26/11/2020



- KEY**
- Subject property
 - Modification footprint
 - Waterbody
 - Cadastral boundary
 - Watercourse
 - Flora survey effort

Flora survey locations

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 5.1



iii Targeted fauna surveys

Targeted fauna surveys were conducted for the species listed below. Stratification units – as well as survey methods and effort – are outlined for each fauna group below. Fauna survey locations are illustrated in Figure 5.2. Survey effort detailed in Appendix C and survey weather summary in Appendix D.

a Nocturnal birds

Nocturnal bird surveys were undertaken within the subject property to target Bush Stone-curlew. Stratification units and area of each survey unit in the subject property is shown in Table 5.7. Bird survey methods and survey effort have been development in accordance with DEC (2004) and DSEWPaC (2010) guidelines. Methods and survey effort are outlined in Table 5.8.

Table 5.7 Stratification units and survey area – nocturnal birds

Vegetation class	Area (ha)
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	2.47
PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	0.35
Total	2.82

Table 5.8 Methods and survey effort – nocturnal birds

Method	Survey description	Survey effort
Transect searches	<ul style="list-style-type: none">• surveyors walked the length of identified habitat for this species within the subject property;• all calls were investigated; and• birds observed or heard were recorded.	DEC (2004) has not resolved bird survey requirements and does not provide guidance on survey effort. DoEWHA (2010) did not have specific guidance for Bush Stone-curlew. As the habitat is considered marginal to support this species, 4 nights of area searches were undertaken for this species.

b **Microchiropteran bats**

Microbat surveys were undertaken within the subject property to target Southern Myotis. Methods and survey effort have been developed in accordance with DEC (2004) and OEH (2018). Methods and survey effort are outlined in Table 5.9.

Table 5.9 **Methods and survey effort - Microchiropteran bats**

Method	Survey description	Survey effort
Roost search (bridges and buildings)	<p>The disused road bridge was searched for the presence of roosting microbats and its suitability to support roosting microbats.</p> <p>The disused farm shed building (Figure 5.2) was not deemed suitable to support roosting microbats. The building is an open large tin shed (Photograph 5.6), with no roof voids (Photograph 5.7). No staining or microbat scats were observed at potential entry points considered suitable to be used by microbats.</p>	The bridge was searched in its entirety. The disused farm shed building was inspected for signs of microbat presence such as guano.
Acoustic detection	<p>OEH (2018) permits the use of acoustic devices to record presence of the Southern Myotis.</p> <ul style="list-style-type: none"> • detectors were set out near bridge and waterbody features; and • detectors were placed out for a minimum of four nights. <p>Calls were analysed by a person experienced in bat call analysis.</p>	OEH (2018) specifies a total effort of 16 nights for each 2.5 km of suitable habitat. An initial habitat assessment indicated that there was approximately 400 m of riparian habitat. As Southern Myotis was already confirmed within the subject property, observed roosting underneath the bridge and were observed foraging on the waterbodies during the frog surveys, only a total effort of 10 nights was undertaken.



Photograph 5.6 Outside of disused farm shed (view from the north and west respectively)



Photograph 5.7 Inside of disused farm shed showing metal truss and roofing

c Amphibians

Amphibian surveys were undertaken within the subject property to target Green and Golden Bell Frog. Stratification units and area of each survey unit in the subject property is shown in Table 5.10. Method and survey effort have been developed in accordance with DoEWHA (2009), DECC (2009) and DSEWPac (2010) and is outlined in Table 5.11.

Table 5.10 Waterbody areas

Target species	Waterway	Area (ha)
Green and Golden Bell Frog	Pond 1 – western	0.04
	Pond 2 – middle	0.24
	Pond 3 – eastern	0.84
	Pond 4 – southern	0.08

Table 5.11 Methods and survey effort - amphibians

Method	Survey description	Survey effort
Habitat assessment	A habitat assessment was undertaken to identify suitable habitat along all the waterbodies within the subject property.	All waterbodies were assessed for suitable habitat.
Diurnal searches	Surveys were undertaken on 30 January 2020 as part of the threatened snail survey, with refuge habitat (eg. logs and tin panels) checked.	The entire subject property was walked in transect lines, where accessible. It is noted that this survey was undertaken concurrent with Cumberland Plain Land Snail and Dural Land Snail survey (Figure 5.2), as both involved searches of the ground layer and refuge sites.
Nocturnal searches	<p>Surveys were undertaken in accordance with the following:</p> <ul style="list-style-type: none"> • surveyed over a minimum of four nights to increase the detection rate (27 February, and 2–4 March inclusive); • between September and March, at the time of peak activity for the species; and • during warm, windless and dry weather conditions following heavy rainfall earlier that month (433mm in total, with a mean of 15mm) (BOM 2020b) (See appendix D for rainfall conditions during survey). 	<p>Each pond was surveyed as per the survey descriptions for four nights. Green and Golden Bell Frog were confirmed calling at a reference population at Kooragang Island on 2 March 2020 by Chad Beranek. Bionet also contains records of Green and Golden Bell Frog observed on 17th February (Wollongong), 25th February (Gosford), and 31st March (Nowra) (NSW Government 2020).</p> <p>Refuge habitat (eg. logs and tin panels) were checked.</p> <p>The quarry pit was surveyed by listening for Green and Golden Bell Frog calls from two vantage points above the quarry, as the quarry itself was inaccessible at the time of the survey. The minimum survey effort was met.</p>
Egg mass and tadpole sampling surveys	<p>Egg mass and tadpole sampling was undertaken in accordance with the following:</p> <ul style="list-style-type: none"> • egg mass (if detected) observation during the nocturnal searches listed above; and • tadpole sampling (if detected) from visual inspections of banks and ponding water where suitable spawning habitat was present. 	DECC (2009) and Commonwealth of Australia do not specify minimum survey requirements for tadpoles. Tadpole searches occurred during each nocturnal search. No egg masses were detected.

d Terrestrial invertebrates

Snail surveys were undertaken for Cumberland Plain Land Snail and Dural Land Snail within the broader property. Stratification units and area of each survey unit in the subject property are shown in Table 5.12. However, in addition to survey of PCT 849 which is associated with habitat for this species, the majority of the site, including PCT 1800 vegetation along Oaky Creek was traversed (Figure 5.2).

Snail survey methods and survey effort have been developed in accordance with NSW NPWS (2010) guidance and Clark 2009 habitat requirements, see Table 5.13.

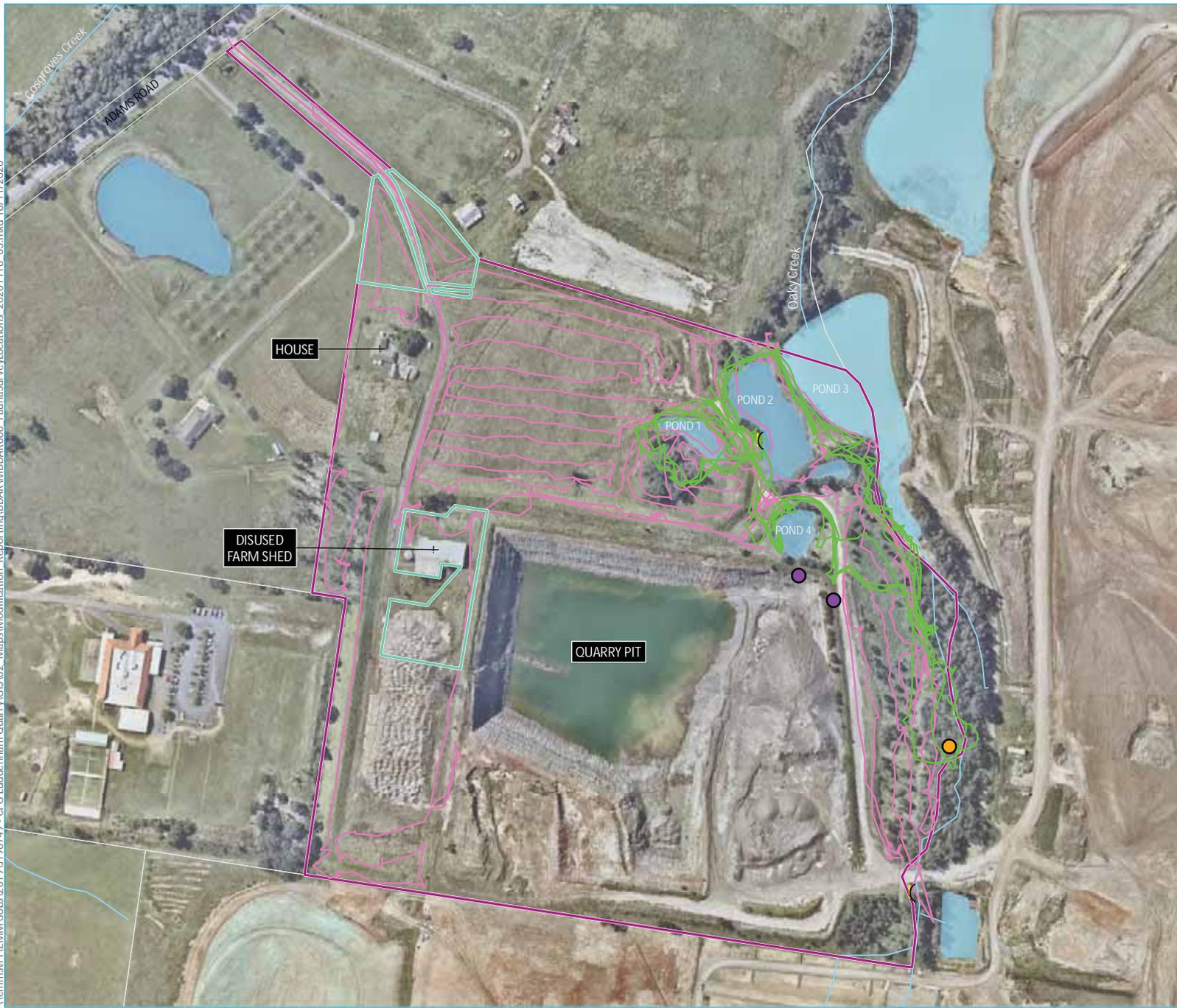
Table 5.12 Stratification units and survey area – terrestrial invertebrates

Stratification unit	Area (ha)
PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	0.35
Total	0.35

Table 5.13 Methods and survey effort – terrestrial invertebrates

Method	Survey description	Survey effort
Area searches	<ul style="list-style-type: none">Searches were performed under logs, debris, leaf and bark accumulation, bases of trees and grass clumps.	Searches of all accessible areas of the subject property (ie excluding the quarry and flooded areas), where vegetation is absent.

\\lemmsvr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02_Maps\Modification_Report\img\BDAR\M\BDR006_FaunaSurveyLocations_20201118_03.mxd 18/11/2020



- KEY**
- Subject property
 - Modification footprint
 - Cadastral boundary
 - Waterbody
 - Watercourse
 - Green and Golden Bell Frog and Bush Stone-curlew survey effort
 - Cumberland Plain land Snail and Dural Land Bell Frog diurnal survey
 - Threatened fauna species survey (anabat)
 - Hollow bearing tree
 - Green and golden bell frog vantage point

Fauna survey locations

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 5.2



Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)

0 50 100
m
GDA 1994 MGA Zone 56

5.3.4 Targeted survey results

iv Threatened flora species results

No threatened flora species were recorded during targeted surveys within the subject property. All candidate threatened flora species are not considered to occur within the subject property following targeted surveys.

v Threatened fauna survey results

The targeted surveys recorded numerous Southern Myotis foraging around the main water bodies, and two Southern Myotis roosting underneath the bridge that crosses Oaky Creek (Photograph 5.8). The bridge is located in the south-east corner of the subject property, outside the impact area.

The anabat surveys identified five threatened bat species:

- Southern Myotis – definite record
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – Vulnerable – definite record
- Little Bent-winged Bat (*Miniopterus australis*) – Vulnerable – possible record
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) – Vulnerable – probable record
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) – Vulnerable – possible record (see note below)

The anabat report (Appendix H) notes that it can be difficult to identify calls between Eastern Broad-nosed Bat (*Scotorepens orion*), Greater Broad-nosed Bat and Eastern False Pipistrelle. The report considers Eastern False Pipistrelle less likely due to marginal habitat for the species.

Other candidate fauna species were not recorded in the subject property and are considered to be unlikely to occur within the subject property following targeted surveys.

a Southern Myotis

Southern Myotis forage over streams and pools catching insects and small fish by raking their feet across the water surface. They roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Southern Myotis were identified roosting underneath a bridge across Oaky Creek (Photograph 5.8) associated with the previous eastern access road, now disused and gated (Photograph 5.9).

Ephemeral ponds, designated as pond 1 to pond 4 (Figure 5.2), may potentially be utilised by Southern Myotis as foraging habitat. It is unknown to what degree these ponds are utilised for foraging by Southern Myotis. However, Southern Myotis was recorded from the Anabat recording site, which was located between all four ponds.

The threatened biodiversity data collection specifies that the species polygon should be land within 200 m of a waterbody with pools/stretchers 3 m or wider, including rivers and creeks. A 200 m buffer was also applied around the confirmed roost site (bridge) for this species. This data was used to determine the potential habitat polygon (the area that may potentially be utilised by the species) (Figure 5.3). No additional native vegetation clearance will occur as part of MOD 5, and therefore no species polygon (ie. area impacted) has been identified for Southern Myotis.

Prescribed impact assessment also requires assessment of species credit species usage of water bodies and human made structures. The disused farm shed was inspected and no suitable roosting habitat for microbats were observed; nor were signs of microbat presence observed. There is potential that water within the quarry pit may potentially also be utilised by Southern Myotis as foraging habitat, though the usage of the quarry pit if any is unknown. It is noted that the current approval allows for dewatering of the quarry pit.

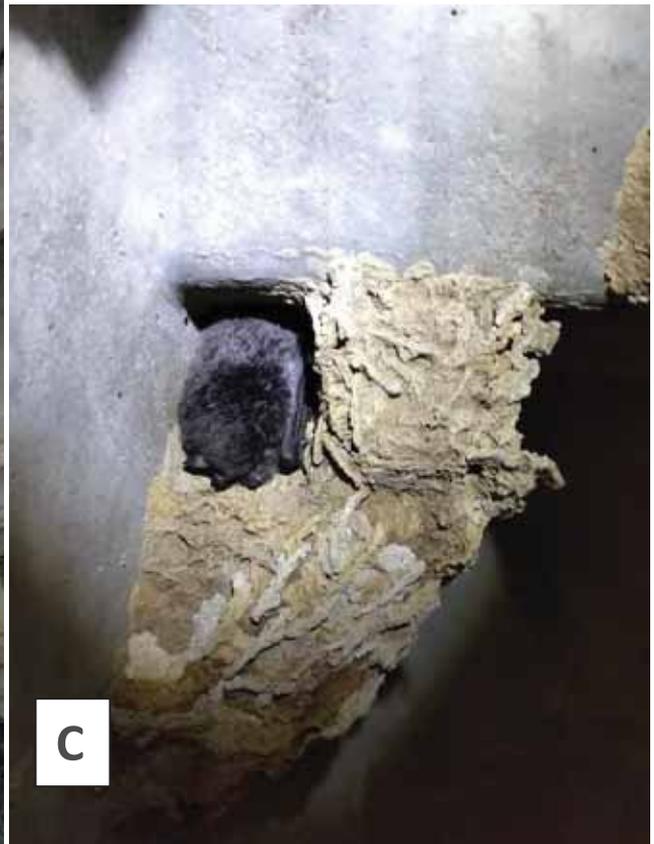
Pond 4 will be decommissioned with water from the quarry pit directed to Pond 2. Use of Pond 2 is consistent with the currently approved water management. It is not proposed to remove Pond 4 as part of MOD 5, and the pond will continue to receive water from its catchment, which is consistent with the situation whilst the quarry has been inactive, over approximately the last two years.



A



B



C

Photograph 5.8 Bridge over Oaky Creek (A) (outside of subject site), concrete bridge supports with Southern Myotis within red oval (B), and close up of roosting Southern Myotis underneath the bridge (C)



Photograph 5.9 Gate leading to the original access road, including the Oaky Creek bridge utilised by Southern Myotis for roosting now on Commonwealth land

b Large-eared Pied Bat

Anabats recorded Large-eared Pied Bats on site.

Large-eared Pied Bats roost in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.

Large-eared Pied Bat is a species credit species. Potential breeding habitat is PCTs associated with the species within 2 km of rocky areas containing caves, scarps, cliffs or escarpments. As the subject property is located within the Cumberland Plain, no such sites are present within this proximity to the site.

c Little Bent-winged Bat

Anabats recorded Little Bent-winged Bats on site.

Little Bent-winged occupy moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. They roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat (*Miniopterus schreibersii*) and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats and appears to depend on the large colony to provide the high temperatures needed to rear its young. Only five nursing sites/maternity colonies are known in Australia.

Little Bent-winged Bat is a dual credit species. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. No breeding habitat is present on site.

d [Greater Broad-nosed Bat and Eastern False Pipistrelle](#)

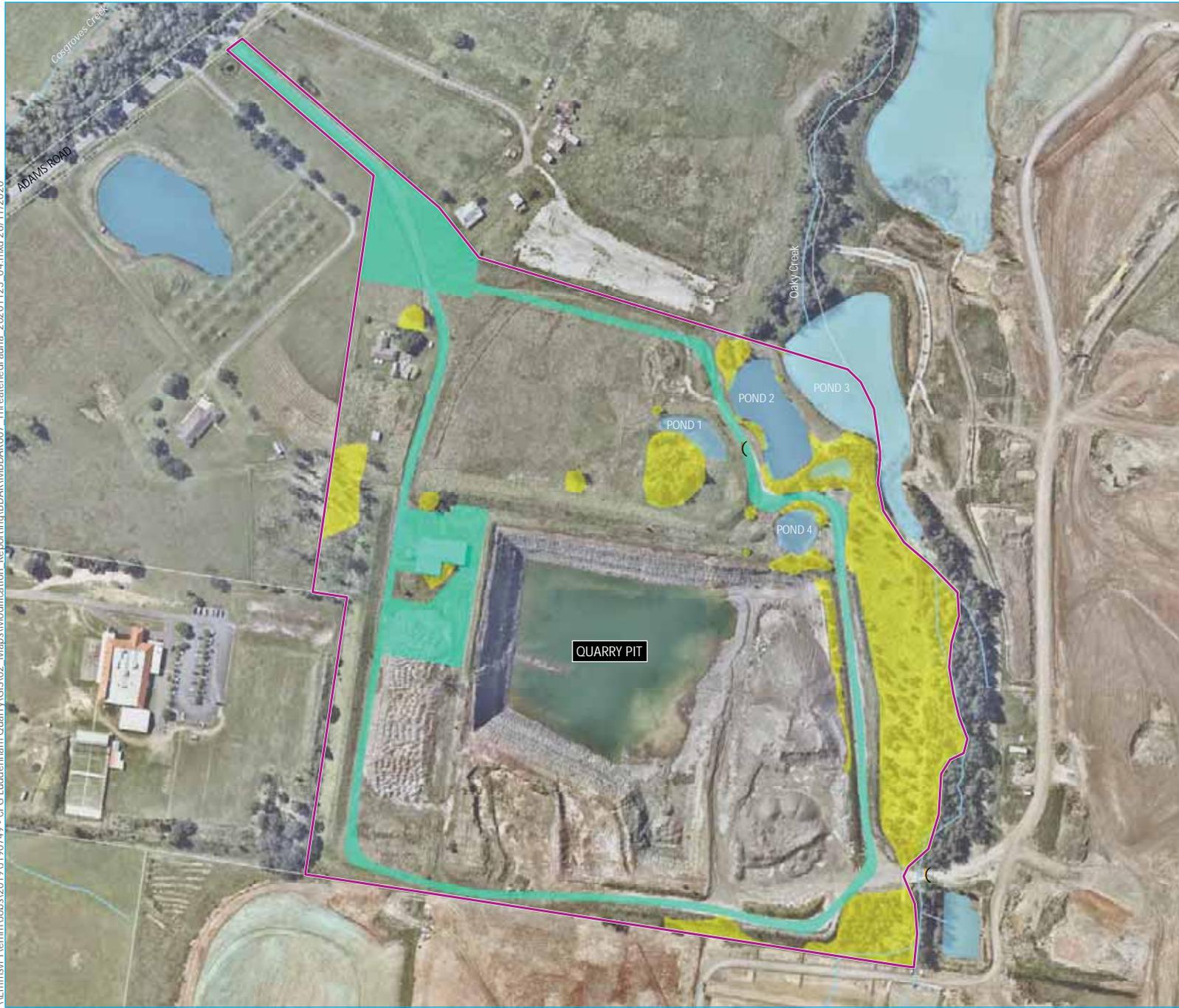
Greater Broad-nosed Bats and Eastern False Pipistrelles are ecosystem species.

e [Green and Golden Bell Frog](#)

Green and Golden Bell Frog inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes waterbodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. This species can occur in highly disturbed areas.

Target survey was undertaken for Green and Golden Bell Frog, and none were recorded on site. Green and Golden Bell Frogs are not considered likely to occur within the subject property.

\\Emsvr1\emmm\jobs\2019\190749 - GPG Luddenham Quarry\GIS\02_Maps\Modification_Report\Inq\BDAR\MBDR007_ThreatenedFauna_20201123_04.mxd 26/11/2020



- KEY**
- Subject property
 - Modification footprint
 - Southern Myotis habitat polygon
 - Cadastral boundary
 - Waterbody
 - Watercourse
- Threatened fauna species survey
- Southern Myotis record
 - Southern Myotis roost

Threatened fauna credit species

Luddenham Quarry site
Biodiversity Development Assessment Reports
Figure 5.3



5.3.5 Species credit species

A list of candidate species credit species predicted to occur within the subject property, along with an assessment of whether the species will be impacted by MOD 5 is provided in Table 5.14.

A summary of the survey results and credits are provided in Table 5.15.

There will not be additional (new) impacts on Southern Myotis as there is currently approval to dewater the quarry pit (Table 5.14).

Table 5.14 Species impact (ha)

Species	Direct (ha)	Indirect (ha)
Southern Myotis	0	0

Southern Myotis will not require offsets in accordance with the BAM (OEH 2017). Species polygons across the subject property are shown in Figure 5.3.

Table 5.15 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Subject area	Recorded during field surveys	Impacted by development	Justification
Flora						
<i>Acacia bynoeana</i>	Bynoe's Wattle	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Acacia pubescens</i>	Downy Wattle	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Dillwynia tenuifolia</i>		2.00	Yes	No	No	Although surveys did not occur during survey season, the shrub form would have been readily detectable because no native shrub species were present in the subject property.
<i>Eucalyptus benthamii</i>	Camden White Gum	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	1.50	Yes	No	No	Not recorded during targeted surveys.
<i>Maundia triglochinoides</i>		2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population		2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Persicaria elatior</i>	Tall Knotweed	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Persoonia bargoensis</i>	Bargo Geebung	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Pimelea curviflora</i> var. <i>curviflora</i>		2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Pomaderris brunnea</i>	Brown Pomaderris	2.00	Yes	No	No	Although surveys did not occur during survey season, the shrub form was readily detectable because no native shrub species were present in the subject property.
<i>Thesium australe</i>	Austral Toadflax	1.50	Yes	No	No	Not recorded during targeted surveys.

Table 5.15 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Subject area	Recorded during field surveys	Impacted by development	Justification
Fauna						
<i>Burhinus grallarius</i>	Bush Stone-curlew	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Litoria aurea</i>	Green and Golden Bell Frog	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	2.00	Yes	No	No	Not recorded during targeted surveys.
<i>Myotis macropus</i>	Southern Myotis	2.00	Yes	Yes	No	Recorded roosting and foraging within the subject property.
<i>Pommerhelix duralensis</i>	Dural Land Snail	2.00	Yes	No	No	Not recorded during targeted surveys.

STAGE 2: IMPACT ASSESSMENT

6 Impact assessment (biodiversity values)

6.1 Potential direct, indirect and prescribed impacts

Without any measures to avoid, minimise or mitigate impacts, the proposed modification would result in the following impacts on biodiversity.

6.1.1 Direct impacts

The majority of impacts will occur within the approved DA 315-7-2003. This includes approval under the current approval to dewater the quarry pit to the water management system.

The quarry was operating until about two years ago. Restarting the use of the site as a quarry will mean that activities when operational will be the same, or similar to, when previously operational. Water from the quarry pit will no longer discharge to Pond 4 (decommissioned in terms of water management usage) but will instead be directed to Pond 2. Pond 2 is currently part of the approved site water management system, and therefore water discharge and use for dust suppression from Pond 2 is not considered to be a new direct (or indirect) impact.

The remaining lands are cleared or exotic dominated grassland. A disused farm shed will also be demolished but was not identified as having habitat for microchiropteran bats. Thus, the direct additional (new) impacts arising from the proposed modification are solely on exotic vegetation.

6.1.2 Indirect impacts

No additional (new) indirect impacts are anticipated to occur as a result of MOD 5.

As identified under the discussion of direct impacts, it is proposed to decommission use of Pond 4, and to recommence use of Pond 2 for water management activities. Pond 2 is already approved for water management usage, and thus this is not considered to be a new indirect impact.

Although Pond 4 will be decommissioned in terms of its use as part of the water management system, this pond is not proposed to be removed as part of MOD 5. Pond 4 will continue to receive flows from its catchment area, which is consistent with the current situation where the quarry has not been operational for approximately two years. Therefore, this is also not considered to be a new indirect impact.

Southern Myotis was identified roosting underneath a concrete bridge for the previous access road from the east. However, this access will no longer be utilised and thus there will not be disturbances associated with vehicular traffic, including trucks, passing over that access road.

6.1.3 Prescribed impacts

Consideration has been given with regards to prescribed impacts on threatened species and communities recorded or assumed to be present within the subject property, as per Section 8.2.1.2 of the BAM (OEH 2017). The prescribed impacts relevant to the proposed modification are documented in Table 6.1, and prescribed impacts are assessed in Table 6.2 - Table 6.4.

Table 6.1 Prescribed biodiversity impacts relevant to the proposed modification

Prescribed impact	Justification
Impacts of development on the habitat of threatened species or ecological communities associated with	
<ul style="list-style-type: none"> karst caves, crevices, cliffs and other features of geological significance 	None have been identified within the MOD 5 site.
<ul style="list-style-type: none"> rocks 	None have been identified within the MOD 5 site.
<ul style="list-style-type: none"> Human made structures 	Assessed in Table 6.2.
<ul style="list-style-type: none"> Non-native vegetation 	Assessed in Table 6.3.
The assessment of the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	The project will not have a direct impact on the connectivity within the area. The site has previously been utilised as a quarry, and the MOD 5 will involve recommencing that operation. Oaky Creek provides limited connectivity to the north and will not be removed. The WSA development is to the south and east, and as such ecological connectivity in these directions is effectively severed.
Impacts of the development on movement of threatened species that maintains their life cycle	No species have been identified where the MOD 5 site is considered to have impacts on their movement. Southern Myotis, and other threatened bats detected, are highly mobile species.
impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	Assessed in Table 6.4.
Impacts of wind turbine strikes on protected animals	Not relevant to MOD 5.
Impact of vehicle strikes on threatened species of animals or on animals that are part of a TEC	No species have been identified within the MOD 5 site that are likely to have an impact from vehicle strikes. Southern Myotis is a highly mobile species and would be active at night when the quarry is not operational.

Table 6.2 Prescribed biodiversity impacts assessment: impacts of development on the habitat of threatened species or ecological communities associated with human made structures

Prescribed impact	Justification
(a) identify the human made structures with potential to be habitat for threatened species or ecological communities	<p>The human made structures with potential to be habitat for threatened species or ecological communities on site are:</p> <p>the disused farm shed. This structure was inspected (Photograph 5.6) and no evidence of microchiropteran bat use or habitat was identified;</p> <p>the house. It is understood that the house is currently used a dwelling, and because it is currently utilised this structure was not inspected and is also highly unlikely to be utilised;</p> <p>the underside of the bridge over Oaky Creek (now no longer used);</p> <p>the quarry pit; and</p> <p>ponds 1–4 which have been constructed for water management activities.</p> <p>The farm shed will be impacted by the proposed MOD 5, as this is proposed to be dismantled. MOD 5 does not propose any change to the usage of the house. The bridge over Oaky Creek is now gated and disused, and this will not change. This structure is not proposed for removal or change in use.</p> <p>The quarry pit will be dewatered, as permitted under the current approval. The potential value associated with the water at the bottom of the pit, which is assessed in Table 6.4. Therefore, the quarry pit is not discussed further under this prescribed matter.</p>
(b) identify the species and ecological communities likely to use the habitat	<p>Surveys identified the following microchiropteran bat species (Appendix H), with no other threatened flora or fauna species identified from surveys conducted:</p> <p>Southern Myotis - roosting under the bridge under the previous eastern access road, with the roost site located just beyond the eastern boundary of the subject property;</p> <p>Large-eared Pied Bat (foraging) – the species can use Fairy Martin (Petrochelidon ariel) nests within human made structures. Whilst these nests were observed under the Oaky Creek bridge, the species was not observed is unlikely to use human made structures on the subject property;</p> <p>Greater Broad-nosed Bat (probable detection) – this species can roost in buildings, but the disused shed was not found to provide suitable bat roosting;</p> <p>Eastern False Pipistrelle (possible detection) - this species can roost in buildings, but the disused shed was not found to provide suitable bat roosting; and</p> <p>Little Bent-winged Bat (possible detection) – this species can utilise culverts, bridges and buildings for roosting, but was not detected roosting.</p> <p>No other threatened species were detected during targeted surveys. This included targeted survey for Green and Golden Bell Frog.</p> <p>It is considered unlikely that any other threatened species or ecological communities use human made structures.</p>
(c) describe the nature, extent and duration of short and long-term impacts	<p>The proposed MOD 5 would remove the farm shed. Inspections of the farm shed identified no evidence of usage by microbats. The tin roof does not provide cavities; nor were any other cavities found.</p> <p>The Oaky Creek bridge will not be disturbed by the MOD 5 activities, as this previous access road will continue to be gated and not utilised.</p>

Table 6.2 Prescribed biodiversity impacts assessment: impacts of development on the habitat of threatened species or ecological communities associated with human made structures

Prescribed impact	Justification
(a) identify the human made structures with potential to be habitat for threatened species or ecological communities	<p>The human made structures with potential to be habitat for threatened species or ecological communities on site are:</p> <p>the disused farm shed. This structure was inspected (Photograph 5.6) and no evidence of microchiropteran bat use or habitat was identified;</p> <p>the house. It is understood that the house is currently used a dwelling, and because it is currently utilised this structure was not inspected and is also highly unlikely to be utilised;</p> <p>the underside of the bridge over Oaky Creek (now no longer used);</p> <p>the quarry pit; and</p> <p>ponds 1–4 which have been constructed for water management activities.</p> <p>The farm shed will be impacted by the proposed MOD 5, as this is proposed to be dismantled. MOD 5 does not propose any change to the usage of the house. The bridge over Oaky Creek is now gated and disused, and this will not change. This structure is not proposed for removal or change in use.</p> <p>The quarry pit will be dewatered, as permitted under the current approval. The potential value associated with the water at the bottom of the pit, which is assessed in Table 6.4. Therefore, the quarry pit is not discussed further under this prescribed matter.</p>
(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the habitat to these species or ecological communities	<p>No microbats have been recorded as breeding, nesting or roosting in Bionet within 5 km of the site.</p> <p>Habitat details are provided in the Likelihood of Occurrence assessment – fauna species (Appendix F, Table G.3).</p> <p>The subject property does not contain suitable maternity roost habitat for any microbat species except for Southern Myotis. Given the open nature of the Oaky Creek bridge it is likely not suitable for use as a maternity roost, and therefore is likely to be of limited value to the species.</p>
(e) predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.	<p>The proposed MOD 5 would remove the farm shed. Inspections of the farm shed identified no evidence of usage by microbats. Tin sheds are common in the locality.</p> <p>The Oaky Creek bridge will not be removed or disturbed, and the old eastern access road will be gated off and not utilised.</p> <p>Therefore, it is considered unlikely that there will be any consequences to the local and bioregional persistence of the suite of threatened species and communities likely to use these areas of habitat.</p>

Table 6.3 Prescribed biodiversity impacts assessment: impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation

Prescribed impact	Justification
(b) identify the species and ecological communities likely to use the habitat	<p>No threatened species have been identified as using non-native vegetation. Cumberland Plain land Snail, Dural Land Snail, and Green and Golden Bell Frog can potentially utilise disturbed areas, possibly included non-native vegetation, but none were detected during target survey. No threatened flora species were detected during target survey.</p> <p>A number of threatened microchiropteran bats (Southern Myotis, Large-eared Pied Bat, Greater Broad-nosed Bat, Eastern False Pipistrelle, and Little Bent-winged Bat) have been recorded (or potentially recorded), and some of these species may potentially forage for insects, or fly over the non-native vegetation.</p>
c) describe the nature, extent and duration of short and long-term impacts	<p>The proposed MOD 5 would involve construction impacts and loss of non-native vegetation. The extent of duration is expected to persist for the length that the quarry is operational.</p>
(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the habitat to these species or ecological communities	<p>The non-native vegetation is not considered to be of importance to the threatened microchiropteran bats. These species are likely to prefer foraging within intact native vegetation. There are significant areas of non-native vegetation within the region.</p>
(e) predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.	<p>The proposed MOD 5 would remove non-native vegetation for the length of operation of the quarry. This is likely to be of negligible consequence to the threatened microchiropteran bats.</p>

Table 6.4 Prescribed biodiversity impacts assessment: water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)

<p>(a) identify water bodies with potential to be habitat for threatened species or threatened ecological communities that are likely to be impacted by the proposal</p>	<p>The riparian habitat contains areas of dams and standing water associated with Southern Myotis and Swamp Oak Floodplain Forest EEC. The quarry pit also contains some water.</p>
<p>(b) identify the threatened species and threatened ecological communities likely to use the habitat</p>	<p>The existing consent (DA 315-7-2003) allows water bodies to be impacted in certain ways as part of the quarry’s operation, as well as to dewater the quarry pit. MOD 5 would not add to those impacts. It is proposed that quarry pit water will go to Pond 2 and will bypass Pond 4, which will be decommissioned. Pond 2 is part of the current water management system. Pond 4 will continue to receive flows from its catchment and is not proposed to be removed as part of MOD 5.</p>
<p>(c) identify hydrological processes that sustain threatened species or threatened ecological communities and the species and communities that are dependent on them</p>	<p>Southern Myotis and Swamp Oak Floodplain Forest EEC.</p>
<p>(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the water body or hydrological process to these species or ecological communities</p>	<p>Oaky Creek receives surface and groundwater flows. This creek only flows during times of high rainfall. Swamp Oak Floodplain Forest EEC is dependent on the duration of waterlogging.</p>
<p>(e) describe the nature, extent and duration of known short and long-term impacts on water bodies and hydrological processes</p>	<p>Swamp Oak Floodplain Forest EEC relies on water bodies for its sustenance. The EEC is associated with grey-black clay-loams and sandy loams where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains (OEH 2020). The EEC forms part of a complex of forested wetland and treeless wetland communities found throughout the coastal floodplains of NSW.</p> <p>Water within the quarry pit has, however, only been present temporarily (for approximately 2 years since previously quarrying operations stopped), and thus is unlikely to be of significance within the bioregion.</p> <p>The value of Oaky Creek and the four ponds along, or in close proximity to Oaky Creek, will be of relevance to the Swamp Oak Floodplain Forest EEC present along Oaky Creek. This vegetation is heavily disturbed, and as documented in this report is heavily dominated by Swamp Oak which is likely responding to previous disturbance and the periodic inundation of the site but may be in a transitional state between PCT 1800 and PCT 835. Irrespective the water bodies and hydrological processes will be relevant to the vegetation along Oaky Creek.</p>
<p>(f) describe the nature, extent and duration of known short and long-term impacts on water bodies and hydrological processes</p>	<p>MOD 5 will reinstate the quarry to being operational. Any indirect impacts to water bodies or hydrological processes are therefore anticipated to be the same as previously occurred. An updated Surface Water Assessment (EMM 2020a) has been prepared which identifies that water from disturbed areas will flow via diversion bunds (which are already in place) to the quarry pit. Water from the quarry pit will be pumped to the ‘Water Management Dam’ (which is equivalent to Pond 2 in this report; Figure 5.2). Captured water will then be used for dust suppression of unsealed roads and disturbed areas, and discharge of excess water from the site via a licensed discharge point (LDP) to Oaky Creek.</p>

Table 6.4 Prescribed biodiversity impacts assessment: water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)

(f) describe the nature, extent and duration of short and long-term impacts on water quality	MOD 5 will reinstate the quarry to being operational. There may be some impacts on Pond 2 used to treat water, though this will be consistent with previous impacts from when the quarry was previously operational.
(g) predict the consequences of the impacts for the bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information	<p>There will be minimal impacts, as MOD 5 proposes to reinstate the quarry to being operational. Any indirect impacts to water bodies or hydrological processes are therefore anticipated to be the same as previously occurred.</p> <p>It is noted that the quarry has consent to dewater the quarry pit, and therefore this will not be a new impact or disturbance.</p> <p>Swamp Oak Floodplain Forest EEC is present. However, no new clearing of this vegetation community is proposed under MOD 5, and water management to be generally as per previous operations with the exception of Pond 4 being decommissioned. This pond will be left in its current state and will no longer form part of the operational water management system of the quarry.</p>
(h) predict the nature, extent and duration of short and long-term impacts on the habitat and life cycle of species using the natural features of any water dependent plant community	<p>Impacts will occur for the life of the quarry. The modification does not seek to increase the quarry life, production rate or the approved area or depth of the quarry footprint.</p> <p>The nature and extent of disturbances are expected to be consistent with impacts occurring under the existing consent (DA 315-7-2003).</p>
(i) justify predictions of impact on any water dependent plant communities, with appropriate modelling and with reference to relevant literature and other published sources of information	No groundwater extraction has been proposed as part of the works. The proposed minor impacts to landform are unlikely to change the natural drainage of the area. Draining water accumulated in the quarry pit is allowed under DA NO. 315-7-2003. The quarry pit was regularly drained up until about two years ago. Therefore, the project is unlikely to have additional impacts on any water-dependent plant communities; beyond what is currently allowed under the existing consent (DA 315-7-2003).
(j) predict the cumulative impacts of the project together with existing mining operations mining underneath the same water dependent plant communities	MOD 5 does not propose changes to the currently approved extraction.
(k) based on predictions of impacts on water dependant plant communities and the species they support, calculate the maximum predicted offset liability in accordance with the Upland Swamp Policy	The maximum predicted offset liability to water dependent plant communities resulting from MOD 5 is nil, as per the Addendum to NSW Biodiversity Offsets Policy for Major Projects (OEH 2016e).
(l) justify any prediction of ‘nil’ or ‘negligible’ environmental consequences for any impact on water dependent plant communities and the species they support.	<p>The prediction of nil consequences is based off:</p> <ul style="list-style-type: none"> • MOD 5 will not impact any Upland Swamps, and • All impacts will be consistent with the existing consent (DA 315-7-2003).

6.2 Measures to avoid, minimise and mitigate impacts

6.2.1 Avoidance measures

MOD 5 has been designed, where possible, to avoid impacts to sensitive biodiversity areas.

The MOD 5 site has been sited to avoid potential impacts to the Swamp Oak Floodplain Forest Endangered Ecological Community (EEC) (PCT 1800) along the eastern boundary of the subject property and Cumberland Plain Woodland CEEC (PCT 849) that is present between the existing internal road and the western boundary.

Iterative project planning, informed by the baseline studies outlined above, has allowed a range of impacts to be avoided and others to be minimised throughout the life of the project.

Key avoidance measures that are to be implemented by the proponent comprise:

- avoidance of direct impacts to Oaky Creek;
- no impacts to PCT 849; and,
- minimisation of impacts to PCT 1800, by only impacting habitat within the existing DA NO. 315-7-2003 impact area (consisting of up to 0.08 ha in poor condition).

6.2.2 Mitigation measures

i Retention of vegetation, pre-clearing and clearing works

Site preparation works will require clearing of some native vegetation under the existing approvals. These works have the potential to have an impact on fauna species including an indirect impact on the retained vegetation and fauna habitat. The following controls will prevent or minimise impacts to vegetation and fauna species:

- Implement exclusion zones around all areas of retained vegetation and fauna habitat. These areas will be fenced using appropriate fencing materials and designated and signed as 'No-go Zones' or 'Environmentally Sensitive Areas.'
- Where feasible or when required, set up tree protection zones (TPZs) around all retained trees and immediately adjacent to the disturbance footprint. If required, TPZs are to be established in accordance with the Australian Standard AS 4970-2009 Protection of trees on development sites (Standards Australia Committee 2009).

If trees are removed within the currently approved footprint under the existing DA 315-7-2003, where native tree trunks are greater than 25 m and 3 m in length these will be placed into the riparian corridor to enhance habitat in this area.

These measures will be incorporated into a Construction Environmental Management Plan (CEMP).

ii Weed control

Indirect impacts could occur due to the introduction and/or spread of weeds into the subject property. To prevent this occurring the following controls will be implemented:

- Appropriate management and disposal of weed species during clearing works, in accordance with the CEMP.

iii Water Management

The key water management strategy adopted across the site is containment and management of potentially sediment-laden runoff from disturbed areas and reuse where feasible. The key features of the water management system include:

- diversion of runoff from undisturbed catchments away from disturbed areas and off site;
- collection of all potentially sediment-laden runoff from disturbed areas of the site within the quarry pit and the Water Management Dam;
- use of captured runoff for dust suppression of unsealed roads and disturbed areas; and
- discharge of excess water from the site via a licensed discharge point to Oaky Creek.

The Surface Water Assessment (EMM 2020a) carried out for the proposed modification concluded that the existing and proposed water quality controls are expected to function to prevent any material change or degradation of the water quality of Oaky Creek due to discharges.

The Surface Water Assessment Modification 5 report (EMM 2020a) concludes:

Potable water for the offices, and amenities will be sourced from the Sydney Water potable water supply network. Potable water will also be used for dust suppression activities when demand exceeds the supply from water stored within the Water Management Dam. Wastewater generated by on-site amenities will be discharged to a septic holding tank, which will be pumped out by an approved licensed contractor when required.

Discharges will occur due to overflows from the Water Management Dam into Oaky Creek. The dam will receive runoff from a minor catchment as well as pumped transfers from the quarry pit, which will capture the majority of catchment runoff. Reuse of stored runoff for dust suppression of unsealed roads will reduce the volume and frequency of discharges. Discharges will occur most frequently following periods of rainfall, at which time there is expected to be dilution by coincident flows in Oaky Creek.

The water quality of discharges from the Water Management Dam into Oaky Creek is expected to have similar characteristics to the water quality within the creek upstream of the site. Occasional discharges from the Water Management Dam are not expected to materially change or degrade the water quality of Oaky Creek.

Flood modelling undertaken as part of the environmental impact statement for the Western Sydney Airport predicted that the disturbed areas of the site would remain above the limit of flooding along Oaky Creek for all events up to and including the probable maximum flood. The Water Management Dam was predicted to be periodically inundated by overflows from Oaky Creek. This would correspond with times of discharge from the Water Management Dam (ES4).

The surface water balance for the proposed modification has been updated in the response to submission period (refer Section 4.3.3 of the Submissions Report), including an allowance for in pit storage during times of high rainfall, and the Water Management Dam will be maintained to meet capacity requirements. Noting that the water balance carried out for Surface Water Assessment assumed a conservative depth of the Water Management Dam. Further work has been carried out and confirmed the existing footprint of the Water Management Dam can accommodate 7 ML of water. Maintenance work on this Water Management Dam is approved under the existing consent and will not impact on adjacent native vegetation.

The revised results of the water balance model predict on average, overflow events will occur two times per year with a total volume of 2.6 ML/year discharged under medium rainfall conditions. Overflows are expected to cease shortly after the wet weather conditions end and runoff subsides. Importantly, overflows are only expected to occur when streamflow in receiving watercourses is naturally elevated.

iv Sediment control

Management of sedimentation will be a key measure to minimise and mitigate impacts. Management measures will be put in place to control sediment. The key period for mobilisation of large amounts of coarse sediment will be during construction. Key management measures to be implemented to manage this risk include:

- sediment controls are to be put in place within the MOD 5 site, and shall be consistent with relevant standards, including:
 - *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom 2004);
 - *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries* (DECC 2008);
- an erosion and sediment control plan (ESCP) are to be prepared for each construction zone;
- where practical, clean water will be diverted around, rather than through, construction areas;
- consider local soil characteristics, topography and environmental constraints and proposed construction methods and identify risks associated with proposed activities;
- all temporary drainage and sediment control measures will be designed to have non-erosive hydraulic capacity and be structurally sound for the design events specified in Table 6-1 in (DECC 2008);
- consider all practical erosion control and rehabilitation methods and apply the most appropriate method;
- apply enhanced erosion controls where significant risks are identified;
- include measures to manage the storage and handling of hydrocarbons and other chemicals that have potential to pollute receiving water;
- include measures to manage accidental leaks and spills; and
- be progressively amended as required during construction.

v Dewatering of quarry pit

Dewatering of the quarry pit is allowed under the existing approval.

The quarry pit will need to be dewatered. The lowest point is in the northeast of the quarry. As the pit is dewatered, the water level will retreat towards this lowest point. It is recommended that an ecologist is present during the removal of the final water from the depression and sump around the dewatering pipe inlet (about 10 m by 10 m). Any native animals captured would be moved to the adjacent Pond 2 or Pond 3 outside the quarry pit. This mitigation measure is proposed from an animal welfare perspective, to allow ecologists to capture large aquatic animals such as eels (if any are present), before all water is removed from the quarry pit. No threatened species are expected to occur.

It is noted that the pit quarry was drained regularly until the quarry ceased operating about two years ago. The pit contains no vegetation. Any potential habitat structures are highly artificial (comprising the cliffs of the quarry wall) and pose very little protection for wildlife.

vi **Noise, vibration and lighting**

Impacts from noise and vibration will occur during the construction period, and also during operations from worksite activity. Some impacts to fauna species such as the foraging habitat for the Southern Myotis may result. It is noted that the site will also have experienced previous noise impacts from operation of the quarry and will also be immediately adjacent to Western Sydney International Airport which is currently being constructed. Thus, there will be some additional noise impacts.

6.2.3 Summary of measures to avoid, minimise and mitigate impacts

A summary of impacts arising from the proposed development, and measures outlined above to avoid, minimise and mitigate impacts, is provided in Table 6.5.

Table 6.5 Summary of impacts, and measures to avoid, minimise and mitigate

Impact	Impact avoidance	Impact minimisation	Impact mitigation
<p><i>Removal and disturbance of native vegetation and threatened species habitat.</i></p> <p>Type: direct and indirect impact, approved under the existing DA 315-7-2003.</p> <p>Frequency: once, during construction.</p> <p>Intensity: removal of up to 0.08 ha under the existing approval of native vegetation habitat that is listed as a TEC under the BC Act and potential habitat for threatened species.</p> <p>Duration: initial stages of construction.</p> <p>Consequence: permanent removal of native vegetation and threatened species habitat.</p>	<p>MOD 5 will not remove any native vegetation outside the approved existing clearance area (DA 315-7-2003). The proposed additional areas are dominated by exotic species.</p>	<p>Siting of infrastructure in areas subject to existing disturbance.</p> <p>Use of the existing road network to minimise requirement for removal of exotic vegetation.</p> <p>Detailed design of MOD 5, resulting in further minimisation of impacts to exotic vegetation.</p> <p>Minimisation of clearing during construction, wherever possible.</p>	<p>Establishment of exclusion zones around retained vegetation, including fencing and signage.</p> <p>Vegetation clearing undertaken in accordance with the two-stage process.</p> <p>Trees may be removed within the currently approved footprint under the existing DA 315-7-2003. Where native tree trunks are greater than 25m and 3 m in length these will be placed into the riparian corridor to enhance habitat in this area.</p>
<p><i>Increase in weeds and pathogens.</i></p> <p>Type: indirect impact, relating to works proposed under the approved DA 315-7-2003.</p> <p>Frequency: ongoing during construction and operation.</p> <p>Intensity: unknown.</p> <p>Duration: ongoing through construction phase.</p> <p>Consequence: potential to impact on threatened species habitat, resulting in decline in habitat quality.</p>	<p>The MOD 5 will not impact any native vegetation outside the approved existing clearance area (DA 315-7-2003).</p>	<p>Restricting impacts to the area approved for clearing under DA 315-7-2003.</p> <p>Appropriate disposal and management of weeds</p>	<p>Existing roads will be used to access construction areas.</p>

Table 6.5 Summary of impacts, and measures to avoid, minimise and mitigate

Impact	Impact avoidance	Impact minimisation	Impact mitigation
<p><i>Changes to runoff regimes and sediment impacts.</i> Type: prescribed impact, relating to works proposed under the approved DA 315-7-2003. Frequency: ongoing during construction and operation. Intensity: potential to mobilise large amounts of sediment and impact on EEC habitat. Duration: initial stages of construction and potential ongoing operational discharges. Consequence: impact water quality, erosion and sedimentation in the area and breeding success.</p>	<p>Siting of key infrastructure away from sensitive receiving environments. Design of surface water management system. Fully enclosing all waste handling and storage within the MOD 5 to prevent rainfall interactions with waste. Reuse of recycled water to minimise discharges from the site.</p>	<p>Appropriately designed stormwater sediment basin in accordance with the blue book, which does not directly impact on native vegetation, and which is designed to avoid any scouring impacts from overflow discharge. Stabilisation and rehabilitation of works areas as soon as practicable.</p>	<p>Not required.</p>
<p><i>Impacts to aquatic fauna from dewatering the quarry pit.</i> Type: prescribed impact, relating to works proposed under the approved DA 315-7-2003. Frequency: once, during dam dewatering. Intensity: potential loss of aquatic fauna when ponds are drained. Duration: initial stages of operation when the quarry is drained. Consequence: potential loss of aquatic fauna.</p>	<p>The quarry pit may be dewatered under the current DA NO. 315-7-2003 (as modified). The pit was dewatered regularly until operations ceases about two years ago, therefore it is unlikely that any aquatic fauna species will be significantly impacted.</p>	<p>Dewatering of the quarry sump pit (an area approximately 10 m by 10m in the northeast of the quarry) will be undertaken under supervision of an ecologist and aquatic animals captured (if any) relocated to Ponds 2 or 3.</p>	

6.3 Impact summary

6.3.1 Serious and irreversible impacts (SAIL)

No species were identified as candidate species for serious and irreversible impacts (SAIL), as per Section 6.5 of the BC Act.

6.3.2 Impacts requiring offsets

As no native vegetation is impacted, no impacts from MOD 5 will require offsets.

A credit report is not provided, as there is no clearing of additional native vegetation proposed, and consequently no offsets are required. It is noted that similarly a BAM calculator assessment has not been submitted, though entry of plot data occurred and was used to inform vegetation integrity scores and threatened species assessments provided in this report.

6.3.3 Impacts not requiring offsets

No impacts from MOD 5 will require offsets.

7 Impacts to MNES

7.1 Desktop assessment to identify candidate species and communities

A detailed desktop assessment was completed evaluating a range of information sources to gather information on the biodiversity values across the survey area and identify those MNES considered to have potential to occur. Information sources reviewed are summarised below:

- Department of Environment and Energy Protected Matter Search Tool (PMST); and
- BioNet, held and maintained by the NSW Office of Environment and Heritage (OEH), to access the following:
 - Atlas of NSW Wildlife;
 - Threatened Biodiversity Data Collection;
 - Threatened species profiles; and
 - Vegetation Classification System.

7.1.1 Candidate species assessment

A list of species and communities with potential to occur within the impact area was generated following the desktop assessment. No communities were identified as candidates for assessment. Species are listed in Table 7.1 were considered to have potential to occur within the broader subject property based on the desktop assessment.

Table 7.1 Threatened and migratory species with potential to occur in the subject property based on the desktop assessment

Scientific name	Common name	EPBC Act ¹	BC Act ²
Ecological Community			
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community	-	EN	EN
Flora			
<i>Persicaria elatior</i>	Tall Knotweed	VN	V
<i>Pomaderris brunnea</i>	Brown Pomaderris	VN	V
Fauna			
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	VU	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V
Migratory species			
<i>Cuculus optatus</i>	Horsfield's Bronze-Cuckoo	Mi	-
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi	-
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	-

Table 7.1 Threatened and migratory species with potential to occur in the subject property based on the desktop assessment

Scientific name	Common name	EPBC Act ¹	BC Act ²
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi	-
<i>Tringa nebularia</i>	Common Greenshank	Mi	-

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4B – critically endangered, E3 – endangered, V2 - vulnerable

An assessment of likelihood was completed for listed TECs, Threatened flora and fauna and migratory species predicted to occur in the region by the PMST search (Appendix F; Table F.1 to Table F.4). This assessment identified the following threatened species and migratory species were considered candidate species requiring further survey or assumed presence in Table 7.2.

Table 7.2 Threatened and migratory species further assessment or presumed presence

Scientific name	Common name	Survey undertaken	Recorded / assumed presence
Ecological Community			
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community		Yes	Recorded, but within Oaky Creek only. There will be no direct impact, and indirect impacts will be consistent with the current approval.
Fauna			
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Yes	Recorded (one pass assumed to be a movement over the site)
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Incidental sighting	Recorded (foraging)
Migratory species			
<i>Cuculus optatus</i>	Horsfield's Bronze-Cuckoo	No	Assumed presence
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	No	Assumed presence
<i>Gallinago hardwickii</i>	Latham's Snipe	No	Assumed presence
<i>Tringa nebularia</i>	Common Greenshank	No	Assumed presence

7.2 Significant impact assessments

To support a determination as to whether MOD 5 is likely to have a 'significant impact' on threatened species the *Matters of National Environmental Significance – Significance Impact Guidelines 1.1* (DoE 2013) have been applied.

A 'significant impact' is defined as "an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends on the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts" (DoE 2013).

Consideration has been given to all communities, threatened and migratory species with potential to occur within the subject property, with reference to DoE (2013). Significant impact assessments have been completed for the species listed in Table 7.2 considered to have potential to be impacted by MOD 5 following the process outlined in this assessment report.

Note that the *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland* ecological community will not have new impacts from the proposed modification (in addition to the current DA 315-7-2003), and hence no impact assessment has been completed for this community.

Significant impact assessment for the identified communities and species are provided in Appendix G.

The assessment concluded that no significant impacts are considered in the context of the findings of the proposed modification's biodiversity assessment and the area of high-quality habitat in the region.

8 References

Badger Mining Company Pty Limited 2003, *Development Consent, DA No. 315-7-2003, For Badger Mining Company Pty Limited*.

Benson DH, and Howell, J 1990, *Taken for granted: the bushland of Sydney and its suburbs*. Kangaroo Press, Sydney.

BOM 2020a, *Groundwater Dependent Ecosystems Atlas*, viewed 29 March 2020, <http://www.bom.gov.au/water/groundwater/gde/index.shtml>.

BOM 2020b, *Daily Rainfall*, Badgerys Creek AWS, <http://www.bom.gov.au/?ref=hdr>, viewed 19 October 2020.

Clark, SA 2009. *A review of the land snail genus Meridolum (Gastropoda: Camaenidae) from central New South Wales, Australia*. Molluscan Research 29(2):61-120.

Commonwealth of Australia 2016, *Western Sydney Airport – Airport Plan*. https://www.westernsydneyairport.gov.au/sites/default/files/Western_Sydney_Airport_Plan.pdf

DEC 2004, *Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities*, Department of the Environment and Conservation, Hurstville.

DECC 2008, *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries*.

DECC 2009, *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna Amphibians*, Department of Environment and Climate Change, Sydney.

DoE 2013, *Matters of National Environmental Significance – Significance Impact Guidelines 1.1*, Department of Environment, Canberra.

DoEE 2017a, *Interim Biogeographic Regionalisation of Australia (IBRA) Version 7*, Department of the Environment and Energy, Canberra.

DoEE 2017, *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*, Department of the Environment and Energy, Canberra.

DoEE 2018a, *Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*. Department of the Environment and Energy, Canberra. Available: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141-conservation-advice.pdf>

DoEE 2018b, *Directory of important wetlands*, Department of the Environment and Energy, Canberra.

DEWHA 2008, *Threat Abatement Plan for Predation by the European Red Fox*. Department of the Environment, Water, Heritage and the Arts, Canberra.

DoEWHA 2009, *Significant impact guidelines for the vulnerable green and golden bell frog (Litoria aurea)*, Department of Environment, Water, Population and Communities, Canberra.

DoEWHA 2010, *Survey Guidelines for Australia's Threatened Birds*, Department of Sustainability, Department of Environment, Water, Population and Communities, Canberra.

DIRD 2016, *Western Sydney Airport EIS Biodiversity Assessment*, prepared for Western Sydney Unit – Western Sydney Airport EIS, 21/24265.

Douglas Nicolaisen & Associates Pty Ltd 2003, *Environmental Impact Statement – Proposed Clay/Shale Extraction Operation – Lot 3 - 272 Adams Road Luddenham NSW*, prepared for Badger Mining Company Pty Limited 275 Adams Road Luddenham NSW.

DPI 2013, *Policy and guidelines for fish habitat conservation and management*, NSW Department of Primary Industries, Sydney.

DPIE 2020, *The Draft Cumberland Plain Conservation Plan. A conservation plan for Western Sydney to 2056*, NSW Department of Planning, Industry and Environment, available [https://shared-drupal-s3fs.s3-ap-southeast-2.amazonaws.com/master-test/fapub_pdf/00+-+CPCP/edited_2.+Draft+Cumberland+Plain+Conservation+Plan+\(in+template\).pdf](https://shared-drupal-s3fs.s3-ap-southeast-2.amazonaws.com/master-test/fapub_pdf/00+-+CPCP/edited_2.+Draft+Cumberland+Plain+Conservation+Plan+(in+template).pdf)

DSEWPaC 2010, *Survey Guidelines for Australia's Threatened Frogs*, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

EMM 2019, *Exploratory Works Biodiversity Management Plan, Snowy 2.0*. Report prepared for Snowy Hydro Ltd by EMM Consulting Pty Ltd, St Leonards, NSW.

EMM 2020a, *Luddenham Quarry – Modification 5 Surface Water Assessment*, prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Ltd.

EMM 2020b, *Snowy 2.0 Main Works Revised Biodiversity Development Assessment Report*, prepared for Snowy Hydro Limited by EMM Consulting Pty Ltd.

EMM 2020c, *Luddenham Advanced Resource Recovery Centre Bushfire Assessment*, prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Ltd.

EMM 2020d, *Luddenham Quarry Scoping Report MOD5 DA 315-7-2003*, prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Ltd.

EMM 2020e, *Luddenham Quarry Modification Report MOD5 DA 315-7-2003*, prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Ltd.

EMM 2020f, *Luddenham Quarry Modification 5 Response to submissions*, prepared for Coombes Property Group and KLF Holdings Pty Ltd by EMM Consulting Pty Ltd.

Landcom 2004, *Managing Urban Stormwater: Soils and Construction – Volume 1*.

Keith, DA & Pellow, BJ (2015), *Review of Australia's Major Vegetation classification and descriptions*. Centre for Ecosystem Science, UNSW, Sydney.

NPWS 2010, *Cumberland Plain Large Land Snail, Environmental Impact Assessment Guidelines*, NSW National Parks and Wildlife Service.

NPWS 2016, Sydney Basin, <https://www.environment.nsw.gov.au/bioregions/SydneyBasin-Climate.htm> accessed 17 February 2020, NSW National Parks and Wildlife Service.

NSW Government 2011, *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act*, <https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2011-2012/swamp-oak-floodplain-forest-of-the-nsw-north-coast-minor-amendment-determination>, accessed 26 October 2020.

NSW Government 2020, *Bionet, Species Sightings Search*, <https://www.environment.nsw.gov.au/AtlasApp/Default.aspx?a=1>, accessed 19 October 2020.

NSW Parliamentary Counsel's Office 2011, *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011*.

NSW RFS 2020, *Development Application, State Significant – EIS & DA Exhibition – Waste or resource management facility, 275 Adams Road Luddenham NSW 2745, 3//DP623799*, prepared for Penrith City Council by NSW Rural Fire Service.

OEH 2010, NSW Wetlands spatial data, <https://datasets.seed.nsw.gov.au/dataset/nsw-wetlands047c7> accessed 16 March 2020.

OEH 2013, *The Native Vegetation of the Sydney Metropolitan Area*, Version 2.0 – VIS_ID 3817, NSW Office of Environment and Heritage, Sydney.

OEH 2014, *NSW VIS: Classification Version 2.1 Public User Manual*/NSW Office of Environment and Heritage, Sydney.

OEH 2015, *Remnant Vegetation of the western Cumberland subregion*, 2013 Update. VIS_ID 4207. NSW Office of Environment and Heritage, Sydney.

OEH 2016, *NSW Guide to Surveying Threatened Plants*. NSW Office of Environment and Heritage, Sydney.

OEH 2016a, *Mitchell Landscapes Version V3.1*, NSW Office of Environment and Heritage, Sydney.

OEH 2017, *Biodiversity Assessment Method (BAM)*, NSW Office of Environment and Heritage, Sydney.

OEH 2020, *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – profile*, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10945>, accessed 26 October 2020.

Phillips C 2004, *Assessment report: Proposed clay/shale extraction operation, Lot 3 – 275 Adams Road, Luddenham*, prepared for Badger Mining Company Pty Limited.

Serov P, Kuginis L, Williams JP 2012, *Risk Assessment Guidelines for Groundwater Dependent Ecosystems*. Department of Primary Industries, Office of Water, NSW Government.

UBM Ecological 2009, *Vegetation Management Plan for a clay shale quarry, Adams Road, Luddenham*, Prepared for Blue Sky Mining P/L.

Appendix A

Vegetation integrity assessment – datasheets



BAM Site – Field Survey Form

Plot ID:	P01	Date:	24-02-20	Project number:	J190749	Plot dimensions:	20x50	
Datum:	GDA94	Easting:	288,740	Recorders:	RP			
Zone:	56	Northing:	6,249,454	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	164	
Plant Community Type:	849: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion				Condition class:	Poor	PCT confidence:	medium
Vegetation Class:	Coastal Valley Grassy Woodlands				EEC:	no	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	3
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	3
	Shrubs:	0
	Grasses etc.:	62
	Forbs:	0.6
	Other:	0
High Threat Weed cover:		93.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	3
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	6		
20 – 29 cm:	11	Tree hollow count	1
10 – 19 cm:	2		
5 – 9 cm:	0		
< 5 cm:	0		

*Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.*

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
	Subplot:	1	2	3	4
Subplot score (%):	1	1	45	1	35
Average litter cover (%):	16.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Plot Disturbance

Cultivated, no evidence of grazing or mowing (grass is very dense). All trees have severe dieback. Half are dead. All are dying.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (follage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P01	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Eucalyptus moluccana</i> (Grey Box)	3	10	no	N
	<i>Cenchrus clandestinus</i> (Kikuyu Grass)	85	10000	no	HTE
Forb (FG)	<i>Einadia</i> spp.	0.1	4	no	N
	<i>Malva parviflora</i> (Small-flowered Mallow)	0.1	100	no	E
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	50	10000	no	N
	<i>Rapistrum rugosum</i> (Turnip Weed)	0.1	100	no	E
Forb (FG)	<i>Senecio</i> spp. (Groundsel, Fireweed)	0.2	100	no	N
	<i>Plantago lanceolata</i> (Lamb's Tongues)	0.3	20	no	E
	<i>Setaria parviflora</i>	2	500	no	E
Forb (FG)	<i>Rumex</i> spp. (Dock)	0.1	5	no	N
Grass & grasslike (GG)	<i>Eriochloa pseudoacrotricha</i> (Early Spring Grass)	10	2000	no	N
	<i>Solanum linnaeanum</i> (Apple of Sodom)	0.1	2	no	E
	<i>Paspalum dilatatum</i> (Paspalum)	2	15	no	HTE
	<i>Chloris gayana</i> (Rhodes Grass)	6	45	no	HTE
Forb (FG)	<i>Dichondra repens</i> (Kidney Weed)	0.2	40	no	N
	<i>Sida rhombifolia</i> (Paddy's Lucerne)	0.2	4	no	E
	<i>Verbena caracasana</i> (Shore Verbain)	0.1	5	no	E
	<i>Solanum nigrum</i> (Black-berry Nightshade)	0.1	2	no	E
	<i>Araujia sericifera</i> (Moth Vine)	0.1	2	no	HTE
	<i>Juncus bufonius</i> (Toad Rush)	0.1	1	no	E
Grass & grasslike (GG)	<i>Paspalidium distans</i>	2	500	no	N

BAM Site – Field Survey Form

Plot ID:	P02	Date:	24-02-20	Project number:	J190749	Plot dimensions:	10x40	
Datum:	GDA94	Easting:	289,130	Recorders:	RP			
Zone:	56	Northing:	6,249,503	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	86	
Plant Community Type:	1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley				Condition class:	Poor	PCT confidence:	medium
Vegetation Class:	Coastal Floodplain Wetlands				EEC:	no	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	3
	Forbs:	5
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	30
	Shrubs:	0
	Grasses etc.:	80.1
	Forbs:	0.7
	Other:	0
High Threat Weed cover:		13.6

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1	Tree hollow count	0
20 – 29 cm:	0		
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
	Subplot:	1	2	3	4
Subplot score (%):	35	50	1	1	5
Average litter cover (%):	18.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Positioning plot very difficult. Dam in right, road in left, PCT curves in thin sliver. Steepish slope down to dam, very dense regrowth. Subplots are not representative of the PCT - they reflect the narrowness of the PCT, and the road/dam

Plot Disturbance

Exotic grass. Rubbish partially visible in tall dense vegetation. No evidence of grazing or mowing.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (follage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P02	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Casuarina glauca</i> (Swamp Oak)	30	25	no	N
	<i>Paspalum dilatatum</i> (Paspalum)	6	100	no	HTE
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	50	10000	no	N
	<i>Rumex crispus</i> (Curled Dock)	0.1	2	no	E
	<i>Verbena caracasana</i> (Shore Verbain)	0.1	2	no	E
	<i>Verbena bonariensis</i> (Purpletop)	0.1	4	no	E
	<i>Chloris gayana</i> (Rhodes Grass)	1	20	no	HTE
	<i>Alternanthera philoxeroides</i> (Alligator Weed)	0.1	5	no	HTE
	<i>Plantago lanceolata</i> (Lamb's Tongues)	0.1	15	no	E
Forb (FG)	<i>Phyllanthus virgatus</i> (Wiry Spurge)	0.1	10	no	N
Forb (FG)	<i>Einadia</i> spp.	0.3	5	no	N
Grass & grasslike (GG)	<i>Typha orientalis</i> (Broad-leaved Cumbungi)	30	1000	no	N
	<i>Asparagus asparagoides</i> (Bridal Creeper)	0.1	10	no	HTE
	<i>Lycium ferocissimum</i> (African Boxthorn)	0.3	11	no	HTE
	<i>Setaria parviflora</i>	1.5	6	no	E
	<i>Rapistrum rugosum</i> (Turnip Weed)	0.1	15	no	E
Forb (FG)	<i>Commelina cyanea</i> (Native Wandering Jew)	0.1	1	no	N
	<i>Dimorphotheca ecklonis</i> (Cape Daisy)	0.2	3	no	E
	<i>Madiola caroliniana</i> (Red-flowered Mallow)	0.1	2	no	E
	<i>Senecio madagascariensis</i> (Fireweed)	0.1	1	no	HTE
Forb (FG)	<i>Einadia nutans</i> (Climbing Saltbush)	0.1	5	no	N
	<i>Dipogon lignosus</i> (Dolichos Pea)	0.1	2	no	E
	<i>Cenchrus clandestinus</i> (Kikuyu Grass)	6	50	no	HTE
	<i>Chenopodium album</i> (Fat Hen)	0.1	6	no	E
Forb (FG)	<i>Portulaca oleracea</i> (Pigweed)	0.1	1	no	N
	<i>Conyza sumatrensis</i> (Tall fleabane)	0.1	6	no	E
Grass & grasslike (GG)	<i>Carex</i> spp.	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	P03	Date:	24-02-20	Project number:	J190749	Plot dimensions:	20x20	
Datum:	GDA94	Easting:	289,086	Recorders:	RP			
Zone:	56	Northing:	6,249,612	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	87	
Plant Community Type:	1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley				Condition class:	Medium	PCT confidence:	medium
Vegetation Class:	Coastal Floodplain Wetlands				EEC:	yes	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	5
	Forbs:	6
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	50
	Shrubs:	0
	Grasses etc.:	15.7
	Forbs:	1.6
	Other:	0.1
High Threat Weed cover:		101.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	9
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
	Subplot:	1	2	3	4
Subplot score (%):	60	25	15	50	1
Average litter cover (%):	30.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Drainage line running through plot (currently wet). Contains a bees nest

Plot Disturbance

No evidence of grazing or mowing. Scattered rubbish.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (follage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P03	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Casuarina glauca</i> (Swamp Oak)	50	26	no	N
	<i>Setaria parviflora</i>	2	20	no	E
	<i>Asparagus asparagoides</i> (Bridal Creeper)	1	100	no	HTE
Other (OG)	<i>Glycine tabacina</i> (Variable Glycine)	0.1	20	no	N
Grass & grasslike (GG)	<i>Aristida warburgii</i>	0.5	10	no	N
	Forb (FG)	<i>Centella asiatica</i> (Indian Pennywort)	0.1	5	no
<i>Paspalum dilatatum</i> (Paspalum)		30	5000	no	HTE
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	10	3000	no	N
	<i>Araujia sericifera</i> (Moth Vine)	2	200	no	HTE
Forb (FG)	<i>Galium spp.</i>	0.1	5	no	N
Forb (FG)	<i>Phyllanthus virgatus</i> (Wiry Spurge)	0.1	1	no	N
	<i>Alternanthera philoxeroides</i> (Alligator Weed)	0.1	20	no	HTE
	<i>Cenchrus clandestinus</i> (Kikuyu Grass)	60	10000	no	HTE
	<i>Solanum nigrum</i> (Black-berry Nightshade)	0.1	3	no	E
Forb (FG)	<i>Einadia nutans</i> (Climbing Saltbush)	0.2	2	no	N
Grass & grasslike (GG)	<i>Sporobolus elongatus</i> (Slender Rat's Tail Grass)	0.1	1	no	N
Forb (FG)	<i>Oxalis exilis</i>	0.1	5	no	N
Grass & grasslike (GG)	<i>Bothriochloa macra</i> (Red Grass)	0.1	4	no	N
	<i>Lycium ferocissimum</i> (African Boxthorn)	8	20	no	HTE
Grass & grasslike (GG)	<i>Microlaena stipoides</i> (Weeping Grass)	5	1000	no	N
	<i>Sida rhombifolia</i> (Paddy's Lucerne)	3	150	no	E
Forb (FG)	<i>Dichondra repens</i> (Kidney Weed)	1	50	no	N

BAM Site – Field Survey Form

Plot ID:	P04	Date:	24-02-20	Project number:	J190749	Plot dimensions:	20x20	
Datum:	GDA94	Easting:	289,191	Recorders:	RP			
Zone:	56	Northing:	6,249,517	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	255	
Plant Community Type:	1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley				Condition class:	Medium	PCT confidence:	medium
Vegetation Class:	Coastal Floodplain Wetlands				EEC:	yes	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	2
	Forbs:	6
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	50
	Shrubs:	0
	Grasses etc.:	25
	Forbs:	0.7
	Other:	0
High Threat Weed cover:		66

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	4
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	2		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

*Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.*

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
	Subplot:	1	2	3	4
Subplot score (%):	45	90	10	75	50
Average litter cover (%):	54				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Multiple semi-connected swamps in PCT. edge of plot contains a swamp.

Plot Disturbance

Little weediness inside PCT. main weeds in plot are because PCT is too narrow, so includes the road verge weeds too. This is delineated on the floristics data sheet.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (follage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P04	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Casuarina glauca</i> (Swamp Oak)	50	65	no	N
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	15	8000	no	N
	<i>Asparagus asparagoides</i> (Bridal Creeper)	2	30	no	HTE
	<i>Alternanthera philoxeroides</i> (Alligator Weed)	0.1	2	no	HTE
	<i>Juncus acutus</i>	60	500	no	HTE
	<i>Solanum nigrum</i> (Black-berry Nightshade)	0.1	3	no	E
	<i>Araujia sericifera</i> (Moth Vine)	0.1	5	no	HTE
	<i>Chloris gayana</i> (Rhodes Grass)	1	4	no	HTE
Forb (FG)	<i>Einadia nutans subsp. nutans</i> (Climbing Saltbush)	0.1	5	no	N
	<i>Plantago lanceolata</i> (Lamb's Tongues)	0.1	10	no	E
	<i>Rapistrum rugosum</i> (Turnip Weed)	0.1	25	no	E
Forb (FG)	<i>Commelina cyanea</i> (Native Wandering Jew)	0.1	2	no	N
	<i>Solanum pseudocapsicum</i> (Madeira Winter Cherry)	0.1	1	no	E
Forb (FG)	<i>Chamaesyce drummondii</i> (Caustic Weed)	0.1	1	no	N
	<i>Paspalum dilatatum</i> (Paspalum)	0.8	5	no	HTE
	<i>Madiola caroliniana</i> (Red-flowered Mallow)	0.1	25	no	E
	<i>Setaria parviflora</i>	0.4	5	no	E
	<i>Solanum linnaeanum</i> (Apple of Sodom)	0.1	1	no	E
	<i>Verbena caracasana</i> (Shore Verbain)	0.1	2	no	E
	<i>Rumex crispus</i> (Curled Dock)	0.1	2	no	E
Forb (FG)	<i>Einadia spp.</i>	0.1	1	no	N
Forb (FG)	<i>Portulaca oleracea</i> (Pigweed)	0.2	15	no	N
	<i>Paspalum dilatatum</i> (Paspalum)	2	50	no	HTE
	<i>Chenopodium album</i> (Fat Hen)	0.1	10	no	E
Forb (FG)	<i>Oxalis exilis</i>	0.1	5	no	N
Grass & grasslike (GG)	<i>Microlaena stipoides</i> (Weeping Grass)	10	3000	no	N

Appendix B

Vegetation integrity assessment – plot data



Table B.1 **Vegetation integrity data**

plot	pct	Condition class	zone	easting	northing	bearing	comp Tree	comp Shrub	comp Grass	comp Forbs	comp Ferns	comp Other	struc Tree	struc Shrub	struc Grass	struc Forbs	struc Ferns	struc Other	Fun Large Trees	Fun Hollow trees	Fun Litter Cover	Fun Len Fallen Logs	Fun Tree Stem 5 to 9	Fun Tree Stem 10 to 19	Fun Tree Stem 20 to 29	Fun Tree Stem 30 to 49	Fun Tree Stem 50 to 79	Fun Tree Regen	Fun High Threat Exotic
P01	849	Poor	56	288,740	6,249,454	164	1	0	3	4	0	0	3.0	0.0	62.0	0.6	0.0	0.0	0	1	16.6	3.0	0	1	1	1	0	0	93.1
P02	1800	Poor	56	289,130	6,249,503	86	1	0	3	5	0	0	30.0	0.0	80.1	0.7	0.0	0.0	0	0	18.4	0.0	1	1	0	1	0	1	13.6
P03	1800	Medium	56	289,086	6,249,612	87	1	0	5	6	0	1	50.0	0.0	15.7	1.6	0.0	0.1	1	0	30.2	9.0	1	1	1	1	1	1	101.1
P04	1800	Medium	56	289,191	6,249,517	255	1	0	2	6	0	0	50.0	0.0	25.0	0.7	0.0	0.0	0	0	54.0	4.0	1	1	1	1	0	1	66.0

Appendix C

Fauna survey effort summary



Table C.1 **Fauna survey effort**

Surveyor	Survey Type	Start Date	Survey Effort
JB JW	Nocturnal Birds / Green and Golden Bell Frog	27/02/2020	1.5 hr
JB JW	Nocturnal Birds / Green and Golden Bell Frog	02/03/2020	1.5 hr
JB RP	Nocturnal Birds / Green and Golden Bell Frog	03/03/2020	1.5 hr
JB JW	Nocturnal Birds / Green and Golden Bell Frog	04/03/2020	1.5 hr

Appendix D

Targeted survey weather conditions



Table D.1 **Weather conditions during fauna surveys**

Date	Min Temp (°C)	Max Temp (°C)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
27/02/2020	18	27	0	NNE	35
02/03/2020	16	37	0	SE	52
03/03/2020	19	21	0	S	20
04/30/2020	18	23	11.2	NE	37

Appendix E

EPBC PMST 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.

Report created: 22/01/20 12:38:33

[Summary](#)

[Details](#)

[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

No Image
Available

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

[Coordinates](#)

[Buffer: 1.0Km](#)

No Image
Available

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:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	35
Listed Migratory Species:	15

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	21
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:	None
Invasive Species:	46
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

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
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community may occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	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	Foraging, feeding or related behaviour likely to occur within area
--	-----------------------	--

Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
---	------------	--

Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may 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 known 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
---	-----------------------	--

Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
--	------------	--

Fish

Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
---	------------	--

Name	Status	Type of Presence
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically 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
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may 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 likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Acacia pubescens Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat may occur within area
Allocasuarina glareicola [21932]	Endangered	Species or species habitat may occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Genoplesium baueri Yellow Gnat-orchid [7528]	Endangered	Species or species habitat may occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat likely to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat may occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat likely to occur within area
Pomaderris brunnea Rufous Pomaderris [16845]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat may occur within area
Pultenaea parviflora [19380]	Vulnerable	Species or species habitat known to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may 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		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to 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 known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area

Migratory Wetlands Species

Name	Threatened	Type of Presence
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
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name

Commonwealth Land -

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 area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		habitat may occur within area 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 known 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 known 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
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Invasive Species

[[Resource Information](#)]

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 Resources 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
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		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
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		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		

Name	Status	Type of Presence
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
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
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		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
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		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

-33.870702 150.715732,-33.870693 150.715721,-33.870577 150.715925,-33.871406 150.71717,-33.871753 150.717588,-33.872109 150.717921,-33.872608 150.719659,-33.872715 150.720657,-33.872537 150.720603,-33.873071 150.720968,-33.873766 150.721011,-33.874301 150.721633,-33.874871 150.721483,-33.875281 150.721655,-33.875548 150.721376,-33.87594 150.72129,-33.876136 150.721032,-33.876474 150.721182,-33.876741 150.72114,-33.876064 150.716397,-33.874319 150.716784,-33.874283 150.716526,-33.871967 150.717191,-33.870702 150.715732

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](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-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.

Appendix F

EPBC Act protected matters likelihood of occurrence assessment



F.1 Likelihood of occurrence assessment – threatened ecological communities

Table F.1 Likelihood of occurrence assessment – threatened ecological communities

Threatened Ecological Community	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification for EPBC Act threatened ecological communities
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	E	V	Negligible	This EEC was not recorded within the subject property. It is not associated with PCT 849 or PCT 1800.
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community	EN	E1	Present along Oaky Creek. Not within the MOD 5 footprint	Recorded, but within Oaky Creek only. There will be no direct impact, and indirect impacts will be consistent with the current approval
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CE	E1	Negligible	This EEC was not recorded within the subject property. It is not associated with PCT 849 or PCT 1800.
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	E1	Low	This habitat is associated with PCT 849; however, it does not align with the EPBC Ac listing because it is less than 0.5 ha in size.
Western Sydney Dry Rainforest and Moist Woodland on Shale	CE	E1	Negligible	This EEC was not recorded within the subject property. It is not associated with PCT 849 or PCT 1800.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable
 2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V - vulnerable

F.2 Likelihood of occurrence assessment – threatened flora

Table F.2 Likelihood of occurrence assessment – threatened flora

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Likelihood of occurrence (following targeted survey)	Justification
<i>Acacia bynoeana</i>	Bynoe's Wattle	VN	E1	Low	Negligible	Bynoe's Wattle is a semi-prostrate shrub to a metre high. It is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1–5 plants). Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple. This species was not recorded during targeted surveys.
<i>Acacia pubescens</i>	Downy Wattle	VN	V	Low	Negligible	Downy Wattle occurs in open woodland and forest, in a variety of plant communities. Hybridises with other wattle species (<i>A. baileyana</i> , <i>A. decurrens</i> and <i>A. jonesii</i>). High Sensitivity to loss (ie providing protection above the listing status) based on recent population decline. Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.
<i>Allocastrum glareicola</i>		EN	E1	Negligible	Negligible	Grows in Castlereagh woodland, which is absent from the subject property. Found in open woodland with Parramatta Gum, Red Ironbark, Narrow-leaved Apple (<i>Angophora bakeri</i>), Scribbly Gum (<i>Eucalyptus sclerophylla</i>) and White Feather Honey Myrtle (<i>Melaleuca decora</i>); none of these species are present within the subject property. Therefore, suitable habitat is considered to be absent.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	VN	V	Negligible	Negligible	Found in grassy sclerophyll woodland on clay loam or sandy soils. When not flowering, only a single leaf is visible above ground, and this leaf regrows each year. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 1800, as such this species is not considered to occur within the subject property.

Table F.2 Likelihood of occurrence assessment – threatened flora

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Likelihood of occurrence (following targeted survey)	Justification
<i>Cynanchum elegans</i>	White-flowered Wax Plant	EN	E1	Low	Negligible	The rare species is known in rainforest gullies scrub and scree slopes. Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	EN	E1	Negligible	Negligible	Grows in dry sclerophyll forest and moss gardens over sandstone, none of which is present within subject property. Therefore, suitable habitat is considered to be absent from the subject property.
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Square Raspwort,	VN	V	Negligible	Negligible	Predicted to occur in the Cumberland IBRA sub-region, but not recorded there. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property, except for the vegetation type “Miscellaneous ecosystems - highly disturbed areas with no or limited native vegetation”. Species habitat is considered absent from the subject property.
<i>Persicaria elatior</i>	Tall Knotweed	VN	V	Moderate	Negligible	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.
<i>Persoonia hirsuta</i>	Hairy Geebung,	EN	E1	Negligible	Negligible	Known to occur in the Cumberland IBRA sub-region. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property.
<i>Persoonia nutans</i>	Nodding Geebung	EN	E1	Negligible	Negligible	Known to occur in the Cumberland IBRA sub-region. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property.

Table F.2 Likelihood of occurrence assessment – threatened flora

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Likelihood of occurrence (following targeted survey)	Justification
<i>Pimelea spicata</i>	Spiked Rice-flower	EN	E1	Negligible	Negligible	<p>In the Cumberland Plain this species is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) on well-structured clay soils. It is associated with Grey Box, Forest red gum (<i>E. tereticornis</i>) and narrow-leaved ironbark (<i>E. crebra</i>). Blackthorn (<i>Bursaria spinosa</i>) is often present at sites (and may be important in protection from grazing) and Kangaroo Grass (<i>Themeda australis</i>).</p> <p>This species was assumed to be present on site as it can only be identified within 3–4 years of a fire. No records of this species occur within 5 km of the subject property. This species has only ever been recorded at three sites near Colo, Georges and Nepean Rivers within Wollemi National Park. The local population is unknown.</p> <p>The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this species is not considered to occur within the subject property.</p>
<i>Pomaderris brunnea</i>	Brown Pomaderris	VN	V	Moderate	Negligible	<p>Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. It is associated with Cabbage Gum (<i>Eucalyptus amplifolia</i>) Rough-barked Apple (<i>Angophora floribunda</i>), Parramatta Wattle (<i>Acacia parramattensis</i>), Blackthorn, and White Kunzea (<i>Kunzea ambigua</i>).</p> <p>Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.</p>
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	EN	E1	Negligible	Negligible	<p>Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. Habitat requires a native groundcover (ie over 50% native species). Subject property does not contain suitable habitat for this species.</p>
<i>Pultenaea parviflora</i>		VN	E1	Low	Negligible	<p>May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property.</p>

Table F.2 Likelihood of occurrence assessment – threatened flora

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Likelihood of occurrence (following targeted survey)	Justification
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	VN	E1	Negligible	Negligible	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. The subject property is outside the known distribution for this species.
<i>Thesium australe</i>	Austral Toadflax	VN	V	Low	Negligible	It occurs in shrubland, grassland or woodland, often on damp sites. Vegetation types include open grassy heath dominated by Swamp Myrtle (<i>Leptospermum myrtifolium</i>), Small-fruit Hakea (<i>Hakea microcarpa</i>), Alpine Bottlebrush (<i>Callistemon sieberi</i>), Woolly Grevillea (<i>Grevillea lanigera</i>), Coral Heath (<i>Epacris microphylla</i>) and Poa spp. Kangaroo Grass grassland surrounded by Eucalyptus woodland; and grassland dominated by Barbed-wire Grass (<i>Cymbopogon refractus</i>). The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable

F.3 Likelihood of occurrence assessment – fauna species

Table F.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E4A	Negligible	<p>The Regent Honeyeater is a striking, predominantly black and yellow bird. Its head and neck are black, with warty pink or yellow skin around the eyes. Endemic to mainland south-eastern Australia, the species has a patchy distribution from south-east Queensland, through NSW and the ACT into central Victoria. Records are widely distributed across this range, but the species is only found regularly at a few localities in NSW and Victoria. Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content. Other forest types regularly utilised by the Regent Honeyeater include wet lowland coastal forest dominated by Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum-Ironbark associations and riverine woodlands.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property does not support key habitat or feed tree species.</p>
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	E1	Low	<p>The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds or cutting grass growing over a muddy or peaty substrate.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	E1	Low	<p>The Curlew Sandpiper is a small, slim sandpiper. Inland, the species mainly occur around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table F.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Grantiella picta</i>	Painted Honeyeater	VU	V	Low	<p>The Painted Honeyeater has black upperparts, white underparts, black spots on its flanks and yellow edges to the flight and tail feathers. The bill is a deep pink and the eye red. The species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory, with inland slopes of the Great Dividing Range seeing greatest concentrations and almost all records of breeding. The species has a specialist diet mainly consisting of mistletoe fruits, but also includes nectar. The species inhabits mistletoes in a variety of vegetation types, including eucalypt forests/woodlands, riparian woodlands, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Hirundapus caudacutus</i>	White-throated Needletail	VU	-	Low	<p>An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia. White-throated Needletails almost always forage aerially, at heights up to ‘cloud level’</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Lathamus discolor</i>	Swift Parrot	CE	E1	Negligible	<p>The Swift Parrot is a small fast-flying, nectivorous parrot which occurs in eucalypt forests in south eastern Australia. The species breeds in Tasmania and migrate to mainland Australia in autumn. During winter the parrots disperse across a broad landscape, foraging on nectar and lerps in eucalypt forests, particularly inland box-ironbark and grassy woodlands, and Coastal Swamp Mahogany (<i>E. robusta</i>) and Spotted Gum (<i>Corymbia maculata</i>) woodland when in flower.</p> <p>The subject property is outside of the known breeding habitat area for this species. The subject property does not contain suitable feed tree species for this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Numenius madagascariensis</i>	Eastern Curlew	CE	-	Negligible	<p>The Eastern Curlew is the largest migratory shorebird in the world, migrating to Australia during the northern hemisphere winter. In Australia, the species has a primarily coastal distribution, inhabiting sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property does not provide suitable intertidal habitat.</p>

Table F.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Rostratula australis</i>	Australian Painted Snipe	EN	E1	Low	<p>The Australian Painted Snipe is a stocky wading bird, endemic to Australia and has been recorded at wetlands in all states and territories. The species inhabits shallow ephemeral and permanent freshwater (occasionally brackish) wetlands.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	VU	V	Recorded	<p>Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.</p> <p>The subject property doesn't contain suitable maternity roost habitats in the form of sandstone overhangs.</p> <p>This species was recorded once passing over the subject property during the microbat surveys.</p>
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	Possible	<p>Prefers moist habitats, with trees taller than 20 m. Generally, roosts in eucalypt hollows but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer.</p> <p>The subject property contains one hollow-bearing tree and some human made structures.</p> <p>This species was potentially recorded on site during microbat surveys, via anabats placed on site. The record is uncertain because calls may be easily confused with Eastern Broad-nosed Bat (<i>Scotorepens orion</i>) and Greater Broad-nosed Bat, which are both more likely to occur on site than Eastern False Pipistrelle due to marginal habitat for the species.</p>

Table F.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V	Probable	<p>The Greater Broad-nosed Bat utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. It forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.</p> <p>This species was potentially recorded on site during microbat surveys, via anabats placed on site. The record is uncertain because calls may be easily confused with Eastern Broad-nosed Bat and Eastern False Pipistrelle (though Eastern False Pipistrelle is less likely to occur on site due to marginal habitat for the species).</p>
<i>Miniopterus australis</i>	Little Bent-winged Bat	-	V	Possible	<p>Prefers moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas.</p> <p>Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat (<i>Miniopterus schreibersii</i>) and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats and appears to depend on the large colony to provide the high temperatures needed to rear its young. Only five nursing sites/maternity colonies are known in Australia.</p> <p>Little Bent-winged Bat was potentially recorded on site during microbat surveys, via anabats placed on site. The record is uncertain because calls may be from Chocolate Wattled Bat (<i>Chalinolobus morio</i>) which was confirmed as being present on site.</p>

Table F.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Dasyurus maculatus maculatus</i>	Spotted-tail Quoll	EN	V	Negligible	<p>The Spotted-tailed Quoll is one of Australia’s largest extant marsupial carnivores and has a distinctive spotted appearance. The species is primarily forest-dependent , and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. The species has home ranges of several hundred to several thousand hectares in size and will use multiple dens. moving between den sites every 1–4 days. The species occurs at low densities.</p> <p>The subject property is isolated from areas of suitable habitat for this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Petauroides volans</i>	Greater Glider	VU	-	Negligible	<p>The Greater Glider is the largest gliding possum in Australia. The species is distributed across eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1,200 m above sea level. The species is restricted to eucalypt forests and woodlands, typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The species distribution may be patchy even in suitable habitat.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	VU	E1	Negligible	<p>The Brush-tailed Rock-wallaby Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Feeds on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table F.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Phascolarctos cinereus</i>	Koala	VU	V	Negligible	<p>The Koala is a tree-dwelling, medium-sized marsupial, distributed from Cairns to South Australia, however, the listed population does not include Victoria or South Australia. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus Eucalyptus. The distribution of Koalas is also affected by altitude, with the species limited to below 800 m ASL.</p> <p>The subject property does not contain suitable feed species to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	VU	-	Negligible	<p>The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V	Recorded (foraging)	<p>The Grey-headed Flying-fox is a large, endemic megachiropteran bat occurring in south-eastern Australia. The species distribution extends from Bundaberg in Queensland to Melbourne in Victoria, and from the coast inland to the western slopes of NNSW. The Grey-headed Flying-fox feeds on nectar and pollen from flowers of canopy trees and fleshy fruits from rainforest trees and vines, with regional preferences shown.</p> <p>The species was recorded foraging within the subject property.</p>
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	VU	V	Negligible	<p>The Giant Burrowing Frog are found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table F.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Litoria aurea</i>	Green and Golden Bell Frog	VU	E2	Negligible	This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes waterbodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. This species can occur in highly disturbed areas. This species was not recorded during targeted surveys.
<i>Macquaria australasica</i>	Macquarie Perch	EN	-	Negligible	The Macquarie Perch is found in the Murray-Darling Basin, particularly the upstream reaches of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW. The draft National Recovery Plan for Macquarie Perch identifies four self-sustaining populations; none are within the subject property. Macquarie Perch prefer clear water and deep, rocky holes with extensive cover in the form of aquatic vegetation, large boulders, debris and overhanging banks. They spawn in spring or summer and lay their eggs over stones and gravel in shallow, fast-flowing upland streams or flowing parts of rivers. Macquarie Perch inhabiting impoundments would likely undertake upstream spawning migration in October to mid-January after which adults usually move from the streams to the lake. Migration may not be necessary in stream dwelling fish. The subject property does not contain suitable habitat to support this species. The species has not been recorded within 10 km of the subject property.
<i>Prototroctes maraena</i>	Australian Grayling	VU	-	Negligible	Australian grayling is a primarily freshwater fish found in coastal rivers in south-eastern mainland Australia and Tasmania. The subject property does not contain suitable habitat to support this species. The species has not been recorded within 10 km of the subject property.
<i>Synemon plana</i>	Golden Sun Moth	CE	E1	Negligible	Golden Sun Moth occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by Spear Grasses (<i>Austrostipa</i> spp.) and/or Wallaby grasses (<i>Rytidosperma</i> spp.). They are known to spread into adjacent grasslands where Chilean Needle Grass (<i>Nassella neesiana</i>) and Serrated Tussock (<i>Nassella trichotoma</i>) are present. The subject property does not contain native grasslands. The woodland on site comprises an exotic groundlayer. Chilean Needle Grass and Serrated Tussock were not recorded on site either. Habitat is therefore considered to be absent for this species.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable

F.4 Likelihood of occurrence assessment – migratory species

Table F.4 Likelihood of occurrence assessment – migratory species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
Migratory Marine Birds					
<i>Apus pacificus</i>	Fork-tailed Swift	Mi		Low	<p>Almost exclusively aerial (foraging). The Fork-tailed Swift breeds in Asia but migrates to Australia from September to April. Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 metres high.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
Migratory Terrestrial Species					
<i>Cuculus optatus</i>	Horsfield's Bronze-Cuckoo	Mi		Moderate	<p>In Australia, Horsfield's Bronze-Cuckoo is found in all regions, including some islands. It is widespread on the eastern side of the Great Dividing Range in Queensland and is found down through New South Wales and Victoria to Tasmania and South Australia. The Horsfield's Bronze-Cuckoo is found in many wooded habitats (such as open and dry woodland and forest) with a range of understoreys from grasses to shrubs or heath. Sometimes found near clearings and in recently logged or burnt forests. Found in farmland with some trees, orchards, vineyards and urban parks and gardens.</p> <p>The subject property contains suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Hirundapus caudacutus</i>	White-throated Needletail	VU, Mi		Low	<p>An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia. White-throated Needletails almost always forage aerially, at heights up to 'cloud level'</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table F.4 Likelihood of occurrence assessment – migratory species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi		Negligible	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland. The species has not been recorded within 10 km of the subject property. The subject property does not support suitable rainforest habitat.
<i>Motacilla flava</i>	Yellow Wagtail	Mi		Low	Regular spring-summer visitor in north of Australia, rare vagrant or occasional visitor farther south. Found in marshes, damp paddocks, airfields, cultivated fields, lawns and estuaries. The species has not been recorded within 10 km of the subject property. The subject property is outside the known distribution of the species.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi		Low	The Satin Flycatcher inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. The species can occur at elevations of up to 1,400 m ASL. The Satin Flycatcher breeds in heavily vegetated gullies. The subject property contains some marginal habitat that may be suitable to support this species. The species has not been recorded within 10 km of the subject property.
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi		Negligible	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. The species mainly inhabits wet sclerophyll forests often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>). During migration it can stray into gardens and more open areas. The subject property does not provide suitable habitat for this species. The species has not been recorded within 10 km of the subject property.
Migratory Wetlands Species					
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi		Low	Inhabits a wide range of coastal and inland wetlands, often with muddy or rocky margins. Also known to occur at estuaries, billabongs, dams, pools and lakes, often associated with mangroves. The subject property contains some marginal habitat that may be suitable to support this species. The species has not been recorded within 10 km of the subject property.

Table F.4 Likelihood of occurrence assessment – migratory species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi		Moderate	<p>The Sharp-tailed Sandpiper forages at the edge of water within wetlands or intertidal mudflats, either on bare wet mud, sand or shallow water. They will also forage among inundated vegetation of saltmarsh, grass or sedges. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species was recorded within 10 km of the subject property.</p>
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi	E1	Low	<p>The Curlew Sandpiper is a small, slim sandpiper. Inland, the species mainly occur around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi		Low	<p>Scarce, but regular visitor, usually recorded in summer from November to March. Widespread but scattered records in Australia. Usually found in fresh to saline wetlands, floodplains, swamps, estuaries and lagoons, sometimes with emergent or fringing vegetation such as grass.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi		Moderate	<p>Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species was recorded within 10 km of the subject property.</p>
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, Mi		Negligible	<p>The Eastern Curlew is the largest migratory shorebird in the world, migrating to Australia during the northern hemisphere winter. In Australia, the species has a primarily coastal distribution, inhabiting sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property does not provide suitable intertidal habitat.</p>

Table F.4 Likelihood of occurrence assessment – migratory species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Pandion haliaetus</i>	Osprey	Mi		Negligible	<p>The Osprey is cosmopolitan, being found in many coastal and lake areas of the world. In Australia, it is found on the north and east coast from Broome to the south coast of New South Wales. Ospreys are found on the coast and in terrestrial wetlands of tropical and temperate Australia and off-shore islands, occasionally ranging inland along rivers, though mainly in the north of the country.</p> <p>The subject property contains some marginal habitat that may be suitable to support foraging habitat, however, no active or old nesting sites were observed in the subject property for this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Tringa nebularia</i>	Common Greenshank	Mi		Moderate	<p>The Common Greenshank breeds in the Palaearctic regions and is widespread in Africa, Coastal Asia, the Indian subcontinent, the Philippines and southern New Guinea. They are common throughout Australia in the summer. Common Greenshanks are found both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species was recorded within 10 km of the subject property.</p>

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable

Appendix G

EPBC Act significant impact criteria assessments



G.1 Large-eared Pied Bat (*Chalinolobus dwyeri*)

Table G.1 Significant impact criteria assessment – Large-eared Pied Bat

Species profile	<p>Large-eared Pied Bat</p> <p>Status: Vulnerable (EPBC and BC Act)</p> <p>Distribution: The current distribution of this species is poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, New South Wales in the south.</p> <p>Biology: The large-eared pied bat is a small to medium-sized insectivorous bat measuring approximately 100 mm including the head and tail, and weighing between 7–12 g. It has shiny, black fur on the body and there is a white stripe on the ventral side of the torso where it adjoins the wings and tail. The ears are long and prominent, and lobes of skin adorn the lower lip and between the corner of the mouth and the bottom of the ear.</p> <p>Habitat requirements: Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20–40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.</p> <p>Threats: The main identified threats to this species include:</p> <ul style="list-style-type: none"> • disturbance and damage at primary nursery roosts • long wall mining for coal; • loss of foraging habitat; and • predation by foxes (<i>Vulpes Vulpes</i>) and other predators.
Criteria	Discussions
Lead to a long-term decrease in the size of an important population	The subject property may be used by this species as a commuting route along Oaky Creek. There is no known important population present on the subject property, and the vegetation is unlikely to be of key importance or to lead to a long-term decrease in an important population. No individuals were recorded at WSA (DIRD 2016).
Reduce the area of occupancy for an important population	The subject property may be used by this species as a commuting route along Oaky Creek. No known important population present on the subject property.
Fragment an existing important population into two or more populations	The subject property is considered to be used by this species as a commuting route along Oaky Creek. The commuting habitat will not be impacted on as part of the MOD 5.
Adversely affect habitat critical to the survival of a species	The subject property is considered to be used by this species as a commuting route along Oaky Creek.
Disrupt the breeding cycle of an important population	The subject property does not contain suitable maternity roost habitats in the form of sandstone overhangs. This species was recorded once passing over the subject property during the microbat surveys. The subject property is considered to be used by this species as a commuting route along Oaky Creek. There is no direct habitat loss as part of the MOD 5 that is considered to disrupt the breeding cycle of a population.

Table G.1 Significant impact criteria assessment – Large-eared Pied Bat

Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The subject property does not contain suitable maternity roost habitats in the form of sandstone overhangs. This species was recorded once passing over the subject property during the microbat surveys. The subject property is considered to be used by this species as a commuting route along Oaky Creek. There is no direct habitat loss as part of the MOD 5 that is considered to lead to a substantially modify, destroy or isolate an area of important habitat.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The subject property has the potential to be used by foxes as part of their hunting grounds. As no roosting or breeding habitat is present within the subject property no impacts are expected to occur on important habitat for this species.
Introduce disease that may cause the species to decline	The subject property is considered to be used by this species as a commuting route along Oaky Creek only.
Interfere substantially with the recovery of the species	The subject property is considered to be used by this species as a commuting route along Oaky Creek only.
Conclusion	<p>MOD 5 is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none"> • no maternity roosts or potential habitat to support maternity roosts will be lost; and • MOD 5 will not disrupt the breeding cycle of this species population.

G.2 Grey-headed Flying-fox (*Pteropus poliocephalus*)

Table G.2 Significant impact criteria assessment – Grey-headed Flying-fox

Species profile	<p>Grey-headed Flying-fox</p> <p>Status: Vulnerable (EPBC and BC Act)</p> <p>Distribution: Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia.</p> <p>Biology: The Grey-headed Flying-fox is the largest Australian bat, with a head and body length of 23–29 cm. It has dark grey fur on the body, lighter grey fur on the head and a russet collar encircling the neck. The wing membranes are black, and the wingspan can be up to 1 m.</p> <p>Habitat requirements: Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.</p> <p>Threats: Main threats to Grey-headed Flying-fox is disturbance or destruction of roosting camps.</p>
Criteria	Discussions
Lead to a long-term decrease in the size of an important population	The subject property does not contain roosting camps, this species is highly mobile and would use the site for foraging. The vegetation is unlikely to be of key importance or to lead to a long-term decrease in an important population.
Reduce the area of occupancy for an important population	The subject property does not contain roosting camps, this species is highly mobile and would use the site for foraging.
Fragment an existing important population into two or more populations	The subject property does not contain roosting camps, this species is highly mobile and would use the site for foraging. MOD 5 will not modify destroy or isolate an area of important habitat.
Adversely affect habitat critical to the survival of a species	The subject property does not contain roosting camps, this species is highly mobile and would use the site for foraging.
Disrupt the breeding cycle of an important population	The subject property does not contain roosting camps. MOD 5 is not considered to disrupt the breeding cycle for the local population of this species.
Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The subject property does not contain roosting camps, this species is highly mobile and would use the site for foraging.

Table G.2 Significant impact criteria assessment – Grey-headed Flying-fox

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	As no roosting camps are present within the subject property, no impacts from invasive species are expected to have an impact on important habitat for this species.
Introduce disease that may cause the species to decline	The subject property does not contain roosting camps, this species is highly mobile and would use the site for foraging only.
Interfere substantially with the recovery of the species	The subject property does not contain roosting camps, this species is highly mobile and would use the site for foraging only.
Conclusion	<p>MOD 5 is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none"> • no roosting camps will be impacted on; and • MOD 5 will not disrupt the breeding cycle of this species population.

G.3 Horsfield's Bronze-cuckoo (*Cuculus optatus*)

Table G.3 Significant impact criteria assessment – Horsfield's Bronze-cuckoo

Species profile	<p>Horsfield's Bronze-cuckoo</p> <p>Status: Migratory (EPBC Act)</p> <p>Distribution: In Australia, Horsfield's Bronze-Cuckoo is found in all regions, including some islands. It is widespread on the eastern side of the Great Dividing Range in Queensland and is found down through New South Wales and Victoria to Tasmania and South Australia.</p> <p>Biology: Horsfield's Bronze-Cuckoo is an olive-brown above with pale scaling and a bronze to green sheen on the back and upper tail.</p> <p>Habitat requirements: The Horsfield's Bronze-Cuckoo is found in many wooded habitats (such as open and dry woodland and forest) with a range of understoreys from grasses to shrubs or heath. Sometimes found near clearings and in recently logged or burnt forests. Found in farmland with some trees, orchards, vineyards and urban parks and gardens.</p>
Criteria	Discussion
Substantially modify, destroy or isolate an area of important habitat.	MOD 5 will not remove additional habitat. Up to 0.08 ha of poor condition PCT 1800 will be removed under the current approval. This habitat is not considered important for this species. No impacts to Oaky Creek are to occur, which may be used as a habitat corridor for this species. The MOD 5 is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	This species uses a variety of habitats. Based on the proposed mitigation measures it is not expected that MOD 5 will result in an increase of invasive species.
Disrupt the breeding cycle of a population.	MOD 5 will not remove additional habitat. Up to 0.08 ha of poor condition PCT 1800 will be removed under the current approval. This habitat is not considered important for this species. MOD 5 is unlikely to disrupt the breeding cycle of this species.
Conclusion	<p>MOD 5 is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none"> • no additional habitat is to be removed; and • MOD 5 will not disrupt the breeding cycle of this species population.

G.4 Sharp-tailed Sandpiper (*Calidris acuminata*)

Table G.4 Significant impact criteria assessment – Sharp-tailed Sandpiper

Species profile	<p>Sharp-tailed Sandpiper</p> <p>Status: Migratory (EPBC Act)</p> <p>Distribution: The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage.</p> <p>Biology: The Sharp-tailed Sandpiper is a small-medium wader. The bird has a length of 17–22 cm, a wingspan of 36–43 cm and a weight of 65 g.</p> <p>Habitat requirements: The Sharp-tailed Sandpiper forages at the edge of water within wetlands or intertidal mudflats, either on bare wet mud, sand or shallow water. They will also forage among inundated vegetation of saltmarsh, grass or sedges. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation.</p> <p>Threats: The main identified threats to this species include habitat loss and reduction in water quality and quantity; disturbance; global warming; and hunting.</p>
Criteria	Discussion
Substantially modify, destroy or isolate an area of important habitat.	MOD 5 is not considered to support areas of important habitat for the Latham’s Snipe as per the guidelines identified in <i>Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i> (DoEE 2017). MOD 5 will not remove any of the waterbodies within the subject property that may contain suitable foraging habitat with wet mud. MOD 5 is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	Based on the proposed mitigation measures it is not expected that the MOD 5 will result in an increase of invasive species.
Disrupt the breeding cycle of a population.	The Sharp-tailed Sandpiper breeds in northern Siberia, from the delta of the Lena River, east to Chaun Gulf and east of the Kolyma River delta. No impacts on the breeding cycle of this population is considered to occur.
Conclusion	<p>MOD 5 is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none"> • no suitable foraging habitat will be removed; and • MOD 5 will not disrupt the breeding cycle of this species population.

G.5 Latham’s Snipe (*Gallinago hardwickii*)

Table G.5 Significant impact criteria assessment – Latham’s Snipe

Species profile	<p>Latham’s Snipe</p> <p>Status: Migratory (EPBC Act)</p> <p>Distribution:</p> <p>The Latham’s Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. The species breeds in Japan and on the east Asian mainland.</p> <p>Biology:</p> <p>The Latham’s Snipe is the largest snipe in Australia; mainly brown plumage, with a long straight bill and short pointed wings. The upper body is boldly patterned with black, brown and white. The sexes are similar in appearance and do not show seasonal variation unlike other migratory waders. Juveniles in fresh plumage differ only slightly from adults.</p> <p>Habitat requirements:</p> <p>The Latham’s Snipe occurs in permanent and ephemeral wetlands up to 2,000 m ASL. The species inhabits open, freshwater wetlands with low, dense vegetation.</p> <p>Threats:</p> <p>The main threats associated with the Latham’s Snipe include the loss of habitat caused by the drainage and modification of wetlands, diversion of water for storage or agriculture, development of land and land management practices such as mowing of habitat. The species was also previously legally hunted.</p>
Criteria	Discussion
Substantially modify, destroy or isolate an area of important habitat.	MOD 5 is not considered to support areas of important habitat for the Latham’s Snipe as per the guidelines identified in <i>Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i> (DoEE 2017). MOD 5 is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	The <i>Threat Abatement Plan for predation by the European red fox</i> (DEWHA 2008) identifies the Latham’s Snipe as one of the species likely to be affected by the European red fox. MOD 5 will not result in an increase or introduction of the European red fox into an area of important habitat. As discussed above, the MOD 5 area does not contain important habitat for the species and will not result in invasive species becoming established in an area of important habitat.
Disrupt the breeding cycle of a population.	The Latham’s Snipe breeding range is confined to Japan and far eastern Russia; therefore, MOD 5 will not impact the species breeding cycle.
Conclusion	MOD 5 is unlikely to result in a significant impact on Latham’s Snipe as: no important habitat will be directly impacted on; and the proposed action will not disrupt the breeding cycle of the species.

G.6 Common Greenshank (*Tringa nebularia*)

Table G.6 Significant impact criteria assessment – Common Greenshank

Species profile	<p>Common Greenshank</p> <p>Status: Migratory (EPBC Act)</p> <p>Distribution:</p> <p>The Common Greenshank is a non-breeding migrant to Australia. The species breeds in Eurasia, the northern British Isles, Scandinavia, east Estonia and north-east Belarus, through Russia.</p> <p>Biology:</p> <p>The Common Greenshank is a heavily built, elegant wader, 30–35 cm in length, with a wingspan of 55–65 cm and weight up to 190 g for both males and females.</p> <p>Habitat requirements:</p> <p>The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees.</p> <p>Threats:</p> <p>The main identified threats to this species include: loss/modification of habitat; silt, pollution, weeds or pest invasion; disturbance; and introduced species.</p>
Criteria	Discussion
Substantially modify, destroy or isolate an area of important habitat.	MOD 5 is not considered to support areas of important habitat for the Common Greenshank as per the guidelines identified in <i>Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i> (DoEE 2017). The MOD 5 is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	Based on the highly degraded nature and existing weed infestation on the subject property it is not expected that the MOD 5 will result in an increase of invasive species.
Disrupt the breeding cycle of a population.	The Latham’s Snipe breeding range is confined Eurasia, the northern British Isles, Scandinavia, east Estonia and north-east Belarus, through Russia, therefore MOD 5 will not impact the species breeding cycle.
Conclusion	<p>MOD 5 is unlikely to result in a significant impact on this species as:</p> <ul style="list-style-type: none"> • no important habitat will be directly impacted on; and • the proposed action will not disrupt the breeding cycle of the species.

Appendix H

Acoustic detection survey results





CORYMBIA ECOLOGY

Amy Rowles

415 Parishs Rd, Hilldale, NSW, 2420

Mob: 0418451488

Email: amy@corymbiaecology.com.au

ABN 61854031078

BAT CALL ANALYSIS RESULTS

Jason Brown - EMM

J190749 – Adams Rd, Luddenham

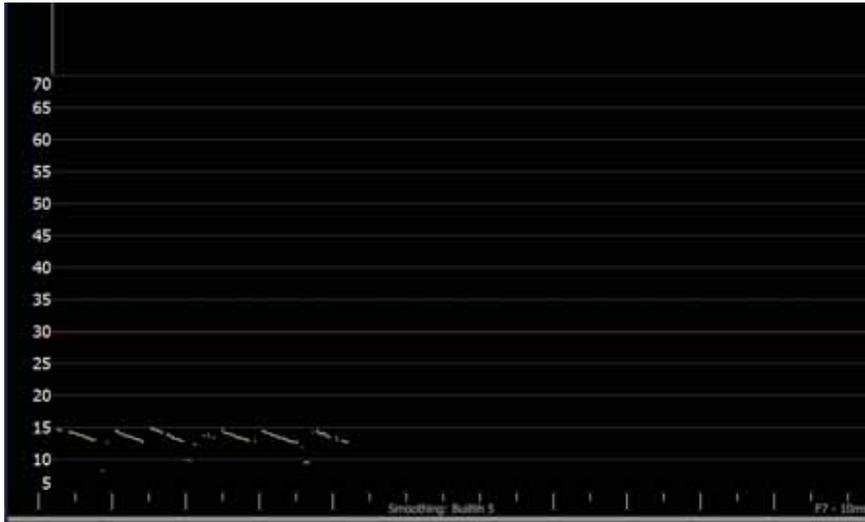
27/02/2020 – 02/03/2020

Species	Anabat A	Anabat B	Notes
	SN507269 3892 files 2692 noise	SN507245 2005 files 855 noise	
<i>Austronomus australis</i>	D	D	
<i>Chalinolobus dwyeri</i>	D	D	Only one pass each detector
<i>Chalinolobus gouldii</i>	D	D	
<i>Chalinolobus morio</i>	D	D	
<i>Miniopterus schreibersii oceanensis</i>	D	Pr	
<i>Miniopterus australis</i>	Po	Po	Poor quality calls. Could just be clutter calls from <i>C. morio</i>
<i>Myotis macropus</i>		D	Lots of activity at Anabat B
<i>Mormopterus norfolkensis</i>	D	D	Can be difficult to ID calls between these species, unless clear highly characteristic passes
<i>Mormopterus norfolkensis</i> or <i>Mormopterus(ozimops) ridei</i>	E	E	
<i>Nyctophilus sp</i>	D	Pr	
<i>Scotorepens orion</i>	Pr	Pr	Calls may be easily confused between <i>Scotorepens orion</i> , <i>Scoteanax rueppellii</i> and <i>F. tasmaniensis</i> . Less likely to be <i>F. tasmaniensis</i> due to marginal habitat for the species.
<i>Scoteanax rueppellii</i>	Pr	Po	
<i>Falsistrellus tasmaniensis</i>	Po		
<i>Vespadelus vulturnus</i>	Pr		Only one pass. Not very clear

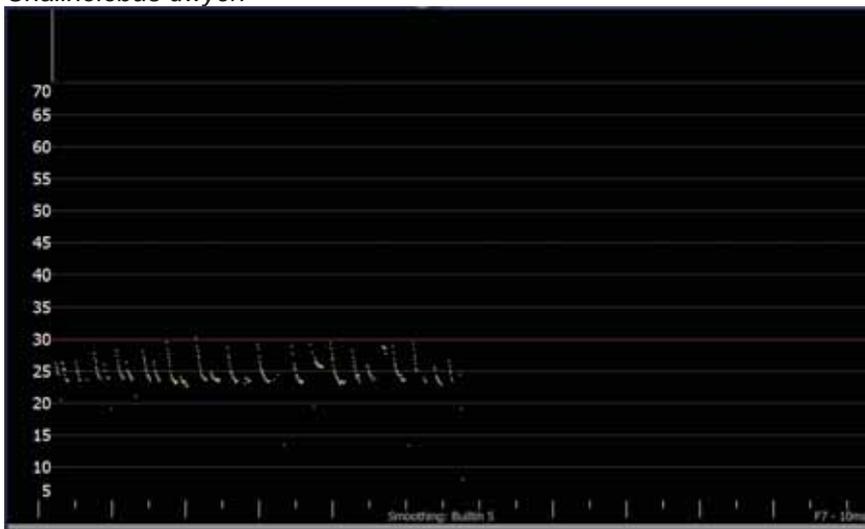
- D – definite; Pr – probable; Po – possible; E-either.
- Calls were analysed using Analoook and Anabat Insight.
- Example calls presented below are displayed in this report at F7 or F8 (bottom right corner).
- Analysis was completed on the 15th March 2020
- The following resources were consulted during analysis:
 - Pennay M., Law B., and Reinhold L. (2004) Bat Calls of NSW. DEC of NSW.
 - Corben C. (2009) Anabat Techniques Workshop, Titley Scientific.
 - Anabat Insight Workshop (2019), Titley Scientific and Balance Environmental.
 - Personal experience analysing calls and collection of reference calls in NSW
- **Please note only species with a definite ID should be entered into Bionet.**

Examples of calls for definite identified species

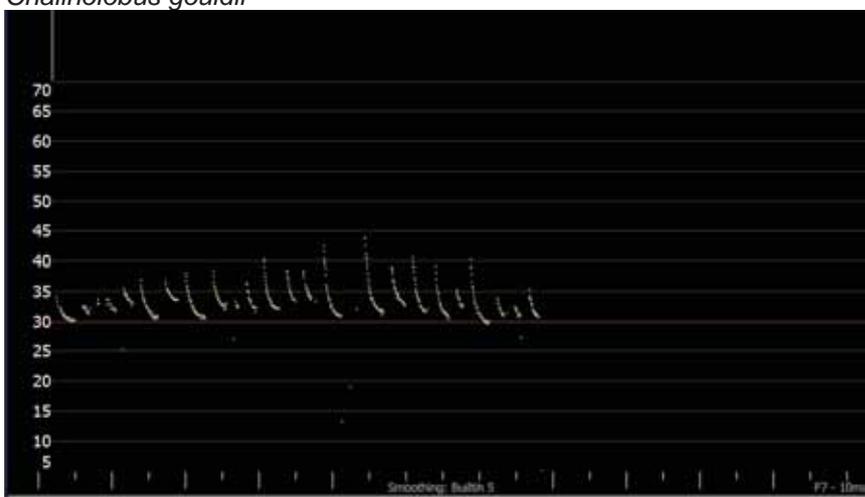
Austronomus australis



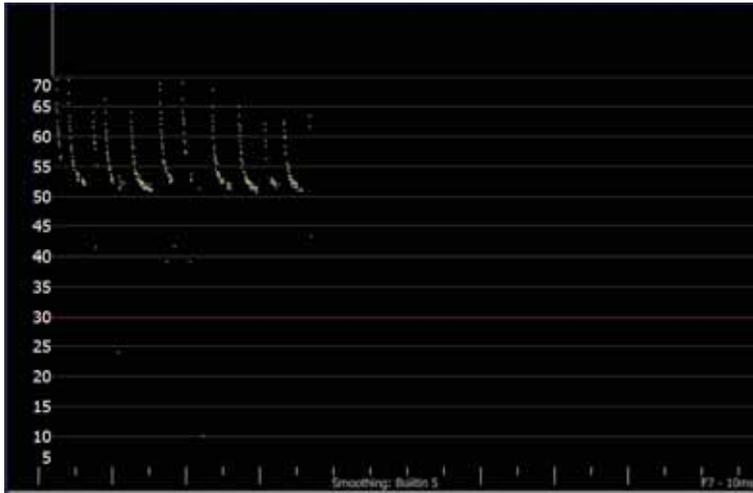
Chalinolobus dwyeri



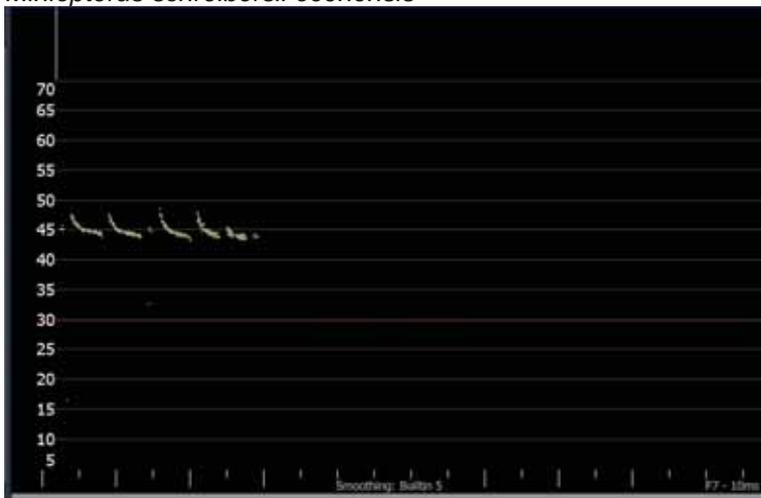
Chalinolobus gouldii



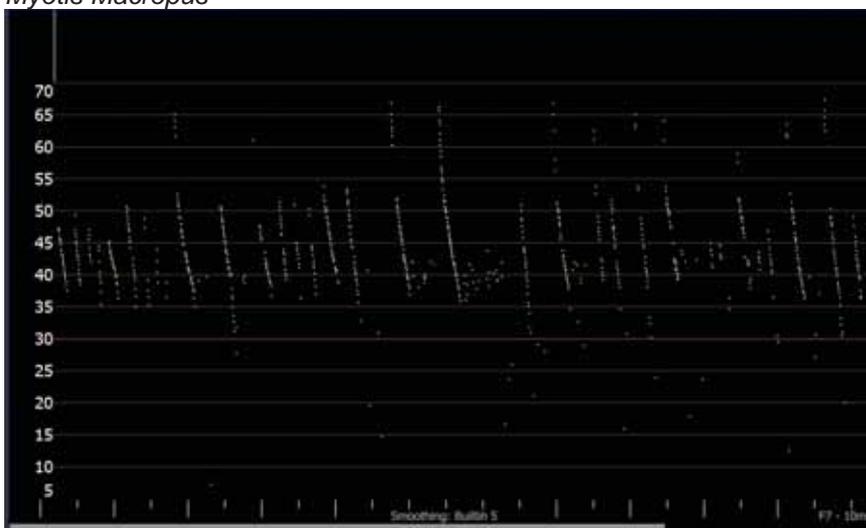
Chalinolobus morio



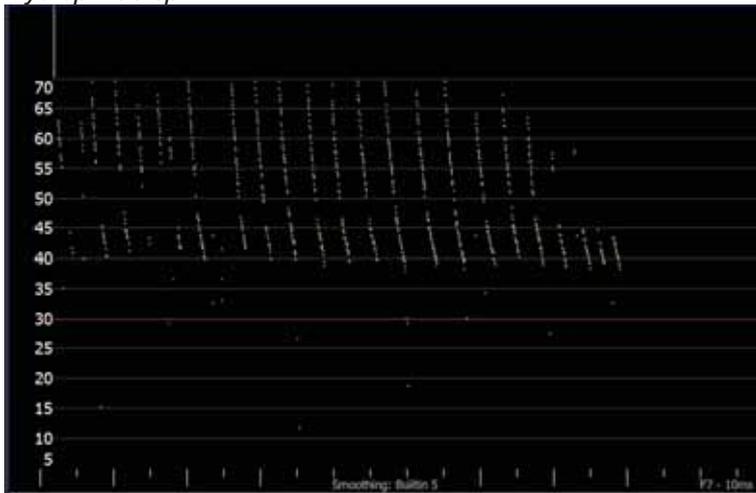
Miniopterus schreibersii ocanensis



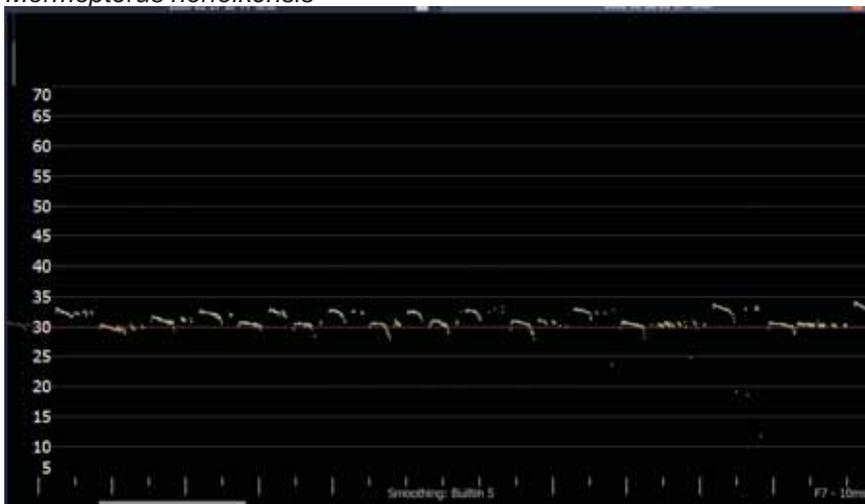
Myotis Macropus



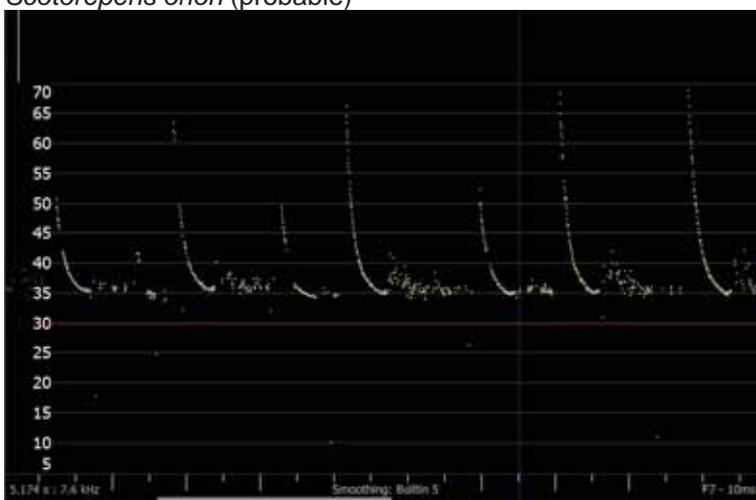
Nyctophilus sp.



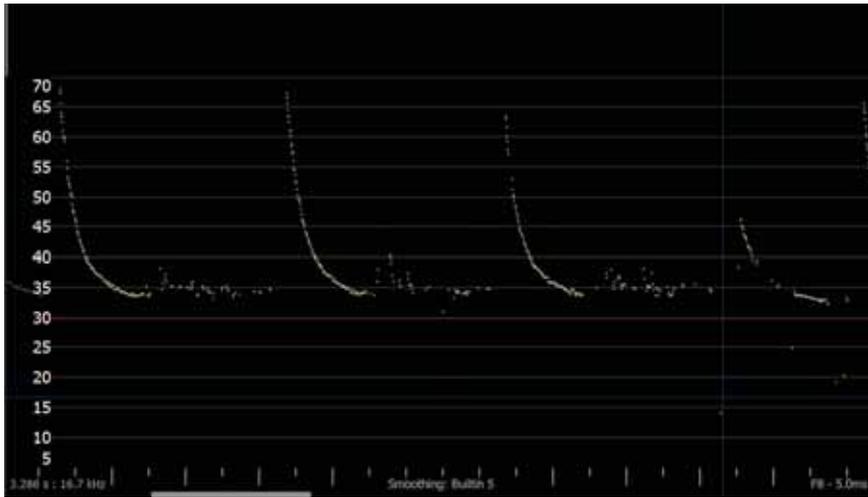
Mormopterus norfolkensis



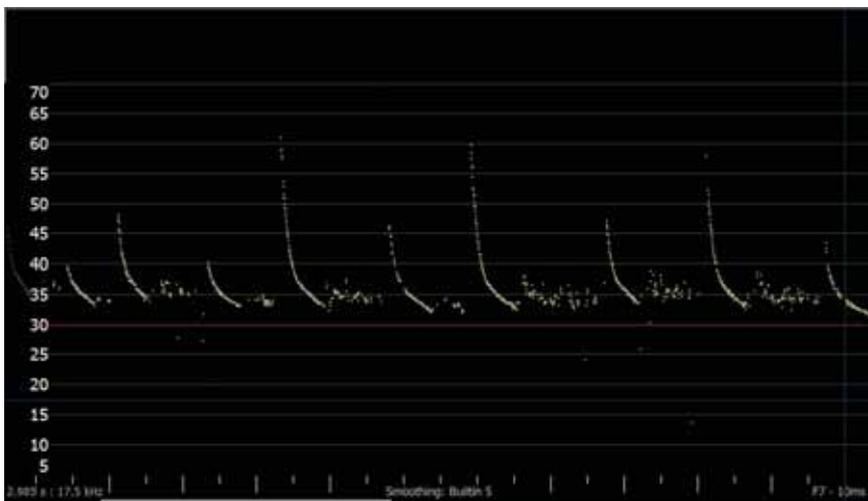
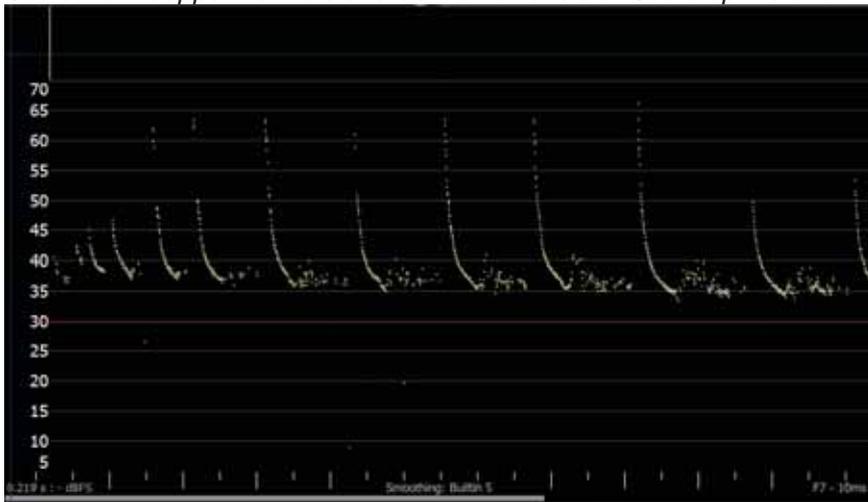
Scotorepens orion (probable)



Scoteanax rueppellii (Probable)



Scoteanax rueppellii or *Falsistrellus tasmaniensis* or *Scotorepens orion*



Amy Rowles

Amy Rowles







APPENDIX E –
Concept design and filling strategy



CONCEPT DESIGN AND FILLING STRATEGY

**Luddenham Quarry
275 Adams Road
Luddenham, NSW**

Prepared for
CFT No.13 Pty Ltd & KLF Holdings Pty Ltd
Level 5, 2 Grosvenor Street
Bondi Junction NSW 2022

Report Number ISA-261-20-21

23 November 2020





REPORT PREPARED BY:

InSitu Advisory Pty Ltd
PO Box 503
Frenchs Forest
NSW 1640

ABN 43 612 657 682

- ❖ This report has been prepared by **InSitu Advisory Pty Ltd** with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client.
- ❖ Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.
- ❖ This report is for the use of CFT No.13 Pty Ltd, KLF Holdings Pty Ltd or any regulator or public entity associated with this project.
- ❖ No warranties or guarantees are expressed or should be inferred by any third parties.
- ❖ This report may not be relied upon by other parties without written consent from InSitu Advisory Pty Ltd.
- ❖ InSitu Advisory disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Report	Status	Date	Prepared	Checked	Authorised
ISA-261-20-21	Revision 0	23 November 2020	Alan Dyer	Darren Herdman	Alan Dyer

TABLE OF CONTENTS

1	INTRODUCTION	4
2	SITE DETAILS	5
2.1	LOCATION	5
2.2	THE SITE	5
2.3	GEOLOGY AND HYDROGEOLOGY	6
2.3.1	<i>Geology</i>	6
2.3.2	<i>Hydrogeology</i>	6
3	LANDFILL CONCEPTUAL DESIGN	6
3.1	REQUIRED DESIGN CONSIDERATIONS	6
3.2	BASE AND SIDEWALL CONTAINMENT ENGINEERING	7
3.2.1	<i>Design Requirements</i>	7
3.2.2	<i>Concept Design</i>	8
3.3	LANDFILL GAS CONSIDERATION	8
3.4	CAPPING AND REHABILITATION	9
3.4.1	<i>Design Requirements</i>	9
3.4.2	<i>Concept Design</i>	9
4	FILLING STRATEGY	10
5	ADDRESSING DPIE CONSIDERATIONS	12
6	CONCLUSIONS AND RECOMMENDATIONS	13
7	CLOSE	14
8	REFERENCES	15

LIST OF FIGURES

Figure 1	Site Location Plan
Figure 2	Typical Construction Details
Figure 3	Conceptual Excavated Landfill Profile
Figure 4	Conceptual Top of Engineering Surface
Figure 5	Conceptual Final Waste Profile
Figure 6	Conceptual Staged Tipping Plan
Figure 7	Indicative Tipping Sections

1 INTRODUCTION

InSitu Advisory Pty Ltd (InSitu Advisory) was commissioned by CFT No.13 Pty. Limited (CFT) and KLF Holdings Pty Ltd to undertake a Concept Design and Filling Strategy (CDFS) at the Adams Road Quarry, 275 Adams Road, Luddenham, NSW 2745 (see Figure 1).

CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), has recently acquired the property at 275 Adams Road, Luddenham NSW (Lot 3 in DP 623799, 'the site') within the Liverpool City Council municipality. The site is host to an existing shale/clay quarry.

CPG owns, develops, and manages a national portfolio of office, retail, entertainment, land, and other assets. The company's business model is to retain long-term ownership and control of all its assets. CPG has the following staged vision to the long-term development of the site:

- **Stage 1** Quarry Reactivation: **Solving a problem.** CPG intends to responsibly avoid the sterilisation of the remaining natural resource by completing the extraction of shale which is important to the local construction industry as raw material used by brick manufacturers in Western Sydney. Following the completion of approved extraction activities, the void prepared for rehabilitation.
- **Stage 2** Advanced Resource Recovery Centre (ARRC) and Quarry Rehabilitation: **A smart way to fill the void:** CPG in partnership with KLF Holdings Pty Ltd (KLF) and in collaboration between the circular economy industry and the material science research sector, intends to establish a technology-led approach to resource recovery, management, and reuse of Western Sydney's construction waste, and repurposing those materials that cannot be recovered for use to rehabilitate the void. This will provide a sustainable and economically viable method of rehabilitating the void for development.
- **Stage 3** High Value Employment Generating Development: **Transform the land to deliver high value agribusiness jobs.** CPG intends to develop the rehabilitated site into a sustainable and high-tech agribusiness hub supporting food production, processing, freight transport, warehousing, and distribution, whilst continuing to invest in the resource recovery R&D initiatives. This will deliver the vision of a technology-led agribusiness precinct as part of the Aerotropolis that balances its valuable assets including proximity to the future Western Sydney Airport (WSA) and Outer Sydney Orbital.

This CDFS aims to address the comments from the Department Planning, Industry and Environment (DPIE) and government agencies in respect to an Environmental Impact Statement (EIS) application to establish the ARRC prepared by EMM Consulting Pty Ltd.

It is noted that infilling of the quarry void does not form part of the ARRC application. Infilling of the void will be the subject of a future modification application of the existing quarry consent. This CDFS, therefore, provides high level information to DPIE and government agencies to demonstrate the feasibility of infilling the void with the material and as per the methodology described herein.

The main considerations that this CDFS addresses are as follows:

- *The wildlife assessment submitted as part of AIA refers to the Western Sydney Airport EIS and that Western Sydney Airport EIS did not identify the Proposed Development site as a risk. When the Western Sydney Airport EIS was prepared a waste management facility was not proposed for the site and therefore it is not relevant that the Western Sydney Airport EIS did not identify the site as an area of concern. (Western Sydney Airport);*

- *This Department is concerned about the consultant's claim that quarries are "low risk", given International Civil Aviation Organisation wildlife management guidance identifies quarries and waste facilities as key potential off-airport attractants. (Department of Infrastructure, Transport, Regional Development and Communications);*
- *The application states "This ARRC application seeks approval to transfer non-recyclable residues to the void. It does not seek approval for the placement of this material, which will be subject to a separate approval." WSA seeks clarification regarding the Applicant's intent on how it proposes to manage and dispose of waste that is not recycled. (Western Sydney Airport);*
- *The EIS states that it is the intent of the facility to receive garden waste, wood waste and vegetative waste, but does not provide detail of how this waste is to be managed or disposed of. These types of waste are organic waste and if disposed of in the quarry void would likely result in the generation of land fill gas as the waste breaks down. This would require management of land fill gas and may give rise for the need for flaring or plumes to manage land fill gases. Management of any land fill gas (e.g. flaring) needs to be assessed as it can create a hazard to Airport operations. In addition, wildlife hazards associated with landfilling will need to be assessed. Further information and clarification on this matter is required. (Western Sydney Airport); AND*
- *Importantly, it remains unclear from the documents provided what is ultimately proposed for the development site and what are the timings of the various stages of development and operations over the medium to long term. ... The Department would like more information on the Proponent's long-term plans for the site to better consider the potential impacts on the Airport (Department of Infrastructure, Transport, Regional Development and Communications).*

This CDFS is based upon a review of existing documents (previous project reports and NSW EPA Environmental Guidelines: Solid Waste Landfills, Second Edition 2016) and site inspection observations made by InSitu Advisory. A preliminary landfill voidspace assessment has previously been estimated to determine the likely waste void space achieved post quarrying adhering to the requirements of the NSW EPA Environmental Guidelines 2016 (Landfill Guidelines).

The landfill concept design presented within this CDFS assumes that the quarry will be extracted to its full extent as approved by Development Approval No. 315-7-2003 issued by the Minister for Infrastructure, Planning and Natural Resources on 23 May 2004 and as subsequently modified (assuming other aspects of the Landfill Guidelines are also adhered to). It has been assumed that Modification 5 will be approved and that the quarry will extract up to 300,000 tonnes per annum (t/pa) until 31 December 2024.

2 SITE DETAILS

2.1 Location

The Adams Road Quarry is located approximately 65km west of the Sydney CBD and locally some 350 metres to the south east of the intersection between Adams Road and Elizabeth Drive in the suburb of Luddenham, NSW (see Figure 1).

2.2 The Site

The site is a dormant quarry that was previously worked to produce clay, shale and structural clay used for the manufacture of bricks and pavers. Interbedded sandstone was also quarried with the clay/shale but is typically not used in the brick manufacturing process.

The site is an irregular shaped parcel with an area of 19.09 Ha, comprising one single lot (Lot 3). The site comprises a single open pit which is bordered to the east and south by Commonwealth land, to the north by open farming land and a residential dwelling, and to the west to quarry related buildings and open stockpiles. The eastern boundary of the subject property is demarcated by Oaky Creek.

The separate landholdings of Lot 281 DP 571171 and Lot 1 DP 838361 are located to the north and south of the property respectively. The Commonwealth land is currently being prepared for the construction of the Western Sydney Airport. The site sits independent of any land set aside for this airport.

2.3 Geology and Hydrogeology

2.3.1 Geology

The Penrith 1:100,000 series geological sheet shows that the site is underlain by the Bringelly and Ashfield Shales of the Wianamatta Group and Hawkesbury Sandstone. Quaternary alluvial sediments are also located within the vicinity.

The Bringelly Shale is a low permeability geological unit that hosts a number of landfills in the vicinity due to its ability to provide a natural geological barrier to compliment engineered landfill containment barriers protecting the groundwater. Nearby waste management facilities within the Bringelly Shale include SUEZ - Elizabeth Drive, Brandown - Elizabeth Drive, Bingo - Orchard Hills and Hi-Quality – Kemps Central.

2.3.2 Hydrogeology

The Luddenham Quarry Modification Report DA 315-7-2003 MOD5, dated August 2020, prepared by EMM Consulting Pty Ltd presents the findings of a qualitative groundwater assessment. The assessment states *the most recent groundwater standing water levels (SWLs) measured in the bores were in May 2017. These ranged from 58.36 m AHD (bore BSM1) in the south-west to 46.83 m AHD to the north-east (bore BSM3), with the inferred groundwater flow direction to the north-east mirroring the prevailing topography. Quarrying activities have disrupted natural groundwater flow, with some local groundwater flows likely to be towards the pit. Groundwater quality measured at this time indicated that groundwater was near neutral, saline (total dissolved solids (TDS) of approximately 18,000 mg/L), and with elevated total nitrogen concentrations. Relatively low concentrations of metals were also reported for the bores sampled, less than the relevant guideline values.*

Any landfill detailed design will likely need to consider groundwater ingress and its effect on the engineered containment system proposed. Hydraulic uplift pressures in some instances can disrupt and damage an engineered barrier unless mitigating design measures are installed.

3 LANDFILL CONCEPTUAL DESIGN

3.1 Required Design Considerations

The Protection of the Environment Operations Act 1997 prescribes the waste classification system in NSW. The Act defines six waste classes:

- general solid waste (putrescible)
- general solid waste (non-putrescible)
- restricted solid waste

- special waste
- hazardous waste
- liquid waste

Inert Waste Class 2 would now sit within the general solid waste (non-putrescible) classification.

The original environmental impact statement for the quarry (Douglas Nicolaisen & Associates Pty Ltd, 2003, Environmental Impact Statement – Proposed Clay/Shale Extraction Operation – Lot 3 - 272 Adams Road Luddenham NSW, prepared for Badger Mining Company Pty Limited) describes the backfill and rehabilitation of the void using materials that satisfy the criteria for Class 2 inert waste.

The EPA's Waste Classification Guidelines (NSW EPA, 2014) provide further guidance on how to classify waste for disposal.

3.2 Base and Sidewall Containment Engineering

3.2.1 Design Requirements

The Landfill Guidelines state that the base and walls of solid waste landfill cells should be lined with a durable material of very low permeability to form a barrier between the waste and the groundwater, soil and substrata.

For General Solid Waste (non-putrescible) Landfills (Inert Waste Class 2) the primary barrier system should include the following components, from bottom to top:

- a compacted sub-base 200 millimetres thick to provide a firm, stable, smooth surface of high bearing strength on which to install the liner;
- a compacted clay liner at least 1000 millimetres thick, with an in situ hydraulic conductivity of less than 1×10^{-9} metres/second; for landfills receiving more than 20,000 tonnes of waste per year, the liner should include a geomembrane over the compacted clay; the base liner should have gradients of greater than 1% longitudinally and 3% in transverse directions;
- a leachate collection layer comprising a 300 millimetres thick gravel drainage layer including collection pipework, which slopes to a sump or other extraction point from which leachate can be conveyed from the cell; the pipes should be at least 150 millimetres in internal diameter, be placed on the floor at intervals of not more than 25 metres (running the length of the cell), and be laid at gradients of at least 1% longitudinally into the sump and 3% in transverse directions.

As an alternative to compacted clay, a geosynthetic clay liner (GCL) may be used, provided it is used in composite with an overlying geomembrane liner.

A protection or cushion geotextile should be used to protect geomembranes from damage by construction equipment and overlying materials.

A separation geotextile should be placed above the drainage layer to reduce the ingress of fines from the overlying waste.

A geonet drainage geocomposite may be used for side wall drainage to a groundwater collection sump should groundwater seepages be noticed after final excavation.

3.2.2 Concept Design

The concept design for the proposed landfill is presented within Figures 2-4 adopting the requirements outlined within the Landfill Guidelines. Figure 3 shows a concept excavation surface that has side slopes and basal levels in accordance with the DA consent for the extent of clay/shale extraction. The basal liner would either be a minimum 1000mm of compacted clay/shale with an overlying 2mm high-density polyethylene (HDPE) liner (and protection geotextile), or a GCL alternative to the 1000mm of clay shale. The GCL would still need to have an overlying HDPE and protection geotextile (see design option within Figure 2).

Bringelly clay/shale has been proven to be suitable for use in landfill leachate barriers (subject to meeting design, construction and testing requirements) as shown in nearby facilities including Brandown, and SUEZ both on Elizabeth Drive, Kemps Creek.

In order to collect and manage accumulated leachate from the base of the landfill, a minimum 300mm aggregate drainage layer would be installed above the protection geotextile. Within the leachate drainage aggregate would need to be a connected network of minimum 150mm internal diameter slotted pipes placed across the landfill floor at typically 25m spacing. The leachate pipework would fall to a lowered sump whereby a side wall extraction riser would be placed that was extended in lifts to the surface, whereby leachate could be extracted and managed.

Due to the steep sided nature of the quarry walls (approx. 70 degrees once extracted to defined limits), the concept design presented allows for progressive construction of the side walls upon the completed landfill basal area. It is not possible to construct a compacted clay/shale wall from the base of the proposed landfill to the final surface for wall stability and safety in construction reasons.

Similar to other nearby steep sided landfills within the Bringelly Shale, the side wall engineering should be built in lifts of approximately 3m in height. The clay/shale barrier would typically be some 3m in width to allow construction plant to traverse along, this being subsequently trimmed back to the required minimum thickness of 1m. With the wall constructed under Construction Quality Assurance (CQA) supervision, in accordance with the Landfill Guidelines, the overlying 2mm HDPE liner needs to be installed. Overlying the HDPE will be a non-woven needle punched protection geotextile.

With EPA approval of the CQA Validation report, waste would be emplaced to the level of the engineered side walls to provide a supporting buttress to the engineered walls and to provide a safe working platform for the construction of subsequent side wall lifts. Side wall construction-waste emplaced should continue until the top of the landfill walls are reached. A concept filling plan and tipping cross sections are presented in Figures 6 and 7 respectively.

3.3 Landfill Gas Consideration

The waste type proposed is general solid non-putrescible waste and, as such, is not anticipated to produce significant amounts of landfill gas. Therefore, a formal gas collection and treatment system is not currently proposed. However, should future environmental monitoring at the site suggest that landfill gas emissions are near permissible levels, a number of engineering controls, such as the inclusion of a landfill gas collection and treatment system, will be assessed and implemented as necessary and in consultation with NSW EPA.

3.4 Capping and Rehabilitation

3.4.1 Design Requirements

The final capping of general and restricted solid waste landfills should comprise, from bottom to top:

- a seal-bearing surface consisting of a properly designed and engineered layer of material at least 300 millimetres thick to support the sealing layer; the material should meet recognised specifications for engineered materials, such as QA Specification 3071: Selected Material for Formation (NSW Roads and Maritime Services, December 2011), as amended from time to time;
- a sealing layer, comprising a compacted clay layer at least 600 millimetres thick, with an in situ saturated hydraulic conductivity of less than 1×10^{-9} metres/second; and
- a revegetation layer at least 1000 millimetres thick and comprising clean soils and vegetation with root systems that will not penetrate into lower layers; the upper 200 millimetres should be a topsoil layer, which can include compost to help with vegetation establishment and growth.

Alternatives may be proposed to the designs and specifications, these are detailed within the Landfill Guidelines.

Waste disposal to land will allow (subject to Development Consent and NSW EPA EPL conditions) waste to not only be emplaced back to original ground level, but will allow for a domed landform to facilitate adequate stormwater management infrastructure. NSW EPA Guidelines, Section 9.1 states 'to facilitate runoff and minimise ponding of water, the cap should have a gradient of greater than 5% to defined drainage points. However, to reduce the risk of erosion, steep caps (greater than 20%) should be avoided. A 20% slope angle equates to a 1(V):5(H).

3.4.2 Concept Design

The proposed capping concept design is in accordance with the Landfill Guidelines utilising a composite capping system comprising a Geosynthetic Clay Liner and overlying Liner Low Density Geomembrane (LLDPE). To protect the composite capping barrier, a protection geotextile is to be placed above the LLDPE (see Figure 2).

As with the basal engineering requirements, Bringelly clay/shale has been proven to be suitable for use in landfill engineering barriers (subject to meeting design, construction and testing requirements), providing a robust, low permeability layer appropriate for landfill capping applications.

Although the Landfill Guidelines allow side slope gradients to be <20%, the completed landfill surface needs to support further industrial development requiring a flatter topographical landform. The concept design proposed shows a slightly domed landform over the deepest section of the quarry/landfill to represent and acknowledge the settlement of the waste anticipated, allowing the domed surface to typically settle to a near level surface in respect to the surrounding land.

The detailed design would need to calculate the actual settlement rates expected to produce a final pre-settlement waste surface. Settlement would typically be driven by a number of factors including waste moisture content, waste composition, degree of compaction, waste depth etc. The proposed concept landform pre-settlement waste landform is presented as Figure 5.

Rehabilitation soils to a typical depth of minimum 1,000mm shall be placed over the protection geotextile. The soil profile will be typically 900mm subsoil and an overlying minimum 100mm of topsoil. A components of the concept design layers are presented within Figure 2. Due to the proposed future development over the site, the detailed capping design of the emplaced fill may consider additional VENM (additional 2m) over and above the minimum 1m to allow for unimpeded foundation design and construction.

Revegetation would typically include grasses and shallow rooted shrubs as required. Deep rooted plants and trees should be avoided that have roots that extend down to the composite capping barrier having the potential to damage or penetrate the engineered layers.

4 FILLING STRATEGY

Waste emplacement within the landfill would commence on receiving all necessary approvals and consents, including that for the CQA Validation report.

Due to engineering side walls constraints, waste will be emplaced in a series of lifts to provide support to the engineered side walls. The concept filling strategy utilises an entry point into the landfill in the south-eastern corner, directly off of the existing eastern side site access road.

A detailed design may consider dividing up the base of the landfill into a number of sub-cells to satisfy the requirements of a water balance assessment, as long as leachate was managed and extracted from the sub-cells appropriately.

Although the surface area of the landfill base is approximately 52,000m² (based on Figure 4), that active tipping face should be kept as small as possible, in accordance with section 6.1 of the Landfill Guidelines. The Landfill Guidelines under 'Operating practices for odour control' states that operators should '*keep the active face as small as practicable. Ideally, the area of the tipping face should be no more than 600 square metres (i.e. 30 x 20 metres) where health and safety considerations allow*'.

Waste should be placed in discrete layers (typically 1m to 2m in thickness) to allow for adequate compaction of the waste and to remove cavities or voids within the waste mass. Compaction trials should be undertaken to ascertain the most appropriate waste lift thickness that is suited to the compaction plant used. Suitable waste compaction allows for a more efficient use of the waste void space, reduces subsequent waste settlement, better controls litter and odour release etc.

In accordance with the Landfill Guidelines, Section 8, emplaced waste will be covered regularly during operations with a suitable material to minimise odour, dust, litter, the presence of scavengers and vermin, the risk of fire, rainwater infiltration into the waste (and therefore the amount of leachate generated) and the emission of any landfill gas. Covering of waste will include:

- Daily cover – typically virgin excavated natural material (VENM) in the form of soil with a minimum depth of 150mm.
- Intermediate cover – being a more substantial cover than daily cover used to close off a cell that will not receive additional lifts of waste for some time or will not be finally capped for some time. The intermediate soil layer would typically be a minimum 300mm of VENM and have a minimum impermeability requirement.

- Alternate daily cover material – which may include (subject to EPA approval) inert waste materials (e.g. crushed building waste and glass), waste-derived organic materials, and speciality manufactured covers (e.g. plastic sheets, tarps, foams and fabricated metal landfill lids).

A concept filling plan and tipping cross sections are presented in Figures 6 and 7 respectively. The landfill entry access ramp is progressively shortened as the waste lifts rise within the landfill until it is removed. The access ramp will need to be moved laterally as the waste lifts increase in order to engineer the side wall behind the access ramp for each lift. The access ramp length in respect to waste lift height is indicated within Figure 6.

Mobile plant and equipment used for waste placement and compaction within the cell would normally include the following:

- Waste compactor – a heavy wheeled compactor with four pad-foot ‘spiked’ steel wheels designed to break up waste and providing compaction. Compactors vary in machine weight depending on make and model, but a typical example would be a 40 tonne CAT826K https://www.cat.com/en_AU/products/new/equipment/compactors/landfill-compactors.html or a 32 tonne Tana H320 <https://tana.fi/products/tana-h320/>
- Tracked bulldozer - to push waste into layers to allow greater efficiency to the waste compactor and for general trimming of the waste surface and placement of cover soils.
- Articulated dump truck/s - to transport the residual waste from the ARRC to the landfill working area, and to transport cover soils from any cover soil stockpile to the working area.
- Tracked excavator or front wheeled loader – used to load residual waste at the ARRC into the articulated dump trucks and to load VENM for waste covering.

In order to achieve a shallow **pre-settlement** ‘domed’ final landform, the conceptual top of waste contours are presented within Figure 5. The final landform (**post settlement**) is required to be flat to allow for proposed warehouse construction. Rate of settlement is dependent on degree of compaction afforded to the emplaced waste, moisture content of the waste, waste type etc. Adequate compaction of a residual waste derived from a C&D recycling stream, together with a capping design that incorporates approximately 3m of covering VENM and shallow capping slopes will provide a geotechnically stable landform (subject to appropriate loading calculations and warehouse foundation design etc). Waste settlement calculations would need to be undertaken to ascertain when the majority of waste settlement would likely take place. It is anticipated that the settlement would be in excess of 12 months. Waste settlement can be accelerated operationally through regular leachate extraction, reduced waste layer thickness, and continual compaction. Additional engineering measures can be considered (subject to trials and approvals) to accelerate compaction, these include measures such as dynamic compaction. Dynamic compaction is a method that is used to increase the density of the soil which involves dropping a heavy weight repeatedly on the ground at regularly spaced intervals usually by a crane or similar.

5 ADDRESSING DPIE CONSIDERATIONS

The following DPIE considerations are responded to under each specific point, as follows:

- *The wildlife assessment submitted as part of AIA refers to the Western Sydney Airport EIS and that Western Sydney Airport EIS did not identify the Proposed Development site as a risk. When the Western Sydney Airport EIS was prepared a waste management facility was not proposed for the site and therefore it is not relevant that the Western Sydney Airport EIS did not identify the site as an area of concern. (Western Sydney Airport);*
 - Landfill facilities that dispose of general solid waste (non-putrescible) waste, specifically construction and demolition residual wastes, with good operational practices do not normally attract wildlife, specifically birds or scavengers due to the nature of the waste handled at the facility. Unlike putrescible waste facilities that do attract these pests due to food scraps and other organics being present. The waste entering the site is initially dropped off in an enclosed shed facility which is processed to recover recyclables and resources such as timber, steel, crushed a concrete/brick etc. Residual waste would be transferred to the landfill voidspace where it would be deposited, spread, compacted and covered in soil in accordance with an approved Landfill Environmental Management Plan (LEMP) and in accordance with the Landfill Guidelines and a NSW EPA EPL.
- *This Department is concerned about the consultant's claim that quarries are "low risk", given International Civil Aviation Organisation wildlife management guidance identifies quarries and waste facilities as key potential off-airport attractants. (Department of Infrastructure, Transport, Regional Development and Communications);*
 - As detailed above, some landfills can be attractants for wildlife, but this statement would depend on the waste authorised for disposal. Disposal of construction and demolition residue with little or no organic content would not typically attract pests and vermin.
- *The application states "This ARRC application seeks approval to transfer non-recyclable residues to the void. It does not seek approval for the placement of this material, which will be subject to a separate approval." WSA seeks clarification regarding the Applicant's intent on how it proposes to manage and dispose of waste that is not recycled. (Western Sydney Airport);*
 - A separate application will made to infill the quarry with non-recyclable material and imported material for cover and direct infill. However, it is noted that no recyclable residual waste will leave the resource recovery facility via the internal access roads to the landfill void. Waste will be deposited from the vehicle onto the landfill active tipping face. Waste shall be spread to a thickness determined in the NSW EPA EPL and compacted. Daily cover shall be applied to the required thickness, using EPA approved materials in accordance with the Landfill Guidelines, approved LEMP and EPL.

- *The EIS states that it is the intent of the facility to receive garden waste, wood waste and vegetative waste, but does not provide detail of how this waste is to be managed or disposed of. These types of waste are organic waste and if disposed of in the quarry void would likely result in the generation of land fill gas as the waste breaks down. This would require management of land fill gas and may give rise for the need for flaring or plumes to manage land fill gases. Management of any land fill gas (e.g. flaring) needs to be assessed as it can create a hazard to Airport operations. In addition, wildlife hazards associated with landfilling will need to be assessed. Further information and clarification on this matter is required. (Western Sydney Airport);*
 - The landfilling of organic wastes is not encouraged due to the decomposition of the organic matter, the generation of landfill gas and the likelihood of differential settlement of the waste mass as a result. The garden waste, wood waste and vegetative waste will be chipped, mulched and converted to compost for subsequent rehabilitation use or for resale (subject to testing, quality standards and markets). The Landfill Guidelines allow for 'waste-derived organic materials' to be used as an alternate daily cover material (Section 8.3), although significant volumes are not anticipated to be used for this manner.
- *Importantly, it remains unclear from the documents provided what is ultimately proposed for the development site and what are the timings of the various stages of development and operations over the medium to long term. ... The Department would like more information on the Proponent's long-term plans for the site to better consider the potential impacts on the Airport (Department of Infrastructure, Transport, Regional Development and Communications).*
 - We understand that the timing for the resource recovery facility construction and the development of the landfill is still being considered by the site owners, however it is anticipated the fill could take up to 15 years depending on market conditions.

6 CONCLUSIONS AND RECOMMENDATIONS

Rehabilitation of the void by infilling the quarry with inert wastes (non-recyclable material and imported cover material) would be a commercially viable method of site rehabilitation, subject to the necessary approvals.

An engineered containment liner typically comprising 1,000mm of compacted clay with an overlying HDPE liner and protection geotextile would be required. Management of leachate would need to be undertaken by the installation of a 300mm aggregate leachate drainage blanket and collection/extraction pipework. Engineered side walls would be required to be constructed in a series of lifts of typical 3m height for wall stability and construction health and safety considerations

Waste would be placed in a series of lifts immediately after each engineered side wall has been constructed, with each waste surface providing a platform for subsequent engineered lifts to be constructed.

Emplacement of general solid waste (non-putrescible) waste would minimise the attraction of vermin, pests etc detrimental to any neighbouring airport, also good operation practices would minimise the generation and transport of litter, odour and dust etc.

7 CLOSE

This report has been prepared by InSitu Advisory Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

InSitu Advisory Pty Ltd disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

8 REFERENCES

Clark, N.R., and Jones, D.C., (Eds), 1991 Penrith 1:100,000 Geological Sheet 9030. New South Wales Geological Survey, Sydney.

EMM Consulting. 2020. Luddenham Quarry Modification Report, DA 315-7-2003 MOD5, reference J190749 RP12, v3 Final, 6 August 2020.

Herbert, C., Department of Mineral Resources and Development, Geological Survey of New South Wales, *The Geology and Resource Potential of the Wianamatta Group*, Bulletin No.25, 1979.

National Integrated Creative Solutions Pty Ltd. *Environmental Assessment Report*, Luddenham Clay and Shale Quarry, reference NICS_162001_EAR_REV03, 25 August 2016.

NSW EPA, Environmental Guidelines: Solid Waste Landfills, Second Edition, April 2016.
https://www.epa.nsw.gov.au/~media/EPA/Corporate_Site/resources/waste/solid-waste-landfill-guidelines-160259.ashx

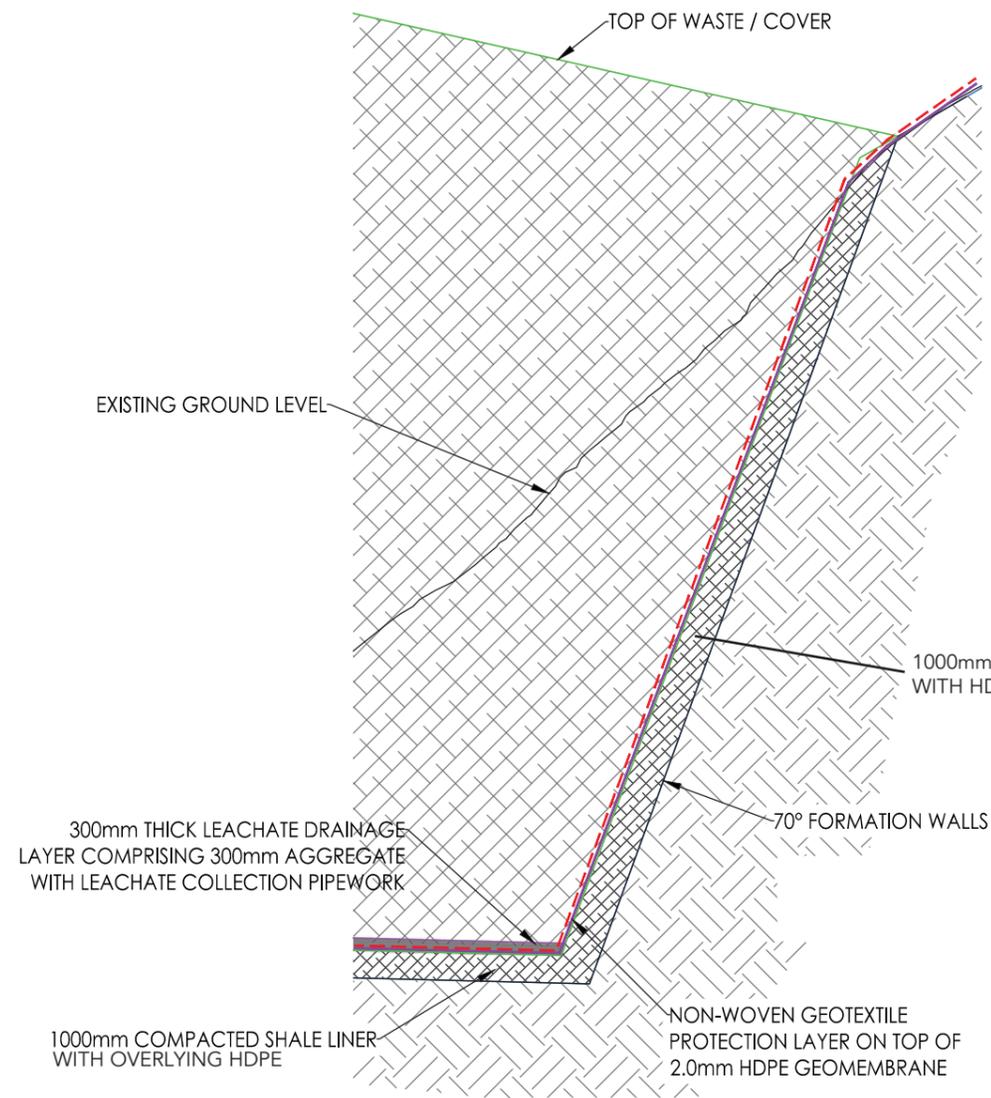
NSW Government Department of Planning and Environment, Development Consent, File No. P91/02045, DA 315-7-2003) 23 May 2004, modified 13 May 2015.

FIGURES

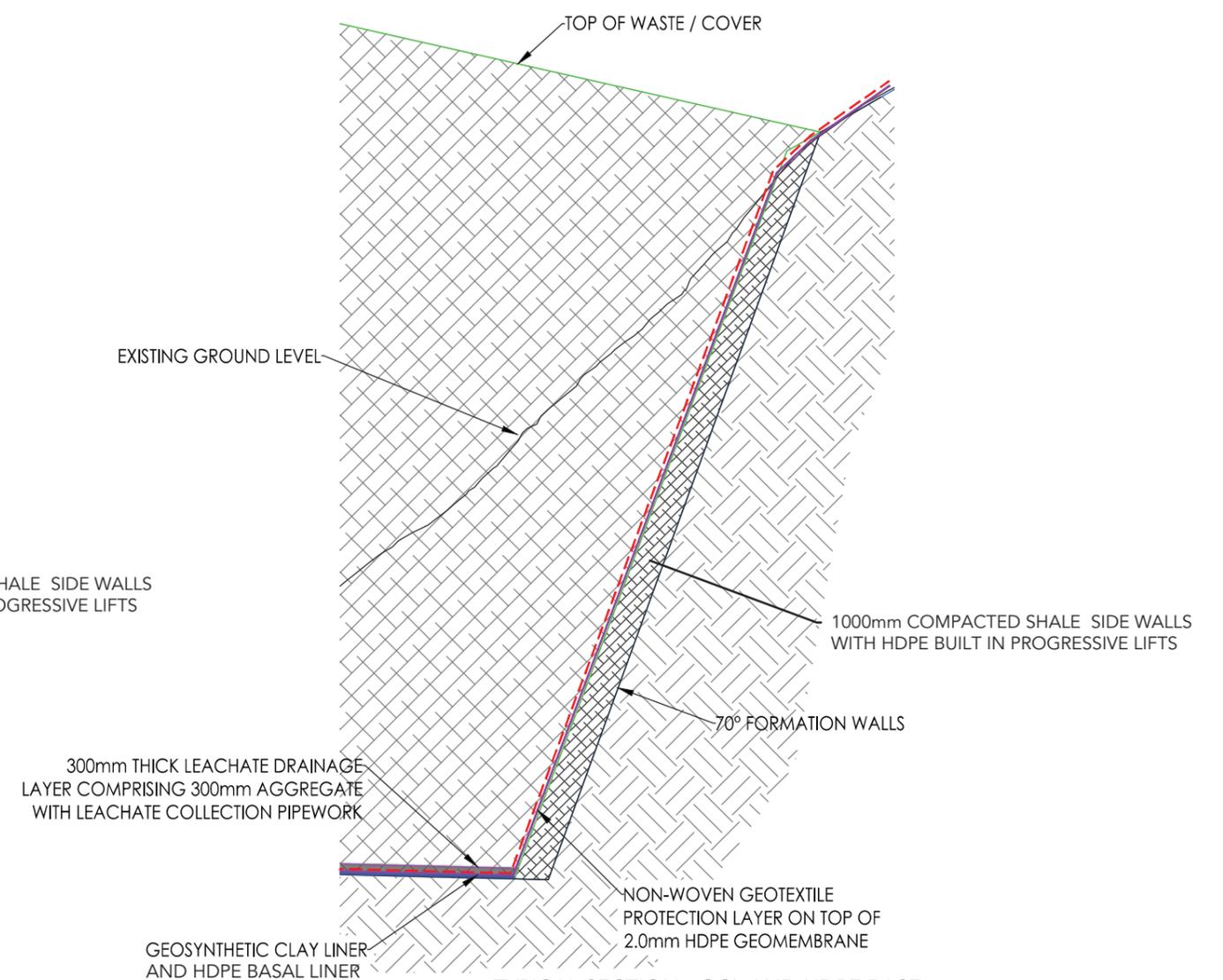


LEGEND

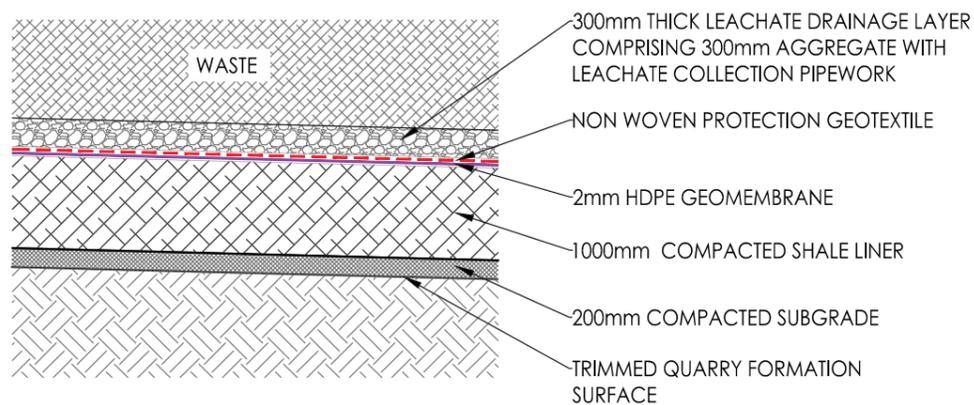
Site Boundary



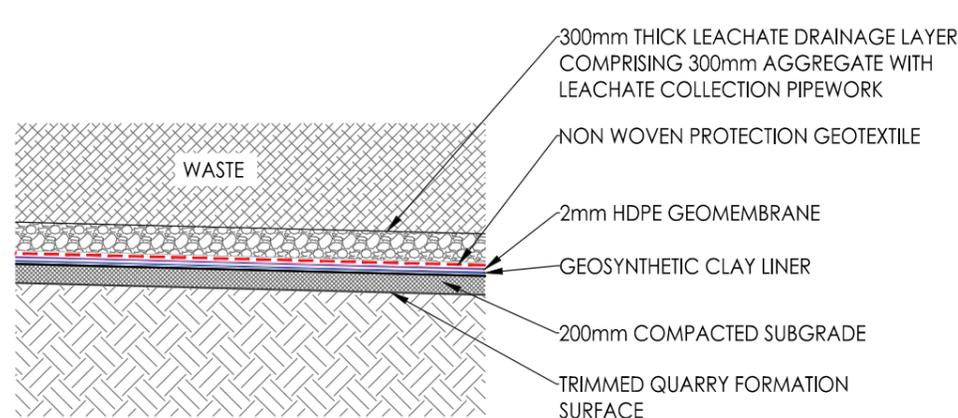
TYPICAL SECTION - COMPACTED SHALE/HDPE BASE
SCALE 1:250



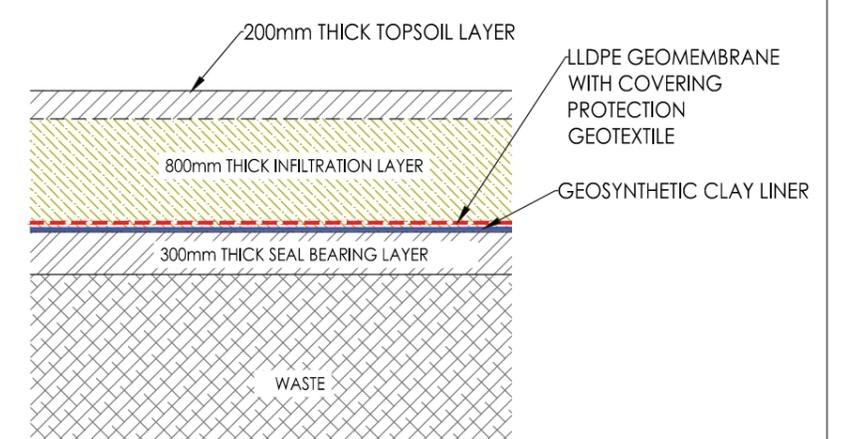
TYPICAL SECTION - GCL AND HDPE BASE
SCALE 1:250



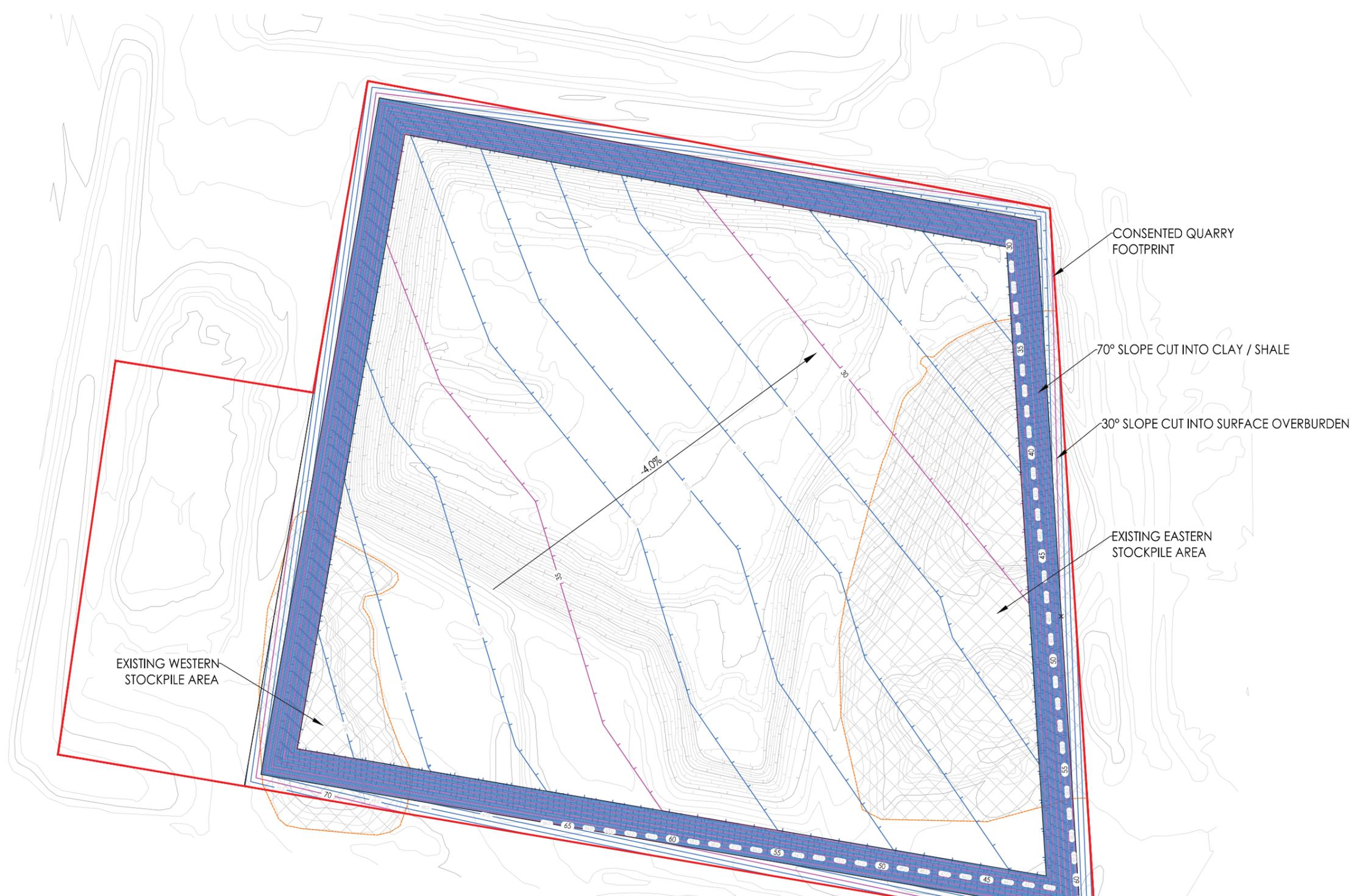
TYPICAL BASAL LINER - COMPACTED CLAY/SHALE
SCALE 1:75



TYPICAL BASAL LINER - GCL & HDPE
SCALE 1:75



TYPICAL SECTION THROUGH CAPPING LAYERS
SCALE 1:50

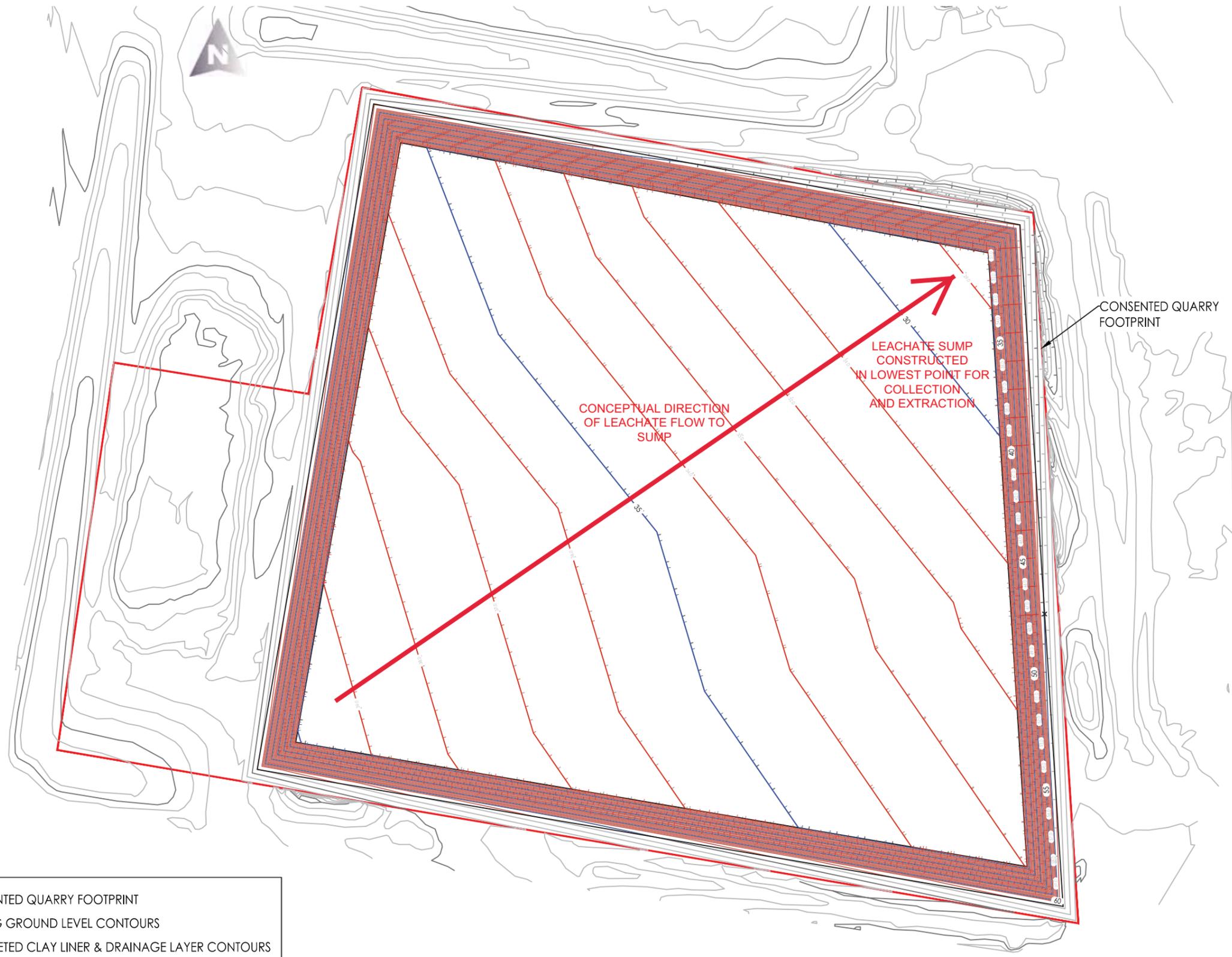


LEGEND:

	CONSENTED QUARRY FOOTPRINT
	EXISTING GROUND LEVEL CONTOURS
	COMPLETED EXCAVATION CONTOURS



CLIENT: **CFT No.13 PTY LTD**
SITE: **LUDDENHAM QUARRY**
TITLE: **CONCEPTUAL EXCAVATED LANDFILL PROFILE**
DATE: **16.11.2020** SCALE: **1:1,500** PAPERSIZE: **A3** DWG: **FIGURE 3**
THIS DRAWING AND ITS CONTENTS ARE CONFIDENTIAL, ARE SUBJECT TO RETURN ON DEMAND AND MAY NOT BE COPIED OR DISCLOSED TO ANY THIRD PARTY OR USED DIRECTLY OR INDIRECTLY FOR ANY OTHER PURPOSE THAN AS EXPRESSLY DETERMINED IN WRITING BY INSITU ADVISORY PTY LTD.

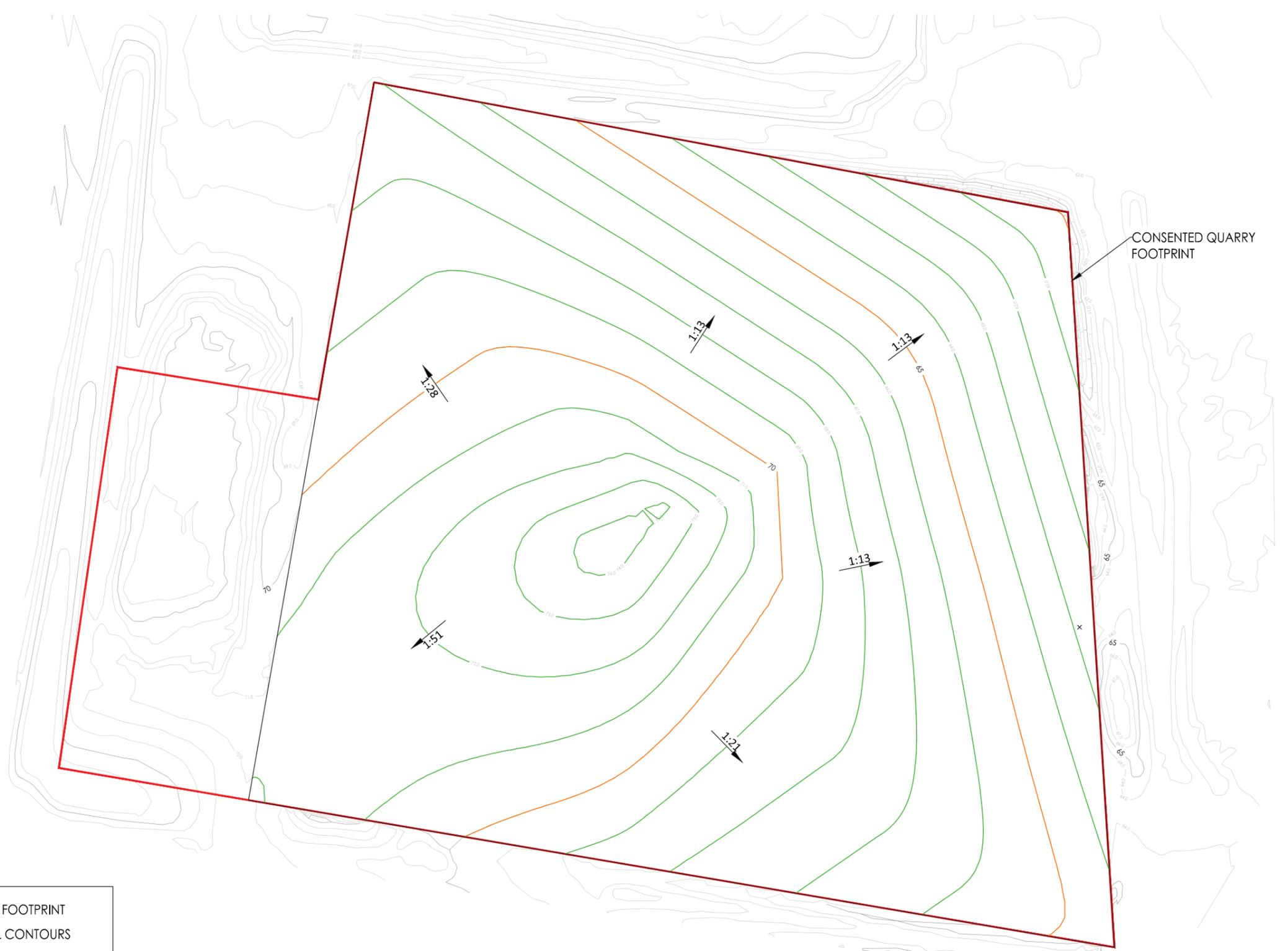


LEGEND:

	CONSENTED QUARRY FOOTPRINT
	EXISTING GROUND LEVEL CONTOURS
	COMPLETED CLAY LINER & DRAINAGE LAYER CONTOURS



CLIENT: **CFT No.13 PTY LTD**
 SITE: **LUDDENHAM QUARRY**
 TITLE: **CONCEPTUAL TOP OF ENGINEERING SURFACE**
 DATE: **16.11.2020** SCALE: **1:1,500** PAPERSIZE: **A3** DWG: **FIGURE 4**
THIS DRAWING AND ITS CONTENTS ARE CONFIDENTIAL, ARE SUBJECT TO RETURN ON DEMAND AND MAY NOT BE COPIED OR DISCLOSED TO ANY THIRD PARTY OR USED DIRECTLY OR INDIRECTLY FOR ANY OTHER PURPOSE THAN AS EXPRESSLY DETERMINED IN WRITING BY INSITU ADVISORY PTY LTD.



CONSENTED QUARRY FOOTPRINT

LEGEND:

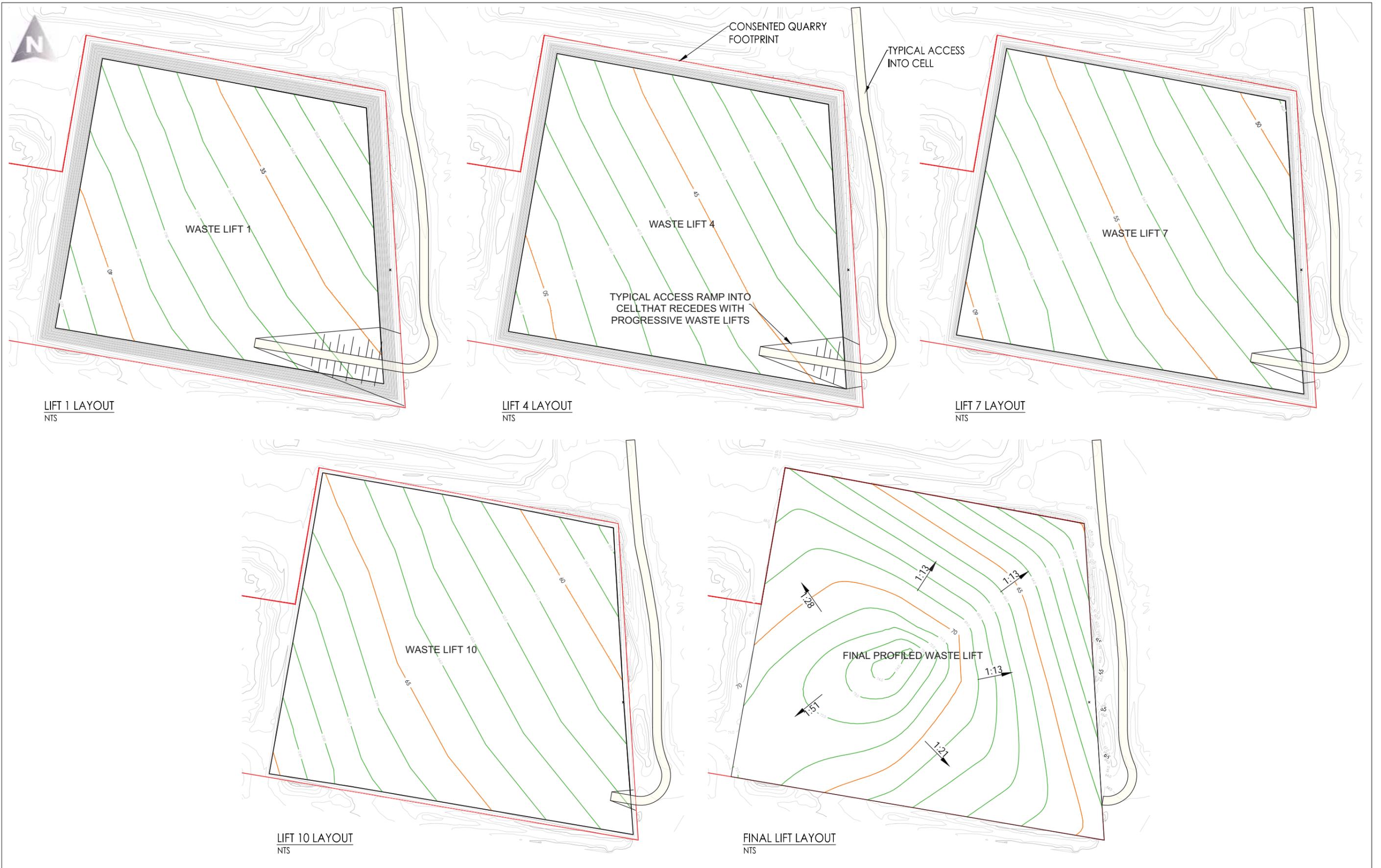
	CONSENTED QUARRY FOOTPRINT
	COMPLETED LANDFILL CONTOURS
	PROPOSED RESTORATION PROFILE



CONCEPTUAL FINAL WASTE PROFILE SHOWING SHALLOW DOMING TO ALLOW FOR INITIAL STORM WATER MANAGEMENT AND SUBSEQUENT WASTE SETTLEMENT TO LEVEL GROUND



CLIENT: **CFT No.13 PTY LTD**
SITE: **LUDDENHAM QUARRY**
TITLE: **CONCEPTUAL FINAL WASTE PROFILE**
DATE: **15.11.2020** SCALE: **1:1,500** PAPERSIZE: **A3** DWG: **FIGURE 5**
THIS DRAWING AND ITS CONTENTS ARE CONFIDENTIAL, ARE SUBJECT TO RETURN ON DEMAND AND MAY NOT BE COPIED OR DISCLOSED TO ANY THIRD PARTY OR USED DIRECTLY OR INDIRECTLY FOR ANY OTHER PURPOSE THAN AS EXPRESSLY DETERMINED IN WRITING BY INSITU ADVISORY PTY LTD.



LIFT 1 LAYOUT
NTS

LIFT 4 LAYOUT
NTS

LIFT 7 LAYOUT
NTS

LIFT 10 LAYOUT
NTS

FINAL LIFT LAYOUT
NTS



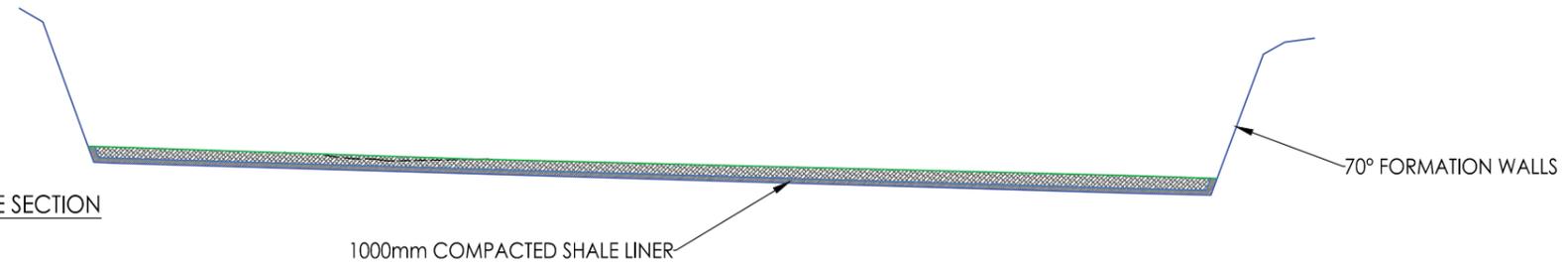
LEGEND:

	CONSENTED QUARRY FOOTPRINT
	EXISTING GROUND LEVEL CONTOURS
	COMPLETED CLAY LINER & DRAINAGE LAYER CONTOURS

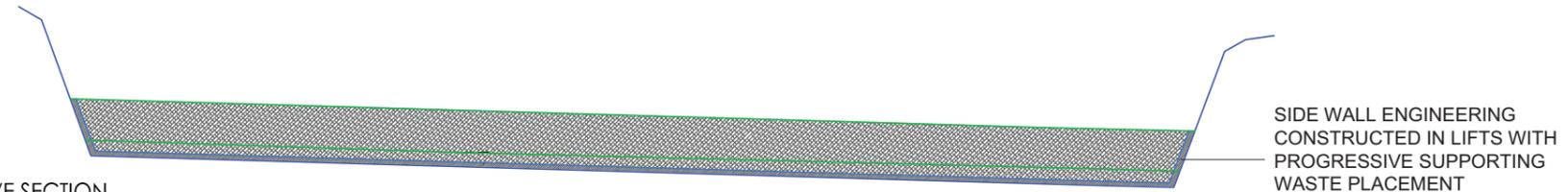
CLIENT: **CFT No.13 PTY LTD**
 SITE: **LUDDENHAM QUARRY**
 TITLE: **CONCEPTUAL STAGED TIPPING PLAN**
 DATE: **15.11.2020** SCALE: **1:1,500** PAPER SIZE: **A3** DWG: **FIGURE 6**
THIS DRAWING AND ITS CONTENTS ARE CONFIDENTIAL, ARE SUBJECT TO RETURN ON DEMAND AND MAY NOT BE COPIED OR DISCLOSED TO ANY THIRD PARTY OR USED DIRECTLY OR INDIRECTLY FOR ANY OTHER PURPOSE THAN AS EXPRESSLY DETERMINED IN WRITING BY INSITU ADVISORY PTY LTD.



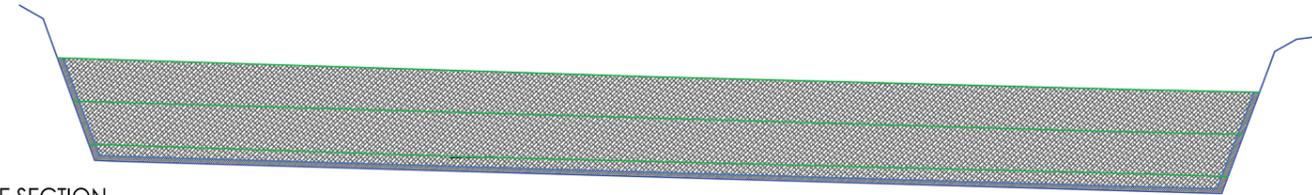
LIFT 1 INDICATIVE SECTION
NTS



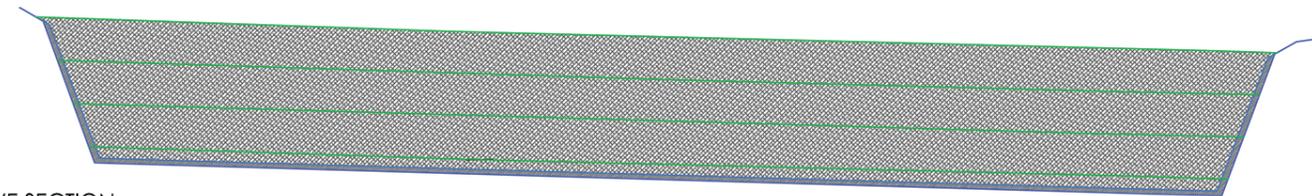
LIFT 4 INDICATIVE SECTION
NTS



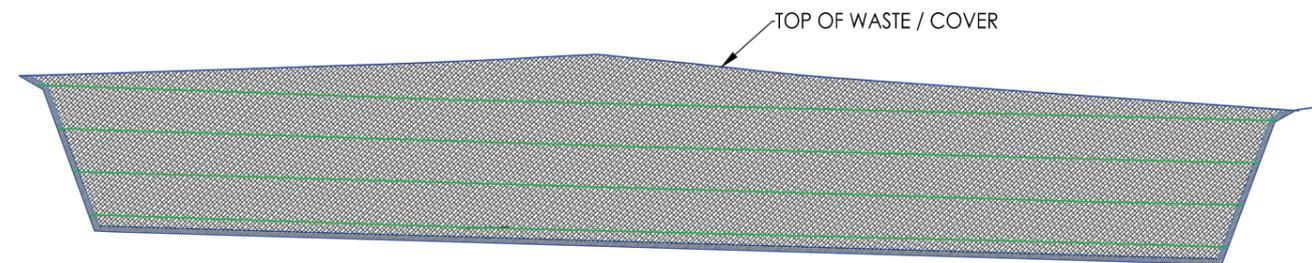
LIFT 7 INDICATIVE SECTION
NTS



LIFT 10 INDICATIVE SECTION
NTS



FINAL LIFT INDICATIVE SECTION
NTS





InSitu Advisory

Sydney Office

P.O. Box 503, Frenchs Forest NSW 1640

Phone: +61 (0)409 169 661 **Email:** alan@insituadvisory.com
Phone: +61 (0)433 984 699 **Email:** darren@insituadvisory.com

Brisbane Office

P.O. Box 713 Ashgrove QLD 4060

Phone: +61 (0)417 638 488 **Email:** shaun@insituadvisory.com



APPENDIX F –
Water sampling laboratory results



CERTIFICATE OF ANALYSIS

Work Order : ES2035920 Client : EMM CONSULTING PTY LTD Contact : Patrick Carolan Address : 6/146 Hunter Street Newcastle 2300 Telephone : 02 4907 4800 Project : J190749 Order number : ---- C-O-C number : ---- Sampler : Callan Douchkov Site : ---- Quote number : EN/112/20 No. of samples received : 6 No. of samples analysed : 6	Page : 1 of 6 Laboratory : Environmental Division Sydney Contact : Sepan Mahamad Address : 277-289 Woodpark Road Smithfield NSW Australia 2164 Telephone : +61 2 8784 8555 Date Samples Received : 14-Oct-2020 09:00 Date Analysis Commenced : 14-Oct-2020 Issue Date : 21-Oct-2020 13:27
---	--



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	OC_US	PIT	WMD	OC_Pond	OC_DS
Client sampling date / time				13-Oct-2020 18:10	13-Oct-2020 17:40	13-Oct-2020 18:35	13-Oct-2020 18:45	13-Oct-2020 19:05	
Compound	CAS Number	LOR	Unit	ES2035920-001	ES2035920-002	ES2035920-003	ES2035920-004	ES2035920-005	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.85	8.65	8.42	7.84	7.82	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	851	5970	1550	764	782	
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L	463	3290	780	388	398	
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L	<5	13	6	50	16	
EA045: Turbidity									
Turbidity	----	0.1	NTU	12.6	3.1	4.3	19.7	6.4	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	148	604	185	98	119	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.001	
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Copper	7440-50-8	0.001	mg/L	0.001	0.002	0.002	<0.001	<0.001	
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Manganese	7439-96-5	0.001	mg/L	0.027	0.002	0.002	0.144	0.026	
Nickel	7440-02-0	0.001	mg/L	<0.001	0.003	0.001	<0.001	<0.001	
Zinc	7440-66-6	0.005	mg/L	0.026	<0.005	<0.005	<0.005	<0.005	
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.01	0.01	<0.01	<0.01	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.13	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	6.38	<0.01	0.07	0.04	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	6.51	<0.01	0.07	0.04	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.4	1.4	1.0	0.2	0.2	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	OC_US	PIT	WMD	OC_Pond	OC_DS
Client sampling date / time				13-Oct-2020 18:10	13-Oct-2020 17:40	13-Oct-2020 18:35	13-Oct-2020 18:45	13-Oct-2020 19:05	
Compound	CAS Number	LOR	Unit	ES2035920-001	ES2035920-002	ES2035920-003	ES2035920-004	ES2035920-005	
				Result	Result	Result	Result	Result	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L	0.4	7.9	1.0	0.3	0.2	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	0.01	<0.01	0.03	0.01	0.01	
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EP025: Oxygen - Dissolved (DO)									
Dissolved Oxygen	----	0.1	mg/L	9.2	10.0	9.4	9.9	9.6	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)		Client sample ID			Sed_Pond	----	----	----	----
Client sampling date / time		13-Oct-2020 18:20			----	----	----	----	
Compound	CAS Number	LOR	Unit	ES2035920-006	-----	-----	-----	-----	
				Result	----	----	----	----	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	8.05	----	----	----	----	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	913	----	----	----	----	
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L	478	----	----	----	----	
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L	232	----	----	----	----	
EA045: Turbidity									
Turbidity	----	0.1	NTU	64.1	----	----	----	----	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	141	----	----	----	----	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	----	----	----	----	
Arsenic	7440-38-2	0.001	mg/L	0.001	----	----	----	----	
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----	
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----	
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----	
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----	
Manganese	7439-96-5	0.001	mg/L	0.001	----	----	----	----	
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----	
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----	
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----	
Iron	7439-89-6	0.05	mg/L	0.22	----	----	----	----	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	0.09	----	----	----	----	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	0.02	----	----	----	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L	0.02	----	----	----	----	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.6	----	----	----	----	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	Sed_Pond	----	----	----	----
Client sampling date / time				13-Oct-2020 18:20	----	----	----	----	
Compound	CAS Number	LOR	Unit	ES2035920-006	-----	-----	-----	-----	
				Result	----	----	----	----	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L	1.6	----	----	----	----	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	0.12	----	----	----	----	
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----	----	
EP025: Oxygen - Dissolved (DO)									
Dissolved Oxygen	----	0.1	mg/L	8.9	----	----	----	----	

QUALITY CONTROL REPORT

Work Order : ES2035920 Client : EMM CONSULTING PTY LTD Contact : Patrick Carolan Address : 6/146 Hunter Street Newcastle 2300 Telephone : 02 4907 4800 Project : J190749 Order number : ---- C-O-C number : ---- Sampler : Callan Douchkov Site : ---- Quote number : EN/112/20 No. of samples received : 6 No. of samples analysed : 6	Page : 1 of 7 Laboratory : Environmental Division Sydney Contact : Sepan Mahamad Address : 277-289 Woodpark Road Smithfield NSW Australia 2164 Telephone : +61 2 8784 8555 Date Samples Received : 14-Oct-2020 Date Analysis Commenced : 14-Oct-2020 Issue Date : 21-Oct-2020
---	--



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA005P: pH by PC Titrator (QC Lot: 3307690)									
ES2035913-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.06	6.43	9.34	0% - 20%
ES2035125-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.40	7.37	0.406	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 3307696)									
ES2035837-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	613	615	0.344	0% - 20%
ES2035913-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	63	63	0.00	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3315686)									
ES2035811-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	17900	17900	0.145	0% - 20%
ES2035957-002	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	642	624	2.68	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3316142)									
ES2035609-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	288	282	2.28	0% - 20%
ES2035984-003	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1620	1650	1.59	0% - 20%
EA025: Total Suspended Solids dried at 104 ± 2°C (QC Lot: 3315685)									
ES2035811-001	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	123	125	2.02	0% - 20%
ES2035957-002	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	90	94	4.36	0% - 50%
EA025: Total Suspended Solids dried at 104 ± 2°C (QC Lot: 3316143)									
ES2035609-001	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	71	60	16.8	0% - 50%
ES2035984-003	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	6	<5	0.00	No Limit
EA045: Turbidity (QC Lot: 3307822)									
ES2035719-001	Anonymous	EA045: Turbidity	----	0.1	NTU	4.6	4.6	0.00	0% - 20%
ES2035920-003	WMD	EA045: Turbidity	----	0.1	NTU	4.3	4.3	0.00	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3314265)									
ES2035916-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.013	0.014	0.00	0% - 50%



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3314265) - continued									
ES2035916-001	Anonymous	EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.813	0.804	1.11	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.019	0.020	0.00	0% - 50%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.14	0.15	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.06	0.06	0.00	No Limit
ES2035125-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3314268)	WMD	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2035986-001	Anonymous	EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.021	0.021	0.00	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.004	0.004	0.00	No Limit
EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.020	0.020	0.00	No Limit		



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3314268) - continued									
ES2035986-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.06	0.06	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.53	0.53	0.00	0% - 50%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3311524)									
ES2035807-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.02	0.00	No Limit
ES2035920-004	OC_Pond	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3309435)									
ES2035913-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2035945-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3311525)									
ES2035807-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.67	0.74	9.34	0% - 20%
ES2035920-004	OC_Pond	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.07	0.06	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3311521)									
ES2035807-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.2	1.2	0.00	No Limit
ES2035920-005	OC_DS	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.2	0.2	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3311520)									
ES2035807-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	2.36	2.38	0.641	0% - 20%
ES2035920-005	OC_DS	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.01	0.02	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 3309434)									
ES2035945-003	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2035799-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
EA005P: pH by PC Titrator (QCLot: 3307690)									
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	99.8	98.0	102	
				----	7 pH Unit	99.3	98.0	102	
EA010P: Conductivity by PC Titrator (QCLot: 3307696)									
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	2100 µS/cm	99.4	95.0	113	
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3315686)									
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2000 mg/L	93.0	87.0	109	
				<10	293 mg/L	110	66.0	126	
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3316142)									
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2000 mg/L	99.3	87.0	109	
				<10	293 mg/L	93.7	66.0	126	
EA025: Total Suspended Solids dried at 104 ± 2°C (QCLot: 3315685)									
EA025H: Suspended Solids (SS)	----	5	mg/L	<5	150 mg/L	95.7	83.0	129	
				<5	1000 mg/L	89.5	82.0	110	
EA025: Total Suspended Solids dried at 104 ± 2°C (QCLot: 3316143)									
EA025H: Suspended Solids (SS)	----	5	mg/L	<5	150 mg/L	106	83.0	129	
				<5	1000 mg/L	96.1	82.0	110	
EA045: Turbidity (QCLot: 3307822)									
EA045: Turbidity	----	0.1	NTU	<0.1	40 NTU	98.8	91.0	105	
EG020F: Dissolved Metals by ICP-MS (QCLot: 3314265)									
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	92.5	80.0	116	
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	90.1	85.0	114	
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	89.9	84.0	110	
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	89.6	85.0	111	
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	87.0	81.0	111	
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	89.1	83.0	111	
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	86.2	82.0	110	
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	88.0	82.0	112	
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	88.4	81.0	117	
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	86.6	85.0	115	
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	90.5	82.0	112	
EG020F: Dissolved Metals by ICP-MS (QCLot: 3314268)									
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	91.9	80.0	116	
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	88.3	85.0	114	



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
EK020F: Dissolved Metals by ICP-MS (QCLot: 3314268) - continued								
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	87.8	84.0	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	88.1	85.0	111
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	86.8	81.0	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	88.1	83.0	111
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	85.8	82.0	110
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	87.6	82.0	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	87.4	81.0	117
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	85.8	85.0	115
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	99.8	82.0	112
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3311524)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	104	90.0	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3309435)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	102	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3311525)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	99.3	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3311521)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	85.9	69.0	101
				<0.1	1 mg/L	70.2	70.0	118
				<0.1	5 mg/L	78.7	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3311520)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	87.8	71.0	101
				<0.01	0.442 mg/L	74.2	72.0	108
				<0.01	1 mg/L	85.1	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3309434)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	103	85.0	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery(%)	Recovery Limits (%)	
					MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 3314265)							
ES2035125-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	111	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	112	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	104	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	103	70.0	130



Sub-Matrix: WATER

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 3314265) - continued							
ES2035125-002	Anonymous	EG020A-F: Lead	7439-92-1	1 mg/L	100	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	108	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	106	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	109	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3314268)							
ES2035920-004	OC_Pond	EG020A-F: Arsenic	7440-38-2	1 mg/L	87.2	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	88.4	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	88.0	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	90.5	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	89.5	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	88.2	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	86.6	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	89.0	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3311524)							
ES2035807-001	Anonymous	EK055G: Ammonia as N	7664-41-7	1 mg/L	98.1	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3309435)							
ES2035913-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	101	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3311525)							
ES2035807-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	84.9	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3311521)							
ES2035807-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	25 mg/L	88.2	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3311520)							
ES2035807-002	Anonymous	EK067G: Total Phosphorus as P	----	5 mg/L	86.5	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3309434)							
ES2035799-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	91.1	70.0	130



CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 31 Burma Road Pooraka SA 5095
Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4063
Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Colomondah Drive Clinton QLD 4680
Ph: 07 7471 5600 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740
Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westhill Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 129 Sydney Road Mudgee NSW 2850
Ph: 02 6372 6735 E: mudgee.mel@alsglobal.com

NEWCASTLE 5/85 Maitland Road Mayfield West NSW 2304
Ph: 02 4014 2600 E: samples.newcastle@alsglobal.com

NOOWRA 473 Geary Place North Nowra NSW 2541
Ph: 02 4423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Moolga WA 6000
Ph: 08 9209 7855 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Donna Court Buder QLD 4818
Ph: 07 4756 5600 E: townsville.environmental@alsglobal.com

WOLLONGONG 66 Kenny Street Wollongong NSW 2500
Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: EMM Consulting Pty Ltd		TURNAROUND REQUIREMENTS : <input type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: Newcastle		(Standard TAT may be longer for some tests e.g. Ultra Trace Organics)		Custody Seal Intact? Yes No	
PROJECT: J190749		<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Free ice / frozen ice bricks present upon receipt? Yes No	
PROJECT NO.:		ALS QUOTE NO.: EN112/20		Random Sample Temperature on Receipt: °C	
ORDER NUMBER:		COUNTRY OF ORIGIN: Australia		Other comment:	
PURCHASE ORDER NO.:		COC SEQUENCE NUMBER (Circle)			
PROJECT MANAGER: Patrick Carolan		CONTACT PH: 0439 694 514			
SAMPLER: Callan Douchkov		SAMPLER MOBILE: 0401 663 352		RECEIVED BY: <i>[Signature]</i>	
COC Emailed to ALS? (YES / NO)		EDD FORMAT (or default):		DATE/TIME: 14/10/20	
Email Reports to: pcarolan@emmconsulting.com.au; emmconsulting@esdat.net		RELINQUISHED BY: Callan Douchkov		DATE/TIME:	
Email Invoice to: pcarolan@emmconsulting.com.au		DATE/TIME:		DATE/TIME:	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: pH requires same day testing

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).				Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	pH, Electrical Conductivity, Dissolved Oxygen, TDS, TSS, Turbidity and Hardness	Ammonia, nitrate, nitrite, Nox, TKN, TN, TP and Reactive P	Aluminium, arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc	
1	OC_US	13/10/2020 18:10	w		3	x	x	x	<p style="text-align: center; font-size: 2em; font-weight: bold;">HIT</p> <p>Environmental Division Sydney Work Order Reference ES2035920</p>  <p>Telephone : + 61-2-8784 8555</p>
2	PIT	13/10/2020 17:40	w		3	x	x	x	
3	WMD	13/10/2020 18:35	w		3	x	x	x	
4	OC_Pond	13/10/2020 18:45	w		3	x	x	x	
5	OC_DS	13/10/2020 19:05	w		3	x	x	x	
6	Sed_Pond	13/10/2020 18:20	w		3	x	x	x	
TOTAL					18				

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugol's Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

