

# **Karara Mining Limited**

## **Annual Compliance Report**

### **Karara Iron Ore Project Environmental Protection and Biodiversity Conservation Act 1999 Approval 2006/3017**

**1 July 2020 – 30 June 2021**

CORP-EN-REP-1139

28 June 2021

## **Disclaimer**

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### CORP-EN-REP-1139 ANNUAL COMPLIANCE REPORT 2020 KIOP EPBC 2006/3017

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REV	DESCRIPTION	ORIG	REVIEW	APPROVED	DATE
1	Issued for Use	R Houlihan	A Marais	G Trench	28-Jun-21

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## Declaration of accuracy

In making this declaration, I am aware of sections 490 and 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) making it an offence in certain circumstances to knowingly provide false or misleading information or documents. The offence is punishable on conviction by imprisonment or a fine, or both. I declare that all the information and documentation supporting this compliance report is true and correct in every particular. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed



Full name (please print)

Dr Gaomai Trench

Position (please print)

General Manager Health, Safety, Environment and  
Communities

Organisation

Karara Mining Ltd / 68 070 871 831

Date

28 June 2021

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## 1 INTRODUCTION

This Annual Compliance Report 2020 has been prepared by Karara Mining Limited (KML) to demonstrate compliance with the Karara Iron Ore Project (KIOP) conditions of approval under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) (2006/3017).

A list of the definitions referred to in this report is listed in Table 1.

**Table 1: Definitions**

Term	Description
CMSR	Centre for Mine Site Restoration
DAWE	Department of Agriculture, Water and Environment
DBCA	(WA) Department of Biodiversity, Conservation and Attractions
DMIRS	(WA) Department of Mines, Industry Regulation and Safety
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EMS	Environmental Management System
GIS	Geographical Information System
KIOP	Karara Iron Ore Project
KML	Karara Mining Limited
TSF	Tailings Storage Facility
WStS	Western Spiny-tailed Skink

## 2 DESCRIPTION OF ACTIVITIES

A description of the approved actions and activities undertaken by KML in the reporting period is listed in Table 2.

**Table 2: Description of Activities**

Approval	Description
EPBC Number	2006/3017
Project Name	Karara Iron Ore Project (KIOP)
CAN	070 871 831
Approved Action	To construct and operate a magnetite iron ore mine, processing plant and associated infrastructure, as described in the Public Environmental Review, dated September 2008
Activities undertaken in the reporting period	Karara Mining Limited continued to maintain KIOP in its operational phase of the project. During the reporting period KML have: <ul style="list-style-type: none"> <li>• Undertaken magnetite ore mining and processing</li> <li>• Continued operations of project infrastructure (rail, transmission line, water and port).</li> </ul>
Location	Mid-West Region of WA approximately 215 km south-east of Geraldton and 320 km north-northeast of Perth.
Responsibility	Greg Oliver: Manager Environment and Communities
Reporting Period	1 July 2020 to 30 June 2021
Report Date	28 <sup>th</sup> June 2021

### **3 COMPLIANCE WITH APPROVAL CONDITIONS**

KML conducted an audit against all Conditions of Approval (2006/3017) in June 2021; The findings are outlined in Table 3 below.

One minor non-compliance was in relation to Condition 3, which requires tenements M59/650, E59/1138, 59/1496-99 and E59/1500 to be relinquished by 31 March 2012 or, if not relinquished, KML was to provide an offset area approved by the Minister.

All tenements have now been relinquished, with M59/650 (being the final tenement) being surrendered on Friday 18<sup>th</sup> June 2021.

As the requirement for Condition 3 is to relinquish tenure for the purposes of the development of a Class A Nature Reserve, KML is of the opinion that this condition has now been met, and for future reports will be marked as 'complete'.

KML were compliant with all other Conditions of Approval.

**Table 3: Compliance Table**

Ref.	Condition	Compliant / Non-Compliant	Finding	Evidence
1.01	In order to minimise the impact on the EPBC listed endangered WStS ( <i>Egernia stokesii badia</i> ) the person taking the action must implement the Environmental Procedure – WStS Management, Monitoring and Translocation, dated 18 September 2017.	Compliant	The WStS Management, Monitoring and Translocation Procedure CORP-EN-PRO-1024 was implemented in 2010, prior to the commencement of operations in 2013.  During the reporting period, WStS monitoring was undertaken in accordance with the WStS Management and Monitoring Procedure CORP-EN-PRO-1024. Results are detailed in Section 4.2 of this report.	<ul style="list-style-type: none"> <li>KML Environmental Procedure - WStS Management, Monitoring and Translocation (CORP-EN-PRO-1024_4) dated 18/09/2017.</li> <li>KML WStS Monitoring register and sighting data sheets.</li> </ul>
2.01	In order to minimise the impact on the EPBC listed vulnerable Malleefowl ( <i>Leipoa ocellata</i> ) the person taking the action must implement the Environmental Procedure – Malleefowl Management and Monitoring, dated 27 November 2017.	Compliant	The Malleefowl Management and Monitoring Procedure CORP-EN-PRO-1035 was implemented in 2010, prior to the commencement of operations in 2013.  During the reporting period, Malleefowl monitoring was undertaken in accordance with the Malleefowl Management and Monitoring Procedure CORP-EN-PRO-1035. Results are detailed in Section 4.1 of this report.  The procedure was last updated in October 2019 (rev 4) and was not provided to DOEE as required under Condition 7. This is discussed under Condition 7.	<ul style="list-style-type: none"> <li>KML Environmental Procedure - Malleefowl Management and Monitoring (CORP-EN-PRO-1035) revision 4 dated 7/10/2019.</li> <li>KML Malleefowl register.</li> </ul>
3.01	In order to minimise the impact on the EPBC listed endangered WStS ( <i>Egernia stokesii badia</i> ) and the EPBC listed vulnerable Malleefowl ( <i>Leipoa ocellata</i> ) from the loss of potential habitat the person taking the action must relinquish tenure over the tenements M59/650, E59/1138, 59/1496-99 and E59/1500 at or before the time the Government of Western Australia gazettes the areas for the purpose of Conservation and/or:  a) by 31 March 2012 provide the Department with confirmation that the tenements have been relinquished and secured under a conservation agreement or, if not,	Minor Non-Compliant	As per previous annual audit reports, the tenements E59/1138, E59/1496-99 and E59/1500 were surrendered on 21 February 2014, with all but E59/1138 being placed into an area classified as Section 19 under the Mining Act 1978.  In June 2021, KML surrendered Mining Lease M59/650, after all rehabilitation commitments had been met and a sign-off inspection had occurred by the Department of Biodiversity, Conservation and Attractions (DBCA) and Department of Mines, Industry Regulation and Safety (DMIRS) in late 2020.  Whilst the State and Federal Governments are aware of the status of tenement relinquishment, and KML has been actively addressing this requirement for a number of years, failure to relinquish M59/650 within the required timeframe is considered a minor non-compliance.  As the intent of this condition has now been met, KML consider this condition is now classified as Closed.	<ul style="list-style-type: none"> <li>EPBC Referral and Determination for Mungada Ridge Rehabilitation (Mining Lease 59/650) (EPBC 2019/8556)</li> <li>Letters to DMIRS and DBCA outlining status of Mungada Ridge Rehabilitation (dated 21 May 2020)</li> <li>Email to DAWE outlining surrender of Mining Lease M59/650</li> </ul>
3.02	b) Provide an offset area approved by the Minister, of at least equal area to the project's disturbance footprint and with suitable habitat for both WStS and Malleefowl, which can be vested for conservation purposes.	Not Applicable	As M59/650 has been surrendered, it can be considered that this alternative is now no longer required. This condition is now considered 'closed'	As above

Ref.	Condition	Compliant / Non-Compliant	Finding	Evidence
4.01	In order to increase knowledge of the EPBC listed endangered WStS ( <i>Egernia stokesii badia</i> ) and the EPBC listed vulnerable Malleefowl ( <i>Leipoa ocellata</i> ) the person taking the action must provide for the Minister's approval a Research Plan that includes:	Compliant	DAWE accepted the KML Research Plan to Support Offset Requirements for the Malleefowl and WStS (CORP-EN-PLN-1039). The Centre for Mine Site Restoration (CMSR) Research Project addresses priority research areas outlined in the KML Research Plan.  The status of the CMSR Research Project is detailed in Section 5 of this report.	<ul style="list-style-type: none"> <li>Research Plan to Support Offset Requirements for the Malleefowl and WStS (CORP-EN-PLN-1039) dated 11/08/2017</li> <li>'EPBC Fauna Stress Monitoring' Research Project Proposal agreement between Curtin University (CMSR) and KML</li> </ul>
4.02	(a) how the \$400,000 research offset over ten years will be directed to improve knowledge of the WStS and the Malleefowl;	Compliant	The CMSR research project proposal outlines the budget for proposed research. KML cash expenditure totals \$250,000 plus KML cash in-kind of \$200k.  To date, \$100k cash has been paid for Project 1 and 2. The remaining \$150k cash allocation is for Project 3 of the Research Plan and is scheduled to be paid in two instalments in the second half of 2021.	<ul style="list-style-type: none"> <li>'EPBC Fauna Stress Monitoring' Research Project Proposal agreement between Curtin University (CMSR) and KML</li> <li>CMSR Progress Report - March 2020</li> </ul>
4.03	(b) who will be responsible for the research;	Compliant	The accepted CMSR Research Project Proposal included details of who will be responsible for the research.  The Research Project Progress Report - June 2021 includes information on who has been involved in conducting research proposals to date. This report is included as Appendix	<ul style="list-style-type: none"> <li>'EPBC Fauna Stress Monitoring' Research Project Proposal agreement between Curtin University (CMSR) and KML</li> <li>CMSR Progress Report - June 2021</li> </ul>
4.04	(c) what the aims of the research will be;	Compliant	The accepted CMSR Research Project Proposal details the aims of the research.  The Research Project Progress Report – March 2020 reiterates the three primary objectives of the Research Project.	<ul style="list-style-type: none"> <li>'EPBC Fauna Stress Monitoring' Research Project Proposal agreement between Curtin University (CMSR) and KML</li> <li>CMSR Progress Report - June 2021</li> </ul>
4.05	(d) the commencement date of the research;	Compliant	The research project proposal refers to the project milestones of the research proposal. The commencement date of the research is 8 May 2018, as detailed in the Curtin University Research Services Agreement for EPBC 2006/3017.  As outlined in the Research Project Progress Report – March 2020, Project 1 literature review has been completed and a final report has been received. Project 2 is underway. Project 3 has commenced with the finalisation at end of 2021.	<ul style="list-style-type: none"> <li>'EPBC Fauna Stress Monitoring' Research Project Proposal agreement between Curtin University (CMSR) and KML</li> <li>CMSR Progress Report - June 2021</li> </ul>
4.06	(e) who will be provided with the research data;	Compliant	As outlined in the Research Project Progress Report – March 2020, findings from Project 1 were presented to the WA Malleefowl Recovery Group on 27 August 2019. Project 2 research was presented at an international conference (Society for Ecological Restoration 2019) and information regarding this project was also presented at a meeting of the Gunduwa Regional Conservation Association.	<ul style="list-style-type: none"> <li>CMSR Progress Report - March 2020 includes copies of presentations made to the WA Malleefowl Recovery Group and at the Society for Ecological Restoration 2019 conference</li> </ul>

Ref.	Condition	Compliant / Non-Compliant	Finding	Evidence
4.07	The Research Plan must be provided within six months of commencement of operations. The approved plan must be implemented.	Compliant	The CMSR Research Project Proposal (accepted by DAWE on 1 March 2018) addresses priority research areas outlined in the KML Research Plan to Support Offset Requirements for the Malleefowl and WStS (CORP-EN-PLN-1039). The Research Proposal has been implemented, as outlined in the Research Project Progress Report – June 2021 and described in 4.05 above.	<ul style="list-style-type: none"> <li>CMSR Progress Report – June 2021</li> </ul>
5.01	The person taking the action must submit to the Department a report annually on 1 July each year addressing the compliance with the conditions of approval (or other data as may be agreed by the Minister). This report must be made publicly available on the internet within 30 days of it being provided to the Minister.	Compliant	Annual compliance reports have been submitted yearly since obtaining project approvals. The 2020 EPBC Compliance Report (CORP-EN-REP-1139) was emailed to DAWE 28 June 2020. The 2020 EPBC Compliance Report is available on the KML public website.	<ul style="list-style-type: none"> <li>2019/2020 annual compliance report (CORP-EN-REP-1139)</li> <li>2020 EPBC Compliance Report at <a href="https://www.kararamining.com.au/wordpress/wp-content/uploads/2020/06/2020-EPBC-Compliance-Report-1611645-1.pdf">Microsoft Word - 1611645_1 (kararamining.com.au)</a></li> </ul>
6.01	The person taking the action must maintain accurate records of all activities associated with or relevant to the above conditions of approval, and make them available on request by the Department. Such documents may be subject to audit by the Department and used to verify compliance with the conditions of approval.	Compliant	KML maintain a document control system with the most current procedures, plans and reports made available to employees. This system captures any changes made to plans and procedures from the last revision. The Malleefowl procedure, WStS procedure and the research plan have all been document controlled. Further to controlled documents, KML maintain a shared drive with filed documents and emails recorded, including Malleefowl and WSTS sightings reports. A comprehensive Geographical Information System is also maintained, showing such features as location of significant fauna and flora.	<ul style="list-style-type: none"> <li>KML Environmental Procedure - WStS Management, Monitoring and Translocation (CORP-EN-PRO-1024)</li> <li>KML Environmental Procedure - Malleefowl Management and Monitoring (CORP-EN-PRO-1035).</li> <li>Research Plan to Support Offset Requirements for the Malleefowl and WStS (CORP-EN-PLN-1039).</li> <li>'EPBC Fauna Stress Monitoring' Research Project Proposal agreement between Curtin University (CMSR) and KML</li> <li>Malleefowl and WStS sighting reports</li> <li>GIS database - layers PER - Fauna survey areas, Malleefowl Mounds, Skink Monitoring Areas, Rare fauna sightings and feral animal sightings.</li> </ul>
7.01	The person taking the action may choose to revise a Plan specified in conditions 1 or 2 without submitting it for approval under section 143A of the EPBC Act, if the taking of the action in accordance with the revised Plan would not be likely to have a new or increased impact.	Compliant	The Malleefowl Management and Monitoring Procedure (CORP-EN-PRO-1035) was updated to revision 4 in October 2019 to incorporate a number of minor administrative changes. This was not submitted to DAWE prior to implementation, and was termed a non-compliance in the previous annual report.	<ul style="list-style-type: none"> <li>KML Environmental Procedure - Malleefowl Management and Monitoring (CORP-EN-PRO-1035).</li> </ul>

Ref.	Condition	Compliant / Non-Compliant	Finding	Evidence
	<p>If the person taking the action makes this choice they must notify the Department in writing that the approved Plan has been revised and provide the Department, at least four weeks before implementing the revised plan, with:</p> <p>a) an electronic copy of the revised Plan;</p> <p>b) an explanation of the differences between the revised Plan and the approved Plan; and</p> <p>c) the reasons the person taking the action considers that taking the action in accordance with the revised Plan would not be likely to have a new or increased impact."</p>		This document has now been submitted to DAWE for review and acceptance.	<ul style="list-style-type: none"> <li>KML Environmental Procedure - WStS Management, Monitoring and Translocation (CORP-EN-PRO-1024_4)</li> </ul>
7.02	<p>The person taking the action may revoke their choice under condition 7 at any time by notice to the Department. If the person taking the action revokes the choice to implement a revised Plan, without approval under section 143A of the EPBC Act, the Plan approved by the Minister must be implemented.</p>	Not applicable	This scenario has not occurred to date.	
7.03	<p>If the Minister gives a notice to the person taking the action that the Minister is satisfied that the taking of the action in accordance with the revised Plan would be likely to have a new or increased impact, then:</p> <p>a) condition 7 does not apply, or ceases to apply, in relation to the revised Plan; and</p> <p>b) the person taking the action must implement the Plan approved by the Minister.</p> <p>To avoid any doubt, this condition does not affect any operation of conditions 7 and 7 A in the period before the day the notice is given. At the time of giving the notice the Minister may also notify that, for a specified</p>	Not applicable	This scenario has not occurred to date.	

Ref.	Condition	Compliant / Non-Compliant	Finding	Evidence
	period of time, condition 7 does not apply for one or more specified Plans required under the approval.			
7.04	Conditions 7, 7 A and 7B are not intended to limit the operation of section 143A of the EPBC Act which allows the person taking the action to submit a revised Plan to the Minister for approval.	Not applicable	This scenario has not occurred to date.	
7.05	If, for the purposes of the Plan approved by the Minister under condition 4, the person taking the action wishes to carry out an activity otherwise than in accordance with the approved Plan, the person taking the action must submit to the Department for the Minister's written approval a revised version of the Plan. The person taking the action must not commence the varied activity until the Minister has approved the varied Plan. If the Minister approves the revised Plan, the Plan must be implemented in place of the Plan originally approved.	Not applicable	This scenario has not occurred to date.	
8.01	If the Minister believes that it is necessary or desirable for the better protection of the listed threatened species to do so, the Minister may request that the person taking the action make specified revisions to any plans approved pursuant to this Annexure. The person taking the action must comply with any such request. The revised plans must be implemented.	Not applicable	This scenario has not occurred to date.	
9.01	If the action has not substantially commenced within 5 years the date this approval the action must not commence without the written agreement of the Minister.	Compliant	KML has implemented the proposal. Official grand opening of KIOP occurred on 9 April 2013.	<ul style="list-style-type: none"> <li>Australian Securities Exchange (ASX) Announcement: <a href="http://www.asx.com.au/asxpdf/20130409/pdf/42f4rsg492wnz8.pdf">http://www.asx.com.au/asxpdf/20130409/pdf/42f4rsg492wnz8.pdf</a></li> </ul>

## 4 COMPLIANCE WITH MANAGEMENT PLANS

During the reporting period, KML undertook management and monitoring of the Malleefowl and WStS, in accordance with the environmental procedures:

- CORP-EN-PRO-1035 – Malleefowl Management and Monitoring,
- CORP-EN-PRO-1024 – WStS Management, Monitoring and Translocation.

### 4.1 Malleefowl Management and Monitoring

KML have monitored Malleefowl annually since 2008 in accordance with the Environmental Procedure - Malleefowl Monitoring and Management CORP-EN-PRO-1035.

Monitoring is undertaken by the KML Environment team throughout the Malleefowl breeding season, from 1<sup>st</sup> September until 30<sup>th</sup> April so that accurate information can be gathered on populations and mound activity. KML uses the National Malleefowl Monitoring Manual (National Malleefowl Recovery Team, 2016) to define and determine which mounds shall be monitored within any given year. Mounds that were active the previous year and those in close proximity to infrastructure are monitored as a priority, followed by mounds with less recent activity. Selections of mounds with an unverified status in close proximity to activity or infrastructure are included in the monitoring schedule.

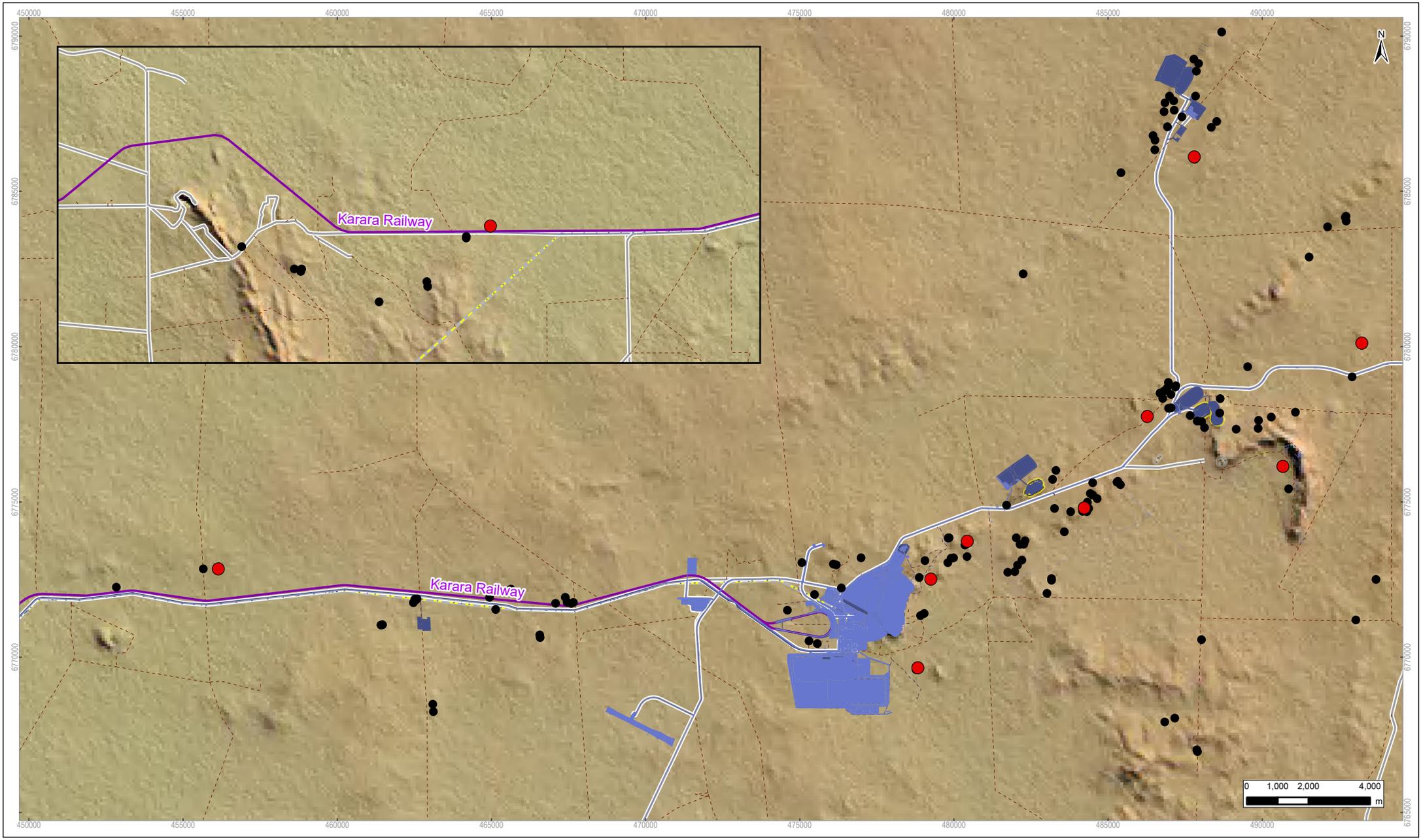
A total of 157 mounds were surveyed over the reporting period, of which ten were reported as active (Figure 1). This was comparable to previous reporting periods which have recorded between 7-10 active mounds (Table 4).

There were 19 Malleefowl sightings (25 individuals) during the reporting period. Overall, the location and number of Malleefowl sightings recorded has remained relatively consistent in recent reporting periods.

Four new Malleefowl mounds were found during the reporting period (Table 5) no new mounds were classified as active.

Details of mounds surveyed and Malleefowl sightings are provided in Appendix A and B respectively.

No Malleefowl mortalities were recorded during the current recording period.



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KIOP EPBC 2006/3017 – Figure 1  
**Malleefowl Mound Monitoring 2020/21**

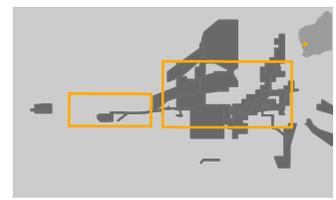
**Monitored Mounds 2020/21**

- Active
- Inactive
- KML Open Ground Disturbance
- KML Rehabilitation
- Karara Power Transmission

- Railway (Freight)
- Roads Regional**
- Main
- Minor
- Highway
- Track



GDA 1994 MGA Zone 50 SCALE: 1:160,000



**Table 4: Malleefowl Monitoring Results 2017-2021**

Year	Mounds Surveyed	Category		% Active mounds	No. Sighted
		Active	Inactive		
2017/2018	116	7	109	6	40
2018/2019	89	10	79	13	21
2019/2020	84	10	74	14	24
2020/2021	157	10	147	6	19

**Table 5: New Malleefowl Mounds Identified during the Reporting Period**

Mound ID	Easting	Northing	Profile type	Status	Comments
905	487162	6768039	3	D	Cone with vegetation, inactive for some time.
906	482020	6773843	3	D	Looks recent. Some scratchings, could be malleefowl or rabbits, rabbit scat,
907	484503	6775218	1	E	Opportunistic mound (Not a target mound on map). Reasonable old 20 years. 8m diameter 300mm at eastern edge, 600 high at western edge.
908	492692	6784165	1	E	Old stony mound. Very large 10m diameter, 1.5M high.

A total of 910 mounds of varying status (ancient through to fresh and actively used) have been identified and surveyed since 2008. The percentage of all mounds that are active has ranged from 4% (in 2012 and 2016) to 15% (in 2009) over the past 12 years. The average activity over the 13 years of monitoring is 8.75%. The total number of mounds monitored in any one year has varied since the commencement of monitoring (ranging from 73 to 191), however the total number of active mounds identified each year has remained relatively consistent, ranging from 5 to 14, with a 12 year average of 10 active mounds identified per year.

A spatial analysis of monitoring data shows that Malleefowl have occupied various mounds within operational areas where impacts to Malleefowl activity may be anticipated, with many sites being used for multiple years over the reporting period. This would suggest that Malleefowl are relatively undisturbed by proximity to mining activity. This is supported by findings of other resource companies in the region actively mining and monitoring Malleefowl activity, for example the nearby Extension Hill Hematite Operation (Mount Gibson Mining Ltd and Extension Hill Pty Ltd 2013).

#### **4.2 Western Spiny-tailed Skink Management and Monitoring**

KML mapped prospective WStS habitat in 2008 and has been monitoring since 2011 to determine whether mining is impacting on the local population. To investigate potential impacts of mining, monitoring sites within monitoring areas are divided into two categories:

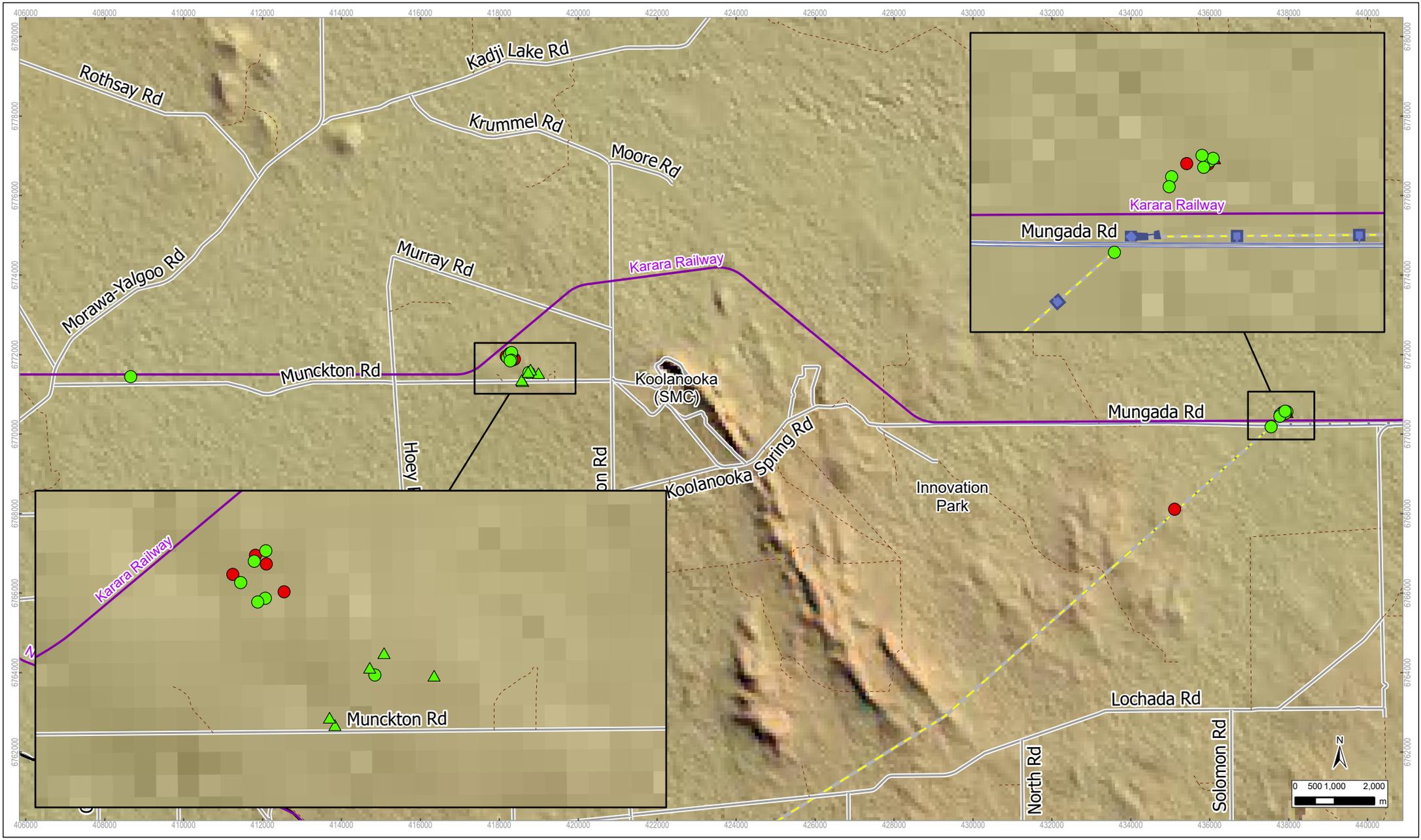
- Impact Sites: within 500 m from mining disturbance
- Control Sites: outside 500 m from mining disturbance

WStS monitoring is undertaken in accordance with the Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC) survey guidelines for Australia's threatened reptiles (Commonwealth of Australia, 2011). Monitoring is undertaken during breeding season between spring and summer by a fauna specialist or trained personnel from the KML Environmental Department. Monitoring involved thoroughly searching for WStS skinks and/or scats in sheltering sites such as hollow logs/trees and roots, piles of timber and rocky outcrops within prospective skink habitats. Monitoring includes details on evidence of WStS, such as the age, contents and size of scats and latrines and photographs of monitoring sites and scats so as to adequately determine recent activity or presence of WStS. WStS are classified as present using direct observation, camera trap evidence or presence of scat. Scat evidence is further broken down into fresh or old scats, with the presence of fresh scats a better indicator of skink activity.

Annual WStS monitoring in the reporting period was undertaken in September 2020. Monitoring of 152 sites was undertaken, including 69 control sites, 73 impact sites, 10 translocation sites and two survey sites. Monitoring identified that 70 sites were inhabited (32 at control sites and 38 at impact sites) and 82 were uninhabited (37 at control sites, 35 at impact sites and all 10 translocation sites). (Figures 2 - 5). These results are comparable to previous years (Figure 6).

A translocation program for WStS colonies within KML disturbance areas has been in place since the commencement of the project in 2010. A total of ten WStS and 21 potential WStS

colonies (habitat log piles) have been translocated since the start of the project. All translocation sites have been monitored on an annual basis, however, no evidence of WStS has been observed at the relocation sites. KML, in coordination with Curtin University, will continue investigations under the existing research agreement to improve our understanding of factors which may influence translocation success.



24 June 2021  
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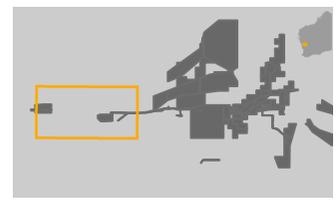
**Western Spiny-tailed Skink Monitoring 2020/2021**

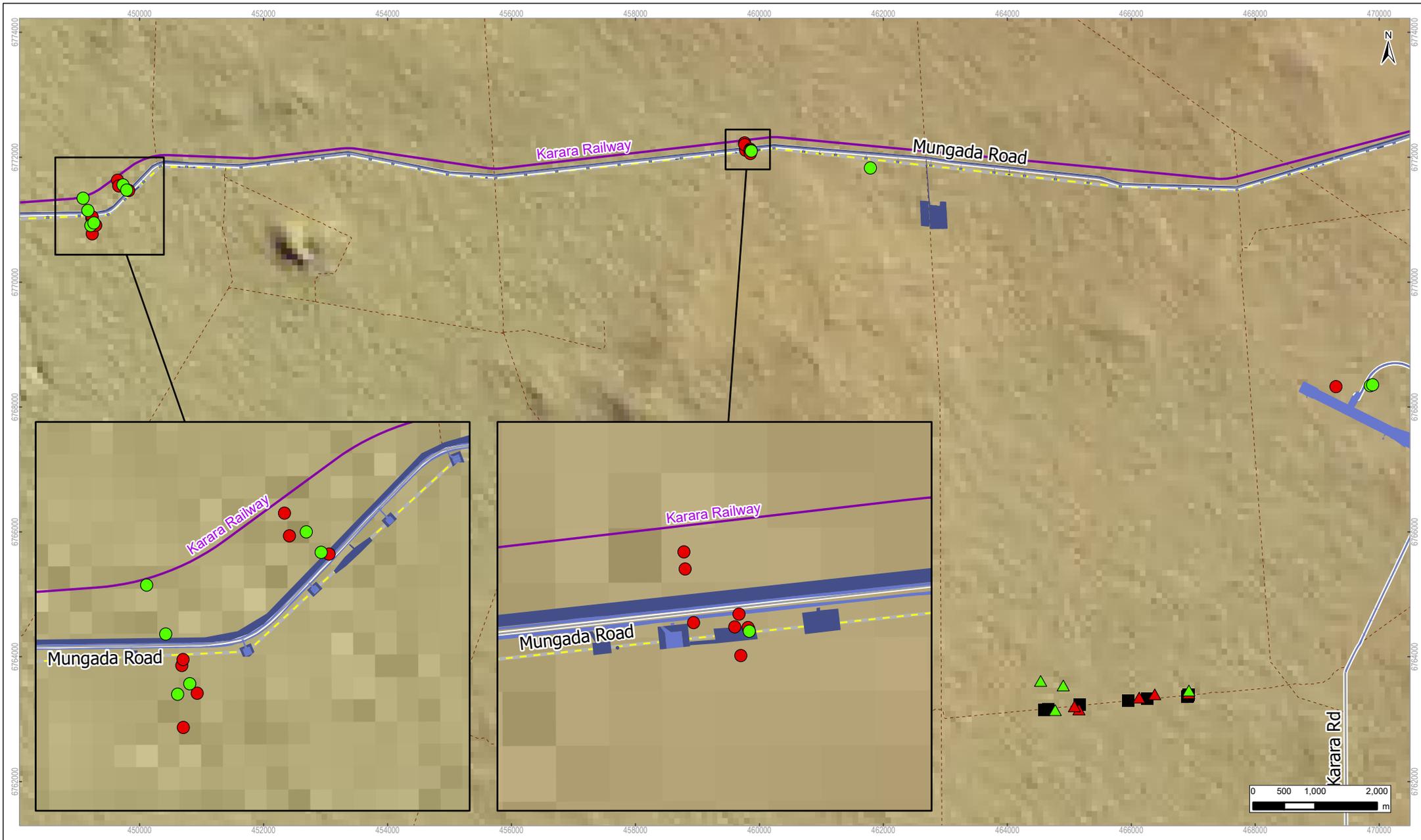
- WSTS 2020/21  
 Status, SiteType
- ▲ Inhabited, Control
  - Inhabited, Impact
  - ▲ Uninhabited, Control
  - Uninhabited, Impact

- Uninhabited, Translocation
- KML Open Ground Disturbance
- KML Rehabilitation
- Railway (Freight)
- Karara Power Transmission

- Roads Regional
- Main
  - Minor
  - Highway
  - Track

GDA 1994 MGA Zone 50 SCALE: 1:125,000





24 June 2021  
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**Western Spiny-tailed Skink Monitoring 2020/2021**



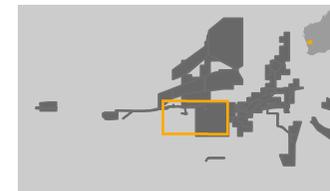
WSTS 2020/21  
 Status, SiteType

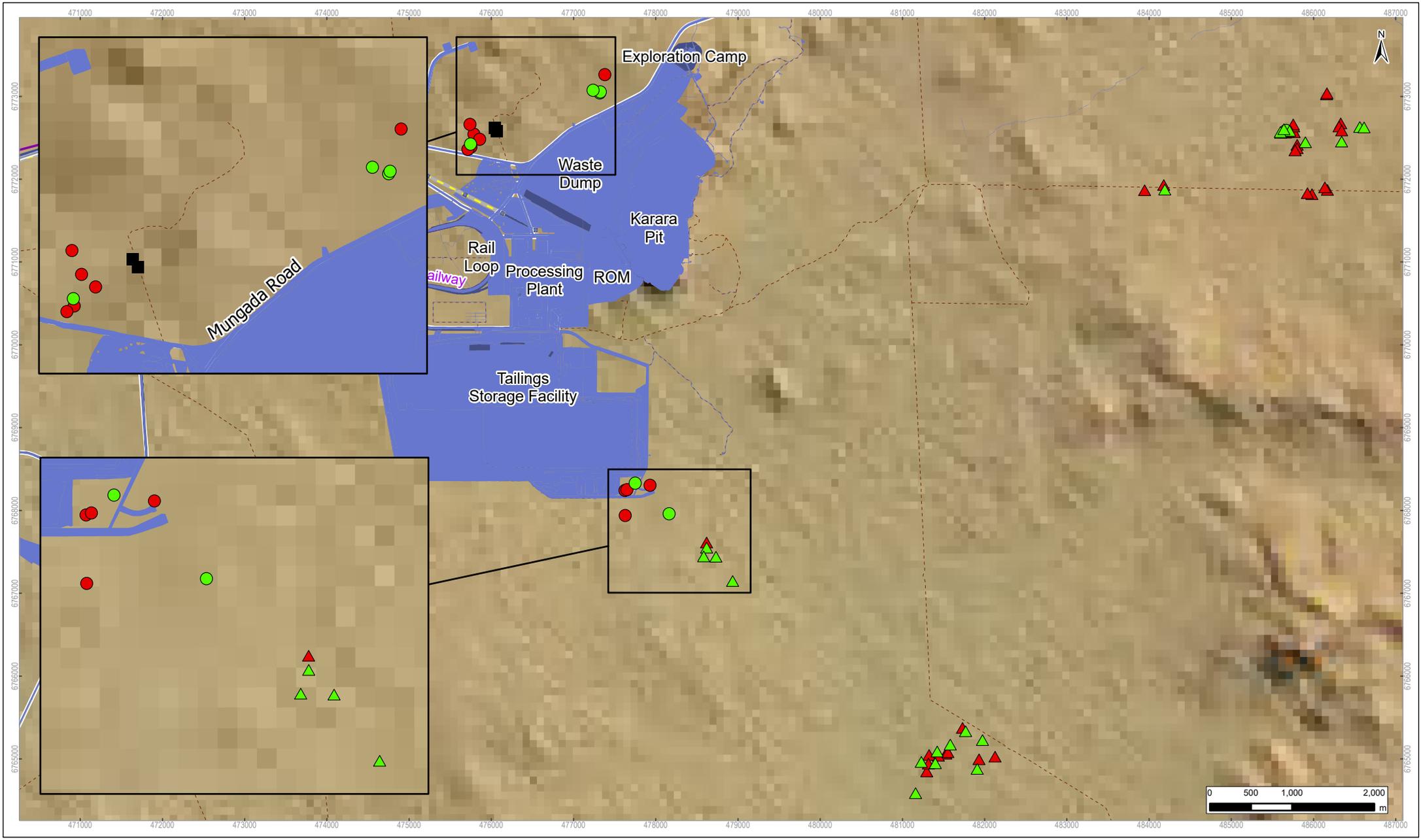
- ▲ Inhabited, Control
- Inhabited, Impact
- ▲ Uninhabited, Control
- Uninhabited, Impact

- Uninhabited, Translocation
- KML Open Ground Disturbance
- KML Rehabilitation
- Railway (Freight)
- Karara Power Transmission

- Roads Regional
- Main
  - Minor
  - Highway
  - - - Track

GDA 1994 MGA Zone 50 SCALE: 1:80,000





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**Western Spiny-tailed Skink Monitoring 2020/2021**



**WSTS 2020/21  
 Status, SiteType**

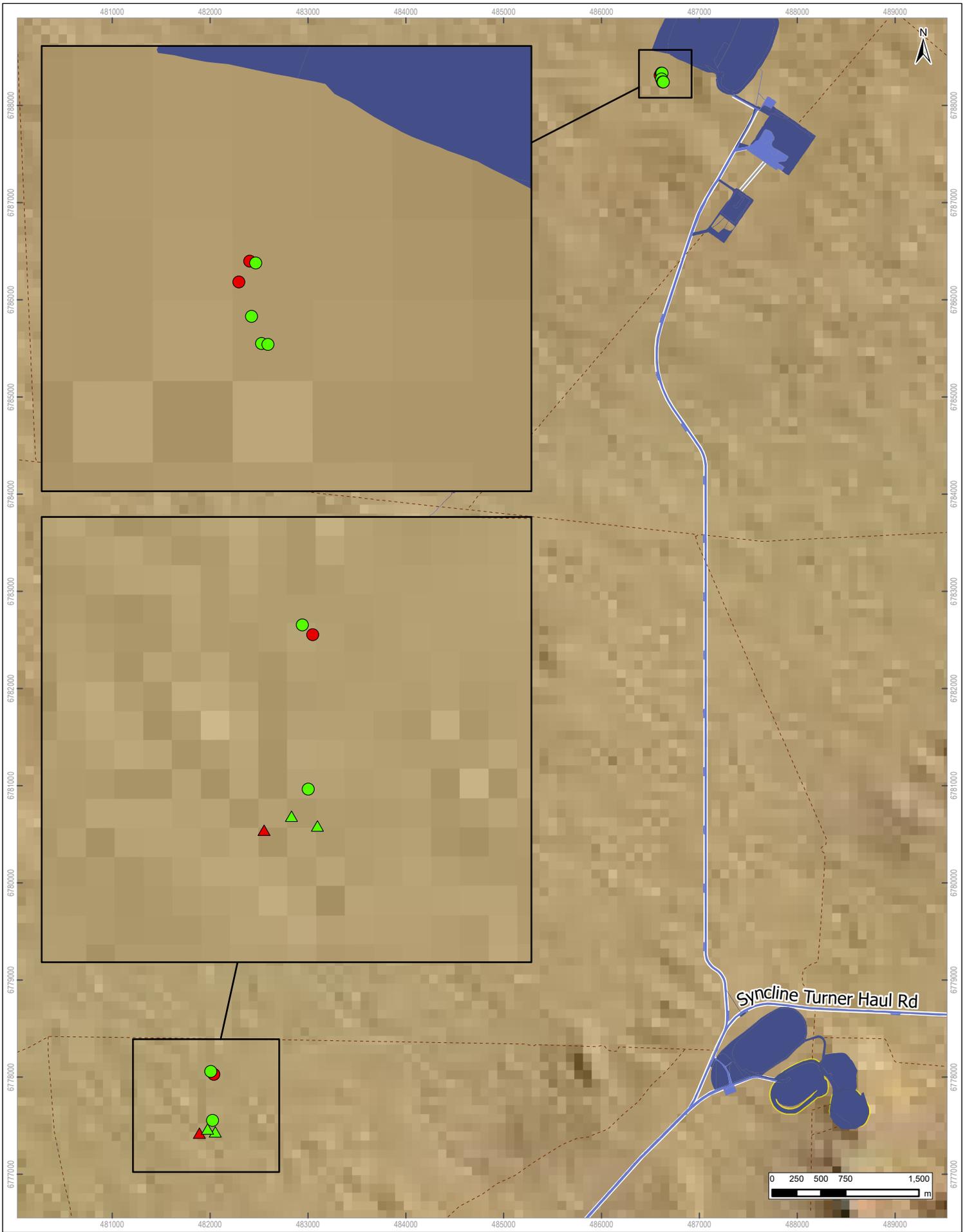
- ▲ Inhabited, Control
- Inhabited, Impact
- ▲ Uninhabited, Control
- Uninhabited, Impact

- Uninhabited, Translocation
- KML Open Ground Disturbance
- KML Rehabilitation
- Railway (Freight)
- Karara Power Transmission

- Roads Regional**
- Main
  - Minor
  - Highway
  - Track

GDA 1994 MGA Zone 50      SCALE: 1:60,000





24 June 2021  
 Version: A  
 Size: A4  
 Ref: K0102 F4

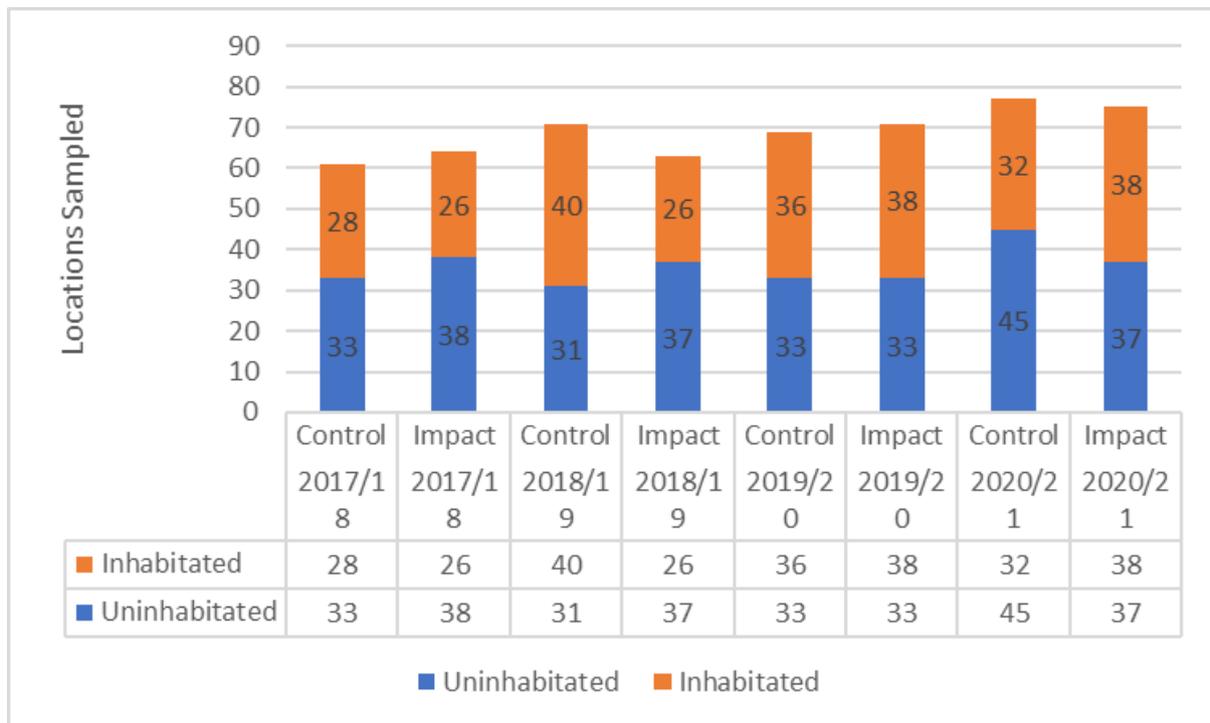


### Western Spiny-tailed Skink Monitoring 2020/2021

- |                        |                               |                |
|------------------------|-------------------------------|----------------|
| WSTS 2020/21           | ■ Uninhabited, Translocation  | Roads Regional |
| Status, SiteType       | ■ KML Open Ground Disturbance | — Main         |
| ▲ Inhabited, Control   | ■ KML Rehabilitation          | — Minor        |
| ● Inhabited, Impact    | — Railway (Freight)           | — Highway      |
| ▲ Uninhabited, Control | — Karara Power Transmission   | - - - Track    |
| ● Uninhabited, Impact  |                               |                |

GDA 1994 MGA Zone 50 SCALE: 1:50,000





**Figure 6: WStS evidence recorded at control and impact sites across all KML tenements**

No mortalities of WStS were recorded over the reporting period.

KML’s objective of monitoring for the presence or absence of WStS on an annual basis has been achieved in each successive year since the commencement of monitoring in the spring of 2011. Monitoring results to date strongly suggest that mining related activities are not impacting WStS populations. Whilst presence/absence data varies between years, skink activity at impact and control sites are closely aligned, with an average presence of skinks at control sites comparable to at impact sites (both around 50%). Similarly, at sites where skink presence is observed the indicators of recent activity (fresh scats) were also consistent between impact and control sites.

## 5 STATUS OF RESEARCH PROPOSAL

The CMSR Research Project Proposal addresses priority research areas outlined in the KML Research Plan to Support Offset Requirements for the Malleefowl and WStS (CORP-EN-PLN-1039).

The Research Proposal is currently in execution, and the 2020 Progress Report was provided to KML in March 2020.

Project 1 'Habitat requirement, translocation success and breeding programs for Malleefowl – review and gap analysis' has been completed. The gap analysis remains consistent with the last published review of the species, and did not identify any novel findings. A presentation on these findings was made to the WA Malleefowl Recovery Group in August 2019.

Project 2 'Threat assessment and recovery strategies for WStS (*Egernia stokesii badia*)' is underway. A significant amount of data has been collected to better understand: the features of WStS habitat; predation pressure on WStS; and diet of adult and juvenile WStS. A number of publications are currently being prepared based on this data. A population genetics study will also commence over the next six months, which aims to provide information on potential dispersal routes between colony log piles.

Project 3 'Evaluating stress levels in EPBC listed fauna inhabiting mining sites. A preliminary assessment' has commenced and is planned to be completed in Q4 2021.

## **6 NEW ENVIRONMENTAL RISKS**

No new environmental risks, in relation to management of conservation significant fauna and feral animal management were identified during the reporting period.

## 7 OTHER INFORMATION

### 7.1 Feral Animal Monitoring

In accordance with KML Environmental Procedure – Feral Animal Management and Monitoring CORP-EN-PRO-1050, KML monitor feral animal sightings and trapping success to ensure feral animal numbers are not increasing nor having a detrimental impact on conservation significant flora and fauna and other native fauna and flora resident on KML tenements. KML implements an active feral animal control program that includes baiting and trapping.

A summary of the feral animals trapped over the past 4 years is provided in Table 6. Trappings and sightings of other feral animals has remained relatively consistent over the period.

**Table 6: Feral animals trapped at KIOP between 2017-2021.**

Reporting Year	Cats	Foxes	Goats	Other
2017/2018	9	0	3	
2018/2019	11	0	1	
2019/2020	5	0	0	
2020/2021	10	0	1	1

## 8 CONCLUSION

As outlined above, operations of KIOP are largely compliant with the requirements of the EPBC approval conditions (EPBC 2006/3017).

Monitoring data for the reporting period, along with data collected over the duration of mining operations, has continued to demonstrate that KML mining activities have not impacted on Malleefowl or WStS populations in the area. KML will continue to monitor Malleefowl and WStS activity for the life of the mine in accordance with the approved monitoring procedures. Feral animal populations remain at manageable levels. KML's ongoing extensive environmental management activities, such as feral management and progressive rehabilitation, are to date successful in minimising impacts on Malleefowl and WStS communities, and the wider environment in the vicinity of KIOP operations.

## 9 REFERENCES

Commonwealth of Australia, 2011. Survey Guidelines for Australia's Threatened Reptiles. Department of Sustainability, Environment, Water, Populations and Communities.

Mount Gibson Mining Ltd and Extension Hill Pty Ltd, 2013. Annual Compliance Report Extension Hill Hematite Haulage Road and Rail Siding. [http://www.mtgibsoniron.com.au/wp-content/uploads/17.04.13-Extension-Hill-Annual-Compliance-Report-2012\\_2013.pdf](http://www.mtgibsoniron.com.au/wp-content/uploads/17.04.13-Extension-Hill-Annual-Compliance-Report-2012_2013.pdf)

National Malleefowl Recovery Team, 2016. National Manual for the Malleefowl Monitoring System: Edition 2016-1.

## APPENDIX A: MALLEEFOWL MOUNDS MONITORED 2020 SURVEY

MFM ID	Easting	Northing	Profile Type	Status
MFM4	475478	6772019	6	E
MFM8	480424	6773239	1	E
MFM9	479987	6773199	6	E
MFM10	476987	6773200	6	E
MFM14	479058	6773109	6	E
MFM20	479906	6773187	1	E
MFM28	479034	6771408	6	E
MFM31	478915	6771340	6	E
MFM33	467658	6771763	1	E
MFM34	467587	6771734	1	E
MFM35	467078	6771735	1	E
MFM47	467453	6771771	6	E
MFM48	464938	6771925	6	E
MFM49	434067	6770261	6	E
MFM54	424656	6769702	3	C
MFM57	482305	6773749	2	E
MFM60	486836	6767913	3	C
MFM62	475069	6773046	3	B
MFM66	434067	6770262	1	A
MFM67	481707	6774896	6	E
MFM70	488634	6778326	6	E
MFM71	488620	6777863	6	E
MFM72	489152	6777342	6	E
MFM78	490291	6777731	6	E
MFM91	493035	6771199	1	D
MFM98	487782	6789259	6	E
MFM99	483166	6772477	6	E
MFM101	485416	6785600	6	E
MFM104	488684	6790132	1	D
MFM105	482204	6773126	2	E
MFM107	483580	6774038	1	E
MFM110	480433	6773734	4	A
MFM111	488029	6770564	1	D
MFM112	495964	6776212	1	D
MFM115	491075	6777890	1	C
MFM116	496994	6780606	1	D
MFM124	474599	6771513	6	E
MFM127	467394	6771928	1	E
MFM128	465139	6771538	2	E
MFM129	465633	6772192	6	E
MFM130	462588	6771877	6	E
MFM131	462546	6771844	6	E

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<b>MFM ID</b>	<b>Easting</b>	<b>Northing</b>	<b>Profile Type</b>	<b>Status</b>
MFM132	462468	6771754	6	E
MFM134	456141	6772843	1	A
MFM135	433763	6770113	6	E
MFM141	433758	6770052	6	E
MFM147	475298	6770523	6	E
MFM149	466579	6770632	1	E
MFM150	466565	6770717	6	E
MFM151	461468	6771045	6	E
MFM152	461415	6771036	6	E
MFM183	490669	6776144	1	A
MFM199	484500	6775616	1	D
MFM203	487889	6777604	6	E
MFM204	488033	6777586	1	E
MFM205	488126	6777392	1	E
MFM227	484330	6774993	3	C
MFM228	492716	6784198	6	E
MFM233	478770	6769600	6	E
MFM235	478829	6769659	1	A
MFM237	483017	6772057	1	E
MFM244	486270	6777752	4	A
MFM245	486771	6778333	1	C
MFM246	486818	6778572	1	D
MFM249	491518	6782886	6	E
MFM250	492120	6783858	1	E
MFM252	476090	6772999		
MFM253	476184	6772971		
MFM272	493229	6780113	4	A
MFM284	475569	6770436	1	E
MFM302	476349	6772230	1	E
MFM407	487876	6767015	6	E
MFM408	487897	6766960	6	E
MFM440	430226	6767481	6	E
MFM443	432196	6768098	6	E
MFM444	432161	6768295		
MFM445	427086	6768804		
MFM446	427050	6768705	6	E
MFM447	426789	6768806	6	E
MFM490	479801	6773044	6	E
MFM517	489864	6777368	6	E
MFM518	489880	6777627	1	D
MFM520	483785	6774685	1	D
MFM570	482245	6782343	1	E
MFM571	463116	6768247	2	E

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<b>MFM ID</b>	<b>Easting</b>	<b>Northing</b>	<b>Profile Type</b>	<b>Status</b>
MFM574	486682	6778505	6	E
MFM575	486912	6778665	1	D
MFM578	487199	6778740	1	E
MFM579	487179	6778702	6	E
MFM580	487038	6778460	6	E
MFM588	487835	6788068	1	D
MFM595	487126	6787917	1	D
MFM596	486522	6786648	5	E
MFM620	496132	6775727	1	D
MFM621	496016	6776292	1	D
MFM622	495964	6776217		
MFM623	495787	6775788	6	E
MFM624	495854	6776000	1	D
MFM625	495789	6776253	1	D
MFM626	495615	6775828	1	E
MFM628	487815	6786039	6	E
MFM629	487795	6786109	4	A
MFM630	486515	6786337	6	E
MFM631	486457	6786797	1	E
MFM632	486814	6787567	1	D
MFM634	487144	6787614	6	E
MFM638	487394	6787399	1	E
MFM639	488346	6787062	6	E
MFM640	488521	6787252	1	E
MFM641	486989	6788065	6	E
MFM645	486844	6787853	6	E
MFM649	487862	6788871	1	E
MFM661	493689	6772504	1	D
MFM664	484645	6775106	1	D
MFM666	483165	6772533		
MFM667	495335	6775229	5	C
MFM670	482141	6773633	2	E
MFM671	482264	6773638	2	E
MFM672	481745	6772735	6	E
MFM673	482062	6772961	6	E
MFM675	481973	6772754	2	E
MFM683	485398	6775553	6	E
MFM684	485316	6775662	6	E
MFM685	485287	6775637	6	E
MFM694	486961	6778015	1	E
MFM696	487042	6778029	6	E
MFM697	486925	6787081	1	E
MFM721	497141	6780062	6	E

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MFM ID	Easting	Northing	Profile Type	Status
MFM722	497117	6780117	6	E
MFM724	483261	6774790	6	E
MFM726	484308	6774686	3	C
MFM727	484225	6774807	6	A
MFM735	489526	6779354	3	C
MFM754	483306	6776015	6	E
MFM755	486954	6778847	6	E
MFM756	484370	6774791	6	E
MFM757	484172	6774697	1	E
MFM762	479251	6772514	4	A
MFM763	462514	6771868		
MFM764	455654	6772844		
MFM766	484423	6775272	1	D
MFM770	479843	6773844	6	E
MFM771	479811	6773838	6	E
MFM773	480356	6773611	6	E
MFM778	463097	6768486	6	E
MFM780	492722	6784046	6	E
MFM782	483201	6775726	6	E
MFM802	492914	6779028	3	C
MFM809	495658	6775287	3	D
MFM815	487934	6789119	6	E
MFM826	487662	6777781	1	C
MFM829	490854	6775420	3	C
MFM832	478874	6772568	2	D
MFM905	487162	6768039	3	D
MFM906	482020	6773843	3	D
MFM907	484503	6775218	1	E
MFM908	492692	6784165	1	E

Mound Status	Status Description
A	Active (Profile 4): Mound almost certainly contains eggs. Mound is covered over, dome-shaped and surface is freshly disturbed (that day), often with small excavations around the lower perimeter where the male has scratched material onto the centre of the mound. There will be no ant-line tracks and very few tracks of small animals present, as the surface of the mound is being worked constantly.
B	Inactive (Profile 4): Mound is covered over and dome-shaped, but surface is not disturbed, having assorted animal tracks and ant-lion traps on it. This is a mound that has been fully-prepared for incubation in that year, but has been abandoned. Note that it may also have been prepared in an earlier year but this will have been recorded.
C	Inactive (Profile 3 or 5): Mound has been excavated and filled with leaf-litter, but has been abandoned.
D	Inactive (Profile 1 or 2): Mound has been excavated but no further progress has been made.
E	Inactive (profile 1 or 6): No recent activity. Profile 1 and 6 grade into each other, but mounds can be roughly aged (i.e. time since last used) by their appearance.
Unverified	Mound found opportunistically and requires inspection by a trained and competent person to verify status

## APPENDIX B: MALLEEFOWL SIGHTINGS 2020/2021

Date	Easting	Northing	#	Location
01-Aug-20	481251	6772515	1	Gardner Track towards Euro Bore
20-Aug-20	478879	6772576	1	Karara East Track in bush towards Dust bottle no 26
22-Aug-20	480198	6774533	1	Mungada Road, ~800m east of the Karara East Track intersection
14-Sep-20	469278	6771983	2	Mungada Road, west of Gate One, adjacent to the Surge Tank, on Rail Access Road
03-Nov-20	474098	6770845	1	Jones Way, at the Crest of the hill
08-Nov-20	479485	6774257	1	Mungada Road (gravel section), just east of the Karara East track intersection
14-Nov-20	467926	6771563	1	Mungada Road, just east of the Barrier Fence
15-Nov-20	478553	6772026	1	Karara East Road, near the Stage 3 and 4 pit boundary
10-Dec-20	484931	6775969	2	Mungada Road, just before Terapod haulage road
10-Dec-20	486160	6776888	2	Terapod Haul Road
13-Dec-20	474001	6770901	1	Jones Way, where rail loop is closest to the road.
27-Dec-20	485243	6776090	2	Terapod Haul Road
28-Dec-20	455988	6772783	1	Omega Track. North of the Karara Railway and to the east of the track near MFM134 (a known active mound) being monitored
04-Jan-21	473723	6771140	1	Jones Way
13-Jan-21	488476	6778699	1	Syncline Haul Road
18-Jan-21	480140	6774491	1	Mungada Road - SE of Karara East turnoff
26-Jan-21	426933	6770434	1	Approx 45 KM west of gatehouse 1
26-Jan-21	480162	6774537	2	Approximately 800 east of Karara East Rd on Mungada Rd
27-Jan-21	480936	6774798	2	West of Blue Hills North turn off. Next to bend

**APPENDIX C: EPBC FAUNA STRESS MONITORING PROGRESS REPORT**

**Final Report - March 2021**  
**EPBC fauna stress monitoring**  
**Karara Mining Limited EPBC 2006/3017**

**FULL TITLE:** Evaluating threats, recovery strategies and managing stress levels of EPBC listed fauna (Western Spiny-tailed Skink [*Egernia stokesii badia*] and the Malleefowl [*Leipoa ocellata*]) associated with mining activities.

### **1. LOCATION/S OF PROJECT ACTIVITIES:**

The research project is being undertaken at the Karara Iron Ore Project (KIOP) in the Midwest region of Western Australia. The Karara Mining Limited (KML) mine site is located 215 km south-east of Geraldton and 320 km north-northeast of Perth. So far, research has only been undertaken on site but surrounding areas, such as nearby timber, nature or conservation reserves may also be utilised as reference sites as required/appropriate.

### **2. RESEARCH OBJECTIVE:**

The endangered Western Spiny-tailed Skink (WSTS, *Egernia stokesii badia*) and the EPBC-listed vulnerable Malleefowl (*Leipoa ocellata*) both occur within the impact footprint of the KIOP, and KML has environmental programs in place to monitor the occurrence and abundance of these two species (CORP-EN-PRO-1024). This research program was developed to build on current monitoring practices undertaken at KML to deliver a comprehensive and holistic approach towards the conservation of these species and includes three primary objectives:

- a) Undertake a literature review of the habitat requirements, translocation successes and breeding programs for Malleefowl incorporating fire history (depending on data available). This review would allow the identification of any significant research gaps from which specific and targeted projects could be (Project 1);
- b) Quantify the impacts of feral animals on the WSTS, as well as examining the specific ecological requirements of the subspecies to improve translocation site selection and management practice for future translocations of colonies (Project 2); and
- c) Evaluate the enigmatic effects of mining activities in the mid-west of Western Australia and how this impacts upon fauna health (Project 3).

The research program builds on a foundation of restoration science research being undertaken on-site, lifting it to the next level of impact assessment through the incorporation of high-level and innovative monitoring technologies.

### **3. FINAL PROJECT REPORTING:**

The EPBC-listed WSTS (*Egernia stokesii badia*) and Malleefowl (*Leipoa ocellata*) both occur within the impact footprint of the KIOP, and KML has environmental programs in place to monitor the occurrence and abundance of these two species. However, the health and resilience of these populations are poorly understood. KML and researchers within the School of Molecular and Life Sciences, in conjunction with the Centre for Mine Site Restoration (CMSR) at Curtin University (Curtin) have developed and implemented the following research programs that aim to evaluate the threats, recovery strategies and levels of stress experienced by fauna residing in close proximity to active mining operations.

#### **Habitat requirement, translocation success and breeding programs for Malleefowl (*Leipoa ocellata*) – review and gap analysis (Project 1)**

##### *Background*

Malleefowl (*Leipoa ocellata*) are listed as Vulnerable under the EPBC Act, and are known to occur on land managed by Karara Mining Ltd (KML). The species is threatened through the clearing of habitat for mining, mining infrastructure, and farming, as well as fragmentation and isolation, predation (foxes and potentially cats and raptors), and altered fire regimes.

The Malleefowl has received considerable on-ground conservation activity with a number of NGOs (Bush Heritage Australia), community groups (Malleefowl Preservation Group, Great Victoria Desert Biodiversity Trust, North Central Malleefowl Preservation Group (NCMPG) and Friends of North Eastern Malleefowl (FONEM), industry (e.g. KML, Mt Gibson Mining, Asia Iron, Top Iron, Mineral Resources, SMC), practitioners & consultants (Bamford Consulting Ecologists, Ecologia Environment, MWH Global) and government (DBCA) undertaking surveys. As such, there are likely to be sizable datasets and information available in the grey literature, which currently remains un-synthesised. Further, there is a substantial heritage of scientific literature publications on nesting activity (Priddel & Wheeler 2003), fire regimes (Parsons & Gosper 2011), fragmentation (Parsons et al 2008), captive-rearing (Priddel & Wheeler 1994) and reviews from other regions (e.g. NSW, Priddel & Wheeler 1999), but these

are in isolated in journals unavailable to the public without costly subscriptions. There has also been very little contribution to this body of work in the last decade, and many questions surrounding the species remain persistently unaddressed.

A review of the status of current knowledge of Malleefowl in Western Australia is warranted to consolidate data and findings to date. A gap analysis would identify the future research priorities for this species in the region.

#### *Objectives*

A review of both the grey and scientific literature was proposed to assess the current state of knowledge for Malleefowl in the mid-west region of Western Australia. This review was proposed to include a gap analysis to direct future research priorities.

#### *Project description*

Consultation with relevant stakeholders will be undertaken to identify and source grey literature of Malleefowl survey and research efforts undertaken to date that are not currently available publically or online. A review of the literature will be undertaken and synthesised into a database and review paper produced. A gap analysis will also be undertaken to inform the future direction of Malleefowl research.

#### *Key research tasks*

- Identify and consult with relevant stakeholders (Government, NGOs, Community groups, Industry),
- Undertake a review of grey and scientific literature, and
- Undertake a gap analysis of work completed to date and identify future research priorities.

#### *Resourcing*

This project was undertaken by a Curtin employed Post-Doctoral Fellow, funded by KML in collaboration with the wider research team.

#### *Final Project Reporting*

The literature review and gap analysis has been completed. The major finding of the research hinges upon a backward projected species distribution model that shows that much of the distribution of the Malleefowl available at the time of European settlement in Australia is now unsuitable for the species, meaning that populations that were once on the fringes, such as those at Karara, are now essential holdouts for the species. The gap analysis remains consistent with the last published review of the species, mainly because there has been very little published research in the last decade, regardless of the increase in malleefowl survey effort. Major gaps still exist around the demographics, recruitment and movement patterns of juveniles, little understanding of fecundity and recruitment success relative to the number of eggs laid, including a lack of knowledge concerning the potential for temperature dependent sex determination in the species, and the subsequent influences of a changing climate, and very little empirical data on the impacts of land management (including feral predation, competition with agricultural stock and fire regimes) on the persistence, recruitment and dispersal patterns of the species.

The literature review and gap analysis did not identify very many novel findings that have not been acknowledged as constraints on our understanding of Malleefowl for the last decade. The distribution modelling component; however, did suggest interesting patterns in decline and restriction of the species since European settlement of Australia that merits future attention around the role of arid regions as refuge niches, but such research would be outside the scope of the current program.

#### *Publications/ conference presentations/ other significant communications of research*

As indicated above, the literature review is not being considered for publication. A future publication may be forthcoming around the distributional work, but this is likely to require substantial further development and research. A presentation of these findings was made to the WA Malleefowl Recovery Group on August 27<sup>th</sup> 2019.

#### *Additional comments*

None.

### **Threat assessment and recovery strategies for Western Spiny-tailed Skink (WSTS; *Egernia stokesii badia*) (Project 2)**

#### *Background*

The WSTS (*Egernia stokesii badia*) is currently listed as Endangered under the EPBC Act, and is known to occur on tenement land managed by Karara Mining Ltd (KML). This species is threatened primarily by habitat loss and degradation (e.g., clearing for mining infrastructure or agriculture, or vegetation structure alteration through grazing by feral goats), but may also be at risk from predation by feral cats or foxes.

The management and monitoring of WSTS populations is critical for the ongoing maintenance and recovery of the species, and individuals have been translocated from impacted areas to suitable habitat (log piles with hollows) as part of KML's Western Spiny Tailed Skink Management and Monitoring Procedure (CORP-EN-PRO- 1024). However, translocation success rates have been variable, post-translocation monitoring involves only presence/absence assessment, and provides no information on the adaptability of translocated individuals to these areas. In some cases, natural logs providing habitat suitable for WSTS translocation are in short supply, and it has been suggested that artificial logs may represent an option to provide additional habitat for the species.

#### *Objectives*

This research program aims to quantify both the indirect (habitat degradation through grazing) and direct (predation) impacts of feral animals on the WSTS, as well as examining the success of translocation efforts by assessing the behaviour of individuals in natural and artificial log habitats.

#### *Project description*

WSTS are known to live in log piles in small social groups. The specific characteristics that determine whether a log pile and surrounding landscape is suitable for WSTS is currently unknown, which limits environmental practitioners' ability to select appropriate translocation sites when populations are identified within impact areas. In order to improve the success rates of translocations, the features of WSTS habitat will be recorded and modelled including the characteristics of the logs in which they are inhabiting such as size, as size, configuration, surrounding vegetation and canopy structure. eDNA analysis will also be used to understand how the WSTSs use the log piles they select. Further, to obtain an understanding of important species to support colony foraging, and ontogenetic dietary study will be completed.

The impact that invasive fauna has on WSTS will also be determined. Camera traps will monitor WSTS-predator interactions, as well as replica model experiments and predatory bird surveys at areas with inhabited log piles, uninhabited log piles and control sites without logs.

#### *Key research tasks*

- Features of WSTS habitat will be recorded including the characteristics of the logs in which they inhabit, e.g., size, species, surrounding vegetation structure.
- Log piles will be monitored using camera traps, accompanied by replica model experiments and predatory bird surveys to quantify the presence and abundance of feral animals and inform WSTS-predator interactions.
- The diet of skinks at different sites will be analysed from scats using visual identification and genetics to inform on habitat requirements.
- Use of crevices/hollows by WSTS and other predators within the log will be determined using eDNA.

#### *Resourcing*

This project is being undertaken by PhD student Holly Bradley, enrolled through Curtin University and supervised by Assoc/Prof Bill Bateman, Dr Sean Tomlinson and Dr Mike Craig. The student is supported through an RTP scholarship, with operational funding being provided by KML and further in-kind-support by Curtin University and KML.

#### *Final Project Reporting*

A significant amount of data has been collected on the features of WSTS habitat and log pile characteristics. LiDAR has been used to map log piles to provide very detailed data on log pile characteristics. Holly has also collected camera trap data, survey and plasticine model data aimed at understanding predation pressure on WSTS at log piles and at in other parts of the environment.

WSTS scats have been collected from multiple occupied log sites and Holly is using this to understand diet of adult and juvenile WSTS, and eDNA samples have been collected from log hollows to help understand hollow usage by the skinks and their predators.

#### *Upcoming work over the next six months*

The data collected so far is now at the stage where Holly can prepare publications. She currently has one manuscript published (a global literature review on mitigation translocations titled Mitigation translocation as a management tool), and has completed a manuscript on the impact of predation, now being reviewed for publication. Digitisation of LiDAR data is complete, and analysis and final write-up is now underway. Data analysis from dietary studies and eDNA samples will be completed within the next two-three months, with final submission aimed for the end of October 2021. .

#### *Publications/ conference presentations/ other significant communications of research*

Holly presented her research at a major international conference (Society for Ecological Restoration 2019 in Cape Town), and at the Society for Ecological Restoration Australasia Conference in Darwin 2021. Holly also won a Gunduwa Regional Conservation Association project grant to assist in her research and has presented at the public Blues for the Bush and Dalwallinu Show and at Gunduwa's last AGM. Holly has also published a science communication piece for the Natural History of Ecological Restoration blog, and has an article accepted for publication by The Conversation, co-authored with Badimia elder Darryl Fogarty, on the importance of bringing western and traditional knowledge together in restoration.

#### *Additional comments*

There have been some changes to what we originally planned, but these changes relate primarily to experimental aspects rather than changes to research questions. There have been increasing publications recently relating to translocation of animals, many of which suggest that the translocations of reptiles are rarely successful. Holly has written a systematic review of these papers, which has provided backing to support that her study has collected significantly more rigorous data relating to the environmental requirements and pressures of the WSTS than any other comparable reptilian study. As such, her study provides essential data that may be used to understand how best to carry out translocations of the WSTS to increase the likelihood of successful re-establishment into new areas. Difficulties with the possibility of attaching trackers to individuals, and difficulties with extracting host DNA from scats for a genetics study has also led to a focus instead on using eDNA to understand how WSTS and predators utilise log piles.

### **REVISED PROJECT Evaluating stress levels in EPBC listed fauna inhabiting mining sites. A preliminary assessment (Project 3)**

#### *Background*

Human activities are intensely disruptive to ecosystems and present complex challenges for ecological management, particularly in relation to management of Threatened species. Although the physical footprint of mining activities may be restricted, the ecological impacts can be intensely disruptive to ecosystems that are often uncommon and fragile. Some impacts are clear-cut and abrupt e.g. direct habitat loss from the development of a mine pit; however, mining activities can also have numerous 'indirect' impacts that may be subtle, yet propagate across space and time.

Such subtle, yet significant activities encompass a diverse array of disturbances. These include anthropogenic noise, dust, vibrations, and artificial light pollution, small-scale fragmentation on genetic connectivity, and the introduction of disease and invasive species through various pathways during anthropogenic development. Further, peripheral contamination by metal-laden dusts produced during mineral extraction and processing (e.g. particulates of lead, arsenic, and cadmium) may also be chronically deleterious to resident wildlife. These substances can be deposited into natural areas as dust or by runoff or containment failure, and are persistent in the environment and may bioaccumulate, causing elevated stress levels and reduced fitness at multiple levels within the ecosystem. These disturbances may be profound, pervasive, diverse and interlinked, though their impacts may be overlooked due to their (i) cumulative, (ii) offsite, (iii) cryptic or (iv) secondary nature. Such disturbances are rarely considered in assessments of the impact of human activities on animal communities, yet can adversely affect the movement and behaviour of fauna, and have the potential to alter ecosystem functionality or trigger trophic cascades.

#### *Objectives*

The aim of this project was to identify the impacts of disturbances generated by mining activities on fauna, (both communities in general, and specifically EPBC listed species). Preliminary data collected at Karara via the projects of the CMSR students Sophie Cross and Holly Bradley indicate that both number and diversity of native vertebrates recorded on camera traps increases with increasing distance to the active mining operation. Conversely, feral species are able to thrive both in and immediately surrounding human disturbances, and in habitats with increased distance from the mining footprint. The current research project intended to explore this in further detail, and assess the extent to which anthropogenic noise generated by mining activities impact the presence, activity, and behaviour of native fauna. Further, this project aimed to evaluate the degree to which the peripheral deposition of potentially deleterious substances created by the Karara mining activities might cause metal bioaccumulation in local fauna (the EPBC listed malleefowl). The presence of the EPBC-listed species, the Malleefowl (*Leipoa ocellata*), within the operational area of the Karara Mining Ltd (KML) Iron Ore Project provides an excellent opportunity to assess these effects in an ecological dominant fauna group (birds).

#### *Project description*

#### *Noise impacts*

To assess the potential impacts of anthropogenic noise generated by mining activities on fauna communities, recording stations positioned in varying proximity to the active mine were established. Stations comprised five transects, set 0.5km (opposite the mine), 1km (Karara West), 2km (Exploration village bushland), 3.5km (Karara East), 6km (Blue Hills North), and 8km (Old Pipeline Track) from the active mining operation. Each transect comprised six remote sensing Reconyx Hyperfire covert cameras (spaced 150m apart), and two song meter mini bioacoustics recorders, set at the first and last camera trapping point of each transect (Fig. 1). Recording stations were designed to provide the activity of taxa (birds, mammals, and reptiles) through camera trapping photos, and to record ambient and anthropogenic noise levels within each site. In this way we will collect data for real time reactions to disturbance (mine noise, blasts, and road noises) and records of the activity of native fauna.



Fig. 1: Layout of sites at the KML site. Sites included five transects set at varying proximity to the active mining operation. Circles represent each trapping point.

#### *Contamination by heavy metals to EPBC listed fauna*

Malleefowl are recognised as conservation-dependent taxa under the EPBC Act. Due to increased restrictions relating to research involving threatened species (e.g., ethical issues, permits, necessity for highly experienced personnel to collect invasive samples), we indirectly assessed potential contamination and bioaccumulation of heavy metals from dust deposition from mining activities to malleefowl using feathers, eggshells, and sediment samples from malleefowl mounds. Collection of biological samples of priority species without direct impact to the threatened species allows for an assessment to be reliably inferred without direct impact or disruption to the threatened species.

We collected eggshells, feathers, and sediment samples through non-destructive core sampling of malleefowl mounds of varying ages and proximity to the active mining operation. Samples were collected in November 2020 to avoid disturbances to key breeding periods and events (breeding season during summer). The aim of the soil and eggshell fragment collection and analysis is to investigate if malleefowl mounds located close to the mine infrastructures (waste piles, crushing facilities, etc.) are experiencing an enhanced exposure to arsenic (As), cadmium (Cd) and lead (Pb) generated by the mining operations.

Twenty mounds were sampled. Soil was collected at three depths (0-10 cm; 10-20 cm; 20-30 cm) and five replicates of ca. 150 g were collected at each mound i.e. a total of 15 soil samples per mound. Of these replicates, two were submitted to ChemCentre for analysis of As, Cd and Pb.

Soil samples were analysed by ChemCentre, using the National Association of Testing Authorities (NATA) method iMET2SAICP for metal analysis in sediments and soils. This method uses inductively coupled plasma atomic emission spectrometry (ICP-AES) to quantify metals at specific wavelengths produced by the metal's excited atoms and ions.

The next two soil replicates were sieved through a 1.0 mm then through a 0.5 mm metal mesh sieve to collect egg shell fragments. The malleefowl egg shell is extremely thin and friable, and disintegrates easily when the nesting malleefowl works the soil around and in the nest. Not all malleefowl mounds were active but egg shell fragments were found in eight mounds. These eggshell fragments were mounted in resin at the John de Laeter analytical laboratory at Curtin University, and a suite of metals were quantified by laser ablation inductively coupled plasma mass spectroscopy (LA-ICP-MS). Two shell fragments per mound were analysed.

The fifth soil replicate is stored in the Curtin laboratories as a back up.

In addition to the collection of eggshell fragments, opportunistic collection of feathers and dried faeces took place. These have also been submitted to the ChemCentre (faeces) and the John de Laeter Centre for metal analysis.

Critically, it will significantly enhance the existing monitoring undertaken by KML on EPBC-listed species within its operational footprint by providing a benchmark understanding of the exposure to metal-laden dust and behaviour of these species. This information will assist KML in meeting its ministerial conditions associated with assessing the impacts of mining on EPBC-listed species, and further establish the company as a leader in science-driven best-practice ecological restoration.

#### *Key research tasks (noise and dust impacts)*

The proposed study aims to evaluate whether mining activities taking place at the Karara mine site are resulting in increased metal exposure to inhabitant fauna. To evaluate this we propose to undertake the following at disturbed and reference sites:

- Installation of camera traps and remote acoustic recorders;
- Analysis of camera trap and acoustic data;
- Soil and dust analyses of potential impact and reference sites;
- Collection of non-destructive core samples from malleefowl mounds of various ages to obtain feathers and eggshell fragments to assess potential bioaccumulation over time
- Collection and analysis of Malleefowl eggshell fragments and feathers from the mapped nest mounds for As, Cd and Pb content.

The above will generate information to assess if malleefowl experience chronic exposure to, and bioaccumulation of metals, which can reduce their ability to cope with environmental challenges.

#### *Resourcing*

This project was undertaken by a 0.8 FTE Post-Doctoral Fellow employed for 12-months through Curtin University.

This research will provide an important understanding of the cryptic impacts of mining operations upon native fauna. Critically, it will significantly enhance the existing monitoring undertaken by KML on EPBC-listed species within its operational footprint by providing a benchmark understanding of metal exposure and behaviour of these species.

#### *Final Project Reporting*

Fieldwork for Project 3 was initially delayed for 6 months due to restrictions imposed by the Western Australian Government, and Karara Mining Ltd. resulting from the current COVID-19 pandemic (as planned for/outlined in the Q1 report). During this time, Postdoctoral Research Associate Sophie Cross (SC) met with Gregory Oliver and Andre Marais to discuss logistical arrangements and field plans for field operations and data collection at KML. During the period where site travel and data collection were not feasible, SC worked with researchers in the ARC Centre for Mine Site Restoration, and Curtin School of Molecular and Life Sciences to design, collect and analyse data, and write a manuscript for a review of the literature relating to anthropogenic disturbances to fauna generated by human industries and developments. This review is now published within the journal *Global Ecology and Conservation*. During the period of no travel, SC also purchased acoustic recorders and equipment in preparation for field operations. After the lifting of COVID-19 restrictions by the WA government, and KML, SC planned for and commenced field operations in October 2020, with field operations completed in February 2021. During this period, SC made six site visits to set and maintain equipment, and collect data.

Fieldwork for the research project 3 (EPBC listed malleefowl – contamination assessment) was completed in November 2021 by SC, Bill Bateman (BB), and Monique Gagnon (MG). MG organised analysis of potential contamination by heavy metals of Malleefowl egg shell fragments and feathers, and soil samples collected from nests.

SC has worked with researchers at Curtin and UWA to prepare a manuscript relating to fauna management in mine site restoration, which is anticipated to be submitted for consideration for publication around July 2021. BB is currently working to analyse data for the noise impact and contamination study, with analyses anticipated to be completed by August 2021.

### Key Findings on the impact of noise

Based on preliminary analysis of camera trap data, no significant difference in animal detection seem to be related to noise levels. The animal diversity measured by the number of detections is not impacted by noise levels. There is a small increase in the number of animal detected between 1 and 3 km from mining activities, but no overall significance. This may be partly because Karara started hauling along the road about a month or so in the camera trap program.

### EPBC Listed Fauna Contamination assessment

#### Results from analysis of sediments. malleefowl eggshell fragments and dried faeces

The quantification of metals in soil samples is completed. As and Pb were detected at all sites but Cd was below the limits of detection in all samples except one single surface soil sample at mound No. 205 which was very close to the limit of detection.

There is very little variability in metal levels of sediments collected at various depths of the mounds i.e. within one sediment core, metal levels are similar at all depths. There is also very little variability between the different sediment cores taken within one malleefowl mound. However, a significantly higher inter-mound variability exists, with As levels varying from 4.77 ppm at mound no. 566 along ANFO Road, to 96.2 ppm at mound no. 205 close to the Terapod.

Similarly, Pb shows a low intra-mound variability but a high inter-mound variability although the magnitude of difference between metal levels is less. Levels of 5.4 ppm have been measured in the soil of mound no.566 while levels of 18.3 ppm were found at mound no. 205, close to the Terapod.

Levels of As and Pb measured can be compared to the Ecological Investigation Levels guideline values for soil quality (DEC, 2010). The Ecological Investigation Levels are indicative only, and are to be use as an initial screening to determine if metal concentrations in soils pose a risk to biota. Table 1 compares the measured values to the guidelines for Environmental Investigation Levels (DEC, 2010)

Table 1. Measured As and Pb levels in soils collected in malleefowl mounds located on the Karara mine site.

Mound No.	Location	Measured As (ppm)	Guideline (ppm)
566	ANFO Road	4.77	
205	Terapod	96.2	20
		Measured Pb (ppm)	
566	ANFO Road	5.4	600
205	Terapod	18.3	

There is limited published literature on As and Pb levels in land soils. A few reports have measured metals in proximity to mine sites, for example sediments collected in a freshwater catchment associated with historical mining operations in Victoria, Australia, contained As concentrations up to 1159 ppm (Smith et al. 2003). The naturally occurring As soil concentration can vary significantly, and if screening levels are exceeded, the relevant next step is to determine if the measured levels are naturally occurring in a widespread fashion, or if the high measured levels are related to a local contamination due to waste management issues.

The measured Pb concentrations in soil samples from the Karara mine malleefowl mounds are significantly below the guideline value consequently these levels are not expected to cause adverse impacts to biota coming in contact with these sediments. A thorough literature review is underway to further investigate the As and Pb measured levels in the soil samples collected in various malleefowl mounds from the Karara mine site.

Malleefowl feathers were found at only three mounds and are yet to be analysed as the identification and acquisition of a certified analytical standard appears to be problematic. Malleefowl faeces have also been collected at three locations (different from the feather locations) and as for soil samples, no Cd has been detected while As varied between 4 and 28 ppm while Pb was measured at levels between 1.6 and 9.3 ppm.

An attempt at collecting reference soil from malleefowl mounds, and malleefowl eggshell samples at Chingarrup, in the south-west of Western Australia, is being conducted. Soil and eggshell analysis will be conducted in the same labs, and with the same

methods, as described for the Karara samples. While it is expected that the Chingarrup soil and eggshell metal contents will differ significantly, the exercise aims at correlating soil metal contents with eggshell metal contents at each location.

Multivariate statistical analyses will be conducted to explore if the metal contents in malleefowl mounds at Karara are associated with dominant winds that can potentially carry metal-laden dust particles. Still by statistical analyses, eggshell metal contents will be modelled in relation to the mound metal contents. Reference malleefowl soil and eggshells from Chindarrup will be contrasted with the Karara’s malleefowl soil and eggshell. Completion of statistical analyses is expected to occur in Oct/Nov 2021.

The outcomes of chemical analyses of soil samples and malleefowl eggshells will inform management on metal levels the endangered malleefowl is exposed to at various locations of the Karara mine site. These levels will be compared to published levels at other sites, and to the reference Chindarrup samples.

References:

DEC Department of Environment and Conservation (2010) Contaminated Sites Management Series – Assessment levels for soils, sediment and water. 53 pages.

Smith E., Smith J., Smith L., Biswas T., Correll R., Naidu R. (2003) Arsenic in Australian environment: an overview. *Journal of Environmental Science and Health, Part A*, 38:223-239.

*Publications/ conference presentations/ other significant communications of research*

**Cross, S.L.,** Bradley, H.S., Tudor, E.P., Craig, M.D., Tomlinson, S., Bamford, M.J., Bateman, P.W. and Cross, A.T. A life of mine approach to fauna monitoring is critical for recovering functional ecosystems to restored landscapes. Under review.

**Cross S.L.,** Cross, A.T., Tomlinson, S., Clark-Ioannou, S.M., Nevill P.G. and Bateman, P.W. (2021). Mitigation and management plans should consider all anthropogenic disturbances to fauna. *Global Ecology and Conservation*. Online early. doi: 10.1016/j.gecco.2021.e01500

*Additional comments*

SC commencing new role outside of Curtin University as of 3/3/21. Research outcomes not anticipated to be impacted; work will be prepared for submission after role departure in collaboration with MG and BB.

**5. ALIGNMENT WITH RESEARCH PRIORITIES**

The proposed research as outlined above has been designed to deliver outcomes specifically towards the priority research areas as outlined in the KML Research Plan to Support Offset Requirements for the Malleefowl and Western Spiny-tailed Skink Karara Mining Limited – EPBC2006/3017 (CORP-EN-PLN-1039). The table below indicates the numbered items that this research program will deliver to.

**Table 1. Alignment with research priorities outlined in CORP-EN-PLN-1039**

Species & item	Delivery through the proposal	Final Progress
<b>Western Spiny-tailed Skink</b>		
1. Resolving the taxonomic and conservation status of WA taxa within the <i>E. stokesii</i> complex	No	N/A
2. Investigating goat exclusion/control zones around populations on pastoral leases.	Yes (Project 2)	Exclusion zones through fencing are no longer a component of the research as camera-trapping studies have detected very few goats within the study area.
3. Analysing the activities and diets of predators around populations and assess whether fox/feral cat control is required	Yes (Project 2 & 3)	Substantial. PhD candidate Holly Bradley has made extensive surveys of predation using both camera traps to identify likely predators at inhabited log piles and in the surrounding habitat, undertaking unbounded point count surveys targeting predatory bird species and also using plasticine models to record predation activity. The greatest predation threats to <i>E. s. badia</i> appear to be by proximity to disturbance, feral cats and Corvid species.

		Large collections of <i>E. s. badia</i> scat have also been collected to be assessed using visual detection to identify dominant components of the diet.
4. Trialling artificial refugia in areas where logs have been largely removed.	Yes (Project 2)	None to date. Complications to the progress, including the COVID-19 global pandemic, a requirement to expand the predation experiments (above) and to resolve refuge characteristics at high resolution using LiDAR have meant that Holly is unlikely to be able to progress this research during her PhD. She will, however, be able to provide a detailed research plan around which a trial can be constructed.
<b>Malleefowl</b>		
5. Defining appropriate genetic units for management of Malleefowl	No	N/A
6. Describing the habitat requirements of Malleefowl, with a view to identifying important habitat components that may underlie variations in breeding densities quantitative description and analysis involving at least 40 monitoring sites.	Yes (Project 1)	This has been partly completed in the distribution modelling of Project 1, which suggests that none of the habitats where the species is currently found have been optimal habitat in the past. Nevertheless, these relictual populations on the fringes of the distribution are now essential holdouts for Malleefowl. Although not extensively researched, fecundity in these fringe populations is likely lower than in previous core habitat, and research into fecundity, recruitment and juvenile movements has been strongly advocated.
7. Mapping fires in Malleefowl habitat and monitor the effects of fire at Malleefowl monitoring sites.	Yes (Project 1)	The gap analysis in Project 1 indicated this to be a substantial and pervasive knowledge gap. The distribution modelling provided could be readily updated with fire history data were these data available, but none had been located at the time that the gap analysis was finalised.
8. Review past and current translocation, captive, rearing and breeding programs.	Yes (Project 1)	This has been completed and summarised in the literature review and gap analysis. Very little progress has been made on this front in the last decade, and it remains unclear whether the species is a good candidate for translocation, nor how to harvest and rear chicks in captivity.

**Table 2. Alignment with recovery actions as outlined in CORP-EN-PLN-1039 identified to be relevant to research plan**

Species & item	Delivery through the proposal	Progress to date
<b>Western Spiny-tailed Skink</b>		
1. Determine the essential habitat requirements of mainland WA populations.	Yes (Project 2)	The habitat requirements of WSTS is one of the key focus areas of Holly's PhD. The characteristics of the log piles are being examined in a high level of detail through LIDAR as well as research into diet requirements and predation impacts.
2. Clarify the distribution and conservation status of the various taxa of <i>E. stokesii</i> and their population trends.	No	N/A
3. Identify threatening processes and techniques to mitigate their impact.	Yes (Project 2 & 3)	One of the major threatening processes for this species appears to be that its preferred habitat in fallen logs is also a preferred foraging habitat

		for predators, especially avian predators and feral cats.
4. Manage known populations in remnant woodland areas.	Yes (Project 2)	Research to date has only been at the Karara site. Some research may be undertaken as a part of Project 3 at Charles Darwin Reserve.
5. Protect habitat and create new habitat where required for populations to persist.	Yes (Project 2)	Work ongoing throughout 2020 will characterise inhabited log piles to a very high resolution (mm) for roughly a 10m radius surrounding the focal logs. These characteristics will hopefully be used to guide the creation of new habitat
6. Develop a strategy to translocate at-risk populations to suitable sites when the need arises.	Yes (Project 2 & 3)	Although Project 2 is unlikely to result in a trial translocation, it will provide an experimental design around which such a translocation could be undertaken.
<b>Malleefowl</b>		
7. Reduce permanent habitat loss	No	N/A
8. Reduce predation	No	N/A
9. Reduce isolation of fragmented populations	No	N/A
10. Promote Malleefowl-friendly agricultural practices	No	N/A
11. Examine population dynamics: longevity, recruitment and parentage	Yes (Project 1)	Current knowledgebase of these parameters are provided in the review paper (Project 1). However, these have all been identified as persistent knowledge gaps on which very little progress has been made in the last decade
12. Describe habitat requirements that determine Malleefowl abundance	Yes (Project 1 & 3)	These have been identified as part of a large-scale distribution modelling exercise. The distribution forcing factor that was notably absent in these models was fire history, and it is strongly advocated that, should such a data set be made available, it be incorporated into updates of these models.
13. Define appropriate genetic units for management of Malleefowl	No	N/A
14. Assess captive breeding and re-introduction of Malleefowl	Yes (Project 1)	A discussion of captive breeding and the reintroduction of Malleefowl is provided in the review paper (Project 1). However, these have all been identified as persistent knowledge gaps on which very little progress has been made in the last decade
15. Investigate infertility and agrochemicals	No	N/A
<b>Noise impacts on fauna</b>		
1. Enigmatic impact review	Yes (Project 3)	A review paper of the global literature assessing enigmatic impacts of human development on fauna has been published within the journal <i>Global Ecology and Conservation</i> .
2. Investigate impact of noise on fauna surrounding mining	Yes (Project 3)	COVID-19 delayed fieldwork and reduced the available field time, however SC has completed all fieldwork and data collection for noise impact study (3 months of data collection). SC in process of analysing bioacoustics data and camera trapping data. Manuscript in preparation.
<b>Quantifying exposure to deleterious material on EPBC fauna</b>	Yes (Project 3)	SC, BB, MG completed sample collection in October 2020. MG currently in process of

<b>1. Collect feathers, egg shells, scats of EBC listed Malleefowl</b>		analysing data, anticipated completion by Nov 2021. BB to obtain additional 'control' samples of egg shells and feathers from malleefowl mounds in SW WA, as a comparative tool. MG to coordinate analysis and results. MG and BB to prepare manuscript.
<b>2. Analyse feathers, egg shells, sediment samples for contaminants</b>	Yes (Project 3)	MG in process of analysing Reference sediment samples and feathers for metal contents. Anticipated completion for chemical analysis by August 2021. Anticipated completion of statistical analysis of metal data in eggshells and sediments by November 2021.

## 6. BUDGET

The drafted budget below recognises cost-saving opportunities by operating the three projects concurrently. Projects awarded on an individual basis would revised estimates. The budget for Project 3 has been revised in alignment with the decision not to proceed to submit for an ARC Linkage.

**Table 3. Detailed budget for proposed Projects 1-3**

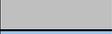
	Budget item		Curtin		Karara	
			Cash (\$)	In-kind (\$)	Cash (\$)	In-kind (\$)
<b>Project 1</b>	Personnel (coordination and supervision)	CM Young		1,191		
		CI Bateman		1,647		
		CI Cross		734		
		PD Mason (1.0 FTE)			25,000	
		PI Houlihan				10,000
	<b>Project 1 Total</b>		<b>0</b>	<b>3,572</b>	<b>25,000</b>	<b>10,000</b>
<b>Project 2</b>	Personnel (coordination and supervision)	CM Young		12,232		
		CI Bateman		16,915		
		CI Cross		10,363		
		PI Houlihan				30,000
		Travel to site, accommodation and messing			15,000	40,000
		Field equipment (GPS remote sensors)			15,000	
		eDNA Analyses (50 samples @ \$120 ea)			6,000	
		Laboratory equipment		25,000	2,000	
		Artificial logs			4,000	
		Camera Traps		10,000	8,000	
	Fencing				20,000	
	<b>Project 2 Total</b>		<b>0</b>	<b>74,509</b>	<b>50,000</b>	<b>90,000</b>
<b>Project 3</b>	Personnel (coordination and supervision)	CM Young		12,232		
		CI Gagnon		16,319		
		CI Bateman		16,915		
		PD Cross (0.8 FTE, 12 months)			100,000	
		PI Oliver				40,000
	Travel to site, accommodation and messing			1,500	60,000	

Field equipment (core sampler, balances, etc.)		15,000	5,000	
Camera Traps/ Bioacoustics			12,500	
Metal analyses of feather samples by ChemCentre, laser ablation analysis of egg shell fragments by John de Leather analytical laboratory.			28,500	
Laboratory equipment			5,000	
Laboratory sundries (resin for mounting egg shell fragments, carrier gas, etc.)		10,000	7,500	
Metal analyses of Soil and dust samples			15,000	
<b>Project 3 Total</b>		<b>70,465</b>	<b>175,000</b>	<b>100,000</b>

	<b>Curtin</b>		<b>Karara</b>	
	<b>Cash (\$)</b>	<b>In-kind (\$)</b>	<b>Cash (\$)</b>	<b>In-kind (\$)</b>
<b>Grand Total</b>		<b>148,546</b>	<b>250,000</b>	<b>200,000</b>

Curtin will issue two invoices for the work, \$100,000 in 2020 and \$150,000 in 2021.

## 7. PROJECT SCHEDULE AND MILESTONES

	Proposed timeline
	Revised timeline
	Underway
	Completed

**Table 4. Project 1 Key research tasks**

Key tasks	2018				2019				2020				2021	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Stakeholder analysis and consultation														
Review and Gap analysis														
Final Project Report														

**Table 5. Project 2 Key research tasks**

Key tasks	2018				2019				2020				2021		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	
PhD student Recruitment & enrolment															
Identification of sites & planning															
Home Range identification															Modified
Camera trapping															
Installation of fencing															No longer relevant
Monitoring of populations															
eDNA gut analyses of ferals (former)															Modified
Gut analysis from scats (updated)															
Publications and reporting															
Progress report to Karara															
Annual reporting to Karara															

