Northern Star Resources Limited

Carouse Dam TSF Cell 4 Project

Preliminary Documentation

EPBC Act Referral: 2021/9026

2 August 2022

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Document control

Revision	Details of review or changes	Prepared by	Date finalised
A	Draft provided to DCCEEW for discussion	Kiera Mews	19 May 2022
1	Draft Submission to DCCEEW for validation	Kiera Mews	2 June 2022
2	Final Submission of document addressing DCCEEW request for further information	Kiera Mews & Larissa Byrne	15 July 2022
3	Minor change to document and Offset Proposal	Kiera Mews & Larissa Byrne	2 August 2022

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both.

I am authorised to bind the approval holder to this declaration, and I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:_____

Full Name: John Albrecht_____

Position: Site Senior Executive_____

Organisation: _Northern Star (Carosue Dam) Pty Ltd_____

Date:__2 August 2022_____

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Introduction

On 26 August 2021, Northern Star Resources Ltd (Northern Star) referred the expansion of the Carosue Dam Tailings Storage Facility (TSF) (the proposed action) (Referral 2021/9026) to the Department of Climate Change Energy, the Environment and Water[1] (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The purpose of the proposed action is to construct an additional cell (Cell 4) and increase the capacity of the TSF at Carosue Dam to allow for continued operations.

Northern Star is currently depositing tailings into Cell 3 (Stage 3) of the existing TSF facility. This cell is nearing capacity, with the recently completed raise of TSF Cell 1/2 (Stage 8) brought online in May 2022. Cell 1/2 Stage 8 will provide enough capacity to last until December 2022, at which time deposition will be switched to TSF Cell 3 (Stage 4), construction of which will commence in June 2022. The TSF raise development plan requires TSF Cell 4 (Starter Embankment) to be brought online after filling of TSF Cell 3 (Stage 4). Northern Star therefore requires construction of the proposed TSF Cell 4 to begin in August 2022 to allow enough time for this cell to be built whilst TSF Cell 3 (Stage 4) is being filled, to avoid potential impacts to the continuation of operations.

Refer to Section 1.2 for details on the location of the controlled action area.

On 11 October 2021, Northern Star received formal notification from the Minister's delegate that the proposed action was a Controlled Action, to be assessed by Preliminary Documentation. The controlling provisions for the Controlled Action decision were:

- Listed threatened species and ecological communities (sections 18 & 18A of the EPBC Act).

The Department determined that the proposed action was likely to have a significant impact on Matters of National Environmental Significance (MNES). These included impacts on:

- Malleefowl (*Leipoa ocellata*) - Vulnerable.

Subsequent advice received from DCCEEW on 5 November 2021 outlined the specific information to be included in the Preliminary Documentation. This document provides the information requested as outlined in Table 1.

Table 1: Regulatory conditions fulfilled by the preparation of the Preliminary Documentation

Item	Additional Information Requested by the Department	Section
1	**Description of the action**	
1a	A description of the action should include the location of all works to be undertaken (including plans and maps) and elements of the action that may have impacts on EBPC Act listed threatened species and communities. It must also include details on how the works are to be undertaken (including stages of development and their timing) and design parameters for any structural elements of the action that may have impacts on EBPC Act listed threatened species and communities. Provide details of the action, including: • a summary and timing of all phases of the proposed action including construction, operations and decommissioning/rehabilitation • the activities associated with each phase of the proposed action • the location, boundaries and size (in hectares) of the proposed action area, any discrete disturbance areas, and any adjoining areas which may be	Section 1

[1] The Department of Agriculture Water and the Environment has now been changed to the Department of Climate Change, Energy the Environment and Water by the Administrative Arrangements Order made on 23 June 2022 and established on 1 July 2022.

Item	Additional Information Requested by the Department	Section
	directly or indirectly impacted by the proposed action. This information should be supported by mapping which meets the Guide for providing maps and boundary data for EPBC Act projects, referenced at item 9d. • a layout plan for the proposed action area, including the location and type of land use, key infrastructure and roads • the anticipated timing and duration (including start and completion dates) of each component of the proposed action, and associated impacts • a description of operational requirements of the action including any anticipated maintenance works • a description and likely timing of rehabilitation activities associated with the proposed action.	
1b	Any feasible alternatives to the action to the extent reasonably practicable, including, the alternative of taking no action, a comparative description of the impacts of each alternative on Matters of National Environmental Significance and sufficient detail to make clear why any alternative is preferred to another. Short, medium and long-term advantages and disadvantages of the options should be discussed.	Section 1
2	Listed threatened species and ecological communities (s18 & 18A) – Malleefowl (Leipoa ocellata) - Vulnerable	
	Baseline data	
2a	Include the results of an updated targeted Malleefowl survey and impact assessment for the development envelope, including the areas surveyed in June 2021. The survey and assessment must: i. Be conducted within the Malleefowl breeding season, as defined in the National Malleefowl Monitoring Manual referenced at item 9a (October to December). ii. Be conducted in accordance with the procedures outlined in the National Malleefowl Monitoring Manual referenced at item 9a, including but not limited to transect spacing of no more than 20m depending on the density of the landscape being searched. iii. Include a photo of all identified mounds, and historical photos of revisited mounds (where possible). iv. Detail any evidence of use by Malleefowl, including mound condition and status in accordance with the descriptors outlined in National Malleefowl Monitoring Manual referenced at item 9a. v. Provide an estimate of the size of the Malleefowl population likely to use the site and surrounds.	Section 2
2b	Include evidence and mapping that demonstrates the location of the 152.6ha of 'suitable habitat' that is located within the development envelope. This should differentiate between suitable habitat (such as that used for forage or cover) and critical habitat (such as that used for breeding).	Section 2

Item	Additional Information Requested by the Department	Section
2c	Include evidence and mapping to show how the extent and location of habitat that is available outside of the development envelope. The purpose of this is to show where displaced birds may reside and quantify potential contraction in individual bird ranges.	Section 2
2d	Details of the methodology used to determine and assess the suitability of habitat present in and around the site.	Section 2
	Assessment of impacts	
2e	Provide a description of all potential impacts (direct, indirect, consequential, and cumulative) on Malleefowl in the development envelope as a result of the proposal including but not limited to the following: i. Fragmentation of habitat and impacts on habitat use due to this fragmentation. The description must include details of the distances between the proposal site and alternative suitable breeding habitat including access to these external habitat areas. ii. The total area (in hectares) of habitat that will be impacted, including the number of Malleefowl breeding mounds that will be removed, and the number that will be impacted due to proximity to the TSF and supporting infrastructure. iii. Increased risk of vehicle strike iv. An estimate of the number of individual adult birds that will be impacted by the proposed activity, and discussion of the likely outcomes for these birds following being displaced from the proposed impact site. v. include a risk assessment of the potential impacts of the proposed action, including whether the nature and/or scale of the potential impacts are unknown, unpredictable or irreversible, and what confidence is placed on the predictions of relevant impacts vi. include details of any relevant policy guidelines, studies, surveys or consultations with subject-matter experts which were not included in the original referral.	Section 2.2
	Avoidance and Mitigation	
2f	Provide a Construction Environmental Management Plan (CEMP) that details how potential environmental impacts associated with construction activities will be managed. The CEMP provided should be developed consistent with the Department's Environmental Management Plan Guidelines referenced at item 9b. The CEMP should include, but not be limited to: i. Procedures to protect fauna during construction, through ensuring that a qualified fauna spotter catcher is present during all clearing and is given sufficient authority to guide clearance activity whilst mitigation measures are undertaken. This should ensure that Malleefowl have safely moved out of the development envelope identified for clearing, of their own volition, before the habitat is cleared.	Section 2.2.2

Item	Additional Information Requested by the Department	Section
	ii. Management actions to avoid and reduce risks to Malleefowl that could be present on site at the time of clearing, such as clearing outside of breeding season. iii. Measures to reduce risk of Malleefowl collision with construction machinery or other vehicles. Suitable measures may include the imposition of suitable vehicle speed limits for all vehicles travelling within any part of the development envelope. iv. Details of how clearing activities will be conducted to allow Malleefowl to move into adjacent native vegetation ahead of clearing activity.	
2g	Provide information (including engineering, technical and operational considerations) that demonstrates why the TSF must be constructed in the proposed location, and not in an alternative location which does not impact MNES. This information should include discussion of any alternative designs that were considered but ruled out prior to acceptance of the current proposed design.	Section 1.2
4	**Offsets**	
4a	An offset is required to compensate for all predicted or potential residual significant impacts (direct and indirect) to EBPC Act listed threatened species and communities, including the Malleefowl. Please provide an Offset Proposal that meets the principles of the *EPBC Act Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (2012)* referenced at item 9c. The Offset Proposal must include, but not be limited to, the following: Details of proposed direct offsets, including: i. A description of the proposed offset site(s) including location, size, current condition and relevant ecological/species habitat features, landscape context and cadastre boundaries of the offset site(s), supported by mapping which meets the Guide for providing maps and boundary data for EPBC Act projects, referenced at item 9d. ii. Baseline survey information to determine the extent, type and quality of Malleefowl habitat at the offset site(s) that was conducted in accordance with relevant guidelines. iii. An outline of the management and monitoring strategies and actions proposed to ensure the offset site attains and/or maintains the same or better habitat quality as the quality of the impact site. iv. Current and likely future tenure of the proposed offset site and details of how the offset site will be legally secured for the full duration of the impact. v. Justification of how the Offset Proposal meets the requirements of the EPBC Act Offsets Assessment Policy, referenced at item 9c.	An Offset Proposal is provided in Appendix C
4b	If possible, details and justification demonstrating how the proposed direct offset will maintain or improve the viability of the protected matter(s) consistent with the EPBC Environmental Offsets Policy referenced at item 9c This includes: i. A conservative estimate of the offset completion criteria (i.e. environmental outcomes) to be achieved, and reasoning for these in reference to the	Details are included in the Offset Proposal (Appendix C) An Offset Environmental Management Plan will be implemented on

Item	Additional Information Requested by the Department	Section
	National Recovery Plan for Malleefowl at item 9e and relevant threat abatement plans (items 9 f-i). ii. Milestones to demonstrate adequate progress towards achieving the offset completion criteria.	commencement of the action.
4c	If desired, a research component that clearly articulates costing and methodology for scientifically robust research activity that will improve Malleefowl outcomes and/or influence Malleefowl management activity including updates to the Malleefowl Recovery Guidelines listed at item 9e.	Not applicable
5	**Ecologically sustainable development**	
5	Please provide a discussion of how the proposed action meets the principles of ecologically sustainable development, as defined in s.3A of the EPBC Act.	Section 4
6	**Environmental record of the person proposing to take the action**	
6	The preliminary documentation must include details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: a) The person proposing to take the action. b) For an action for which a person has applied for a permit, the person making the application. If the person proposing to take the action is a corporation, this extends to the executive officers of the corporation as well and details of the corporation's environmental policy and planning framework must also be included.	Section 5
7	**Other approvals and conditions**	
7	The preliminary documentation must include information on any other requirements for approval or conditions that apply, or that you reasonably believe are likely to apply, to the proposed action. This must include: a) a description of any approval obtained or required to be obtained from a State or Commonwealth agency or authority (other than an approval under the EPBC Act), including any conditions that apply (or are reasonably expected to apply) to the action; and a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action. b) information on impacts to the proposal in the event that the Western Australian Environmental Protection Authority does not agree to vary the condition attached to the associated native vegetation clearing permit that prevents direct impacts to Malleefowl breeding mounds.	Section 6 Please note 7b is no longer required as the Western Australian Environmental Protection Authority has aggreed to vary the condition.
8	**Economic and social matters**	
	Please provide further detail on the social and economic costs and/or benefits of undertaking the proposed action, including: c) estimate of any anticipated economic costs and/or benefits (in AUD) d) basis for any estimations of costs and/or benefits e) potential employment opportunities expected to be generated at each phase of the proposed action f) details of any public and stakeholder consultation activities, including the outcomes	Section 7

Item	Additional Information Requested by the Department	Section
	g) details of any Indigenous stakeholder consultation - noting that the traditional owners of the site are the Nyalpa Pirniku, Maduwongga and Jardu Mar People. This consultation should seek to identify, protect and manage any tangible and intangible cultural heritage values, including culturally significant flora and fauna.	
9	**Relevant standards, policies and other guidance material**	
	The response to this request for additional information must make reference to all relevant standards, policies and other guidance material published by the Department. Any instances where published guidance is not followed must be justified. Where no Commonwealth standards exist, state government and/or industry standards may be useful. These include but are not limited to: a) National Malleefowl Monitoring Manual: 2020_1 Edition (Revised June 2020). Available from: https://www.nationalmalleefowl.com.au/wp-content/uploads/2020/08/Monitoring-Manual-v2020_1.pdf b) Department of the Environment (2014). Environmental Management Plan Guidelines. Canberra, ACT: Commonwealth of Australia. Available from: https://www.environment.gov.au/system/files/resources/21b0925f-ea74-4b9e-942e-a097391a77fd/files/environmental-management-plan-guidelines.pdf c) Department of Sustainability, Environment, Water, Population and Communities (2012). Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy. Canberra, ACT: Commonwealth of Australia. Available from: https://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf d) Department of Agriculture, Water and the Environment (2021). Guide for providing maps and boundary data for EPBC Act projects. Canberra, ACT: Commonwealth of Australia. Available from: https://www.environment.gov.au/system/files/resources/5bb0509e-c4b5-4f7a-910b-5b04d82db491/files/epbca-maps-data-guidelines.pdf e) The National Recovery Plan for Malleefowl Leipoa ocellata (2007). Department of Environment and Heritage, South Australia. https://www.awe.gov.au/environment/biodiversity/threatened/recovery-plans/malleefowl-leipoa-ocellata-2007 f) Department of the Environment (2015). Threat abatement plan for predation by feral cats. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats g) Department of the Environment and Energy (2016). Threat abatement plan for competition and land degradation by rabbits. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016 h) Department of the Environment, Water, Heritage and the Arts (2008). Threat abatement plan for predation by the European red fox. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/predation-european-red-fox	Section 8

Item	Additional Information Requested by the Department	Section
	i) Department of the Environment, Water, Heritage and the Arts (2008). Threat abatement plan for competition and land degradation by unmanaged goats. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-unmanaged-goats	
10	**Other**	
10	a) The response to this request for additional information must include a reference table demonstrating where in the additional information requirements are addressed. Where appropriate, the response must be supported by: i. evidence-based conclusions based on the best available peer-reviewed scientific literature with supporting references cited or expert opinion provided. ii. maps, plans, diagrams and technical information (e.g. specifications, schematics) any images provided must be clearly annotated, in colour and of high resolution; All maps submitted as part of the response to request for additional information must be consistent with the Departments Guide for providing maps and boundary data for EPBC Act projects, referenced at item 9d. iii. scientifically-robust methodologies that are appropriate for purpose, and sufficient description of the methodology used and justification of why the methodology was selected. b) The response will form part of the preliminary documentation that must be published for public comment. Therefore, the contact details of Departmental officers must not be included in the response. The response should not contain commercial in confidence markings. If the response contains sensitive information, please discuss with the assessment officer.	Table 1

1 Description of Action

1.1 Summary of Proposed Action

Northern Star (Carosue Dam) Pty Ltd (Northern Star) proposes to expand the Tailings Storage Facility (TSF) at the Carosue Dam Operations with the construction of TSF Cell 4 and associated infrastructure. The expansion of the TSF is required to ensure continued operation of the mine. The Carosue Dam Project is located approximately 110km north-east of Kalgoorlie in the Pinjin region of the Eastern Goldfields. Carosue Dam was previously owned by Saracen Gold Mines Pty Ltd; however, in February 2021, a merger of equals between Northern Star Resources and Saracen Mineral Holdings was completed. Northern Star (Carosue Dam) Pty Ltd is a wholly owned subsidiary of ASX listed company Northern Star Resources Limited.

To continue processing operations into the future, Northern Star has developed a 10-year TSF permitting design, which includes the construction of an additional cell adjacent to the existing TSF. The project occurs on existing mining tenure (M28/269 & M31/295) and will involve 217.3ha of vegetation clearing within a 229.1ha envelope, of which 52.5ha is considered suitable (used for foraging and cover) and 100.1ha considered critical (used for breeding and foraging) Malleefowl habitat. Within the development envelope, 11.8ha has been previously cleared. The project was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as the development will involve the removal of Malleefowl (*Leipoa ocellata*) mounds within the disturbance footprint.

Northern Star engaged a fauna consultant in June 2021 to critically assess the impacts of the proposed development on Malleefowl within and adjacent to the clearing envelope over an 842ha polygon, with a subsequent survey conducted in December 2021 to confirm mound status during breeding season. These reports have been attached as Appendix A. The June 2021 survey involved operators searching along gridlines 40m apart. Whilst eight nesting mounds of relatively recent occupation were located, there was no evidence of current Malleefowl activity.

The December 2021 a targeted Malleefowl survey was conducted by four operators from December 4 to 9, 2021 involving a total of 525km of traverse along gridlines 20m apart. Nesting mounds were assessed according to the National Malleefowl Monitoring Manual. A total of 23 nesting mounds were located, of which, 13 were 'long unused' and, apart from an indication of past use of habitat by Malleefowl, are of no significance for ongoing existence of Malleefowl in the area. Ten nesting mounds of relatively recent occupation were located, two of which were not found in the June 2021 survey. There were no currently occupied ('active') nesting mounds and no evidence of current Malleefowl activity was found throughout the survey area. Four of the ten nesting mounds were partially degraded, judged not to have been used for at least 5 to 10 years, and classified as 'inactive abandoned'. Six were well-formed, judged to have been used within the past 5 years, and classified as 'inactive recent'. Seven of these nesting mounds fall within the TSF Cell 4 disturbance envelope, four of these determined to be 'inactive recent' and three were 'inactive abandoned'.

The specialist report assessed the proposed development against the EPBC Act's significant impact guidelines (Commonwealth of Australia, 2003) for the Malleefowl and determined that this activity and the removal of unoccupied mounds within the disturbance footprint, would not have a significant impact on the species. This report was submitted with the referral application (2021/9026). Northern Star is committed to conducting clearing of the Project in line with the conditions set out in the approved Native Vegetation Clearing Permit (CPS8000/2) and the Construction Environmental Management Plan (CEMP) to ensure potential impacts to individuals of this species are minimised as far as practically possible.

1.2 Location and layout of Proposed Action

Carosue Dam is located approximately 120km northeast of Kalgoorlie in the Pinjin area of the eastern Goldfields on the boundary between the Shire of Menzies and the City of Kalgoorlie Boulder. Pastoral Stations Pinjin and Menangina South surround Carosue Dam as well as crown land and mining tenure. Miscellaneous Licence L28/24 is the only access road that extends southwest from Carosue Dam for approximately 50km to connect to the nearest public road, Yarri Road (Figure 1).

The proposed TSF expansion and associated infrastructure is located adjacent to the existing tailings storage facility and will abut the western side of the existing wall on mining lease M28/269 and M31/295. The development is surrounded by other key mine infrastructure as seen in Figure 2 and 3. The action area development footprint is 229.1ha. Within this boundary, approximately 217.3ha of native vegetation clearing will be required for the development of TSF Cell 4 and associated infrastructure including roads, topsoil stockpiles, diversions, construction laydown and access.

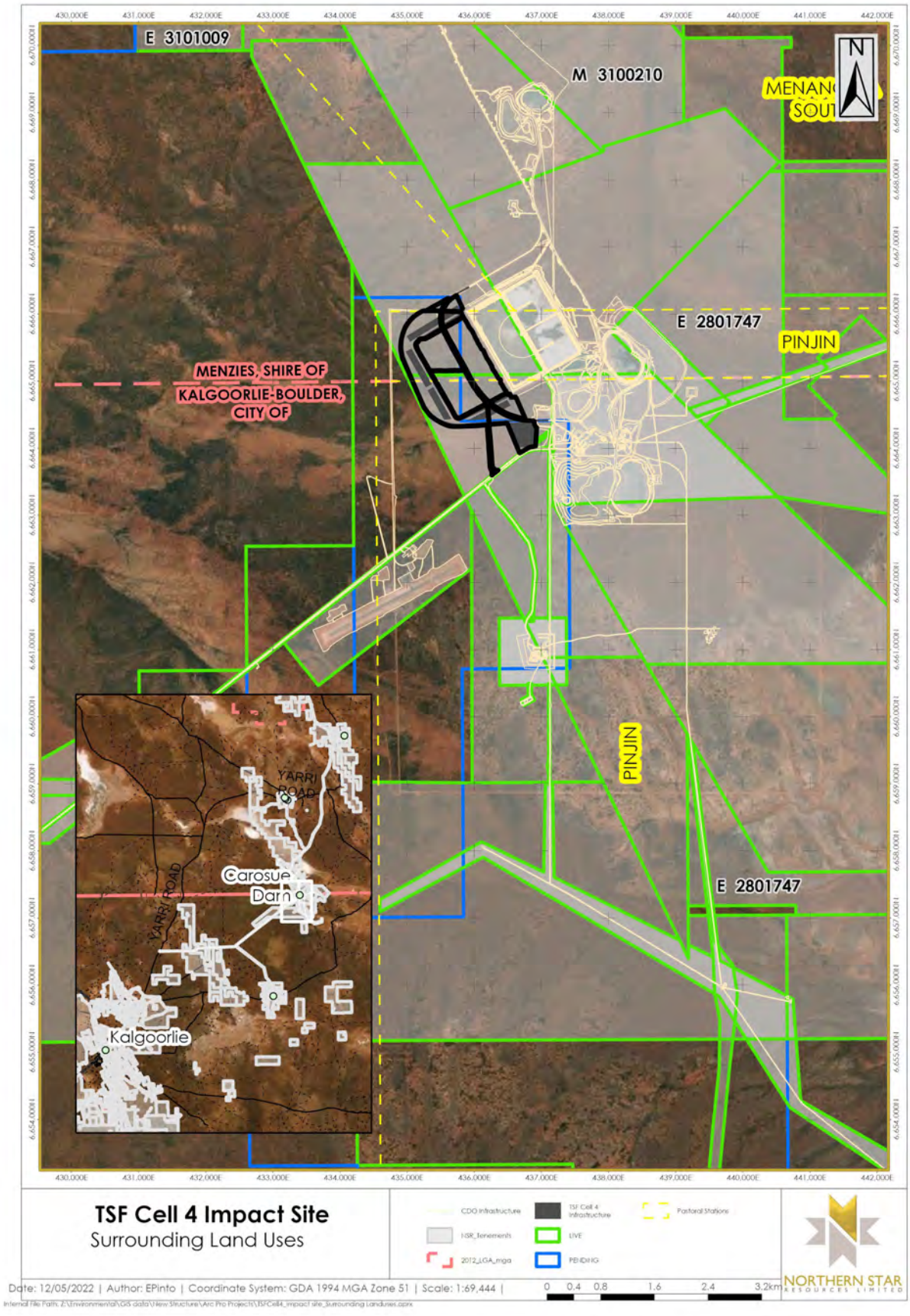

Figure 1: Surrounding land use to Carosue Dam

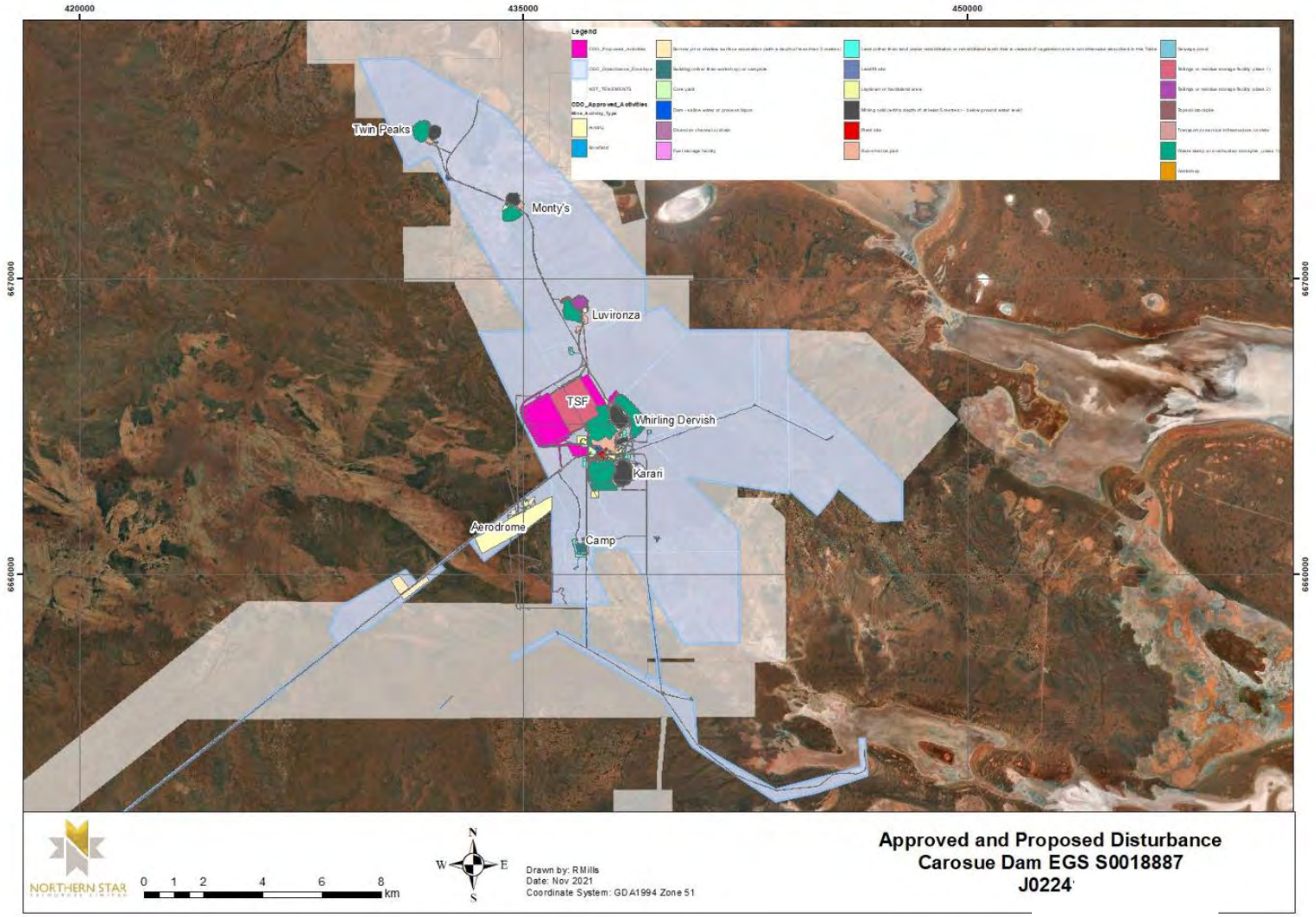

Figure 2: Surrounding mine infrastructure to the controlled action

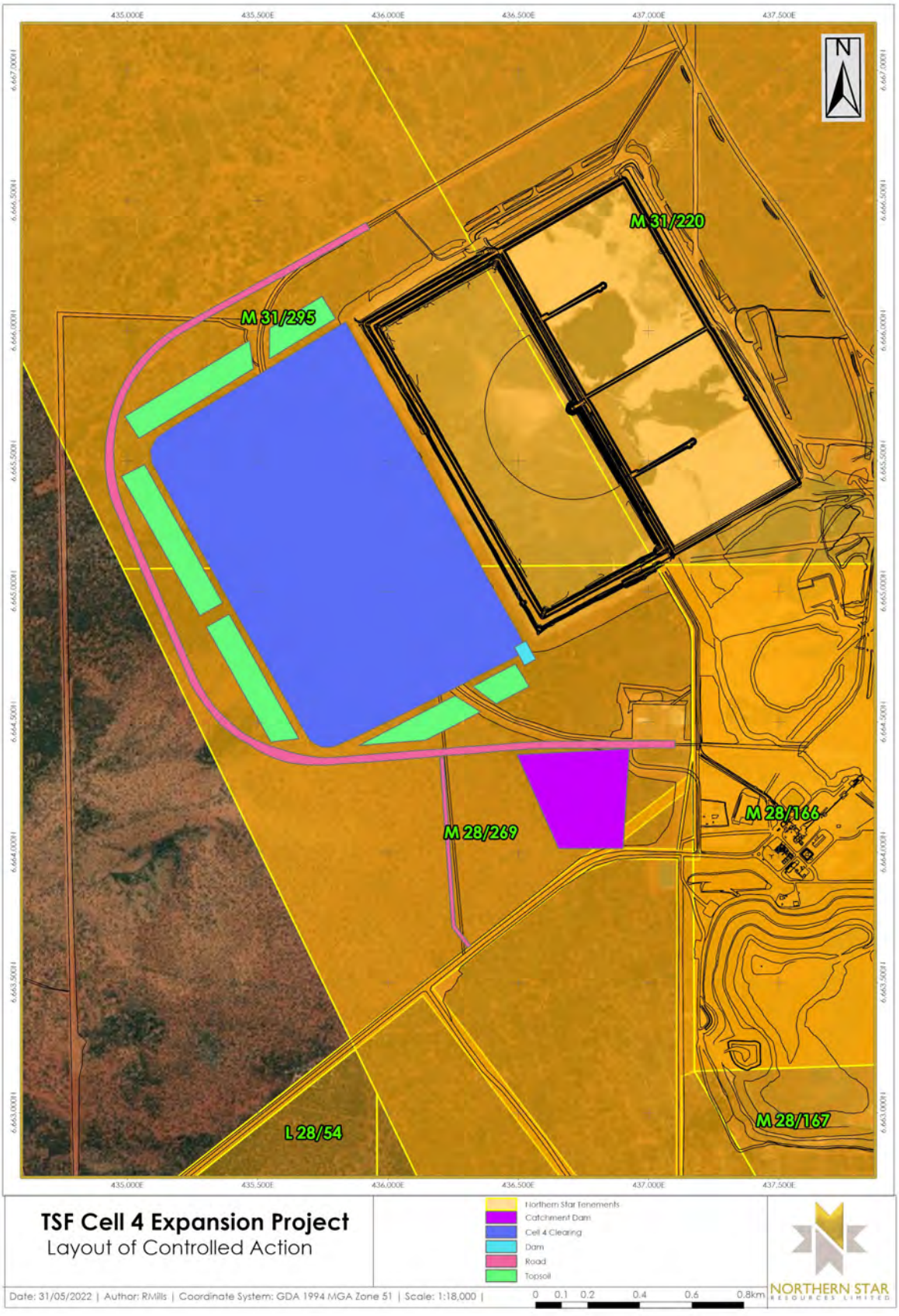

Figure 3: Layout of the Controlled Action

1.3 TSF Cell 4 Design Parameters

TSF Cell 4 will initially be constructed to an embankment crest elevation of RL 375.5m (Starter Stage), with a further 4 stages of upstream raised embankments, which will provide approximately 14.06Mm³ of cumulative storage volume over the current life of mine.

Table 2: Cell 4 Staged Lifts

Stage	Embankment Crest RL (m)	Storage Surface Area (ha)	Storage Vol. (Mm3)
TSF Cell 4- Starter	375.5	120.7	4.44
TSF Cell 4- Stage 1	377.5	121.4	2.42
TSF Cell 4- Stage 2	379.5	119.1	2.42
TSF Cell 4- Stage 3	381.5	118.1	2.39
TSF Cell 4- Stage 4	383.5	117.1	2.37

The starter embankment for Cell 4 will be constructed using compacted clayey mine waste. Similarly, the upstream raised embankment of Cell 4 will be constructed using compacted dried tailings. At the maximum crest level of RL 383.5m, the height of the Cell 4 embankment will be about 18.5m.

The downstream batters of each lift will be capped with a nominal 0.5m-thick mine waste layer to reduce erosion and facilitate future rehabilitation. Each upstream embankment lift will have downstream slopes of 1:2.75 (vertical to horizontal) and 1:2 (vertical to horizontal) upstream slopes. All the starter and upstream embankments will consist of homogeneous embankment constructed using clayey materials. Clayey mine waste is to be placed in thin layers not exceeding 300mm thickness, moisture conditioned to ±2% optimum moisture content (OMC) and compacted to 95% SMDD.

The design width of starter embankment is 8m, while the width of upstream embankment is 6m. The embankment crest will have a 2% design crossfall towards the upstream side as well as nominal 0.4m-high windrows at both downstream and upstream edges. Due to the crossfall of the embankment crest (sloping inwards towards the storage), there will be regular 'drainage' gaps (predominantly at discharge points) in the inner windrow (upstream side) to allow for discharge from the crest of any collected rainfall runoff. This will be managed via sediment traps at the toe of the new facility (Tetra Tech Coffey Pty Ltd (2021).

1.4 Timing and Schedule for Proposed Action

Clearing for the construction of TSF Cell 4 and associated infrastructure, where possible, will be undertaken outside of Malleefowl breeding season, between April and August, inclusive. This is to ensure mounds are not active during clearing activities and individuals can move into adjacent suitable habitat. Clearing is currently anticipated to occur no later than July 2022 to allow construction to commence in August 2022. Provision for clearing within breeding season, if necessary, is outlined in the CEMP and aligns with conditions currently approved in Native Vegetation Clearing Permit 8000/2. Construction of Cell 4 is expected to take seven months (plus an additional 2 months to install miscellaneous items such as pipework, power, fencing, etc), with deposition of tailings material scheduled for January 2024. Operation of the facility will continue for the current life of mine (7+ years).

Table 3 provides a summary and timing of all phases of the proposed action including construction, operation, and decommissioning/rehabilitation, outlining the activities associated with each phase. The anticipated timing and duration of each component, as well as potential associated impacts, have also been included. Potential impacts of the proposed activity, along with mitigation measures are addressed in detail in Section 2.

Table 3: Summary and timing of all phases of the proposed action

Phase	Activity Description	Start Date	Completion Date	Duration	Potential Impacts
Construction	Clearing of impact area	August 2022	August 2022	1 month	Habitat reduction, Vehicle strike
	Construction of embankments	September 2022	April 2023	7 months	Noise, dust
	Compaction & construction of roads	September 2022	October 2022	2 months	Noise, dust, vehicle strike
	Redirection of surface water flows through construction of drainage channels	September 2022	October 2022	2 months	Changed surface water flows Flooding/Water Starvation
Operations	Commence deposition of tailings into Cell 4	January 2024	January 2031	7 years	Noise, Dust
	Maintenance of infrastructure	January 2024	January 2031	7 years	Noise, Dust
	Twice daily inspections of pipelines during operation	January 2024	January 2031	7 years	Noise, Dust
	Road maintenance including dust suppression and surface grading	August 2022	January 2031	9 years	Noise, dust, vehicle strike
Decommissioning & Rehabilitation	Cease deposition and allow consolidation and drying of tailings material	January 2031	July 2031	6 months	Noise, Dust
	Reshape and batter slopes to	August 2031	January 2032	6 months	Noise, Dust
	Cap top surface with competent rock;	January 2032	March 2032	3 months	Noise, Dust
	Respread topsoil;	March 2032	April 2032	2 months	Noise, Dust
	Rip on the contour	April 2032	April 2032	1 month	Noise, Dust
	Seed with local native species	April 2032	April 2032	1 month	Noise, Dust
	Rehabilitation monitoring	September 2032	September 2042	10 years	Nil

1.5 Rehabilitation Activities

Northern Star are required to submit a Mine Closure Plan outlining all rehabilitation and closure activities to the Department of Mines, Industry Regulation and Safety (DMIRS) under state legislation, with each submission of a Mining Proposal. The Carosue Dam Mining Proposal (Revision 3.1) and associated Mine Closure Plan (Revision 7.0) was approved by DMIRS on 25 January 2022. A summary of rehabilitation activities associated with the proposed action have been included below.

A preliminary closure strategy has been developed for the current CDO Paddock Tailings Storage Facility (Cells 1-3). Rehabilitation of the TSF Landform will be undertaken in accordance with the Northern Star Mine Closure Plan with supervision and sign off from the Engineer of Record.

Specifications outlined in the 2017 TSF closure strategy include profiling landform batters to a final design angle (18°), armoured with a 1-metre cover of competent fresh rock and topsoiled (100mm cover). The tailings surface will be covered with waste rock to a specified depth and covered with topsoil.

The general closure and rehabilitation concept of the proposed Super Cell 1-3 and Cell 4 has been outlined in the design report (Tetra Tech Coffey Pty Ltd, 2021). For preliminary planning purposes the following rehabilitation principles were adopted. These will be refined where necessary and included in subsequent revisions of the Mine Closure Plan as required by DMIRS.

General

Once tailings deposition is complete and the top surface has been allowed to dry, settle and consolidate as pore water drains from the tailings mass, the top surface of the storage can be rehabilitated. Due to the segregation of tailings, consolidation settlement of tailings around the embankment (structural zone) is expected to be considerably faster with consolidation time increases with distance away from the structural zone towards the decant pond in the middle.

- Geotechnical investigation including CPTu probing on the tailings beach shall be conducted to investigate the consolidation and strength parameters of the tailings.
- Based on available tailings properties at this stage, a concaved (store and release cover) profile is favoured, combined with a store-and-release type cover system. The choice of the final profile will largely be determined by the tailings geochemistry and will be subject to a further study as part of detailed rehabilitation planning.
- A safe construction methodology of the cover layer will be developed especially over the soft fine failings, in the middle of TSF. Consolidation and the corresponding gain in shear strength around this zone will occur at a very slow rate which may necessitate commencement of cover layer prior to completion of consolidation.
- The top surface may be segmented into sub-catchments to limit runoff potential to the centre of the facility after closure. The design event for any hydrological assessment will be the 100-year rainfall event. The requirement for a spillway at closure would be subject to further studies as part of detailed rehabilitation planning.
- The TSF embankment batter slope and top surface will be revegetated by applying a cover system and topsoil.

Top surface cover

- Placement of a capping layer comprising a 500mm-thick Net Acid Formation (NAF) competent waste rock in one application over the tailings beaches for tailings erosion mitigation.
- The waste rock comprising a mixture of oxide-waste and fresh-waste.
- Placement of a nominal 150-200mm-thick topsoil (overlying the waste rock layer) as a vegetation growth medium, ripped and seeded with local species.
- There may be issues with the migration of topsoil fines into the capping waste rock layer if there are ‘open voids’ in the rock forming this layer. A geotextile used as a separator between the topsoil and waste rock layers could be considered.

Perimeter embankment batters

- The downstream batter slope of the downstream waste dump will be reshaped to form an overall gradient of 1V:3H (18^{o}).
- The batter of the reshaped embankments will be further sheeted with a nominal 100 mm-thick topsoil layer as a vegetation growth medium, ripped and seeded with local species.

Preliminary rehabilitation activities for the Carosue Dam Tailings Storage Facility include:

Topsoil recovery

Where appropriate, topsoil removed during site clearing and the TSF embankment and associated infrastructure construction will be stockpiled downstream of the TSF to assist with future rehabilitation. The assessment of suitable topsoil will be carried out as part of detailed rehabilitation planning.

Decommissioning

The decant pump infrastructure is expected to be removed as part of the TSF closure. During the decommissioning period, water at the decant will be allowed to evaporate. Monitoring and recovery bores will be plugged and decommissioned as required.

Closure

At closure, the TSF will remain a permanent feature of the landscape, with the deposited tailings completely enclosed by an engineered perimeter embankment comprising compacted fill materials and waste rock capping. Suitable topsoil for rehabilitation will be sourced from designated stockpiles. These rehabilitation materials should be won from the designated stockpiles using an excavator and transported to the TSF using small dump trucks. The materials should be placed and spread to reduce segregation.

The downstream slopes of the final embankments will be progressively covered with appropriate growth medium, contour ripped, seeded with native species and fertilised as appropriate. At final closure, the TSF decant area will be sealed by:

- Removal of the filter rock to a level between 2 and 5m below the surrounding tailings surface;
- Covering the rock layer surrounding the decant structure with geofabric to prevent movement of fine material through rock voids;
- Backfilling excavations with tailings to the adjacent tailings level; and
- Capping the decant area with a minimum 500mm of clayey mine waste (to be validated with field trials or otherwise).

Treatment of the decant area as outlined above will reduce ingress of water into the TSF foundation and limit groundwater mounding under the facility. The decant accessway will be dozed down to the surrounding tailings surface prior to placement of mine waste covering.

1.6 Consideration of Alternatives to the Proposed Action

Consideration of alternative options to TSF Cell 4, including In-Pit storage facilities, alternative locations for a new paddock-style tailings facility or not proceeding with the project were reviewed. Northern Star did not deem any of these options feasible due to environmental and/or economic aspects.

The existing TSF (Cell 1-3) is located on mining tenements M31/220, M31/295 and M28/269. The TSF embankment toe is approximately 350 m west of the Whirling Dervish open pit and 1km north-west of the process plant. The facility is constrained by leases to the west.

The TSF location was selected based on several factors, including geotechnical suitability and low permeability foundation for the construction of a TSF, its proximity to the process plant and the Whirling Dervish Pit, thus minimising pipework and cost, reducing risk of impacts to infrastructure and potential future gold development.

Environmental impacts were also taken into consideration during the site selection process, with the aim to reduce impacts as much as possible. The ability to utilise the existing TSF wall will result in less clearing of native vegetation compared to a stand-alone facility. Extensive flora and fauna surveys have been conducted in the area to understand the impacts to any priority species in the area. During these surveys, listed Threatened or Priority species were recorded, including Malleefowl (*Leipoa ocellata* – Vulnerable) and *Eremophila arachnoides* subsp. *tenera* (Priority 3).

Malleefowl habitat extends throughout the mining area and regionally. The selected location of the TSF aims to minimise impacts to this habitat through reduced clearing due to the proximity to existing disturbance and infrastructure, and reduced risk of habitat fragmentation. Populations of *Eremophila arachnoides* subsp. *tenera* only occur to the north of the existing TSF and therefore will not be impacted by the proposed location of Cell 4 to the west.

Due to existing disturbance and infrastructure, locations to the east and south of the existing facility were not a viable option. Table 4 identifies the main environmental impacts associated with each option.

Table 4: Environmental impacts of site options

Option (direction from existing facility)	Malleefowl (*Leipoa ocellata*) Vulnerable	*Eremophila arachnoides* subsp. *tenera* (P3)	Heritage	Comment
West	Yes	No	No	Malleefowl habitat present – mounds recorded in the area. No Priority Flora
North	Yes	Yes	No	Connectivity of Malleefowl habitat present – mounds recorded in the area Priority Flora recorded throughout this area.
East	No	No	No	Area highly disturbed – not an option due to existing infrastructure
South	No	No	No	Area highly disturbed – not an option due to existing infrastructure

Based on both operational considerations and environmental impacts, constructing the facility to the west of the existing TSF was the most desirable option.

2 Threatened Species and Ecological Communities – Malleefowl (*Leipoa ocellata*)

2.1 Baseline Data

A number of Environmental Assessments including vegetation and flora surveys, and targeted fauna surveys have been conducted throughout the Carosue Dam region contributing to robust baseline data for the area. Surveys relevant to the impact area of the proposed action have been summarised below and included in Appendix A.

2.2 Previous Surveys

Previous surveys have been conducted in the past across the Carosue Dam region. Details from the relevant surveys covering the proposed impact area are included below.

November 2012

In November 2012 Alexander Holm & Associates conducted a targeted Malleefowl survey to assess flora and vegetation within a 680ha survey envelope surrounding the existing TSF facility at Carosue Dam. Approximately 600ha of this survey area falls within the current survey envelope, the remainder is now occupied by the expanded TSF.

Malleefowl habitat considered most at risk from mining operations and adjoining areas encompassing approximately 90% of the 2012 survey area was searched for evidence of Malleefowl. Operators searched along gridlines 50m apart. Malleefowl were active in the survey area. Three 'active' and three 'long-unused' nesting mounds were located, tracks observed and two birds sighted during the survey (Alexander Holm & Associates 2012).

January 2019

Alexander Holm & Associates and Bamford Consulting Ecologists were contracted in January 2019 to conduct reconnaissance vegetation, flora and fauna surveys within a 3135ha area associated with seismic surveys surrounding Carosue Dam operations area but did not include the disturbance area associated with the TSF expansion.

The 2019 survey considered earlier surveys that fell within or adjoined the project envelope, including the November 2012 survey outlined above, to produce a unified land unit/vegetation association map and description covering a 4896ha area that included the disturbance envelope (Alexander Holm & Associates 2019).

Mining operations at Carosue Dam occupy 619ha of the unified land unit map area. After taking this disturbance area into account 42%, of the remaining 4276ha is occupied by plains supporting acacia shrublands with sparse overstoreys of eucalypts and casuarina (land units 4a and 4b). Chenopod shrublands occur on approximately 36% of the area either on calcareous plains (land unit 4c) or alluvial plains (land units 5a and 5b). Sand plains and sandy rises occupying 5% of the area, typically support spinifex tussock grasslands with sparse eucalypt overstoreys. Low hills and rises on laterite, basalt or felsic rocks occupy the remainder.

Malleefowl were not searched for systematically during this reconnaissance survey, however it was noted that they were active in the survey area and three birds were sighted.

June 2021

Alexander Holm & Associates were contracted by Northern Star in June 2021 to revise and update information from earlier surveys on vegetation and land resources within 842ha surrounding and including a disturbance envelope associated with expansion of the TSF to accommodate Cell 4.

Approximately 60% of the TSF survey area is occupied by either alluvial plains supporting halophytic low shrubland or plains supporting acacia shrublands with sparse overstoreys of

eucalypts and casuarina. Sand plains and sandy rises occupy 22% of the area and typically support spinifex tussock grasslands with sparse eucalypt overstoreys. Low hills and rises on laterite, basalt or metamorphic rocks occupy the remainder (Alexander Holm & Associates 2021).

Alexander Holm & Associates were also to locate, record and map evidence of Malleefowl within the 842ha area. Two operators searched along gridlines 40m apart. A total of 246km was traversed. It is estimated that the search procedures were sufficient to locate 90 to 100% of nesting mounds in less densely vegetated areas and 60 - 80% in more densely vegetated areas. There was little evidence of current Malleefowl activity, no sightings of birds, tracks or significant litter disturbance. Eighteen Malleefowl nesting mounds were found which included the three 'active' nesting mounds previously recorded during the 2012 survey, and one of the three 'long-unused' mounds. The other 'long-unused' mounds had been destroyed by expansion of the TSF and other mining infrastructure. Three other ground disturbances were discounted as either rudimentary, unsuccessful scratchings or ancient diggings unlikely to be Malleefowl nests.

Of these 18 mounds, none were 'active', ten were 'long unused', four were 'inactive abandoned' and four were 'inactive recent' (Alexander Holm & Associates 2021).

2.3 Survey Methodology

2.3.1 Timing of survey and seasonal conditions

The initial Malleefowl survey for the Cell 4 project was conducted in June 2021. As specified in the request (see Item 2a(i) in Table 1:), a follow-up targeted species survey was to be conducted within the Malleefowl breeding season, as defined in the National Malleefowl Monitoring Manual (October to January), (National Recovery Team, 2020).

The follow-up Malleefowl survey was conducted from December 4 to 9, 2021. This survey was during the breeding season of Malleefowl in accordance with the National Malleefowl Monitoring Manual (2020) and is therefore considered suitable timing to determine mound status.

2.3.2 Targeted Malleefowl Survey

In December 2021, operators searched along gridlines 20m apart using GPS devices to maintain position. Gridlines were orientated 10 degrees different from the June 2021 survey to increase opportunities to locate new nesting mounds. A total of 525km was traversed (Appendix A).

It is estimated that the search procedures were sufficient to locate 100% of nesting mounds.

Located nesting mounds were recorded as a) 'long unused' and unlikely to have been used for at least 20 years, b) 'inactive abandoned' unlikely to have been used for at least 5 to 10 years and c) 'inactive recent' possibly used within the last 5 years. No 'active' nesting mounds were found.

Located nesting mounds were photographed, measured and evidence of Malleefowl activity noted in accordance with the procedures outlined in the National Malleefowl Monitoring Manual (National Malleefowl Recovery Team).

Other evidence of Malleefowl activity (disturbance of litter, tracks and sightings) was noted during traverse.

Figure 4: Malleefowl Survey Foot Traverse, December 2021.

2.3.3 Habitat Quality Assessment

In accordance with the EPBC offsets assessment guide (How to use the Offsets assessment guide (awe.gov.au) three components, i) site condition, ii) site context and iii) Malleefowl stocking rate, were rated to provide an assessment of habitat within the disturbance envelope.

The underlying basis for habitat assessment were vegetation surveys conducted over the impact area and surrounds as reported in Alexander Holm & Associates (2012, 2019). These surveys provide spatially-described information within land units each occupying a similar topographic position with similar vegetation and soil type.

Within the 229.1ha disturbance envelope, 11.8ha has been previously cleared for a haul road, minor access roads and boundary fencing, leaving 217.3ha of habitat for assessment. Of this, alluvial plains with chenopods (land unit 5a) occupy 29%; acacia shrubland (land unit 4a) 26%; spinifex sandplain (land unit 4d) 21%; basalt foot slopes (land unit 2b) 20%; sandy rises with spinifex (land unit 1d) 3% and laterite rises (land unit 2a) 1% (Figure 3).

Site Condition

Site condition rating consists of three equally weighted components:

a) vegetation condition (Keighery 1994) and

b) an unweighted sum of binary values (0- absent, 1- present) for the following attributes as described in the National Recovery Plan (Benshemesh 2007):

- Factors rated within the site condition component were: loamy sand or sandy loam soil type (Anon 2009),
- litter availability,
- upper and mid storey canopy cover (Anon 2009),
- level ground
- presence of mallee (Eucalyptus spp.)
- presence of Melaleuca
- presence of mulga (Acacia spp.)
- presence of spinifex (Triodia spp).

c) Feral predator activity within the following categories:

- Not detected in targeted survey
- Scarce (one record within habitat);
- Medium presence (multiple records of single species or single records of more than one species) and
- Abundant (multiple records of more than one species).

Vegetation associations within each of these land units is described in these aforementioned surveys in terms of condition, flora species census and canopy cover based on observations at selected inventory sites distributed throughout the survey areas. Specific data for soil type, habitat condition, and canopy cover were summarised from inventory points falling within and immediately adjacent to the disturbance envelope. Data on litter availability, considered important for Malleefowl nesting and foraging, were visually assessed during the foot traverse in December 2021.

The overall score for Site Condition (including vegetation condition, habitat features and feral predator activity) was converted to a score out of three and weighted in the following manner:

Habitat features - 50%- This majority weighting was assigned as factors such as litter availability, suitable soil type and dense canopy cover are considered essential for successful Malleefowl breeding (Department of Parks and Wildlife 2016a).

Vegetation condition - 25%- Considered of less importance to Malleefowl activity than habitat features.

Feral predators - 25% - While Malleefowl chicks, juvenile and sub-adult birds are most at risk to feral predators such as cats and foxes thereby limiting recruitment into the breeding population, adult mortality to feral predators, appears low (Priddel and Wheeler 1996).

Site Context

Factors rated within the site context component were:

- connectivity of the land units within the assessment envelope with surrounding suitable habitat for Malleefowl.
- records of Malleefowl activity on the site and surrounding habitat.

Malleefowl Stocking Rate

Based on the Likelihood of, or known presence of Malleefowl activity, within each land unit rated according to the following categories:

- Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats;
- Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats
- Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats;
- No records of Malleefowl on site, within known range of Malleefowl, suitable habitat present; and
- Site outside current known range of Malleefowl or habitat is unsuitable.

Composite indexes were summed to provide a summary index for each land unit. Land unit indexes were adjusted in proportion to the area of each land unit within the assessment envelope and then summed to provide a total site habitat score.

Malleefowl habitat beyond the disturbance envelope

Maps and descriptions of land systems, which are areas throughout which there is a recurring pattern of topography, vegetation and soil and consisting of assemblages of more homogeneous land units, were used to assess availability of Malleefowl habitat in areas beyond the limit of detailed survey (Alexander Holm & Associates 2022).

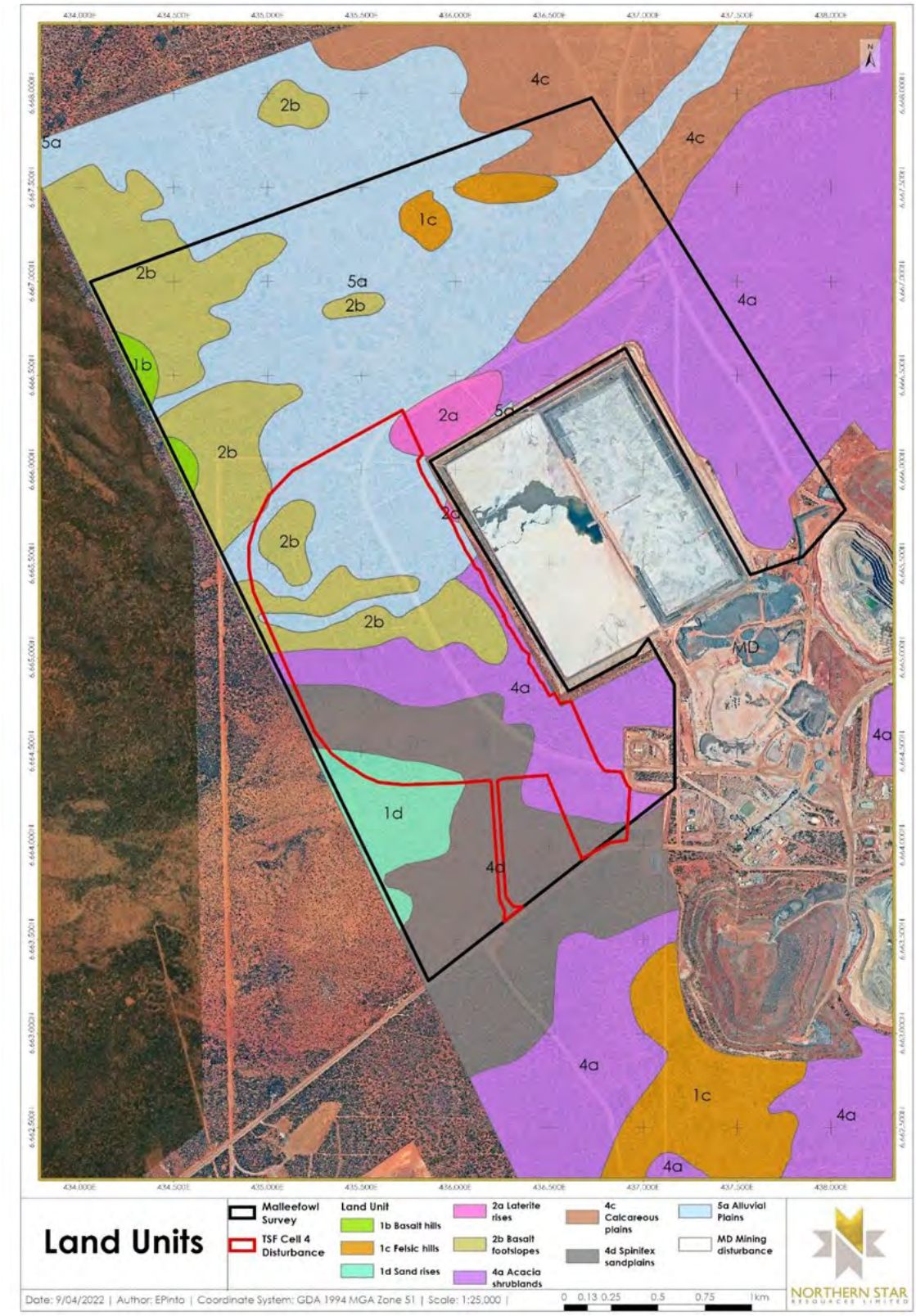

Figure 5: Land units within the survey area and surrounding the survey area.

2.4 Survey Results

2.4.1 Targeted Malleefowl Survey

There was no evidence of recent (within 12 to 18 months) Malleefowl activity throughout the 842ha survey area, no tracks and minimal non-species-specific litter disturbance (Alexander Holm & Associates 2022).

Of the 23 nesting mounds located, 13 were recorded as 'long unused' unlikely to have been used for at least 20 years, and, apart from an indication of past use of habitat by Malleefowl, are of no significance for ongoing existence of Malleefowl in the area (Figure 3).

The remaining ten nesting mounds were considered potentially significant for ongoing existence of Malleefowl in the area and discussed in detail.

None of the ten remaining nesting mounds were 'active'. Seven inactive mounds are located within the disturbance envelope. Four are classified as 'inactive recent' and three 'inactive abandoned'. For the three mounds outside the disturbance envelope, one 'inactive recent' mound is within 40m of the disturbance envelope and two inactive mounds are located greater than 300m from the disturbance envelope and will not be impacted by clearing activities (Figure 4).

Full details of each Malleefowl nesting mound are presented in Table 5 while photographs and summaries of the 'inactive recent' and 'inactive abandoned' nesting mounds are shown in Table 6.

Figure 6: Location of Malleefowl Nesting Mounds within the Survey Area.

Table 5: Malleefowl nesting mounds located within survey areas conducted in November 2012, June and December 2021

Discovery date	CDO mound number	Profile	Is the mound Active?	Freshly Scraped	Inner Crust	Inner Herbs/ Shrubs	Rim Height (cms)	Depth (cms)	Outer Diameter (cms)	Rim Diameter (cms)	Land unit	Notes
10/09/2012	CDO02_001	1	N	N	Y	Y	20	30	400	265	1d	Inactive abandoned
10/09/2012	CDO02_002	1	N	N	N	N	22	22	350	210	4d	Inactive recent
10/09/2012	CDO02_003	1	N	N	Y	Y	18	20	290	170	4a	Inactive recent
14/06/2021	CDO02_004	1	N	N	Y	Y	24	27	360	200	2b	Inactive abandoned
14/06/2021	CDO02_005	1	N	N	N	N	22	30	390	210	2b	Inactive recent
14/06/2021	CDO02_006	1	N	N	N	N	35	30	370	190	2b	Inactive recent
14/06/2021	CDO02_007	1	N	N	Y	N	37	24	350	190	4a	Inactive abandoned
18/06/2021	CDO02_008	1	N	N	Y	N	14	54	270	200	5a	Inactive recent
7/12/2021	CDO02_009	1	N	N	N	N	30	25	370	210	4a	Inactive recent
7/12/2021	CDO02_010	1	N	N	Y	Y	30	30	300	170	4a	Inactive abandoned

Table 6: Photographs Malleefowl nesting mounds located during surveys in November 2012, June and December 2021

Details 2021	November 2012	June 2021	December 2021
CDO02_001 Outer rim: 400cm Inner rim: 265cm Depth: 30cm Within impact area: Yes	 Active	 Inactive abandoned	 Inactive abandoned
CDO02_002 Outer rim: 350cm Inner rim: 210cm Depth: 22cm Within impact area: Yes	 Active	 Inactive recent	 Inactive recent

Details 2021	November 2012	June 2021	December 2021
CDO02_003 Outer rim: 290cm Inner rim: 170cm Depth: 20cm Within impact area: Yes	 Active	 Inactive recent	 Inactive recent
CDO02_004 Outer rim: 360cm Inner rim: 200cm Depth: 27cm Within impact area: No 320m north	Not found	 Inactive abandoned	 Inactive abandoned

Details 2021	November 2012	June 2021	December 2021
CDO02_005 Outer rim: 390cm Inner rim: 210cm Depth: 30cm Within impact area: Yes	Not found	 Inactive abandoned	 Inactive abandoned
CDO02_006 Outer rim: 370cm Inner rim: 190cm Depth: 30cm Within impact area: No 40m west	Not found	 Inactive recent	 Inactive recent

Details 2021	November 2012	June 2021	December 2021
CDO02_007 Outer rim: 350cm Inner rim: 190cm Depth: 24cm Within impact area: Yes	Not found	 Inactive abandoned	 Inactive abandoned
CDO02_008 Outer rim: 270cm Inner rim: 200cm Depth: 54cm Within impact area: No 750m north	Not found	 Inactive recent	 Inactive recent

Details 2021	November 2012	June 2021	December 2021
CDO02_009 Outer rim: 370cm Inner rim: 210cm Depth: 25cm Within impact area: Yes	Not found	Not found	 Inactive recent
CDO02_010 Outer rim: 300cm Inner rim: 170cm Depth: 30cm Within impact area: Yes	Not found	Not found	 Inactive abandoned

2.4.2 Impact of TSF Expansion on Malleefowl

Seven inactive mounds are located within the disturbance envelope. Four are classified as 'inactive recent' and three 'inactive abandoned'. One 'inactive recent' mound is within 40m of the disturbance envelope. Two inactive mounds are located greater than 300m from the disturbance envelope and will not be impacted by clearing activities (Table 7 and Figure 8).

Table 7: Impact on TSF expansion on Malleefowl nesting mounds

Nesting mound	Status	Impact
CDO02_001	Inactive abandoned	Removed – Direct Impact
CDO02_002	Inactive recent	Removed – Direct Impact
CDO02_003	Inactive recent	Removed – Direct Impact
CDO02_004	Inactive abandoned	Indirect impact 320m N of development
CDO02_005	Inactive recent	Removed – Direct Impact
CDO02_006	Inactive recent	Indirect impact 40m W of development
CDO02_007	Inactive abandoned	Removed – Direct Impact
CDO02_008	Inactive recent	Indirect impact 750m NW of development
CDO02_009	Inactive recent	Removed – Direct Impact
CDO02_010	Inactive abandoned	Removed – Direct Impact

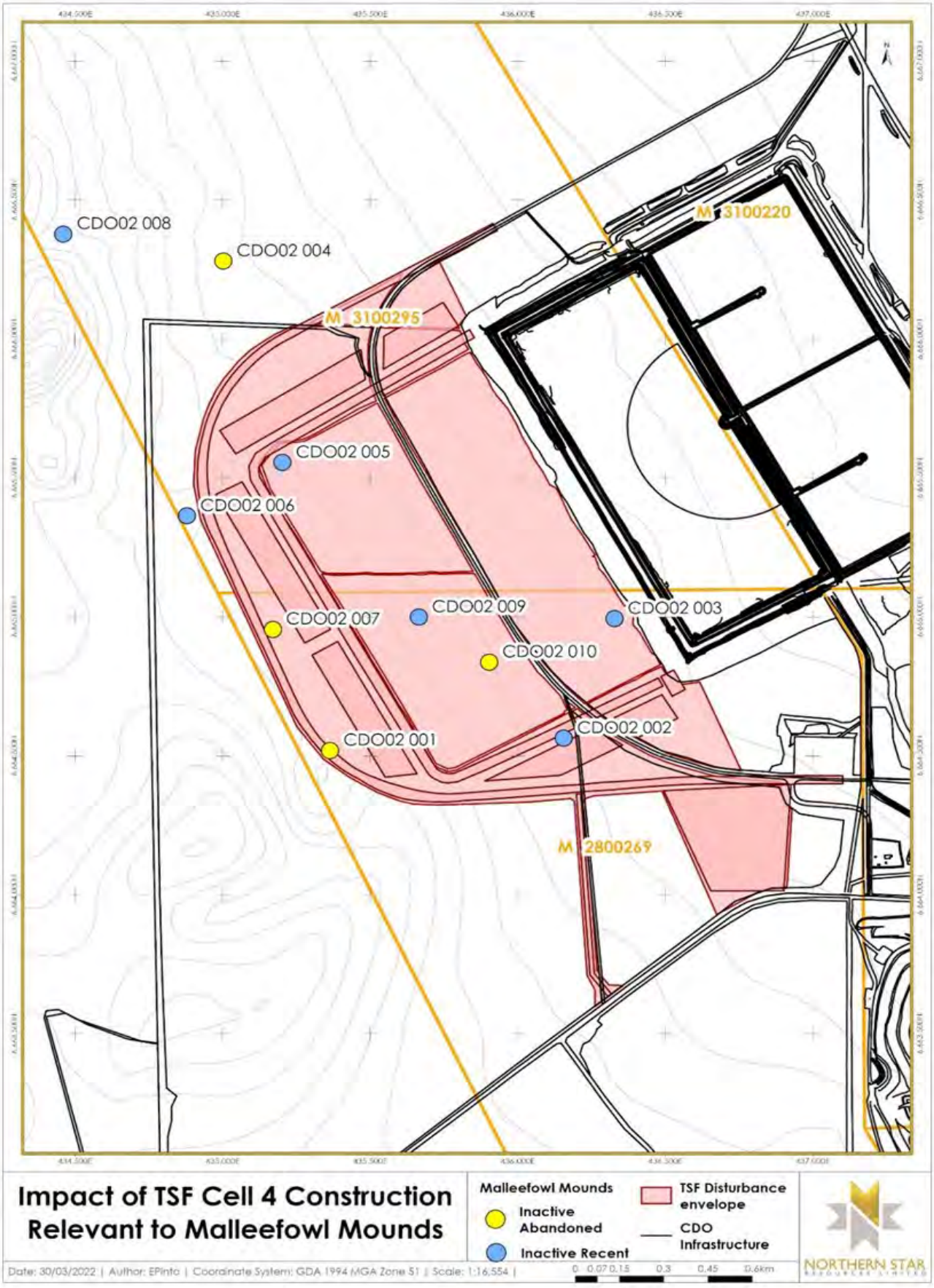

Figure 7: Impact of TSF Cell 4 Construction Relevant to Malleefowl Mounds.

2.4.2.1 Habitat Assessment within disturbance envelope

Malleefowl Stocking Rate

Of the ten more recently occupied nesting mounds, four were located within acacia shrubland (land unit 4a) and three within footslopes of low basalt hills (land unit 2b) at approximately four to six nesting mounds per square kilometre.

One nesting mound was in land unit 5a, alluvial plains and two within land units with spinifex (land units 1d and 4d). These three nesting mounds were found at the margins of acacia shrublands or in small inclusions of acacia within the unit.

Apart from lateritic rises (land unit 2a) where no nesting mounds were found, alluvial plains, mostly dominated by chenopod shrublands, were the least favoured habitat for Malleefowl.

No evidence of predators or their tracks/scats were noted in the survey area.

Site Condition

The survey area has been disturbed by recent mining activity, is mostly within a pastoral lease and has been grazed. Roads, vehicle tracks cut lines fragment the area and pastoral ringlock fences border the area.

Spinifex sandplain and sandy rises were rated most highly for condition; these systems with high infiltration rates and generally shunned by livestock, support nearly intact vegetation communities. Basalt hills and footslopes are in fair condition while lateritic rises, acacia shrubland and alluvial plains are in poor, often very poor condition. Alluvial plains and basalt hills have highest flora diversity while litter availability is highest where acacia is common (basalt footslopes and acacia shrubland). Sandy loam and loamy sand soils which are preferred for mound construction are common on all land units except alluvial plains (Alexander Holm & Associates 2019).

Site Context

The disturbance envelope is part of a regionally significant contiguous suitable habitat as shown in Figure 9. Malleefowl appear to have been active within the past 6-10 years on all land units except laterite rises and alluvial plains.

Connectivity of land units within the disturbance envelope and surrounding country is equally constrained by recently constructed pastoral boundary fencing, high-usage mining haul and access roads, and other mining infrastructure. Road traffic is heavy, affecting all land units for their suitability for Malleefowl, and while all units are fragmented by roads, tracks, cut-lines and fences, acacia shrublands and alluvial plains are the most compromised.

Fire is relatively frequent in spinifex systems (has occurred once within the last 20 years) and least frequent on laterite rises. Other systems probably burnt during extensive fires throughout the goldfields in the mid-1970s (Pringle et al. 1994). Land units lower in the landscape (alluvial plains) are more prone to flood than other units where flooding is unknown.

Site Assessment

When indices for habitat condition, context and Malleefowl stocking rate are combined, sandy rises with spinifex (land unit 1d) score the highest for Malleefowl habitat followed by acacia shrublands (land unit 4a), spinifex sandplain (land unit 4d), and basalt footslopes (land unit 2b) which all rate highly. Alluvial plains (land unit 5a) and lateritic rises (land unit 2a) are of limited value (Table 9).

After combining area-adjusted ratings for each land unit and expressing this as a ratio of the maximum possible score of 10, the total habitat score for the disturbance envelope is 5.7. The habitat assessment for the disturbance envelope is summarised in Table 8.

Within the disturbance envelope most nesting mounds were found within the 100.1ha of acacia shrublands and basalt footslopes, which are therefore considered critical habitat favoured for breeding and foraging by Malleefowl. While two nesting mounds were found in spinifex sandplain and sandy rises with spinifex, these mounds were restricted to small, favoured locations without spinifex, where acacias occur and are not prone to fire. Elsewhere, there were no nesting mounds where spinifex is the dominant ground cover and fire is common. Consequently, these spinifex-

dominated systems covering 52.5ha are considered primarily habitat for foraging and cover. Alluvial plains and lateritic rises, covering 64.8ha which make up the balance of the disturbance envelope, are of limited value as Malleefowl habitat (Alexander Holm & Associates 2022).

Table 8: Habitat assessment summary for disturbance envelope

Assessment component	Factors	Proportional score (out of 10)	Summary
Vegetation			Spinifex sandplain and sandy rises with spinifex occupy 17% of the area; alluvial plains with chenopods 30%; acacia shrubland 26%; basalt footslopes with acacias 19% and lateritic rises 1%.
Site condition	Vegetation condition Site attributes	1.67	Spinifex sandplain and sandy rises with spinifex are mostly in excellent condition and the remainder mostly in fair condition. Litter abundance is optimal in acacia- dominated units and minimal elsewhere. Sandy loam soils suitable for mound construction are prevalent in all land units except alluvial plains. No evidence of predators noted.
Site context	Movement patterns of the species Proximity of the site in relation to other suitable areas of habitat	2.05	Connectivity with surrounding landscapes is compromised by mining infrastructure and pastoral fencing. Site is part of a regionally significant contiguous suitable habitat; records on site for Malleefowl within last 6-10 years; site is within known distribution of species.
Malleefowl stocking rate	Occurrence of nesting mounds.	1.69	No active Malleefowl nesting mounds. Previously active mounds found within acacia shrublands, basalt footslopes, and in localised sites within spinifex units. Lateritic rises unsuitable
Overall site rating		**5.41**	

2.4.2.2 Habitat Assessment outside disturbance envelope

Over the past 10 years, there have been several intensive 20m interval traverse and semi-intensive 40-50m interval traverse searches for Malleefowl activity over approximately 5000ha surrounding and nearby the mine site operation including the proposed disturbance envelope. There were also opportunistic sightings of Malleefowl nesting mounds during vegetation surveys of areas to the north-east and south (Figure 6).

Seventy-one nesting mounds have been identified, five of which were found to be active during Malleefowl monitoring in early December 2021 by Northern Star. Two thirds of these nesting mounds were on the acacia shrublands of land units 4a and 4b (Alexander Holm & Associates 2019) and nesting mounds were common on fringes of spinifex sandplain and footslopes of basalt hills as outlined in Table 9.

Table 9: Malleefowl nesting mounds located in relation to land units during purposeful search and opportunistically during vegetation survey.

Land unit	Nests	Search	Survey	Total	Nests/100ha
			(ha)		
1b Basalt hills	2	44	596	640	0.31
2a Lateritic rises	1	233	186	419	0.24
2b Basalt hill footslopes	9	335	484	819	1.10
4a Acacia shrubland	30	1349		1349	2.22
4b Acacia shrubland on hardpan	18	558	15	573	3.14
4d Spinifex sandplain	8	176		176	4.55
5a Alluvial plains	3	716		716	0.42
Totals	**71**	**4896**	**2084**	**6980**	**1.02**

At the broader land system scale, most mounds are within Deadman land system characterised by level to gently undulating plains with casuarina-acacia shrublands (Pringle et al. 1994) which include the Malleefowl-favoured acacia shrublands of land units 4a and 4b. Nesting mounds occur on footslopes of Lawrence and Leopold land systems characterised by low hills with eucalypt or acacia woodlands with halophytic under-shrubs (Pringle et al. 1994) which include basalt hill footslopes of land unit 2b. Nesting mounds also occur in favoured locations within the extensive Kirgella land system characterised by sandplain supporting spinifex and acacia/eucalypt shrublands (Pringle et al. 1994) which is dominated by spinifex sandplain of land unit 4d.

There is approximately 18,000ha with potential habitat for Malleefowl within 10km of the disturbance envelope consisting of 11,900ha of Kirgella land system, which extends up to 40km to the west and is contiguous with the disturbance envelope, 4500ha of Deadman, 1600ha of Leonora and 300ha of Lawrence land systems.

Within the 4,276ha surrounding Carosue Dam operations, which includes the disturbance envelope and is covered by a unified land unit map (Alexander Holm & Associates 2019), 368ha is considered to be habitat suitable for forage and cover and 2,143ha is considered to be critical habitat used for breeding and forage (*Alexander Holm & Associates 2022).*

Figure 8: Malleefowl habitat relevant to Malleefowl mounds

2.5 Assessment of Impacts

2.5.1 Assessment against EPBC Significant Impact Criteria

The proposed expansion of the TSF will result in clearing or disturbance to 152.6ha of Malleefowl habitat including 52.5ha considered primarily suitable for foraging and cover and 100.1ha considered critical habitat for breeding. Over 2500ha of similar habitat for Malleefowl has been identified in areas adjacent to Carosue Dam operations in earlier fine-scale environmental assessments. Approximately 18,000ha of similar habitat, identified at broader-scales, within 10km of the disturbance envelope, provides additional 'suitable' and/or 'critical' habitat for Malleefowl including Kirgella land system, that extends up to 40km to the west and is contiguous with the habitat identified within the disturbance envelope (*Alexander Holm & Associates 2022)*.

Within the development envelope, four 'inactive recent' and three 'inactive abandoned' nesting mounds will be cleared. There are no 'active' nesting mounds within or near the development envelope and there appears to have been no Malleefowl activity at least within the previous 12 to 18 months. In contrast, five 'active' nesting mounds were located approximately 5km south-east of the disturbance envelope during Malleefowl monitoring by Northern Star in December 2021, re-enforcing the conclusion that Malleefowl have deserted the disturbance area for less-impacted areas, widely available elsewhere.

It is concluded that expansion of the TSF will have negligible impact on the widely dispersed Malleefowl population in this region as there is extensive habitat in adjacent areas for Malleefowl use in subsequent breeding seasons.

In assessing if the proposed development of the TSF Cell 4 will have a significant impact on Malleefowl, the following criteria are considered as to whether there is a possibility that the development will:

1. Lead to a long-term decrease in the size of an important population of a species.

Malleefowl, which may be impacted by the proposed development, are part of a sparse, widely-dispersed population of unknown extent. Malleefowl have been sighted and/or nesting mounds located throughout most of the tenements associated with Carosue Dam operations from around Deep South 70km north of the TSF (Alexander Holm & Associates 2011), 10km to the east (Alexander Holm & Associates 2020) and 6km SW (Alexander Holm & Associates 2017). Records of Malleefowl extend in all directions beyond these locations (Department of Parks and Wildlife 2016b). While this sparse, widely-dispersed population of Malleefowl throughout the Western Australian arid zone can be considered an "important population" necessary for the long-term survival of the species in the region, Benshemesh (2007) states that no particular population or general area can be described as of greater importance for the long-term survival of Malleefowl.

Factors affecting the long-term survival of Malleefowl in the arid-zone include livestock grazing, broad-scale fire, drought and fox-predation (Benshemesh 2007). Localized impacts from mining, such as habitat destruction through clearing, are likely to be of lesser importance. Expansion of the TSF will have negligible impact on the widely dispersed Malleefowl population in this region as there is extensive habitat in adjacent areas for Malleefowl use in subsequent breeding seasons.

2. Reduce the area of occupancy of an important population.

While Malleefowl have been previously sighted within the development envelope and 'active'-occupied nests located in 2012, there is no evidence that Malleefowl are currently present. It is known that Malleefowl in arid areas are verging on nomadic, having irregular or unpredictable home range (Department of Parks and Wildlife 2016b). Nesting mounds, which appear to be un-occupied during poor seasons, occur mostly on foot slopes of basalt hills and in acacia shrubland on extensive plains (Alexander Holm & Associates 2021). Plains supporting acacia shrubland are widespread in the vicinity of the proposed development and occupy 36% or 1800ha while basalt hills occupy a more restricted area of 380ha (Alexander Holm & Associates 2019). Approximately 152ha of preferred habitat will be cleared or disturbed during expansion of the TSF which will have minimal impact on the area of occupancy of Malleefowl due to the broad range of suitable habitat within the region.

3. Fragment an existing important population into two or more populations.

Malleefowl in this arid environment are part of a widely-dispersed, semi-nomadic population. The proposed clearing will not fragment an existing population.

4. Adversely affect habitat critical to the survival of a species.

Malleefowl in the vicinity of the TSF prefer plains supporting acacia shrubland and foot slopes of basalt hills for nesting sites. Similar habitat preferences are noted for the adjacent Great Victoria Desert (Department of Parks and Wildlife 2016b) and are extensive throughout the region (e.g. Pringle et al. 1994). Clearing of 152ha of preferred habitat for the development of the TSF is not considered to be critical for survival of the species due to the availability of similar habitat nearby and throughout the region.

5. Disrupt the breeding cycle of an important population.

Malleefowl appear to occupy nesting sites only during favourable seasons and the four 'inactive recent' nesting mounds affected by this development are not currently occupied. Northern Star will ensure clearing is completed outside of the breeding season while nesting mounds are un-occupied. Malleefowl breeding cycle will not be disrupted while these nesting mounds are un-occupied.

6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Malleefowl nesting mounds in the proposed development area are more abundant in foot-slopes of rocky basalt hills and plains supporting acacia shrublands which are common in the vicinity of the TSF (Alexander Holm & Associates 2019) and extensive throughout the region (e.g. Pringle et al. 1994). The Malleefowl population is unlikely to decline through impacts of this development due to the wide availability of preferred habitat throughout the region.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

Mining activity has potential to increase feral predators of Malleefowl especially fox and cat and to introduce weed species that may invade Malleefowl habitat. Effective putrescible rubbish management and weed control hygiene is essential to minimise adverse effects. Northern Star have procedures in place to address and mitigate risks associated with invasive species, therefore it is unlikely that invasive species will significantly impact Malleefowl populations or habitat due to the proposed development.

8. Introduce disease that may cause the species to decline.

Transmission of disease to Malleefowl is unknown, however risk of transmission will be minimised through practices that minimise presence of feral predators or other non-native fauna. Northern Star have procedures and practices in place to control feral animals as required throughout the project area through trapping and baiting programs, therefore the risk of introducing disease to Malleefowl populations due to the proposed development is considered low.

9. Interfere substantially with the recovery of the species.

Malleefowl survival is threatened by vegetation clearing, predation by fox and cat, increased fire frequency, road mortality and competition with sheep, rabbit, cattle and goat (Department of Parks and Wildlife Fauna facts). Mining activity, such as the proposed expansion of the TSF, has cumulative effects on Malleefowl survival particularly with clearing and road mortality.

In summary suitable and critical habitat for Malleefowl is widespread directly adjacent to the proposed disturbance to accommodate any birds potentially displaced by the activity.

The following recommendations are made to further reduce potential impacts:

- Nesting mounds within and adjacent to the disturbance envelope are monitored monthly for Malleefowl activity prior to and during the breeding season (July to March).
- Clearing is conducted when there is no Malleefowl activity at nesting mounds.
- Clearing conducted in a manner to allow any potential Malleefowl to move into adjacent habitat.

- Spotter to move ahead of dozer during clearing.

2.5.2 Description and Mitigation of Potential Impacts

Northern Star identified potential impacts to Malleefowl resulting from the Carosue Dam TSF Cell 4 project, including the following direct impacts:

- Reduction in population numbers due to removal of breeding mounds
- Fauna injury or mortality due to vehicle strike
- Displacement of adult birds due to habitat clearing
- Increase risk from feral species through predation or competition with Malleefowl

In addition, the following indirect impacts could potentially be experienced during construction and operation:

- Noise from construction, vehicles, and general mine operations impacting Malleefowl movements in the area
- Increased occurrence of weeds, reducing quality of adjacent habitat
- Dust impacting surrounding vegetation
- Altered surface water flow impacting vegetation (e.g. water starvation or flooding)

Table 10 provides a description of the potential impacts to Malleefowl. A full risk assessment of impacts is provided in Table .

Table 10: Description of Potential Impacts to Malleefowl

Potential Impacts	Description of Impact	Mitigation Measures
DIRECT		
Fragmentation of habitat and impacts on habitat use due to fragmentation.	The proposed impact site is located directly adjacent to existing TSF infrastructure within the active mining and process area. Approximately 368ha of habitat suitable for forage and cover and 2,143 ha of critical habitat used for breeding and forage can be found directly adjacent to the impact site in a 4,276ha parcel of land (Alexander Holm & Associates 2019). The impact site is currently disturbed by roads and recently rehabilitated seismic lines. The clearing won't create any fragmentation of existing habitat due to its proposed location.	Site selection was based on reducing impacts to Malleefowl habitat and fragmentation of existing populations.
Reduction in population numbers due to removal of breeding mounds	A total of seven (7) inactive breeding mounds will be removed during clearing activities for TSF Cell 4 and associated infrastructure. During the recent survey no mounds were found to be active with most unlikely being used within the last 5 years. The clearing of these mounds is highly unlikely to contribute to a reduction in population numbers due to the absence of active mounds in the area.	Clearing will be conducted in line with conditions outlined in the approved NVCP and CEMP.
Reduction in habitat size due to clearing	A total of 217.3 ha of native vegetation will be cleared within an	Clearing will be kept to a minimum where possible.

	impact area of 229.1 ha. Of this 52.5 ha is considered suitable (foraging/cover) and 100.1 ha is considered critical (breeding/foraging/cover)	Topsoil and vegetation will be stockpiled for used during rehabilitation activities. Rehabilitation will be conducted upon closure and monitoring will be implemented in line with the Mine Closure Plan approved by DMIRS.
Increased risk of vehicle strike resulting in injury or death of Malleefowl	Vehicles during clearing, construction and operational activities pose a risk to Malleefowl that may traverse the area potentially resulting in the injury or death of individuals.	Clearing Management Procedures are in place on site. Fauna spotter will walk ahead of dozer during clearing activities. Speed limits will be enforced during clearing as well as for vehicles using roads during operation. Clearing pattern will be used in order to allow potential fauna in the area to move easily into adjacent vegetated areas.
Displacement of adult birds due to habitat clearing	Targeted surveys determined that there has been no recent (within 12-18 months) Malleefowl activity within the impact site and surrounding survey area. No active mounds were located and of the mounds located evidence suggests they have not been active for more than 4 or 5 years (Holm, 2022). Based on evidence gathered during the survey it is unlikely that the impacted area currently supports a Malleefowl population and birds have likely already moved into suitable vegetation in adjacent areas.	Clearing conducted to allow potential fauna to move into adjacent vegetated areas. Suitable Malleefowl habitat is located directly adjacent to the clearing site.
Increase risk from feral species through predation or competition with Malleefowl	Reducing vegetated areas may increase predation on, or competition for, Malleefowl.	Feral animal sightings are recorded and cat trapping conducted on site when required. Northern Star work with pastoralists to implement feral animal control. Weed and Feral Animal Control Safe Work Procedure (CDO-ENV-024-SWP) has been implemented at Carosue Dam Operations.
INDIRECT		
Noise from construction, vehicles, and general mine operations impacting Malleefowl movements in the area.	Noise may disrupt birds in the area; however, the impact assessment of the site has indicated that previous Malleefowl populations have likely moved away from this area.	The location of proposed TSF Cell 4 is adjacent to existing mining and processing activities.

Increased occurrence of weeds, reducing quality of adjacent habitat	Encroachment of weeds from recently disturbed areas.	Weed and Feral Animal Control Safe Work Procedure (CDO-ENV-024-SWP) has been implemented at Carosue Dam Operations. Weed hygiene measures are in place across site including the wash down of vehicles.
Dust impacting surrounding vegetation	Dust arising from clearing and construction activities.	Clearing Management Procedures outline measures implemented to reduce dust. During operations, roads will be managed by water carts using saline water for dust suppression in line with normal site procedures.
Altered surface water flow impacting vegetation (e.g. water starvation or flooding)	Altered surface water flows from the construction of embankments, roads and other infrastructure have the potential to cause impacts to vegetation through water starvation or flooding if not managed appropriately.	Surface water studies have been conducted on site with suitable diversions and drainage structures designed by a hydrologist to manage surface water around site and minimise any potential impacts.

Potential impacts to Malleefowl are also addressed in the Risk Assessment (Table 14) including avoidance and mitigation measures, justification for the residual risk ranking and any relevant controlling management plans or procedures.

2.5.3 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) has been developed to outline how potential environmental impacts associated with construction activities will be managed (Appendix B). This plan has been developed in line with the DCCEEW's Environmental Management Plan Guidelines.

2.5.4 Risk Assessment

The proposal has been based on a risk assessment approach. This approach identifies the key risks and potential impacts of the proposed activity on Malleefowl. This process allows identified risks to be evaluated and outlines mitigation measures and effectiveness of these measures. The aim of the risk mitigation measures will be based on the following hierarchy:

- Avoid – avoid impacts where possible;
- Minimise – if impacts cannot be avoided, minimise and manage appropriately;
- Rectify – repair, rehabilitate and restore affected areas as soon as possible after disturbance;
- Reduce – reduce affected area by preservation and maintenance throughout life of mine; and
- Offset – where negative impacts still occur, develop an offset package to achieve a net environmental benefit.

The risk assessment process involves the following:

- Identify activity and tasks being assessed:
  - The activity is known as the aspect and will typically consist of various tasks.
- Identify environmental hazards:
  - Identify aspects that interact with the environment. This is the hazard or source of risk.
- Identify receptors associated with each step:

  - There is often more than one receptor associated with each step (e.g. unauthorised clearing may lead to flora, fauna or soil instability); and
  - Environmental receptors may include flora, fauna, air, soil, watercourses, groundwater, surface water or humans.
- Determine possible impacts of each hazard:
  - Hazards may share similar impacts, but each of these will need to be identified to enable effective management of the hazard (e.g. loss of flora, loss of fauna, contamination of groundwater, erosion and weed establishment).

A risk assessment was completed by Northern Star's Environmental personnel in February 2022. The Risk Assessment has been completed in accordance with the Australian/New Zealand standard 4360:1999 Risk Management. The risk assessment considers the likelihood of an impact event and the relative consequence of that event. The risk assessment outlined in Table is focussed specifically to impacts on Malleefowl and their habitat.

Table 11 and Table 12 outline the various descriptions associated with the various levels of a potential occurrence. The risk matrix in

Table 13 was used to rate risks identified during the workshop.
Table summarises the findings of the assessment and presents measures that have been or will be undertaken to ameliorate risks.

Table 11: Qualitative measures used for the determination of an event likelihood rating

Likelihood		Description
A	Almost Certain	Common or Frequent occurrence (e.g. once per day)
B	Likely	Is known to occur or "it's happened" (e.g. >once per month, but <once per day)
C	Possible	Could occur or "I've heard of it happening" (e.g. >once per year, but <once per month)
D	Unlikely	Not Likely to occur (e.g. <once per year)
E	Rare	Rare / practically impossible (e.g. very unlikely to ever occur)

Table 12: Qualitative measures used for the determination of an event consequence

Consequence		Description
1	Very Low	None or insignificant impact to MNES (Malleefowl) with no effect on ecosystem function.
2	Minor	Moderate to minor impact to MNES (Malleefowl) resulting in a minor, recoverable impact.
3	Moderate	Minor and short-term impact to MNES expected, resulting in a moderate, recoverable impact.
4	Major	Long-term impact to MNES expected, resulting in a major, recoverable impact.
5	Catastrophic	Irreversible impact to MNES expected.

Table 13: Risk Ranking Matrix

		CONSEQUENCES				
LIKELIHOOD		Very Low **1**	Minor **2**	Moderate **3**	Major **4**	Catastrophic **5**
A	Almost Certain	**H** (11)	**H** (16)	**E** (20)	**E** (23)	**E** (25)
B	Likely	**M** (7)	**H** (12)	**H** (17)	**E** (21)	**E** (24)
C	Possible	**L** (4)	**M** (8)	**H** (13)	**E** (18)	**E** (22)
D	Unlikely	**L** (2)	**L** (5)	**M** (9)	**H** (14)	**E** (19)
E	Rare	**L** (1)	**L** (3)	**M** (6)	**M** (10)	**H** (15)

Matrix Legend:

E:	Extreme risk	Immediate action required, further reduction needed. If not possible, Country Manager or COO approval required
H:	High risk	Senior management attention needed
M:	Moderate risk	Management responsibility must be specified
L:	Low risk	Manage by routine procedure

Table 14: Identification and Management of risks associated with the proposed action

	Risk Pathway/Impact	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures	Likelihood	Consequence	Residual Risk	Justification for Residual Risk ranking	EMP or Procedure incorporating risk treatment
Direct Impact	Impacts on habitat use due to fragmentation	C	3	H13	The infrastructure to be constructed within the proposed impact area has been designed to directly abut existing TSF infrastructure, without gaps or creating satellite facilities, therefore fragmentation of habitat is unlikely. Malleefowl habitat and surrounding native vegetation is extensive and generally continuous throughout the region, therefore any potential impacts due to fragmentation is rated as low.	D	2	L5	The impact site is not located in a satellite location where it could potentially break a linkage between favourable habitat plots. It is located directly adjacent to existing infrastructure to minimise fragmentation of habitat.	CDO-ENV-023-SWP Clearing Management
	Reduction in habitat size due to clearing	C	3	H13	Disturbance will be limited to only what is necessary for safe construction and operation of the TSF and associated infrastructure. The facility has been designed to adjoin to abut the existing TSF facility which allows NSR to utilise the existing western wall of the paddock TSF and associated existing cleared areas (11.8ha) within the proposed development envelope, reducing disturbance footprints as far as practically possible. An internal Clearing Activity Permit will be issued by site Environmental personnel and signed off by operators and supervisors involved in the clearing. Disturbed areas will be rehabilitated progressively where possible and upon closure in line with the approved Mine Closure Plan. Implementation of NSR internal Clearing Management Safe Work Procedure. Total footprints of new TSF and miscellaneous infrastructure have been minimised wherever practical to reduce overall disturbance and minimise impacts to Malleefowl habitat. The reduction of habitat size from the proposal is rated as Low.	D	2	L5	Within the immediate 4,276ha surrounding Carosue Dam operations, which includes the disturbance envelope and is covered by a unified land unit map (Alexander Holm & Associates 2019), 368ha is considered to be habitat 'suitable' for forage and cover and 2,143 ha is considered to be 'critical' habitat used for breeding and forage. This habitat extends well beyond this confined area and highlights the limited impact footprint of this proposal. The proposed location of the TSF directly adjacent to the existing facility ensures that disturbance is minimised as far as practically possible.	CDO-ENV-023-SWP Clearing Management
	Reduction in population numbers due to removal of breeding mounds	D	3	M9	The most recent targeted survey conducted in December 2021 determined that the were no active mounds during the 2021 breeding season. It is unlikely there will be a reduction in Malleefowl population due to the removal of breeding mounds. The risk has been rated as Low. Pre-clearance surveys will be undertaken to identify the presence of Malleefowl and mounds in proposed clearing areas. Clearing activities will preferentially occur outside of breeding season. Clearing may however, only occur during breeding season if mounds have been confirmed to be non-active by a suitably qualified environmental specialist. All known active mounds will be avoided and flagged with appropriately sized buffers (50m). Active mounds will be monitored for a suitable period of time to ensure no impacts are sustained by individuals or their young. Clearing will only commence after positive confirmation that the mound is no longer active. Annual monitoring of the Malleefowl population in accordance with the National Malleefowl Monitoring Manual and in consultation with the DBCA and other best practice organisations.	D	2	L5	Malleefowl demonstrate resilience to disturbance in many examples, including at Carosue Dam where nesting mounds have been previously located <10m away from roadways and other infrastructure (outside of the proposed impact site). Proposed buffer zones of 50m are deemed sufficient by DMIRS in the recently approved Purpose Permit (CPS8000/2) amendment to minimise impacts to breeding mounds.	Clearing Permit CPS8000/2 CDO-ENV-051-Pla - Biodiversity Management
	Fauna injury or mortality due to vehicle strike	C	3	H13	Northern Star will continue to implement the following mitigation measures to prevent injury/mortality of Malleefowl at the site: • Reduction in vehicle speed limits within the area. • Clearing procedure outlines strategy required to allow potential fauna within the impact area to move into adjacent habitat areas;	D	3	M9	No Malleefowl have been hit by vehicles around the current TSF Haul Road or TSF area during Saracen or Northern Star's ownership of the project, therefore providing evidence that the likelihood of fauna strike is extremely low. Reduced speed limits during the construction phase of the project will further decrease this risk.	CDO-OHS-SA-003-PLA Carosue Dam Traffic Management Plan CDO-ENV-051-Pla - Biodiversity Management

	Risk Pathway/Impact	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures	Likelihood	Consequence	Residual Risk	Justification for Residual Risk ranking	EMP or Procedure incorporating risk treatment
					• Additional Warning signs will be erected on transport corridors and around the construction site informing of Malleefowl, potentially in the area. • Implementation of the Haul Road Management Safe Work Procedure to reduce the incidence of vehicle strikes. • All operators to report sightings of Malleefowl (live or dead) including mounds. • All personnel will complete an environmental induction prior to commencing work to ensure procedures and management measures are understood.					
	Displacement of adult birds due to habitat clearing	C	2	M8	Clearing will be conducted in accordance with the CEMP, which outlines procedures to allow birds and other fauna to move into adjacent areas of habitat. A total of 2500 ha of suitable Malleefowl habitat surrounds the impact area to support displaced birds. Within the immediate area an additional 4,276ha surrounding the impact site is over 2,500ha of suitable habitat to support displaced birds. Suitable habitat also extends far beyond this.	D	2	L5	Malleefowl are currently not reliant on the mounds within the development footprint which has been confirmed by the various Malleefowl surveys over the area- all mounds are inactive.	Construction Environmental Management Plan (CEMP) CDO-ENV-051-Pla - Biodiversity Management
	Increase risk from feral species through predation or competition with Malleefowl	C	3	H13	Northern Star will continue to implement the following mitigation measures to prevent predation on Malleefowl at the site: • Predator control program implemented. • Monitoring of feral animal activity. • Staff training of feral animal and waste Management • Avoid attraction of feral animals by implementing domestic waste management procedures. • Waste and water sources fenced not available to feral animals. • Putrescible rubbish (including food scraps) and other materials are disposed of into sealed 1 tonne bulka bags prior to burial to prevent feral animals and vermin from accessing the waste, allowing them to breed and increase in numbers. Carosue Dam have existing procedures for feral animal control on site and work closely with neighbouring pastoralists to undertake feral animal control in the surrounding area. It is unlikely there will be an increased risk in predation from the controlled action on Malleefowl. The risk is rated as Low.	D	3	M9	Evidence through sightings, scats and tracks suggest feral animal numbers in the area are low. Recent annual Malleefowl Monitoring to the east of the mine area showed no evidence of cats, little evidence of dogs and some evidence of rabbits. Baiting is carried out by neighbouring pastoralists frequently throughout each year.	CDO-ENV-024-SWP Weed and Feral Animal Control CDO-ENV-051-Pla - Biodiversity Management
Indirect Impacts	Noise from construction, vehicles, and general mine operations impacting Malleefowl movements in the area	C	2	M8	The proposed TSF Cell 4 and associated infrastructure is located within an active mining and processing area. The total footprints of new TSF and miscellaneous infrastructure have been minimised wherever practical to reduce overall disturbance and minimise impacts to Malleefowl. All mounds within the proposed development footprint are not active, therefore risks of mine operations impacting individuals of the species is negligible. It is unlikely that the addition of the controlled action is going to result in Noise/Light impacts to the Malleefowl. The following mitigation measures will be implemented: • Project travel between dusk and dawn will be limited to essential travel only. • Lights will be strategically placed and designed to shine towards plant operations and minimise light exposure to the surrounding environment.	D	2	L5	Studies have demonstrated Malleefowl are extremely resilient to activity and disturbance near their habitat. An active Malleefowl population is present directly east of the mine area (outside of any potential impact area). There are many examples at Carosue Dam where Malleefowl have nested directly adjacent to roads and other mining infrastructure.	Construction Environmental Management Plan (CEMP)

	Risk Pathway/Impact	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures	Likelihood	Consequence	Residual Risk	Justification for Residual Risk ranking	EMP or Procedure incorporating risk treatment
					• Equipment design will specify compliance with Australian Standard noise limits					
	Increased occurrence of weeds, reducing quality of adjacent habitat suitable for Malleefowl.	D	1	L2	A Weed Management Procedure has been implemented on site which includes recording and mapping infestations in a database. All vehicles entering site must be cleaned prior to arrival and checked before they commence work. A Weed Hygiene Certificate is issued to confirm they are free of vegetative and soil material. It is unlikely that the occurrence of weeds will impact adjacent Malleefowl habitat. The risk has been rated as Low.	E	1	L1	The majority of the proposed disturbance will not be susceptible to weed infestations as the haul road will be compacted and trafficked consistently and the entire TSF footprint is not conducive to vegetation growth due to the hypersaline nature of the tailings. Topsoil stockpiles will be monitored in line with the remainder of Carosue Dam and weeds managed as required.	CDO-ENV-024-SWP Weed and Feral Animal Control
	Dust impacting surrounding vegetation suitable for Malleefowl.	D	2	L5	Dust generation from clearing activities and vehicle movement will be mitigated using water suppression via water cart as required during clearing and construction. The construction/clearing activities will only occur for a period of 9 months. It is unlikely that dust generated from the short-term project will impact surrounding vegetation suitable for Malleefowl. Therefore, the risk has been rated as Low. Dusting events are mitigated through clearing procedures, for example clearing must not be undertaken during high wind events.	E	2	L3	Dust suppression once applied is extremely effective due to the hypersaline nature of the water at Carosue Dam. The dust suppression forms a crust over the areas watered, therefore minimising dust generation to an acceptable standard.	CDO-ENV-035-SWP Haul Road Management
	Altered surface water flow impacting vegetation suitable for Malleefowl (e.g. water starvation or flooding)	D	2	L5	Intensive surface water studies have been conducted and appropriate water management infrastructure has been designed to ensure altered surface water flows do not negatively impact on vegetation suitable for Malleefowl. Therefore, it is unlikely that altered water resources will impact on vegetation suitable for Malleefowl. The risk is rated as Low.	E	2	L3	Surface water risks have been assessed and appropriate controls put in place through the design phase to ensure no issues occur during and after construction.	CDO_REP_ TSF4 Expansion Surface and Groundwater Report
	Hypersaline water from dust suppression affecting vegetation suitable for Malleefowl.	D	2	L5	Water carts are fitted with dribble bars rather than spray bars to ensure dust suppression is only applied to immediate area in need of suppression, therefore minimising risk of hypersaline water affecting surrounding vegetation. Sumps are dug in runoff v-drains to capture incidental hypersaline runoff from road watering activities. It is unlikely that hypersaline water will impact suitable Malleefowl habitat. The risk is rated Low.	E	2	L3	Frequent inspections are completed of roadside sumps to ensure they do not need to be dug out and for evidence of salt movement. This is regulated via Tenement Conditions under the Mining Act 1978.	CDO-ENV-035-SWP Haul Road Management
	An increased risk of fire due to construction equipment and activities impacting fauna and Malleefowl habitat.	C	4	E18	Various fire management practices and controls are implemented at the Carosue Dam minesite which contribute to the overall protection of the site and surrounding areas, these include: • Maintaining existing and new fire breaks and implementation of NSR fire management procedures. • Firefighting and suppression equipment located at site and on construction equipment/vehicles. • All equipment and vehicles restricted to designated cleared access tracks/roads. • Staff training and awareness in the prevention and management of fires. • Consultation with relevant agencies (FESA, DBCA) in relation to prescribed burns and fire management.	D	3	M9	Bushfires are becoming more prevalent across the arid region.	Construction Environmental Management Plan (CEMP)

3 Environmental Offsets

The Carosue Dam TSF Cell 4 Project will impact upon 152.6ha of Malleefowl habitat Northern Star proposes to offset residual impacts through a conservation covenant. An Offset Proposal that meets the principles of the EPBC Act *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (2012)* has been included in Appendix C. The below provides a summary.

3.1 Offset Proposal Summary

The Malleefowl (*Leipoa ocellata*) Recovery Plan (Benshemesh, 2007) identifies habitat loss and fragmentation from mining and agriculture, as well as predation and wildfire as the principal factors threatening the species. As such, Northern Star proposes to offset the loss of habitat by securing an offset containing high quality Malleefowl habitat within the Goldfields through the use of a conservation covenant issued under the *Soil and Land Conservation Act 1945*. This will prevent the destruction and/or degradation of high value habitat through potential pastoral and mining activities within the offset area as well as initiate land management practices, that currently don't exist that will provide better conservation outcomes for Malleefowl.

3.2 Location

The proposed offset area will consist of a portion totalling 800ha within EEL55. EEL55 is located on freehold land owned by Northern Star and holds a special land category 'Exempt East Location' (EEL) allowing mining and/or exploration activities to occur on the land under agreement, exempt from the provisions of the *Mining Act 1978* and *Mining Regulations 1981.* EEL55 is surrounded by mining and exploration tenure, however, since Northern Star acquired EEL55 in 2018 no mineral resource development has commenced or been proposed due to insufficient gold mineralisation. There is currently no formal protection or management over EEL55 for the purposes of conservation, to prevent mining, exploration, pastoral or other activities.

It is within Northern Star's contractual rights under a pastoral licence agreement to restrict or exclude the depasturing activities from all or part of EEL55.

Table 14: Offset Area Tenure

Land Description	Tenure	Holder	Security
Exempt East Location Land (EEL) 55	Freehold	Northern Star Resources Ltd	Conservation Covenant to be placed over offset area

3.3 Environmental Value

A habitat quality assessment was undertaken by Phoenix Environmental Services in January 2022 to determine the suitability of EEL55 for use as a Malleefowl Offset. Details of the survey have been included in the Offset Proposal (Appendix C), with the full survey report included as an Appendix within the Offset Proposal. The area contains high quality Malleefowl habitat and abuts the Department of Biodiversity, Conservation and Attractions (DBCA) managed Yallari Timber Reserve.

An additional targeted survey was conducted over EEL55 by Alexander Holm & Associates (2022b) to identify Malleefowl mounds and recent activity of Malleefowl to further demonstrate EEL55's suitability as an offset site.

3.4 Implementation of the Offsets Assessment Guide

The EPBC Act Offsets Assessment Guide (DSEWPC 2012a), also known as the offset calculator, was used to assess the suitability of the proposed offset. The *How to use the Offsets Assessment Guide*

(Department of the Environment and Energy, 2019) was also used as a reference to ensure inputs to the offset calculator were appropriate. This ensures that the proposed offset correlates to, and adequately compensates for, the impacts to the EPBC listed species. The Offset Proposal (Appendix C) details the process undertaken to determine inputs into the offset guide in relation to EEL55.

Consultation with independent subject-matter experts and DCCEEW was conducted throughout this process to ensure adequacy and acceptability of the offset by the department.

3.5 Management and Monitoring Strategies

Preliminary management measures, completion criteria and associated monitoring have been outlined in the Offset Proposal in Appendix C.

The main management measures will include:

- Protection of land through conservation covenant;
- Exclusion of grazing;
- Undertake additional targeted fauna surveys;
- Implementation of feral animal control programs;
- Fire management measures;
- Clean up of any rubbish found within the site;
- Weed management (if required).

Northern Star will implement monitoring programs within EEL55 to measure the success of the offset against its conservation objectives and completion criteria. Monitoring programs will include:

- Initial and follow-up LiDAR imagery and annual Malleefowl mound monitoring within the offset, in line with the National Malleefowl Monitoring Manual (2020);
- Vegetation quality assessments, including weed monitoring;
- Feral animal monitoring;
- Infrastructure maintenance monitoring.

A detailed Offset Management Plan (OMP) has been developed by Northern Star and submitted to the post assessment branch for approval prior to implementation. The OMP details how the offset will be managed to ensure the success of conservation outcomes and completion criteria outlined in the management plan. This management plan has been developed in line with DCCEEW guidelines.

Monitoring programs detailed within the OMP including information outlining monitoring type, purpose, frequency and responsibility.

3.6 Reporting

The effectiveness of management measures and results from monitoring programs will be reported to DCCEEW in the Annual Compliance Report.

3.7 EPBC Act Environmental Offsets Policy

Detail regarding how the proposed offset package aligns with the principles of the EPBC Act Environmental Offsets Policy (DSEWPC 2012b) is described in Table 18 within the Offset Proposal (Appendix C).

4 Ecologically Sustainable Development

Table 15 provides a discussion of how the proposed action meets the principles of ecologically sustainable development, as defined in s.3A of the EPBC Act.

Table 15: Proposed Action Alignment to Principles of Ecologically Sustainable Development

No.	Principle	Consideration of Principle in the Proposal
1	Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	Northern Star's decision-making process has integrated both long and short term social, environmental and economic considerations with the aim to maximise social, economic and environmental benefits through operational design, mine closure, environmental management to mitigate impacts and through security and management of an offset package.
2	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation	Potential environmental impacts were considered during the design phase of the project. A specific and detailed risk assessment was conducted to assess risks and potential impacts to Malleefowl caused by the proposed action (Section 2.5.4). A wide range of environmental studies and targeted surveys have been conducted in the region and an annual monitoring program implemented at Carosue Dam Operations to gain a better understanding of Malleefowl populations in the region. Independent consultants also conducted an assessment on the impacts of the project against the EPBC Act Significant Impact Criteria (Section 2.5.1). An offset package has been developed as part of this proposal (Section 3 & Appendix C), that proposes acceptable management measures to prevent environmental degradation of the site.
3	The principle of inter-generational equity--that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations	The proposal will ensure the health, diversity and productivity of the environment is maintained through security of an offset site to ensure the protection of Malleefowl for the benefit of future generations. Northern Star proposes to manage the site to ensure risks to Malleefowl during all phases of the project are minimised through high quality environmental practices, rehabilitation of the site upon closure or progressively where possible and through the development of an offset package. At the end of the TSF's life, it will be rehabilitated as per the site's Mine Closure Plan.
4	The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making	Detailed environmental surveys have been conducted within the proposed impact area as well as throughout the wider mining region. Any residual impacts due to the project will be suitably offset as outlined in the Offset Proposal (Appendix C). Disturbed areas will also be rehabilitated upon

No.	Principle	Consideration of Principle in the Proposal
		closure in line with the approved Mine Closure Plan.
5	Improved valuation, pricing and incentive mechanisms should be promoted	Northern Star acknowledge the need for improved valuation, pricing, and incentive mechanisms and these have been included in the decisions for location, construction and operation of the controlled action. Incentive mechanisms opportunities at the offset site will be sought as required.

5 Environmental Record of the person proposing to take the action

Northern Star (Carosue Dam) Pty Ltd, previously Saracen Gold Mines Pty Ltd, have had a satisfactory record of responsible environmental management. Since commencement of operation at Carosue Dam in 2006, the company has maintained high environmental standards in line with current best practice guidelines and has maintained compliance with local, state and federal legislation. Audits by the State Departments have not revealed any major environmental issues and all minor issues raised have been rectified in a timely fashion. Northern Star has stringent policies, procedures and management plans to ensure that matters of environmental significance are safeguarded and managed professionally. There are not any past or present proceedings under a Commonwealth, State or Territory environmental law against either the person proposing the action or the person making the application.

Northern Star's Environmental Policy has been included in Appendix D.

6 Other Approvals and Conditions

The development of the TSF expansion and associated infrastructure requires approval under state legislation. Table 16 outlines the relevant approval, its status and an overview of relevant conditions.

Table 16: Relevant approvals relating to the Carosue Dam TSF Cell 4 Project

Approval Instrument	Relevant Legislation	Governing Body	Approval Status	Relevant Conditions/ Commitments
Mining Proposal Carosue Dam Environmental Group Site R3.1	Mining Act 1978 (WA)	Department of Mines, Industry Regulation and Safety	Approved January 2022	The activity must be undertaken in accordance with the approved Mining Proposal.
Carosue Dam Environmental Group Site Mine Closure Plan R7.0	Mining Act 1978 (WA)	Department of Mines, Industry Regulation and Safety	Approved January 2022	The Mine Closure Plan outlines the closure and rehabilitation commitments for the proposed action, including post-closure monitoring.
Native Vegetation Clearing Permit 8000/2	Environmental Protection Act 1986 (WA)	Department of Mines, Industry Regulation and Safety	Amendment granted 10 March 2022	8. Fauna Management - Malleefowl Where clearing authorised under this Permit is to occur between 1 September and 31 January, the Permit Holder shall: (a) Within two weeks prior to undertaking any clearing, engage an *environmental specialist* to conduct an inspection of the area to be cleared to identify *active (in use) Malleefowl (Leipoa ocellata) mounds*. (b) Where an *active (in use) Malleefowl mound* is identified under Condition 8(a) of this Permit, the Permit Holder shall ensure that no clearing occurs within 50 metres of the mound, during the months of September through to January, unless first approved by the *CEO*.
Works Approval	Environmental Protection Act 1986 (WA)	Department of Water and Environmental Regulation	Approved June 2022	The activity must be undertaken in accordance with the approved Works Approval.
Operating Licence L7465/1999/9	Environmental Protection Act 1986 (WA)	Department of Water and Environmental Regulation	Granted	A licence amendment will be submitted once works have been completed under the Works Approval.

7 Economic and Social Matters

7.1 Social and economic costs and benefits

Kalgoorlie-Boulder is located in the Goldfields Esperance region of WA, approximately 600 kilometres (km) east of Perth. This region accounts for 66% of the value of gold production in WA, a major contributor to the WA and Australian economies (Department of Regional Development 2017). Mining and other supporting sectors present the greatest opportunity to generate local and regional economic growth. The proposed action will allow for continued processing operations into the future which will continue to provide gold production for the state and support economic growth.

The benefits of the proposed action include but are not limited to:

- Continued investment into Local, State and Federal economies
- Creation of employment for local and regional community
- Enhance opportunities for an inclusive and diverse workforce
- Improved environmental outcomes through active management of risks
- Creation of opportunities for stakeholder partnerships.

It is estimated that an approximate $12.95M investment is required for the construction of the Proposed Action, which includes estimated costs for environmental management both at the construction site and offset site. Estimated costs have been derived from consultation with expert consultants, service providers and suppliers in relation to costs associated with design and construction, environmental studies, monitoring and environmental management.

Of the total procurement cost of $12.95M, $5M is expected to be from local sources. Local sources include Western Australian owned and operated contracting companies, associated personnel (with a particular emphasis on Kalgoorlie/Perth personnel) and miscellaneous locally sourced construction materials and fuel supplies.

The proposed action (TSF Cell 4) will require a short-term workforce for the construction phase but, longer term, it will provide a 10-year storage capacity of tailings material produced by the Carosue Dam processing plant, ensuring a further 10-year mine life. The anticipated workforce requirements of the construction and operation of the proposed are outlined in Table 17.

Table 17: Project Workforce Requirements for Life-of-Mine

Workforce by Category	Anticipated Project Workforce Requirement (people)	Anticipated Life-of-Mine Workforce Requirement (people)
Northern Star personnel		300
Subcontractors		800
Subconsultants		25
Project Specific Employees	8	
Project Specific Contractors	40	
Offset site monitoring (consultants)	2	
Total workforce	**50**	**1,125**

7.2 Stakeholder Consultation

Stakeholder consultation for the Carosue Dam Project was undertaken by Saracen, now Northern Star, throughout the feasibility and recommissioning phase and is an ongoing process throughout the life of the project. Stakeholder consultation is driven by Northern Star's Stakeholder Policy and associated Stakeholder Mapping and Engagement Global Standard. Closure issues are also discussed during this process.

'Stakeholders' include both internal and external parties who are likely to affect, be affected by, or to have an interest in the proposed mining activities. A Stakeholder Engagement Register relevant to the proposed action has been developed as detailed in Section 7.2.1.

Table 18 outlines the strategy for consulting with stakeholders relevant to the proposed action.

Table 18: Stakeholder Consultation Strategy

STAKEHOLDER	FREQUENCY OF ENGAGEMENT	METHOD OF ENGAGEMENT
INTERNAL		
Senior Management: - Managing Director - Chief Operating Officer - General Manager Operations	Daily/Weekly/Monthly/Annually	Prestarts, daily meetings, management meetings
Mining: - Open Pits Manager - Underground Manager		
Engineering: - Senior Planning Engineer		
Geology: - Geology Superintendent - Senior Mine Geologist - General Manager – Geology and Exploration		
Environment: - Environment Manager		
Input from Survey, Electrical, Safety other departments also sought as required throughout project. *note: position descriptions may change throughout life of the project.		
EXTERNAL		
Commonwealth Government		

Department of Agriculture, Water and the Environment	As required for projects impacting Matters of National Environmental Significance (MNES)	Meetings, email, phone calls, approvals
State Government		
Department of Mines, Industry, Regulation and Safety: - Environment Division - Mineral Titles - Safety and Geological - Geological Survey	As required for new projects or changes to existing projects. Compliance Reports	Phone calls, email, meetings, approvals, closure plans, annual reports
Department of Water and Environmental Regulation		
Department of Biodiversity, Conservation and Attractions		
Department of Planning, Lands and Heritage		
Local Government		
City of Kalgoorlie-Boulder	As required	Meetings, email, phone calls
Indigenous Groups		
Nyalpa Pirniku	As required prior to new projects	Heritage surveys, email, phone calls
Maduwongga Group		
Neighbouring Leaseholders		
Pinjin Pastoral Station	Ongoing	Informal meetings, email, phone calls
Gindalbie Pastoral Station		
Edjudina Pastoral Station		
Other		
National Malleefowl Recovery Team	As required	Meetings, email, phone calls
Goldfields Nullarbor Rangelands Biosecurity Association		

Additional stakeholders will be incorporated into the plan as they are identified.

7.2.1 Summary of Stakeholder Engagement

Engagement with each stakeholder group in relation to the proposed action is discussed below, with a summary provided in Table 20.

7.2.1.1 Commonwealth Government Departments

Department of Climate Change Energy the Environment and Water (DCCEEW)

Initial consultation with DCCEEW commenced early in August 2021 via phone call to discuss the project and the subsequent EPBC Referral. Notification of a 'Controlled Action' was provided by DCCEEW on the 29 September 2021, with approval required through Preliminary Documentation. Northern Star has since engaged in regular consultation with relevant assessing officers to ensure all aspects required by the Department are included in the Preliminary Documentation (this document) and associated documents.

A scoping meeting was held in August 2021 with DCCEEW officers to discuss the proposed project and for Northern Star to gain an understanding of the assessment process and information required for approval.

As part of the Preliminary Documentation, an Offset Proposal is required. On the 28 March, 13 April 2022, Northern Star consulted with DCCEEW regarding several possible options and their suitability as an offset for impacts to Malleefowl. Further consultation was conducted during May 2022 to obtain feedback from DCCEEW on the draft Preliminary Documentation.

7.2.1.2 State Government Departments

Northern Star has undertaken consultation with relevant government departments through the State's approvals processes. Northern Star aims to have regular, open, transparent communication

with relevant State departments to ensure appropriate environmental outcomes while maintaining business continuity.

Department of Mines, Industry Regulation and Safety (DMIRS)

A scoping meeting was held with relevant assessing officers within the Environmental Regulation Branch of the Department on the 18 November 2021. The purpose of this meeting was to outline the proposed action, highlight impacts, risks and management measures and determine requirements for project approval. Northern Star submitted Revision 3.1 of the Mining Proposal and Revision 7.0 of the Mine Closure Plan in relation to the TSF Cell 4 project, both of which were approved in January 2022.

Consultation with the Native Vegetation Branch was undertaken through an amendment application for Native Vegetation Clearing Purpose Permit to remove a condition outlining exclusion zones over inactive Malleefowl mounds within the permit area. This amendment was granted in March 2022 under section 51E of the *Environmental Protection Act 1986* (CPS8000/2).

Department of Water and Environmental Regulation (DWER)

A scoping meeting was held with assessing officers at DWER on the 16 November 2021 to outline the proposed action and ensure all relevant information was included in the Works Approval application and that all relevant environmental risks had been considered. A Works Approval is currently being assessed by the department.

Department of Biodiversity, Conservations and Attractions (DBCA)

Consultation with DBCA involved identification of threatened species across the Goldfields region from the Threatened Species Database. This contributed to regional knowledge around the species distribution throughout the area.
Commenced consultation to identify suitable nature conservation covenants under DBCA.

Department of Primary Industries and Regional Development (DPIRD)
Consultation with DPIRD in June 2022 to identify the options for legal protective mechanism for reserved lands. This has given a broader understanding of the requirements to obtain a conservation covenant under the Soil and Land Conservation Act 1945.

7.2.1.3 Traditional Owners

Consultation has been undertaken at length with the two main Native Title Groups with registered claims over the Project area, namely the Nyalpa Pirniku and Maduwongga Groups. The Nyalpa Pirniku group were initially consulted via Native Title Services Goldfields (NTSG) (Heritage Survey Management Consultancy) in June 2021 regarding the proposed project and were requested to conduct an archaeological and ethnographic survey over the impact area. The survey was subsequently completed between the 4 – 7 August 2021. The group reported that:

"The TSF expansion area does not contain any Aboriginal sites. Works can proceed within the TSF expansion area without impacting any Aboriginal sites" (Czerwinski, 2021).

Initial consultation of the TSF project with the Maduwongga Group was conducted in August 2021, with a survey subsequently conducted on the 7 & 8 August 2021. This survey concluded that no heritage values would be impacted by the TSF expansion (Glendenning, 2021). However, during the survey, members of the Maduwongga Group requested that:

"The hill northwest of tenement M31/295 (not on Northern Star tenements) was also requested by the Maduwongga representatives to be avoided as it may be a part of Tjurkkurpa story" (Glendenning, 2021).

The hill described in the survey report is located several kilometres from the western boundary of Northern Star tenements and will not be impacted by the proposed project.

The Jardu Mar claim over the project site remains unregistered under the *Native Title Act 1993* (Commonwealth). As such, Northern Star concentrates engagement efforts on the two registered claimant groups described above.

7.2.1.4 Neighbouring Leaseholders

Northern Star maintains close relationships with neighbouring leaseholders. Frequent contact is kept between Northern Star and the three main stations affected by the Carosue Dam Operations, namely; Pinjin, Gindalbie and Edjudina stations. The proposed project is located on Pinjin and Gindalbie Pastoral stations.

Pinjin Station representatives were notified of the proposed TSF Cell 4 Project initially on the 25 of May 2021 via email and were invited to attend the Carosue Dam minesite for further discussions. Pinjin station had no objection to the proposed action.

Gindalbie Station owners attended the Carosue Dam minesite for a stakeholder consultation meeting regarding the TSF Cell 4 Project on the 7 October 2021. No objections were raised regarding the project, with both Gindalbie representatives advising that they were supportive of the proposed development.

7.2.1.5 National Malleefowl Recovery Team

Northern Star began working with the National Malleefowl Recovery Team (NMRT) on Malleefowl related projects at Carosue Dam in June 2019. More recently, Northern Star teamed up with members of the NMRT to conduct a training program for site and corporate Environmental staff in line with the requirements of the National Malleefowl Monitoring Manual. A total of six environmental staff were trained in the respective monitoring techniques. These techniques have now been implemented on site as the standard monitoring procedure.

The Malleefowl Recovery Team were consulted in June 2022 to identify partnership opportunities regarding Malleefowl monitoring and to support research projects.

7.2.1.6 Goldfields Nullarbor Rangelands Biosecurity Association (GNRBA)

Consultation with GNRBA in June 2022 sought to seek opportunities to contribute to broader feral animal control measures, share information and provide support.

Table 19: Summary of Recent Project Stakeholder Engagement

Stakeholder	Feedback	Northern Star Response
Gindalbie Station	• Very receptive to Northern Star proactively engaging prior to the works and providing a communication route for any concerns.	• Open invitation to attend site at any time to discuss queries or concerns and further updates to be provided throughout each phase of project.
Pinjin Station	• Generally receptive of project. No concerns raised.	• Open invitation to attend site at any time to discuss queries or concerns and further updates to be provided throughout each phase of project.
Nyalpa Pirniku Group	• Generally receptive of project. Appreciative of invitation to conduct Ethnographic survey of the proposed project location. No concerns raised with proposed development.	• Open invitation to attend site at any time to discuss queries or concerns and further updates to be provided throughout each phase of project.

Stakeholder	Feedback	Northern Star Response
Maduwongga Group	• Generally receptive of project. Concerns raised regarding potential impacts to adjacent hill northwest of tenement M31/295.	• Northern Star have assured the Maduwongga Group that the hill in question is well beyond tenement boundaries and will not be impacted by the proposal. • Open invitation to attend site at any time to discuss queries or concerns and further updates to be provided throughout each phase of project.
DBCA	• Receptive to engagement, no concerns in respect of proposed project. • Opportunities for Nature Conservation Covenants.	• Ongoing engagement at significant project milestones. Engagement intended regarding proposed management of selected offset.
DMIRS and DWER	• Extensive consultation with regards to clearing permits, Mining Proposals, Works Approval.	• Development of approvals that meet federal and state requirements.
DCCEEW	• Extensive consultation with regards to Preliminary Documentation and offset requirements.	• Development of offset proposal that meets federal and state requirements.
National Malleefowl Recovery Team	• Malleefowl monitoring training provided to Northern Star Environmental Staff. • Engagement with Recovery Team for potential research projects to fund.	• Northern Star initiated Carasue Dam monitoring program. • Northern Star may fund research projects on matters relevant to Malleefowl.
Department of Primary Industries and Regional Development	• Engagement with the Officer of the Commissioner of Soil and Land Conservation to obtain information on the Agreements to Reserve and Conservation Covenants.	• Northern Star will apply for a Conservation Covenant with the Soil and Land Commissioner.
Goldfields Nullarbor Rangelands Biosecurity Association	• Engagement to identify opportunities to support regional animal control and fund research projects.	• Northern Star propose to consult with GNRBA in regards to regional bating efforts, support and training for feral animal management.

8 Relevant standards, policies and other guidance material

In the preparation of this document, the following material was utilised for guidance.

Table 20: Guidance Material Utilised

Standard/Policy/Guideline	Consistent Actions
National Malleefowl Monitoring Manual: 2020_1 Edition (Revised June 2020).	Surveys were conducted in line with the National Malleefowl Monitoring Manual
Department of the Environment (2014). Environmental Management Plan Guidelines. Canberra, ACT: Commonwealth of Australia.	The Construction Environmental Management Plan was developed in line with this guidance document.
Department of Sustainability, Environment, Water, Population and Communities (2012). Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy. Canberra, ACT: Commonwealth of Australia.	The Environmental Offsets Policy was used to assess offset options for the proposed action and ensure the proposed aligns with the policy.
Department of Agriculture, Water and the Environment (2021). Guide for providing maps and boundary data for EPBC Act projects. Canberra, ACT: Commonwealth of Australia.	Mapping has been undertaken in accordance with the guidance.
The National Recovery Plan for Malleefowl Leipoa ocellata (2007). Department of Environment and Heritage, South Australia.	The Recovery Plan has been used to guide the implementation of management measures and objectives of the Offset Proposal to contribute to the goals of the recovery plan. This has been outlined in Section 8.1
Department of the Environment (2015). Threat abatement plan for predation by feral cats. Canberra, ACT: Commonwealth of Australia.	The threat abatement plans identify management measures, objectives and actions relating to each threat. The proposal is consistent with the Goals, Objectives and Actions stated within each of the abatement plans to achieve the following: • Prevent the occurrence of feral animals within the site; • Promote the maintenance and recovery of threatened species impacted from predation; and • Increase knowledge and understanding of feral impacts to promote adaptive management for effective control. Appropriate feral animal control will be implemented in consultation with DBCA. This will aid to secure and protect Malleefowl populations across the species range.
Department of the Environment, Water, Heritage and the Arts (2008). Threat abatement plan for predation by the European red fox. Canberra, ACT: Commonwealth of Australia.	
Department of the Environment and Energy (2016). Threat abatement plan for competition and land degradation by rabbits. Canberra, ACT: Commonwealth of Australia.	
Department of the Environment, Water, Heritage and the Arts (2008). Threat abatement plan for competition and land degradation by unmanaged goats. Canberra, ACT: Commonwealth of Australia.	
EPA Technical Guidance: Flora and vegetation surveys for Environmental Impact Assessment (EPA 2016)	Surveys were undertaken in accordance with this EPA technical guidance.

Standard/Policy/Guideline	Consistent Actions
EPA Technical Guidance: Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)	Surveys were undertaken in accordance with this EPA technical guidance. In addition, the malleefowl surveys were conducted in line with the National Malleefowl Monitoring Manual.
EPBC Offsets Assessment Guide (DSEWPAC 2012a)	This guide was used to calculate inputs to ensure the offset is suitable and in proportion to the impact.

8.1 Recovery Plans

The *National Recovery Plan for Malleefowl (Leipoa ocellata)* (Benshemesh J 2007) guides recovery of the species with the primary objective to secure existing populations across the species range and achieve de-listing of the species under the EPBC Act. Table 21 outlines how this Proposal aligns with priority objectives and actions within the recovery plan and the relevant threat abatement plans.

Table 21: Offset Proposal alignment with National Recovery Plan for Malleefowl (*Leipoa ocellata*) (Benshemesh J 2007)

Recovery Plan Objectives	Recovery Plan Priority Actions	Northern Star Offset Proposal
Reduce permanent habitat loss	Retain areas that support Malleefowl and protect them from incremental clearing, and report annually on clearing	The proposed offset site will be secured with a conservation covenant to protect the land from future clearing. The offset will be managed to reduce the risk of degradation and improve habitat quality.
Reduce the threat of grazing pressure on Malleefowl populations	Remove goats and sheep from reserves, if present. Close or fence artificial sources of water in conservation reserves. Erect adequate fencing to protect Malleefowl habitat. Reduce rabbit numbers where they are abundant in or near Malleefowl habitat	Grazing will be prevented at the offset site through adequate fencing. Control of feral animals will be implemented where impacts to Malleefowl are observed. No artificial water sources will be located within the reserve.
Reduce fire threats	Reduce the occurrence of large fires, and promote patchiness of fires, where Malleefowl conservation is a priority in large reserves. Provide for access to and protection of small habitat remnants to prevent fire spreading to or from surrounding land.	Firebreaks will be installed along fence line of offset area. Offset is located near operating Northern Star mine sites which have Emergency Response teams trained to respond to fires in the region. It is also located 42km south-southwest of Kalgoorlie (via gazetted roads) which also has fire response resources.
Reduce predation	Record and centralise details of fox control in or near areas where there are estimates of Malleefowl abundance. Reduce fox numbers in small and isolated habitat remnants where Malleefowl densities have declined, and fox predation is a likely explanation for such declines	Northern Star have feral animal management procedures (*CDO-ENV-024-SWP Weed and Feral Animal Control*) which will be applied to the Offset Site when required to ensure threats to Malleefowl through predation are minimised.

Recovery Plan Objectives	Recovery Plan Priority Actions	Northern Star Offset Proposal
	Reduce fox numbers in large areas of native habitat where Malleefowl densities have declined, and fox predation is a likely explanation for such declines.	Records will be kept of evidence of feral animals noted within the site. Where required Northern Star will work with DCBA regarding implementation of feral animal management.
Monitor Malleefowl and develop an adaptive management framework	Analyse and review monitoring data. Recommend improvements and develop site-specific management plans consistent with a national adaptive management design. Monitor and manage existing monitoring sites across Australia Facilitate and standardise monitoring and coordinate national monitoring effort.	Mounds identified within the Offset site will be surveyed annually in accordance with the National Mallleefowl Monitoring Manual (National Recovery Team, 2020). Results will be provided to the National Malleefowl Monitoring Database.
Determine the current distribution of Malleefowl	Detail the distribution of Malleefowl in remote areas of SA and WA by field surveys, and describe the habitats in which Malleefowl are found.	Targeted Malleefowl surveys and records of opportunistic sightings on Northern Star tenements helps provide an understanding in Malleefowl distribution trends. A targeted intensive survey will be conducted during the first year of this proposal being approved.
Describe habitat requirements that determine Malleefowl abundance	Describe the habitat requirements and preferences of Malleefowl, with a view to identifying important habitat components that may underlie variations in breeding densities.	Northern Star has conducted a number of flora and fauna surveys across their tenements. In areas of potential Malleefowl habitat, targeted assessments are conducted, including the offset site. This data contributes to the understanding of habitat requirements and preferences throughout the Goldfields.
Facilitate communication between groups	Hold a national Malleefowl community forum every three years and support the national newsletter.	Enhance communication between Northern Star and the National Malleefowl Recovery Team to ensure objectives continue to be in alignment. Where possible, a Northern Star representative will attend the national Malleefowl community forum.
Raise public awareness through education and publicity	Publicise the recovery effort, beneficial management practices, the contributions made by community groups, and the legislative protections afforded to the species at national and state level.	Northern Star includes Malleefowl education for workers. Malleefowl management actions implemented on site are included in company reporting including the annual Northern Star Sustainability Report.

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Appendices

Appendix A: Impact Site Survey

ASSESSMENT OF IMPACTS ON MALLEEFOWL OF PROPOSED EXPANSION OF CAROSUE DAM TAILINGS STORAGE FACILITY.

NORTHERN STAR RESOURCES LIMITED

Alexander Holm & Associates

Natural Resource Management Services

April 10, 2022

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1 Summary

Alexander Holm & Associates were contracted by Northern Star Resources (Northern Star) in June 2021 to systematically survey 842ha to locate, record and map evidence of Malleefowl (*Leipoa ocellata*) within and surrounding a disturbance envelope associated with expansion of the Carosue Dam tailings facility. This survey involved operators searching along gridlines 40m apart. While eight nesting mounds of relatively recent occupation were located, there was no evidence of current Malleefowl activity.

In September 2021, the proposed expansion of the TSF was declared a controlled action under section 95A(2) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), requiring further information to assess the relevant impacts of the proposed action. Alexander Holm & Associates were contracted to conduct a targeted Malleefowl survey at 20m spacings of the areas surveyed previously in June 2021 including the disturbance envelope, in accordance with the National Malleefowl Monitoring Manual (National Malleefowl Recovery Team 2019), in order to provide an updated impact assessment and habitat quality score. An assessment of the extent and location of suitable Malleefowl habitat outside the disturbance envelope was also required.

The 842ha survey area, including the disturbance envelope, was searched by four operators from December 4 to 9, 2021 involving 525km of traverse. Nesting mounds were assessed according to the National Malleefowl Monitoring Manual. A total of 23 nesting mounds were located, of which 13 were 'long unused' and, apart from an indication of past use of habitat by Malleefowl, are of no significance for ongoing existence of Malleefowl in the area. Ten nesting mounds of relatively recent occupation were located, two of which were not found in the June 2021 survey. There were no currently occupied ('active') nesting mounds and no evidence of Malleefowl activity was found throughout the survey area. Four of the ten nesting mounds of relatively recent occupation were partially degraded, judged not to have been used for at least 5 to 10 years, and classified as 'inactive abandoned'. Six were well-formed, judged to have been used within the past 5 years, and classified as 'inactive recent'. Seven of these nesting mounds fall within the disturbance envelope, four 'inactive recent' and three 'inactive abandoned'.

Habitat within the disturbance envelope was assessed according to criteria in the 'Offsets assessment guide'. The disturbance envelope is partitioned into six land units, which occupy similar topographic positions with distinctive vegetation and soil type: sandy rises with spinifex, lateritic rises, basalt hill footslopes, acacia shrubland, spinifex sandplain and alluvial plains. Spinifex sandplain and sandy rises with spinifex occupy 25% of the area; alluvial plains with chenopods 29%; acacia shrubland 26%; basalt footslopes with acacias 20% and lateritic rises 1%. Indices for habitat condition, site context and Malleefowl stocking rate, according to the 'Offsets guide' were assigned to each land unit, summed and area-adjusted to provide an overall habitat quality score for the disturbance envelope. These included ratings based on evidence of predatorial animal (cats, dogs, foxes) activity within the search area, however no evidence was found.

Spinifex sandplain and sandy rises with spinifex are mostly in excellent condition and the remainder mostly in fair condition. Litter abundance is optimal in acacia- dominated units and minimal elsewhere. Sandy loam soils suitable for mound construction are prevalent in all land units except alluvial plains.

In terms of 'site context', while the disturbance area is part of a regionally significant contiguous suitable habitat; connectivity of all land units with surrounding landscapes is compromised by mining infrastructure and pastoral fencing.

Previously active mounds were found within acacia shrublands, basalt footslopes, and in small, localised sites within spinifex units while none were found on lateritic rises or alluvial plains.

When indices for habitat condition, context and Malleefowl stocking rate are combined, sandy rises with spinifex scores the highest for Malleefowl habitat followed by acacia shrublands, spinifex sandplain, and basalt footslopes which all rate highly. Alluvial plains and lateritic rises are of limited value.

After combining area-adjusted ratings for each land unit, the total habitat quality score for the disturbance envelope is 5.41 expressed out of the maximum possible score of 10.

Within the disturbance envelope most nesting mounds were found within acacia shrublands and basalt footslopes, which are therefore considered habitat favoured for breeding and foraging by Malleefowl. While two nesting mounds were found in spinifex sandplain and sandy rises with spinifex, these mounds were restricted to small, non-fire-prone locations without spinifex, where acacias occur. Elsewhere, throughout the majority of these units where spinifex is the dominant ground cover and fire is common, there were no nesting mounds. Consequently, these spinifex-dominated systems are considered primarily habitat for foraging and cover. As such, of the 229.1ha disturbance envelope, 11.8ha has been previously cleared, 52.5ha is 'suitable' habitat (used for forage and cover) and 100.1ha is considered to be critical' habitat (used for breeding and foraging). Alluvial plains and lateritic rises, which make up 64.8ha, the balance of the disturbance envelope, are of limited value as Malleefowl habitat.

Seventy-one Malleefowl nesting mounds have been identified during intensive and semi-intensive searches and opportunistic sightings in areas adjacent to and including the disturbance envelope. Two thirds of these nesting mounds were on the acacia shrublands of land units 4a and 4b (Alexander Holm & Associates 2019) and nesting mounds were common on fringes of spinifex sandplain and footslopes of basalt hills. Five of these mounds, approximately 5 km south-east of the disturbance envelope, were found to be active during Malleefowl monitoring by Northern Star in early December 2021. In contrast, none of the nesting mounds within and near the disturbance envelope were active, re-enforcing the assessment that Malleefowl have deserted this area for less- impacted areas, widely available elsewhere.

Within the 4,276ha surrounding Carosue Dam operations, which includes the disturbance envelope and is covered by a unified land unit map (Alexander Holm & Associates 2019), 368ha is considered to be habitat suitable for forage and cover and 2,143ha is considered to be critical habitat used for breeding and forage.

At the broader land system scale, most nesting mounds are within Deadman land system characterised by level to gently undulating plains with casuarina-acacia shrublands (Pringle et al. 1994) which include the Malleefowl-favoured acacia shrublands of land units 4a and 4b Nesting mounds occur on footslopes of Lawrence and Leopold land systems characterised by low hills with eucalypt or acacia woodlands with halophytic under-shrubs (Pringle et al. 1994) which include basalt hill footslopes of land unit 2b. Nesting mounds also occur in favoured locations within the extensive Kirgella land system characterised by sandplain supporting spinifex and acacia/eucalypt shrublands which is dominated by spinifex sandplain of land unit 4d.

Deadman, Kirgella, Lawrence and Leonora land systems occupy approximately 18,000ha within 10km of the disturbance envelope and provide potential habitat for Malleefowl. Kirgella land system, which extends up to 40km to the west and is contiguous with the disturbance envelope, occupies two thirds of the potential habitat.

In assessing the impact of the proposed development on Malleefowl population in the area, four 'inactive recent' and three 'inactive abandoned' nesting mounds will be cleared. There are no 'active' nesting mounds within or near the development envelope and there appears to have been no Malleefowl activity at least within the previous 12 to 18 months. It is concluded that expansion of the TSF will have negligible impact on the widely dispersed Malleefowl population in this region as there is extensive habitat in adjacent areas for Malleefowl use in subsequent breeding seasons.

2 Scope of Works

Northern Star operates the Carosue Dam Gold Mine, located 110km north-east of Kalgoorlie, and plans to expand the Tailings Storage Facility (TSF). The expansion is to accommodate the new TSF cell (Cell 4) and associated infrastructure which involves land clearing of vegetation within a disturbance envelope of approximately 229ha. The outer limit of the proposed haul road which passes around the expanded TSF is taken as the disturbance boundary.

Alexander Holm & Associates have been contracted to:

a) Conduct a targeted Malleefowl survey and updated impact assessment for the disturbance envelope, including the areas surveyed in June 2021. The survey and assessment must:

   i. Be conducted within the Malleefowl breeding season, as defined in the *National Malleefowl Monitoring Manual* referenced at item 9a (October to December).

   ii. Be conducted in accordance with the procedures outlined in the *National Malleefowl Monitoring Manual* referenced at item 9a, including but not limited to transect spacing of no more than 20m depending on the density of the landscape being searched.

   iii. Include a photo of all identified mounds, and historical photos of revisited mounds (where possible).

   iv. Detail any evidence of use by Malleefowl, including mound condition and status in accordance with the descriptors outlined in *National Malleefowl Monitoring Manual* referenced at item 9a.

b) Include evidence and mapping that demonstrates the location of the previously identified 90ha of 'suitable habitat' that is located within the disturbance envelope. This should differentiate between suitable habitat (such as that used for forage or cover) and critical habitat (such as that used for breeding).

c) Include evidence and mapping to show how the extent and location of habitat that is available outside of the disturbance envelope.

d) Details of the methodology used to determine and assess the suitability of habitat present in and around the site.

3 Background

3.1 Species and Habitat Information

3.1.1 Malleefowl (*Leipoa ocellata*)

Malleefowl are a stocky ground-dwelling bird belonging to the family Megopodiidae. This species builds distinctive mounds to incubate their eggs. Breeding season usually begins in September when egg laying begins and ends in late January. Chicks typically begin hatching in November, with most chicks emerging from mounds by January, however it has been noted that in some seasons hatching may continue until March (Benshemesh 2007).

3.1.2 Distribution and Habitat

Historically, Malleefowl have been found in semi-arid mallee shrublands and woodlands across southern Australia (Department of Parks and Wildlife 2016b), but their range has been greatly reduced, mostly attributed to extensive land clearing for agriculture (Department of Parks and Wildlife 2016b).

In Western Australia, Malleefowl habitat consists of acacia-dominated shrublands and woodlands dominated by mallee eucalypts. Malleefowl require a sandy substrate and abundance of leaf litter for the construction of mounds (Department of Parks and Wildlife 2016a). Habitats characterised by numerous food plants (especially leguminous shrubs and herbs), a dense canopy cover and open ground layer are generally associated with high breeding densities. Malleefowl also prefer long unburnt country (Benshemesh 2007).

3.1.3 Conservation Status

Malleefowl is recognised as a threatened species under State and Commonwealth legislation. Malleefowl is listed as Vulnerable nationally under the EPBC Act and is also listed as Vulnerable under the *Biodiversity Conservation Act 2016 (WA)*.

3.1.4 Nesting Mound Characterisation

The National Monitoring Manual provides the following description of 'active' nesting mounds (National Malleefowl Recovery Team 2019) and three other categories for currently non-active nesting mounds are proposed.

The nesting mound categories used in this report are:

Active: Currently being used by Malleefowl as an incubator for their eggs, and likely to contain eggs.

Inactive recent: Potentially used within the last 5 years. Mound well-formed, litter often still present, no evidence of inner crusting or growth of annual herbs or grasses.

Inactive abandoned: Likely unused for more than 5-10 years and possibly abandoned. Mound somewhat degraded, often crusted, annual herbs or grasses maybe present.

Long unused: Unlikely to have been used for at least 20 years. Evidence of an extended period of inactivity such as shrubs or trees growing from hollow or mound. Mound very degraded/poorly formed. Highly unlikely to become active in the future.

3.2 Previous Surveys

Several surveys of landform and vegetation, some including Malleefowl searches, have been conducted in the vicinity of Carosue Dam operations. Summaries of relevant surveys are listed below.

3.2.1 November 2012

Alexander Holm & Associates were contracted In November 2012 to assess flora and vegetation within a 680ha survey envelope surrounding the existing TSF facility at Carosue Dam. Approximately 600ha of this survey area falls within the current survey envelope, the remainder is now occupied by the expanded TSF.

Malleefowl habitat considered most at risk from mining operations and adjoining areas encompassing approximately 90% of the 2012 survey area was searched for evidence of Malleefowl. Operators searched along gridlines 50m apart. Malleefowl were active in the survey area. Three 'active' and three 'long-unused' nesting mounds were located, tracks observed and two birds sighted during the survey (Alexander Holm & Associates 2012c).

3.2.2 January 2019

Alexander Holm & Associates and Bamford Consulting Ecologists were contracted in January 2019 to conduct reconnaissance vegetation, flora and fauna surveys within a 3,136ha area associated with seismic surveys surrounding Carosue Dam operations area but did not include the disturbance area associated with the TSF expansion.

The 2019 survey took into account earlier surveys that fell within or adjoined the project envelope, including the November 2012 survey outlined above, to produce a unified land

unit/vegetation association map and description covering a 4,896ha area that included the disturbance envelope (Alexander Holm & Associates 2019).

Mining operations at Carosue Dam occupy 619ha of the unified land unit map area. After taking this disturbance area into account, 42% of the remaining 4,276ha is occupied by plains supporting acacia shrublands with sparse overstoreys of eucalypts and casuarina (land units 4a and 4b). Chenopod shrublands occur on approximately 36% of the area either on calcareous plains (land unit 4c) or alluvial plains (land units 5a and 5b). Sand plains and sandy rises occupying 5% of the area, typically support spinifex tussock grasslands with sparse eucalypt overstoreys. Low hills and rises on laterite, basalt or felsic rocks occupy the remainder.

Malleefowl were not searched for systematically during this reconnaissance survey, however it was noted that they were active in the survey area and three birds were sighted.

3.2.3 June 2021

Alexander Holm & Associates were contracted in June 2021 to revise and update information from earlier surveys on vegetation and land resources within 842ha surrounding and including a disturbance envelope associated with expansion of the TSF to accommodate Cell 4.

Approximately 40% of the survey area is occupied by either alluvial plains supporting halophytic low shrubland or calcareous plains supporting chenopods, acacia shrublands with sparse overstoreys of eucalypts and casuarina occupy 22%. Sand plains and sandy rises occupy 17% of the area and typically support spinifex tussock grasslands with sparse eucalypt overstoreys. Low hills and rises on laterite, basalt or metamorphic rocks occupy the remainder (Alexander Holm & Associates 2021).

Alexander Holm & Associates were also to locate, record and map evidence of Malleefowl within the 842ha area. Two operators searched along gridlines 40m apart. A total of 246km was traversed. It is estimated that the search procedures were sufficient to locate 90 to 100% of nesting mounds in less densely vegetated areas and 60 - 80% in more densely vegetated areas. There was no evidence of current Malleefowl activity: no sightings of birds, tracks or significant litter disturbance. Eighteen Malleefowl nesting mounds were found which included three nesting mounds previously recorded as 'active' during the 2012 survey, and one of the three 'long-unused' mounds. The other 'long-unused' mounds had been destroyed by expansion of the TSF and other mining infrastructure. Three other ground disturbances were discounted as either rudimentary, unsuccessful scratchings or ancient diggings unlikely to be Malleefowl nests.

Of these 18 mounds, none were 'active', ten were 'long unused', four were 'inactive abandoned' and four were 'inactive recent' (Alexander Holm & Associates 2021).

4 Assessment Methodology

4.1 Assessment Personnel

The November 2012 survey was conducted by Alexander Holm and Andrew Mitchell.

Dr Holm is an ecologist with over 35 years experience in arid environments and Goldfield regions and an accredited environmental consultant with the Environmental Consultants Association of Western Australia.

Mr Andrew Mitchell was assisting botanist to Western Australian Department of Agriculture's rangeland surveys and senior author of "Arid Shrubland Plants of Western Australia" (Mitchell and Wilcox 1994). He has over 35 years experience in arid, semi-arid and tropical ecosystems of Australia.

The January 2019 survey was conducted by Alexander Holm and Mike Bamford

Dr Mike Bamford is a wildlife biologist, scientific illustrator and science communicator and with his wife Mandy, he has operated Bamford Consulting Ecologists since the mid 1980s. Mike has extensive experience in the south-west of Western Australia, Western Australia's Goldfields, Pilbara, Kimberley, the Western Deserts, the Northern Territory, Christmas Island and far north Queensland.

The June 2021 survey was conducted by Alexander Holm and Geoffrey Eliot.

Mr Geoffrey Eliot was soil and landscape technician for the Western Australian Department of Agriculture's rangeland surveys and has over 20 years experience in Western Australian arid regions.

The December 2021 Malleefowl survey was conducted by Holm, Eliot and two assistants.

Mr Wayne Fletcher is a rangeland expert with over 30 years experience for the Western Australian Department of Agriculture specialising in assessment of environmental impacts of pastoralism in arid and semi-arid environments.

Mr Philip Smyth has over 30 years experience with the Western Australian Lands and Surveys Department specialising in characterising and mapping of vegetation and land resources.

Reports were prepared by Dr Alexander Holm (Alexander Holm & Associates).

4.2 Timing of Survey and Seasonal Conditions

The follow-up Malleefowl survey was conducted from December 4 to 9, 2021. This survey was during the breeding season of Malleefowl in accordance with the National Malleefowl Monitoring Manual (2020) and is therefore considered suitable timing to determine mound status.

The Goldfields region is arid to semi-arid with average annual rainfall decreasing from about 250mm in the south-west to 200mm in the north-east. The area experiences hot summers and mild winters with cold nights. Rainfall varies widely between years and droughts are common. Remnants of tropical cyclones occasionally bring heavy summer rain and can cause flooding to the area. The area transitions between desert summer and winter dominated rainfall and desert: non-seasonal bioclimatic (Beard 1990).

Rainfall at Carosue Dam has averaged 242 mm a year since 1970 and in recent years, summer rainfall has become more dominant. Rainfall was exceptionally dry in 2019 (78mm), well below average in 2020 (168mm) and below average in 2021 (181mm) (Figure 1). There have been few effective rainfalls over winter or spring since 2016.

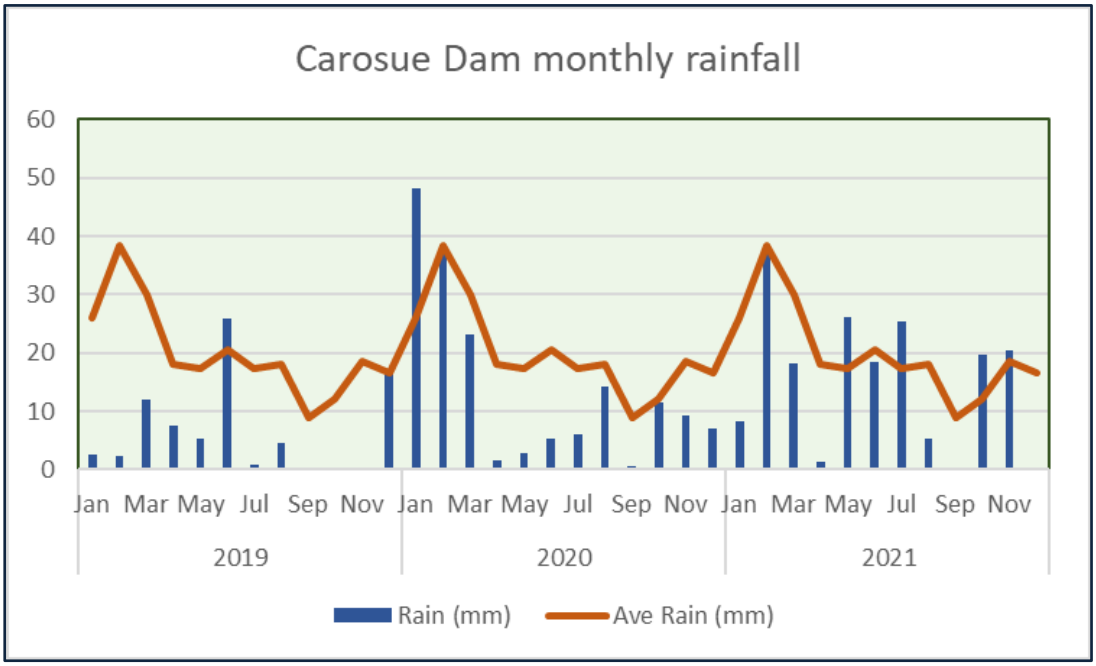

Figure 1: Monthly rainfall at Carosue Dam.

4.3 Targeted Malleefowl Survey

Operators searched along gridlines 20m apart using GPS devices to maintain position. Gridlines were orientated 10 degrees different from the June 2021 survey to increase opportunities to locate new nesting mounds. A total of 525km was traversed (Figure 2).

It is estimated that the search procedures were sufficient to locate 100% of nesting mounds.

Located nesting mounds were recorded as a) 'long unused' and unlikely to have been used for at least 20 years, b) 'inactive abandoned' unlikely to have been used for at least 5 to 10 years and c) 'inactive recent' possibly used within the last 5 years (Section 3.1.4). No 'active' nesting mounds were found (Figure 3).

Located nesting mounds were photographed, measured and evidence of Malleefowl activity noted in accordance with the procedures outlined in the *National Malleefowl Monitoring Manual* referenced at item 9a (National Malleefowl Recovery Team 2019).

Other evidence of Malleefowl activity (disturbance of litter, tracks and sightings) was noted during traverse.

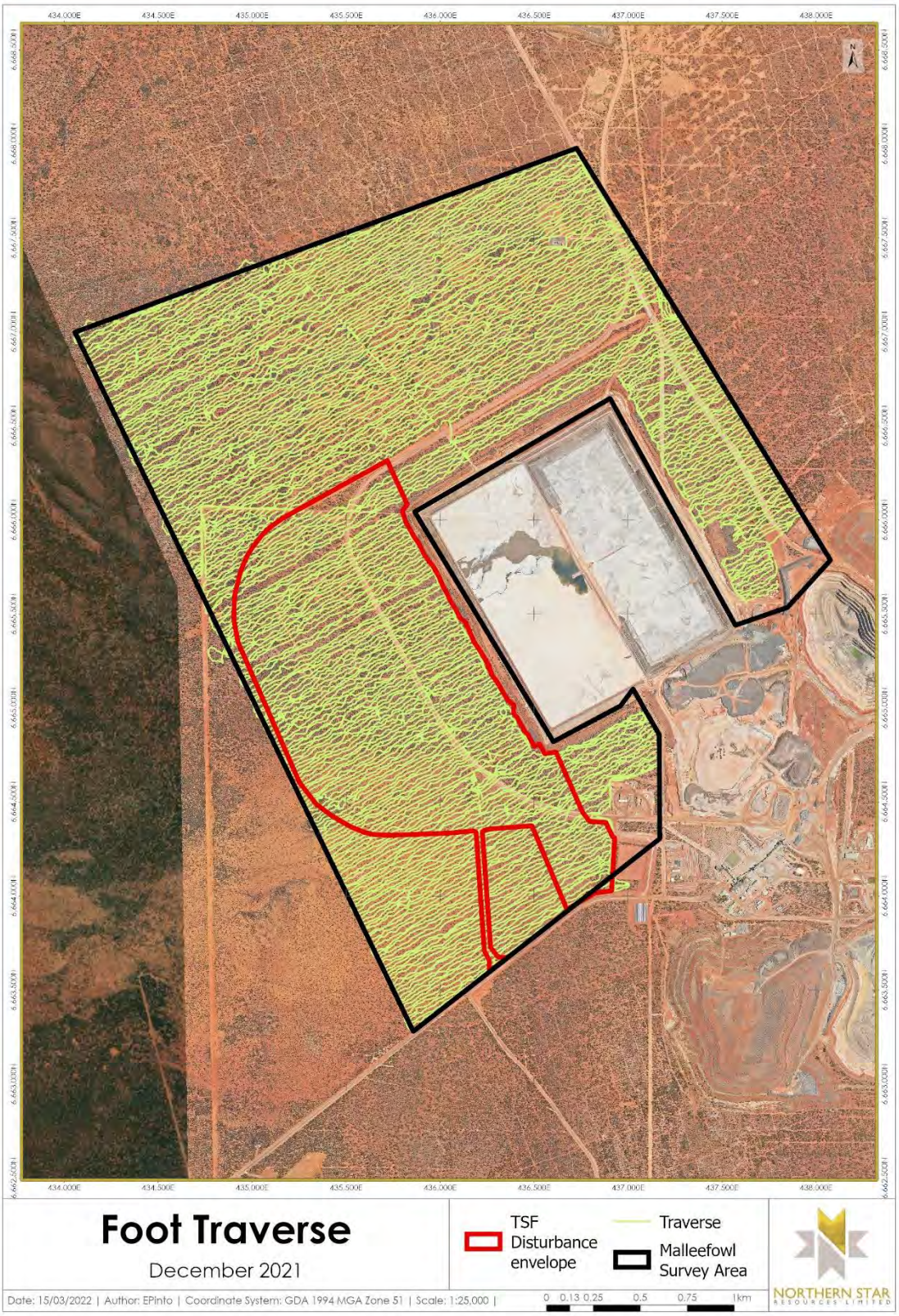

Figure 2: Survey envelope and foot traverse December 2021.

Figure 3: Location of Malleefowl nesting mounds within the survey area

4.4 Habitat Quality Assessment

The underlying basis for habitat assessment were vegetation surveys conducted over the impact area and surrounds as reported in Alexander Holm & Associates (2012c, 2019). These surveys provide spatially-described information within land units each occupying a similar topographic position with similar vegetation and soil type (Christian and Stewart 1953).

Within the 229.1ha disturbance envelope, 11.8ha has been previously cleared for a haul road, minor access roads and boundary fencing, leaving 217.3ha of habitat for assessment. Of this, alluvial plains with chenopods (land unit 5a) occupy 29%; acacia shrubland (land unit 4a) 26%; spinifex sandplain (land unit 4d) 21%; basalt foot slopes (land unit 2b) 20%; sandy rises with spinifex (land unit 1d) 3% and laterite rises (land unit 2a) 1% (Figure 4).

In accordance with the EPBC offsets assessment guide (How to use the Offsets assessment guide (awe.gov.au) three components, i) site condition, ii) site context and iii) Malleefowl stocking rate were rated for each land unit and summed in proportion to the area of each land unit to provide an overall rating of habitat suitability within the assessment envelope.

4.4.1 Site Condition

Site condition rating consists of three components:

a) Vegetation condition (Keighery 1994).
b) Habitat features being an unweighted sum of binary values (0- absent, 1- present) for the following eight attributes as described in the National Recovery Plan (Benshemesh 2007):
    - Loamy sand or sandy loam soil type (Anon 2009);
    - Litter availability;
    - Upper and mid storey canopy cover (Anon 2009);
    - Level ground;
    - Presence of mallee (*Eucalyptus* spp.);
    - Presence of Melaleuca;
    - Presence of mulga (*Acacia* spp.); and
    - Presence of spinifex (*Triodia* spp).
c) Feral predator activity within the following categories:
    - Not detected in targeted survey;
    - Scarce (one record within habitat);
    - Medium presence (multiple records of single species or single records of more than one species);
    - Abundant (multiple records of more than one species).

Vegetation associations within each of these land units is described in these aforementioned surveys in terms of condition, flora species census and canopy cover based on observations at selected inventory sites distributed throughout the survey areas. Specific data for soil type, habitat condition, and canopy cover were summarised from inventory points falling within and immediately adjacent to the disturbance envelope. Data on litter availability was visually assessed during the foot traverse in December 2021.

The overall score for Site Condition (including vegetation condition, habitat features and feral predator activity) was converted to a score out of three and weighted in the following manner:

Habitat features- 50%- This majority weighting was assigned as factors such as litter availability, suitable soil type and dense canopy cover are considered essential for successful Malleefowl breeding (e.g. Department of Parks and Wildlife 2016a).

Vegetation condition- 25%- Considered of less importance to Malleefowl activity than habitat features.

Feral predators- 25% - While Malleefowl chicks, juvenile and sub-adult birds are most at risk to feral predators such as cats and foxes thereby limiting recruitment into the breeding population, adult mortality to feral predators, appears low (Priddel and Wheeler 1996).

4.4.2 Site Context

Factors rated within the site context component were:

- Connectivity of the land units within the assessment envelope with surrounding suitable habitat for Malleefowl; and
- Records of Malleefowl activity on the site and surrounding habitat.

4.4.3 Malleefowl Stocking Rate

Based on the Likelihood of, or known presence of Malleefowl activity, within each land unit rated according to the following categories:

- Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats;
- Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats
- Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats;
- No records of Malleefowl on site, within known range of Malleefowl, suitable habitat present; and
- Site outside current known range of Malleefowl or habitat is unsuitable.

Composite indexes were summed to provide a summary index for each land unit. Land unit indexes were adjusted in proportion to the area of each land unit within the assessment envelope and then summed to provide a total site habitat score.

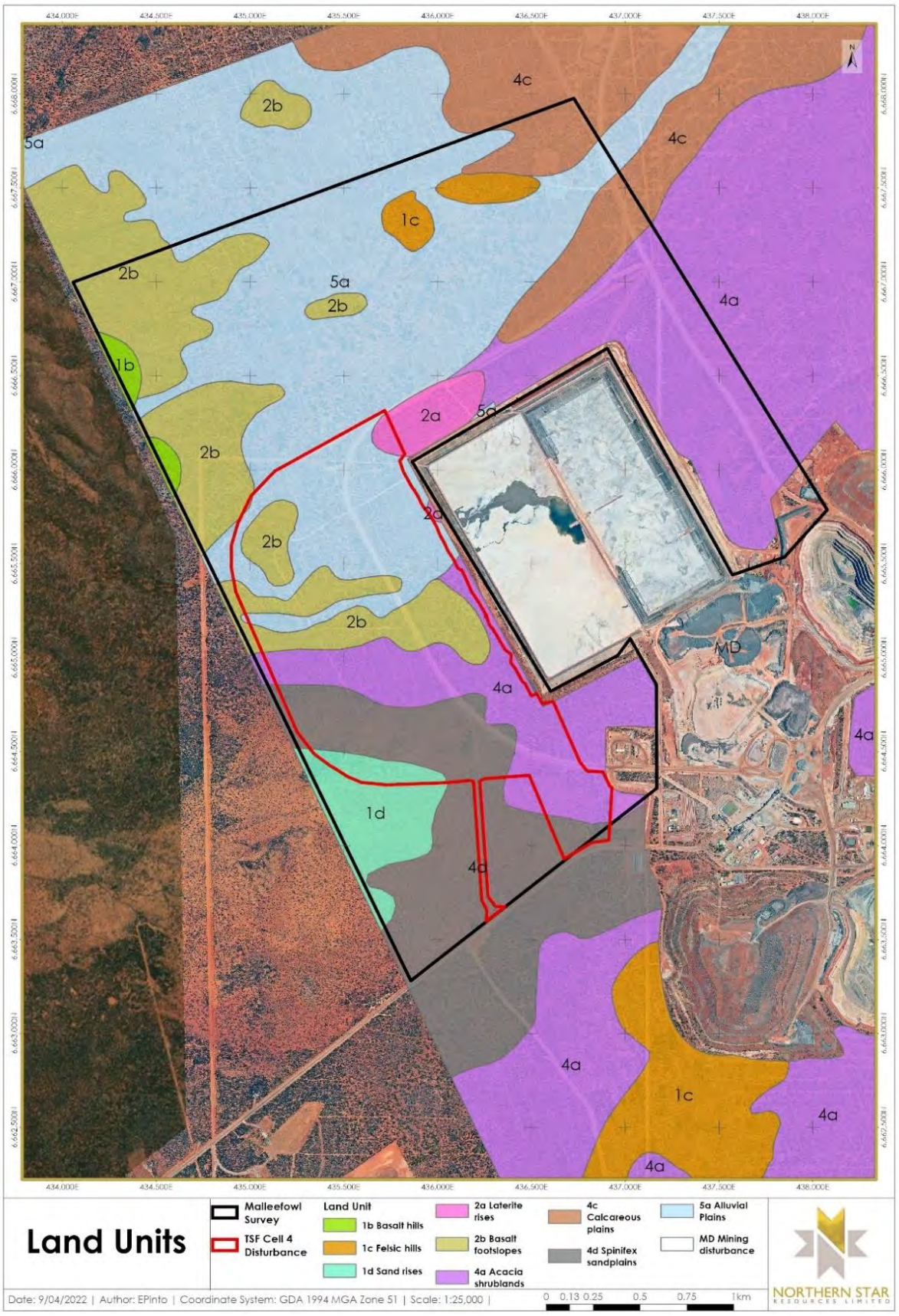

Figure 4: Land units in the vicinity of Carosue Dam Tailings Storage Facility including the Malleefowl survey area and TSF cell 4 disturbance envelope

4.4.4 Malleefowl Habitat Beyond the Disturbance Envelope

Maps and descriptions of land systems, which are areas throughout which there is a recurring pattern of topography, vegetation and soil and consisting of assemblages of more homogeneous land units, were used to assess availability of Malleefowl habitat in areas beyond the limit of detailed survey (Pringle *et al*. 1994).

5 Results

5.1 Malleefowl Survey

There was no evidence of recent (within 12 to 18 months) Malleefowl activity throughout the 842ha survey area, no tracks and minimal non-species specific litter disturbance.

Of the 23 nesting mounds located, 13 were 'long unused' and, apart from an indication of past use of habitat by Malleefowl, are of no significance for ongoing existence of Malleefowl in the area and are considered no further.

None of the 10 remaining nesting mounds were 'active', six were 'inactive recent' and four 'inactive abandoned' (Table 1).

Full details of each Malleefowl nesting mound are presented in Appendix 1, while photographs and summaries of the 'inactive recent' and 'inactive abandoned' nesting mounds are shown in Table 2.

Table 1: Malleefowl nesting mounds located during surveys in November 2012, June and December 2021

Discovery date	CDO mound number	Profile	Is the mound Active?	Freshly Scraped	Inner Crust	Inner Herbs/ Shrubs	Rim Height (cms)	Depth (cms)	Outer Diameter (cms)	Rim Diameter (cms)	Land unit	Notes
10/09/2012	CDO02_001	1	N	N	Y	Y	20	30	400	265	1d	Inactive abandoned
10/09/2012	CDO02_002	1	N	N	N	N	22	22	350	210	4d	Inactive recent
10/09/2012	CDO02_003	1	N	N	Y	Y	18	20	290	170	4a	Inactive recent
14/06/2021	CDO02_004	1	N	N	Y	Y	24	27	360	200	2b	Inactive abandoned
14/06/2021	CDO02_005	1	N	N	N	N	22	30	390	210	2b	Inactive recent
14/06/2021	CDO02_006	1	N	N	N	N	35	30	370	190	2b	Inactive recent
14/06/2021	CDO02_007	1	N	N	Y	N	37	24	350	190	4a	Inactive abandoned
18/06/2021	CDO02_008	1	N	N	Y	N	14	54	270	200	5a	Inactive recent
7/12/2021	CDO02_009	1	N	N	N	N	30	25	370	210	4a	Inactive recent
7/12/2021	CDO02_010	1	N	N	Y	Y	30	30	300	170	4a	Inactive abandoned

Table 2: Photographs of Malleefowl nesting mounds located during surveys in November 2012, June and December 2021

Details Dec. 2021	November 2012	June 2021	December 2021
CDO02_001 Outer rim: 400cm Inner rim: 265cm Depth: 30cm Within impact area?: Yes	 Active	 Inactive abandoned	 Inactive abandoned
CDO02_002 Outer rim: 350cm Inner rim: 210cm Depth: 22cm Within impact area?: Yes	 Active	 Inactive recent	 Inactive recent

Details Dec. 2021	November 2012	June 2021	December 2021
CDO02_003 Outer rim: 290cm Inner rim: 170cm Depth: 20cm Within impact area?: Yes	 Active	 Inactive recent	 Inactive recent
CDO02_004 Outer rim: 360cm Inner rim: 200cm Depth: 27cm Within impact area?: 320m north	Not found	 Inactive abandoned	 Inactive abandoned

Details Dec. 2021	November 2012	June 2021	December 2021
CDO02_005 Outer rim: 390cm Inner rim: 210cm Depth: 30cm Within impact area?: Yes	Not found	 Inactive abandoned	 Inactive abandoned
CDO02_006 Outer rim: 370cm Inner rim: 190cm Depth: 30cm Within impact area?: 40m west	Not found	 Inactive recent	 Inactive recent

Details Dec. 2021	November 2012	June 2021	December 2021
CDO02_007 Outer rim: 350cm Inner rim: 190cm Depth: 24cm Within impact area?: Yes	Not found	 Inactive abandoned	 Inactive abandoned
CDO02_008 Outer rim: 270cm Inner rim: 200cm Depth: 54cm Within impact area?: 750m north	Not found	 Inactive recent	 Inactive recent

Details Dec. 2021	November 2012	June 2021	December 2021
CDO02_009 Outer rim: 370cm Inner rim: 210cm Depth: 25cm Within impact area?: Yes	Not found	Not found	 Inactive recent
CDO02_010 Outer rim: 300cm Inner rim: 170cm Depth: 30cm Within impact area?: Yes	Not found	Not found	 Inactive abandoned

5.2 Impact of TSF Expansion on Malleefowl

Seven inactive mounds are located within the disturbance envelope. Four are classified as 'inactive recent' and three 'inactive abandoned'. One 'inactive recent' mound is within 40m of the disturbance envelope. Two inactive mounds are located greater than 300m from the disturbance envelope and will not be impacted by clearing activities (Figure 3).

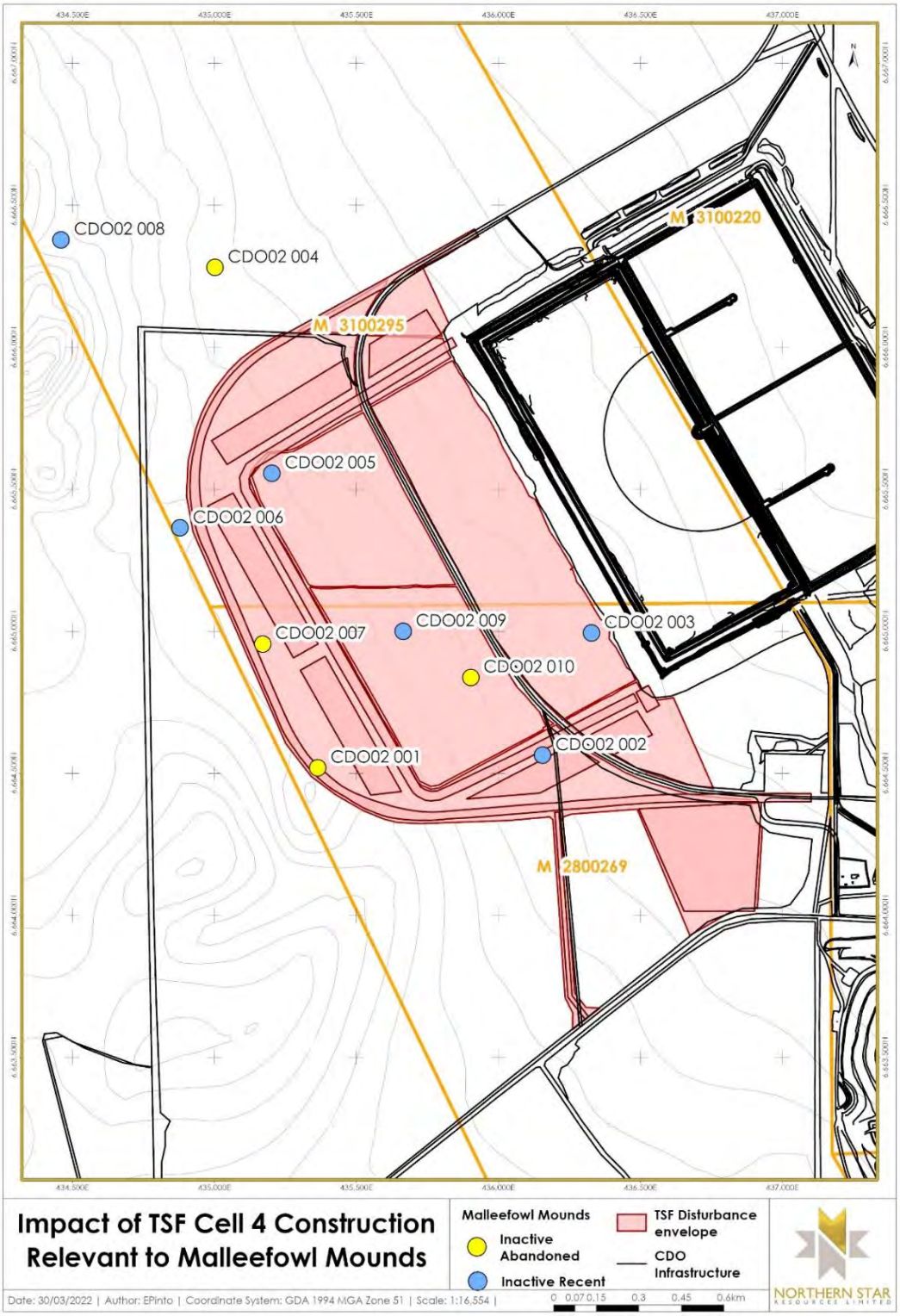

Figure 5: Location of Malleefowl nesting mounds in relation to proposed development.

Table 3: Impact of TSF expansion on Malleefowl nesting mounds

Nesting mound	Status	Impact
CDO02_001	Inactive abandoned	Removed- direct impact
CDO02_002	Inactive recent	Removed- direct impact
CDO02_003	Inactive recent	Removed- direct impact
CDO02_004	Inactive abandoned	Indirect impact- 320m N of development
CDO02_005	Inactive recent	Removed- direct impact
CDO02_006	Inactive recent	Indirect impact- 40m W of development
CDO02_007	Inactive abandoned	Removed- direct impact
CDO02_008	Inactive recent	Indirect impact- 750m NW of development
CDO02_009	Inactive recent	Removed- direct impact
CDO02_010	Inactive abandoned	Removed- direct impact

5.3 Habitat Quality Assessment Within the Disturbance Envelope

5.3.1 Malleefowl Stocking Rate

Of the 10 more recently occupied nesting mounds, four were located within acacia shrubland (land unit 4a) and three within footslopes of low basalt hills (land unit 2b) at approximately 4 to 6 nesting mounds per square kilometre.

One nesting mound was in land unit 5a, alluvial plains and two within land units with spinifex (land units 1d and 4d). These three nesting mounds were found at the margins of acacia shrublands or in small inclusions of acacia within the unit (Figure 6).

Apart from lateritic rises (land unit 2a) where no nesting mounds were found, alluvial plains, mostly dominated by chenopod shrublands, were the least favoured habitat for Malleefowl.

No evidence of predators or their tracks/scats were noted in the survey area.

5.3.2 Site Condition

The survey area has been disturbed by recent mining activity, is mostly within a pastoral lease and has been grazed. Roads, vehicle tracks, cut lines fragment the area and pastoral ringlock fences border the area.

Spinifex sandplain and sandy rises were rated most highly for condition. These systems, with high infiltration rates and generally shunned by livestock, support nearly intact vegetation communities. Other land units are generally in fair condition. Litter availability is highest where acacia is common (basalt footslopes and acacia shrubland). Sandy loam and loamy sand soils, which are preferred for mound construction, are common on all land units except alluvial plains (Alexander Holm & Associates 2019).

5.3.3 Site Context

The disturbance envelope is part of a regionally significant contiguous suitable habitat as shown in Figure 6 and discussed in section 5.4. Malleefowl appear to have been active within the past 6-10 years on all land units except laterite rises and alluvial plains.

Connectivity of land units within the disturbance envelope and surrounding country is equally constrained by recently constructed pastoral boundary fencing, high-usage mining haul and access roads, and other mining infrastructure and while all units are fragmented by roads, tracks, cut-lines and fences, acacia shrublands and alluvial plains are the most compromised.

Table 4: Habitat calculation worksheet for the disturbance envelope

	Factor	Score	Condition	Land unit					
				1d	2a	2b	4a	4d	5a
Site condition	Vegetation condition	5	Pristine	5					
		4	Excellent					4.3	
		3	Very good			2.6			
		2	Good		2		2		2.3
		1	Degraded						
		0	Completely degraded						
			Score out of 3	3	1.2	1.56	1.2	2.58	1.38
	Habitat Features:								
	Sandy soil	3	High suitability (score 6-8 of 8)						
	Litter; Cover; Slope	2	Medium suitability (score 5 of 8)	2			2		
	Mallee; Acacia;	1	Low suitability (score 4 of 8)			1		1	
	Melaleuca; Spinifex	0	Not suitable (score 0-3 of 8)		0				0
			Score out of 3	2	0	1	2	1	0
	Feral Predator Presence	3	Not detected in targeted survey	3	3	3	3	3	3
		2	Scarce (one record within habitat)						
		1	Medium presence (multiple records of single species or single records of more than one species)						
		0	Abundant (multiple records of more than one species)						
			Score out of 3	3	3	3	3	3	3
			Overall score out of 3 weighted by Vegetation condition 25%, Habitat features 50%, Predators 25%	2.50	1.05	1.64	2.05	1.90	1.10
Site context	Movement patterns of the species Proximity of the site in relation to other suitable areas of habitat Overall population or extent of a species	3	Site is part of a regionally large contiguous suitable habitat; records on the site for species within last 5 years; site is within known distribution of species and has connectivity with protected areas						
		2.5	Site is part of a regionally significant contiguous suitable habitat; records of species on site or within 4 km within last 6-10 years; site is within known distribution of species	2.5		2.5	2.5	2.5	
		2	Site is part of a contiguous suitable habitat; records on site or adjacent (within 4 km) to site within last 6- 10 years; site is within known distribution of species						
		1.5	Site is part of a contiguous suitable habitat; records on or adjacent (within 10 km) to site within last 6-10 years; site is located within known distribution of species.						
		1	Site is unsuitable or isolated from suitable habitat. Records on site or in region (within 10 km) within last 10 years and species are capable of migrating to site. Site is located within known distribution of species.		1				1
		0.5	Site is unsuitable or isolated from suitable habitat. Records on site or in region (within 10 km) within last 10 years and species are capable of migrating to site. Site is not located within known distribution of species.						
		0	Unlikely - study area outside current known range of species or habitat is unsuitable						
			Score out of 3	2.5	1	2.5	2.5	2.5	1
Species stocking rate	Likelihood of/known occurrence	4	Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats						
		3	Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats						
		2	Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats	2		2	2	2	
		1	No records of Malleefowl on site, within known range of Malleefowl, suitable habitat present						1
		0	Site outside current known range of Malleefowl or habitat is unsuitable		0				
			Score out of 4	2	0	2	2	2	1
			Score out of 10	7.0	2.1	6.1	6.6	6.4	3.1
			Assessment area (ha)	7.37	2.13	42.96	57.13	45.13	62.63
			Area proportion	0.03	0.01	0.20	0.26	0.21	0.29
			Scaled score (scaled to proportional area of land unit within assessment envelope)	0.24	0.02	1.21	1.72	1.33	0.89
Habitat quality score									**5.41**

5.3.4 Site Habitat Assessment Summary

When indices for habitat condition, context and Malleefowl stocking rate are combined, sandy rises with spinifex (land unit 1d) score the highest for Malleefowl habitat followed by acacia shrublands (land unit 4a), spinifex sandplain (land unit 4d), and basalt footslopes (land unit 2b) which all rate highly. Alluvial plains (land unit 5a) and lateritic rises (land unit 2a) are of limited value (Table 4).

After combining area-adjusted ratings for each land unit and expressing this as a ratio of the maximum possible score of 10, the total habitat score for the disturbance envelope is 5.41(Table 4). The habitat assessment for the disturbance envelope is summarised in Table 5.

Within the disturbance envelope most nesting mounds were found within the 100.1ha of acacia shrublands and basalt footslopes, which are therefore considered critical habitat favoured for breeding and foraging by Malleefowl. While two nesting mounds were found in spinifex sandplain and sandy rises with spinifex, these mounds were restricted to small, favoured locations without spinifex, where acacias occur and are not prone to fire. Elsewhere, there were no nesting mounds where spinifex is the dominant ground cover and fire is common. Consequently, these spinifex-dominated systems covering 52.5ha are considered primarily habitat for foraging and cover. Alluvial plains and lateritic rises, covering 64.8ha which make up the balance of the disturbance envelope, are of limited value as Malleefowl habitat (Figure 6).

Table 5: Habitat assessment summary for disturbance envelope

Assessment component	Factors	Proportional score (out of 10)	Summary
Vegetation			Spinifex sandplain and sandy rises with spinifex occupy 17% of the area; alluvial plains with chenopods 30%; acacia shrubland 26%; basalt footslopes with acacias 19% and lateritic rises 1%
Site condition	Vegetation condition Site attributes	1.67	Spinifex sandplain and sandy rises with spinifex are mostly in excellent condition and the remainder mostly in fair condition. Litter abundance is optimal in acacia-dominated units and minimal elsewhere. Sandy loam soils suitable for mound construction are prevalent in all land units except alluvial plains. No evidence of predators noted.
Site context	Movement patterns of the species	2.05	Connectivity with surrounding landscapes is compromised by mining infrastructure and pastoral fencing.
	Proximity of the site in relation to other suitable areas of habitat		Site is part of a regionally significant contiguous suitable habitat; records on site for Malleefowl within last 6-10 years; site is within known distribution of species.
Malleefowl stocking rate	Occurrence of nesting mounds.	1.69	No active Malleefowl nesting mounds. Previously active mounds found within acacia shrublands, basalt footslopes, and in localised sites within spinifex units. Lateritic rises unsuitable.
Overall site rating		**5.41**	

Within the 4,276ha surrounding Carosue Dam operations, which includes the disturbance envelope and is covered by a unified land unit map (Alexander Holm & Associates 2019), 368ha is considered to be habitat suitable for forage and cover and 2,143ha is considered to be critical habitat used for breeding and forage (Figure 6).

Figure 6: Malleefowl habitat assessment and nesting mounds within the disturbance envelope and surrounds.

5.4 Habitat Outside the Disturbance Envelope

Over the past 10 years, there have been several intensive 20m interval traverse and semi-intensive 40-50m interval traverse searches for Malleefowl activity over approximately 5,000ha surrounding and nearby the mine site operation including the proposed disturbance envelope. There were also opportunistic sightings of Malleefowl nesting mounds during vegetation surveys of areas to the north-east and south (Alexander Holm & Associates 2012a, b, 2020).

Seventy-one nesting mounds have been identified, five of which were found to be active during Malleefowl monitoring in early December 2021 by Northern Star. Two thirds of these nesting mounds were on the acacia shrublands of land units 4a and 4b (Alexander Holm & Associates 2019) and nesting mounds were common on fringes of spinifex sandplain and footslopes of basalt hills (Table 6).

Table 6: Malleefowl nesting mounds located in relation to land units during purposeful search and opportunistically during vegetation survey.

Land unit	Nests	Search	Survey	Total	Nests/100ha
			(ha)		
1b Basalt hills	2	44	596	640	0.31
2a Lateritic rises	1	233	186	419	0.24
2b Basalt hill footslopes	9	335	484	819	1.10
4a Acacia shrubland	30	1,349		1,349	2.22
4b Acacia shrubland on hardpan	18	558	15	573	3.14
4d Spinifex sandplain	8	176		176	4.55
5a Alluvial plains	3	716		716	0.42
Totals	71	4,896	2,084	6,980	1.02

At the broader land system scale, most mounds are within Deadman land system characterised by level to gently undulating plains with casuarina-acacia shrublands (Pringle et al. 1994) which include the Malleefowl-favoured acacia shrublands of land units 4a and 4b Nesting mounds occur on footslopes of Lawrence and Leopold land systems characterised by low hills with eucalypt or acacia woodlands with halophytic under-shrubs (Pringle et al. 1994) which include basalt hill footslopes of land unit 2b. Nesting mounds also occur in favoured locations within the extensive Kirgella land system characterised by sandplain supporting spinifex and acacia/eucalypt shrublands (Pringle et al. 1994) which is dominated by spinifex sandplain of land unit 4d.

There is approximately 18,000ha with potential habitat for Malleefowl within 10km of the disturbance envelope consisting of 11,900ha of Kirgella land system, which extends up to 40km to the west and is contiguous with the disturbance envelope, 4,500ha of Deadman, 1,600ha of Leonora and 300ha of Lawrence land systems.

6 Discussion

No evidence was found during the 2021 June and December surveys, of recent (12 to 18 months prior to survey) Malleefowl activity within the 229ha disturbance envelope or within the entire 842ha Malleefowl search area.

Thirteen 'long unused' nesting mounds, often vegetated with mature shrubs and, while an indication of past preference of Malleefowl for habitat, were of no consequence for Malleefowl re-population of the disturbance envelope. Ten more recently occupied nesting mounds were located during the December 2021 survey, two had not been found during the June 2021 survey. Four of these ten mounds were judged not to have been used for at least 5 years ('inactive abandoned') and six appeared to have been more recently used ('inactive recent'). Seven of these more-recently occupied nesting mounds fall within the disturbance envelope, four 'inactive recent' and three 'inactive abandoned'.

Three of these nesting mounds were active at the time of the 2012 survey when a live bird was sighted (Alexander Holm & Associates 2012c). There has been major disturbance to the area since the 2012 survey. The tailings dam has been extended, the haul road re-routed through the survey area, seismic lines installed and land cleared for boundary fencing. Seasonal conditions since 2016 have been adverse with 2019 one of the driest years on record. It is our assessment that Malleefowl have deserted this area due to increased road traffic, mining activity, drought and fencing.

Habitat within the disturbance envelope was assessed according to criteria in the 'Offsets assessment guide'. The assessment drew on inventory data and land unit mapping from environmental surveys of the area summarised in Alexander Holm & Associates (2019). The disturbance envelope is partitioned into six land units, which occupy similar topographic positions with distinctive vegetation and soil type: sandy rises with spinifex, lateritic rises, basalt hill footslopes, acacia shrubland, spinifex sandplain and alluvial plains. Each of these units was scored for attributes of site condition, site context and Malleefowl stocking rate.

When indices for habitat condition, context and Malleefowl stocking rate are combined, sandy rises with spinifex score the highest for Malleefowl habitat followed by acacia shrublands, spinifex sandplain, and basalt footslopes which all rate highly. Alluvial plains and lateritic rises are of limited value. Malleefowl nesting mounds, found in all land units except lateritic rises, were confined to acacia dominated footslopes of basalt hills and favoured locations within spinifex systems. Spinifex sandplain in the earlier assessment was not considered an important habitat for Malleefowl mainly due to incidence of fire. Two nesting mounds were found in small, favoured locations which escaped a recent fire because there is no spinifex. Elsewhere, throughout the majority of these units where spinifex is the dominant ground cover and fire is common, there were no nesting mounds. Consequently, spinifex sandplain is now included as suitable habitat for forage and cover.

After combining area-adjusted ratings for each land unit and expressing this in relation to the maximum possible score of 10, the total habitat score for the disturbance envelope is 5.41.

Seventy-one Malleefowl nesting mounds have been identified during previous intensive and semi-intensive searches and opportunistic sightings in areas adjacent to and including the disturbance envelope. Five of these mounds, approximately 5 km south-east of the disturbance envelope, were found to be active during Malleefowl monitoring by Northern Star in early December 2021. In contrast, none of the nesting mounds within and near the disturbance envelope were active, re-enforcing the assessment that Malleefowl have deserted this area for less- impacted areas, widely available elsewhere.

Two thirds of these 71 nesting mounds were on acacia shrublands of Deadman land system as described and mapped in Pringle *et al.* (1994). Nesting mounds were also common on fringes of spinifex sandplain associated with Kirgella land system and footslopes of basalt hills associated with Lawrence and Leonora land systems (Pringle et al. 1994).

Deadman, Kirgella, Lawrence and Leonora land systems occupy approximately 18,000ha within 10km of the disturbance envelope and provide potential habitat for Malleefowl. Kirgella

land system, which extends up to 40km to the west and is contiguous with the disturbance envelope, occupies two thirds of the potential habitat.

7 Summary of Impacts and Recommendations

The proposed expansion of the TSF will result in clearing or disturbance to 152.6ha of Malleefowl habitat including 52.5ha considered primarily suitable for foraging and cover and 100.1ha considered critical habitat for breeding. Over 2,500ha of similar habitat for Malleefowl has been identified in areas adjacent to Carosue Dam operations in earlier fine-scale environmental assessments. Approximately 18,000ha of similar habitat, identified at broader-scales, within 10km of the disturbance envelope, provides additional 'suitable' and/or 'critical' habitat for Malleefowl including Kirgella land system, that extends up to 40km to the west and is contiguous with the habitat identified within the disturbance envelope.

Within the development envelope, four 'inactive recent' and three 'inactive abandoned' nesting mounds will be cleared. There are no 'active' nesting mounds within or near the development envelope and there appears to have been no Malleefowl activity at least within the previous 12 to 18 months. In contrast, five 'active' nesting mounds were located approximately 5km south-east of the disturbance envelope during Malleefowl monitoring by Northern Star in December 2021, re-enforcing the conclusion that Malleefowl have deserted the disturbance area for less-impacted areas, widely available elsewhere.

It is concluded that expansion of the TSF will have negligible impact on the widely dispersed Malleefowl population in this region as there is extensive habitat in adjacent areas for Malleefowl use in subsequent breeding seasons.

In assessing if the proposed development of the TSF Cell 4 will have a significant impact on Malleefowl, the following criteria are considered as to whether there is a possibility that the development will:

1. Lead to a long-term decrease in the size of an important population of a species.

Malleefowl, which may be impacted by the proposed development, are part of a sparse, widely-dispersed population of unknown extent. Malleefowl have been sighted and/or nesting mounds located throughout most of the tenements associated with Carosue Dam operations from around Deep South 70km north of the TSF (Alexander Holm & Associates 2011), 10km to the east (Alexander Holm & Associates 2020) and 6km SW (Alexander Holm & Associates 2017). Records of Malleefowl extend in all directions beyond these locations (Department of Parks and Wildlife 2016b). While this sparse, widely-dispersed population of Malleefowl throughout the Western Australian arid zone can be considered an "important population" necessary for the long-term survival of the species in the region, Benshemesh (2007) states that no particular population or general area can be described as of greater importance for the long-term survival of Malleefowl.

Factors affecting the long-term survival of Malleefowl in the arid-zone include livestock grazing, broad-scale fire, drought and fox-predation (Benshemesh 2007). Localized impacts from mining, such as habitat destruction through clearing, are likely to be of lesser importance. Expansion of the TSF will have negligible impact on the widely dispersed Malleefowl population in this region as there is extensive habitat in adjacent areas for Malleefowl use in subsequent breeding seasons.

2. Reduce the area of occupancy of an important population.

While Malleefowl have been previously sighted within the development envelope and 'active'-occupied nests located in 2012, there is no evidence that Malleefowl are currently present. It is known that Malleefowl in arid areas are verging on nomadic, having irregular or unpredictable home range (Department of Parks and Wildlife 2016b). Nesting mounds, which appear to be un-occupied during poor seasons, occur mostly on foot slopes of basalt hills and

in acacia shrubland on extensive plains (Alexander Holm & Associates 2021). Plains supporting acacia shrubland are widespread in the vicinity of the proposed development and occupy 36% or 1,800ha while basalt hills occupy a more restricted area of 380ha (Alexander Holm & Associates 2019). Approximately 152ha of preferred habitat will be cleared or disturbed during expansion of the TSF which will have minimal impact on the area of occupancy of Malleefowl due to the broad range of suitable habitat within the region.

3. Fragment an existing important population into two or more populations.

Malleefowl in this arid environment are part of a widely-dispersed, semi-nomadic population. The proposed clearing will not fragment an existing population.

4. Adversely affect habitat critical to the survival of a species.

Malleefowl in the vicinity of the TSF prefer plains supporting acacia shrubland and foot slopes of basalt hills for nesting sites. Similar habitat preferences are noted for the adjacent Great Victoria Desert (Department of Parks and Wildlife 2016b) and are extensive throughout the region (e.g. Pringle et al. 1994). Clearing of 152ha of preferred habitat for the development of the TSF is not considered to be critical for survival of the species due to the availability of similar habitat nearby and throughout the region.

5. Disrupt the breeding cycle of an important population.

Malleefowl appear to occupy nesting sites only during favourable seasons and the four 'inactive recent' nesting mounds affected by this development are not currently occupied. Northern Star will ensure clearing is completed outside of the breeding season while nesting mounds are un-occupied. Malleefowl breeding cycle will not be disrupted while these nesting mounds are un-occupied.

6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Malleefowl nesting mounds in the proposed development area are more abundant in foot-slopes of rocky basalt hills and plains supporting acacia shrublands which are common in the vicinity of the TSF (Alexander Holm & Associates 2019) and extensive throughout the region (e.g. Pringle et al. 1994). The Malleefowl population is unlikely to decline through impacts of this development due to the wide availability of preferred habitat throughout the region.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

Mining activity has potential to increase feral predators of Malleefowl especially fox and cat and to introduce weed species that may invade Malleefowl habitat. Effective putrescible rubbish management and weed control hygiene is essential to minimise adverse effects. Northern Star have procedures in place to address and mitigate risks associated with invasive species, therefore it is unlikely that invasive species will significantly impact Malleefowl populations or habitat due to the proposed development.

8. Introduce disease that may cause the species to decline.

Transmission of disease to Malleefowl is unknown, however risk of transmission will be minimised through practices that minimise presence of feral predators or other non-native fauna. Northern Star have procedures and practices in place to control feral animals as required throughout the project area through trapping and baiting programs, therefore the risk of introducing disease to Malleefowl populations due to the proposed development is considered low.

9. Interfere substantially with the recovery of the species.

Malleefowl survival is threatened by vegetation clearing, predation by fox and cat, increased fire frequency, road mortality and competition with sheep, rabbit, cattle and goat (Department of Parks and Wildlife Fauna facts). Mining activity, such as the proposed expansion of the TSF, has cumulative effects on Malleefowl survival particularly with clearing and road mortality.

In summary, suitable and critical habitat for Malleefowl is widespread directly adjacent to the proposed disturbance to accommodate any birds potentially displaced by the activity.

The following recommendations are made to further reduce potential impacts:

- Nesting mounds within and adjacent to the disturbance envelope are monitored monthly for Malleefowl activity prior to and during the breeding season (July to March).
- Clearing is conducted when there is no Malleefowl activity at nesting mounds.
- Clearing conducted in a manner to allow any potential Malleefowl to move into adjacent habitat.
- Spotter to move ahead of dozer during clearing.

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Disclaimer

Within the limitation imposed by the scope of review, the data assessment and preparation of the report have been undertaken in a professional manner and in accordance with generally accepted practices using a degree of care ordinarily exercised by professional environmental consultants. No other warranty, expressed or implied, is made.

Appendix 1: Details of all Malleefowl nesting mounds from surveys in November 2012, June and December 2021

Discovery date	Mound Number (July 2021)	Mound Number (Dec 021)	CDO mound number	Easting	Northing*	Profile	Mound Active?	Freshly Scraped	Eggshell (N/S/L)	Prints	Scats	Inner Crust	Moss/ Lichen	Herbs/Shrubs	Rim Height (cms)	Depth (cms)	Outer Dia. (cms)	Rim Dia(cms)	Land unit	Notes
10/09/2012	MF13Jul	MF08Dec	CDO02_001	435364	6664519	1	N	N	N	N	N	Y	N	Y	20	30	400	265	1d	Inactive abandoned
10/09/2012	MF21Jul	MF10Dec	CDO02_002	436156	6664563	1	N	N	L	N	N	N	N	N	22	22	350	210	4d	Inactive recent
10/09/2012	MF11Jul	MF09Dec	CDO02_003	436328	6664994	1	N	N	S	N	N	Y	Y	Y	18	20	290	170	4a	Inactive recent
14/06/2021	MF03Jul	MF02Dec	CDO02_004	435002	6666280	1	N	N	N	N	N	Y	N	Y	24	27	360	200	2b	Inactive abandoned
14/06/2021	MF06Jul	MF03Dec	CDO02_005	435202	6665555	1	N	N	N	G	G	N	N	N	22	30	390	210	2b	Inactive recent
14/06/2021	MF08Jul	MF04Dec	CDO02_006	434879	6665363	1	N	N	S	N	N	N	N	N	35	30	370	190	2b	Inactive recent
14/06/2021	MF19Jul	MF05Dec	CDO02_007	435169	6664955	1	N	N	S	N	N	Y	N	N	37	24	350	190	4a	Inactive abandoned
18/06/2021	MF01Jul	MF01Dec	CDO02_008	434460	6666377	1	N	N	N	N	N	Y	N	N	14	54	270	200	5a	Inactive recent
7/12/2021		MF06Dec	CDO02_009	435664	6664999	1	N	N	S	N	N	N	N	N	30	25	370	210	4a	Inactive recent
7/12/2021		MF07Dec	CDO02_010	435902	6664837	1	N	N	N	N	N	Y	N	Y	30	30	300	170	4a	Inactive abandoned
18/06/2021	MF02Jul			434882	6666373	1	N	N	N	N	N	N	N	N					2b	Long unused
6/12/2021		Lunused		435868	6665673	6	N	N	N	N	N	Y	N	Y					5a	Long unused

Discovery date	Mound Number (July 2021)	Mound Number (Dec 021)	CDO mound number	Easting	Northing*	Profile	Mound Active?	Freshly Scraped	Eggshell (N/S/L)	Prints	Scats	Inner Crust	Moss/ Lichen	Herbs/Shrubs	Rim Height (cms)	Depth (cms)	Outer Dia. (cms)	Rim Dia(cms)	Land unit	Notes
15/06/2021	MF09Jul			434936	6665138	1	N	N	N	N	N	N	N	Y					2b	Long unused
6/12/2021		Lunused		435920	6665579	6	N	N	N	N	N	Y	N	Y					5a	Long unused
10/09/2012	MF20Jul			435955	6665080	1	N	N	N	N	N	Y	N	Y					2b	Long unused
15/06/2021	MF10Jul			435798	6664973	1	N	N	N	N	N	N	N	Y					4a	Long unused
15/06/2021	MF14Jul			435460	6664464	1	N	N	N	N	N	Y	N	Y					1d	Long unused
15/06/2021	MF12Jul			436300	6664988	1	N	N	N	N	N	Y	N	Y					4a	Long unused
6/12/2021		Lunused		436251	6664771	1	N	N	N	N	N	Y	N	N					4a	Long unused
6/12/2021		Lunused		436347	6664471	1	N	N	N	N	N	Y	N	Y					4d	Long unused
16/06/2021	MF17Jul			436850	6664186	1	N	N	N	N		Y	N	Y					4a	Long unused
16/06/2021	MF18Jul			436693	6664037	1	N	N	N	N		Y	N	Y					4d	Long unused
13/06/2021	MF04Jul			434789	6665985	1	N	N	N	N		Y	N	Y					2b	Long unused

* (GDA94 Zone51)

Appendix B: Construction Environmental Management Plan

Carouse Dam TSF Cell 4 Project

Construction Environmental Management Plan

EPBC Act Referral: 2021/9026

15 July 2022

Version No. 2

Proponent Details		
Company Name	Northern Star (Carosue Dam) Pty Ltd	
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Document Control

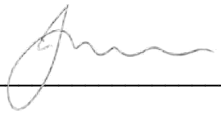
This Construction Environmental Management Plan will be reviewed over the life of the project to ensure new knowledge on Malleefowl populations in and around the project area are incorporated into the plan to ensure the effectiveness of the implemented management measures.

Version	Details of review or changes	Prepared by	Date	Document Reference
Draft	Draft prepared	Larissa Byrne	18 April 2022	Draft
1.0	Draft prepared	Larissa Byrne	02 June 2022	Draft
2.0	Final amended	Larissa Byrne	15 July 2022	Final

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both.

I am authorised to bind the approval holder to this declaration, and I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed: 

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Position: Site Senior Executive

Organisation: Northern Star (Carosue Dam) Pty Ltd

Date: 15 July 2022

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1.0 Introduction

1.1 Background

Northern Star (Carosue Dam) Pty Ltd (Northern Star) proposes to expand the Tailings Storage Facility (TSF) at its Carosue Dam Operations with the construction of TSF Cell 4 and associated infrastructure (the Project).

Targeted surveys surrounding the Project have identified the area supports suitable habitat for Malleefowl. The Project will require the clearing of 217.3 ha of native vegetation of which 152.6 ha is suitable habitat for Malleefowl. Non active mounds (those unlikely to support active Malleefowl populations) have been identified within the Project footprint and will be impacted by project activities.

This Construction Environmental Management Plan (CEMP) has been prepared to support the assessment of the Project under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and accompanies the Preliminary Documentation. It outlines the key risks posed to Matters of National Environmental Significance that have the potential to be impacted by the Project, namely the Malleefowl (*Leipoa ocellata*) (Malleefowl), and how these risks will be managed. It also describes the performance criteria and corrective actions, as well as roles and responsibilities.

1.2 Purpose

The purpose of this CEMP is to:

- provide a framework for the implementation, monitoring and management actions required, to ensure that potential impacts to Malleefowl and their habitat attributable to the expansion of the Carosue Dam TSF are minimised.
- minimise risks to Malleefowl during the construction of TSF Cell 4.

1.3 Key construction activities with potential impacts to the Malleefowl & Primary Management Strategies

The Project involves the construction of a new TSF Cell adjacent to and abutting the existing facility as shown in Figure 1. The following key aspects of the Project have been identified as having the potential to impact Malleefowl:

- Native vegetation clearing;
- Vehicle/equipment movement;

These key construction activities for the Project and their associated primary management strategies have been discussed in Table 1.

All works will be undertaken in accordance with statutory approvals, this CEMP, and relevant site-specific procedures. Employees and contractors are provided with environmental education sessions (inductions, toolbox meetings) prior to commencing work on site and are required to adhere to site procedures.

Table 1: Key construction activities with potential impacts to Malleefowl

Source / Activity	Potential Impact	Primary Strategies for Management	Relevant Document / procedure
Native Vegetation Clearing			
Key Activity - A total of 217.3 ha of Native Vegetation will be cleared for construction activities. 152.6 ha is considered suitable habitat for Malleefowl. A total of 7 mounds within the development envelope will require removal.	Potential loss of suitable habitat for Malleefowl.	Surveys are undertaken to determine baseline habitat information and record mounds. Clearing undertaken in line with statutory approvals. Northern Star Clearing Activity Permit approved by Environment department.	Clearing Management Safe Work Procedure and Clearing Activity Permit.
	Loss of Malleefowl breeding mounds	All Malleefowl, active and inactive mounds will be recorded in a "Malleefowl Register" which will include date, observer, status of mound/Malleefowl and a GPS/location description. Clearing activities will preferentially occur outside of breeding season. Clearing may however, only occur during breeding season if mounds have been confirmed to be non-active by a suitably qualified environmental specialist. All known active mounds will be avoided and flagged with appropriately sized buffers (50m). Clearing will only commence after positive confirmation that there are no active mounds.	Construction Environmental Management Plan (CEMP)
	Fauna unable to escape during clearing	Clearing boundary is marked using GPS and cleared first to prevent over-clearing. Vegetation is then cleared in a systematic pattern allowing fauna to move into adjacent undisturbed vegetation to the north and west of the disturbance footprint (Section 8). Fauna spotter present during clearing. Works cease should fauna require relocation during clearing.	Clearing Management Safe Work Procedure and Clearing Activity Permit.

	Open areas may result in increased predation on Malleefowl.	Sightings of feral animals will be reported to Environment Department and managed in accordance with site procedures.	Weed and Feral Animal Control Procedure.
	Dust impacting surrounding vegetation.	Water carts with dribble bars will be used to manage dust in line with normal Carosue Dam site procedures.	Construction Environmental Management Plan (CEMP)
Vehicle/equipment movement			
Key Activity - Increased equipment and vehicle movements for clearing and construction activities.	Increased vehicle strikes causing injury/death to fauna including Malleefowl.	The following speed limits will apply: • Dozer limited to 10km/hr during clearing activities. • 60km/hr for vehicles travelling on haul road Suitably qualified fauna spotter to walk ahead of dozer during clearing.	Haul Road Management Safe Work Procedure Weed and Feral Animal Control Procedure.
	Minimise pollution from light and noise.	Compliance with industry requirements for noise and light emissions. Light emissions limited to project area.	Construction Environmental Management Plan (CEMP)
	Minimise entrapment leading to injury or death of terrestrial fauna, including the Malleefowl at the catchment dam.	All operators to report sightings of Malleefowl (live or dead) during construction. Daily visual inspection will be undertaken to check for trapped fauna.	Incident Reporting
	Increased occurrence of weeds, reducing quality of adjacent habitat.	Weed hygiene procedure implemented and Weed Hygiene certificate approved	Weed and Feral Animal Control Procedure.
	Increased risk of fire resulting in death/injury and displacement of Malleefowl and/or destruction of Malleefowl habitat and mounds	Emergency Response Team is trained in fire response. Maintain fire breaks and implementation of Northern Star fire management procedures	Construction Environmental Management Plan (CEMP)

2.0 Project Description

2.1 Carosue Dam TSF Expansion Cell 4

Northern Star operates the Carosue Dam Gold Mine, located 110km north-east of Kalgoorlie. Carosue Dam includes four open pits, Karari, Whirling Dervish, Monty's, and Twin Peaks. Karari and Whirling Dervish have been developed into underground mining operations while Luvironza pit, a fifth pit, was used for in-pit tails deposition and completed in 2014.

The Carosue Dam mine site consists of a carbon in leach processing plant, paddock style tailings storage facilities, waste rock dumps, a paste plant, workshops, core farms, turkeys nest dams, laydown areas, roadways, stores, borefields, administration facilities and a dual power station. Other infrastructure includes an aerodrome, solar farm, and accommodation village (Figure 1).

To support ongoing mining operations at Carosue Dam, Northern Star Resources propose to expand the existing Tailings Storage Facility (TSF) by constructing a new TSF cell (Cell 4), and associated infrastructure which involves clearing a total of 217.3ha of Native Vegetation within a development envelope of approximately 229ha. The location of the proposed development envelope for the expansion of the TSF is provided in Figure 2.

The proposed expansion of the TSF was declared a controlled action under section 95A(2) of the EPBC Act requiring further information to assess the relevant impacts of the proposed action.

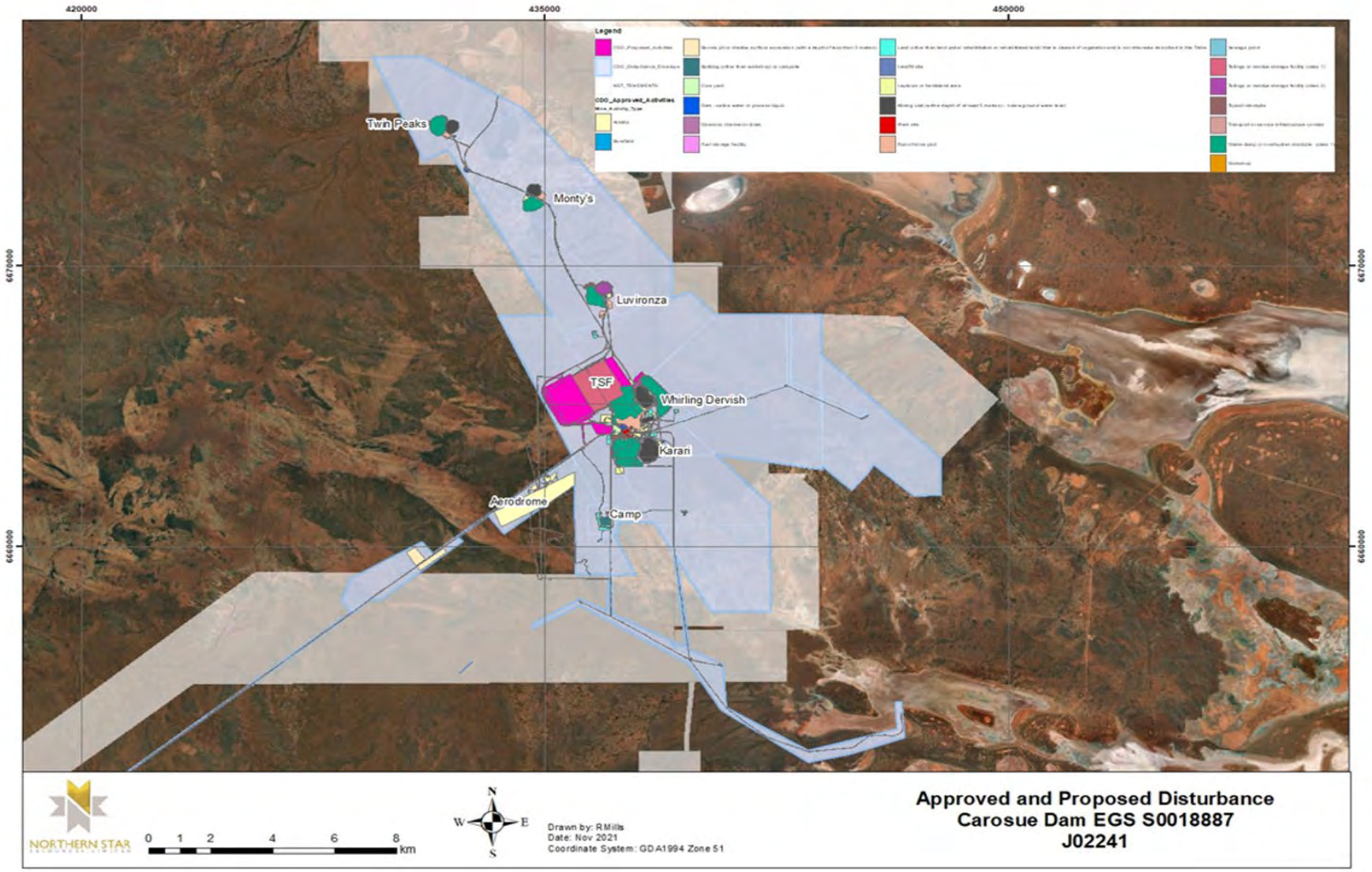

Figure 1: Location of the Project in relation to the Carosue Dam Operations

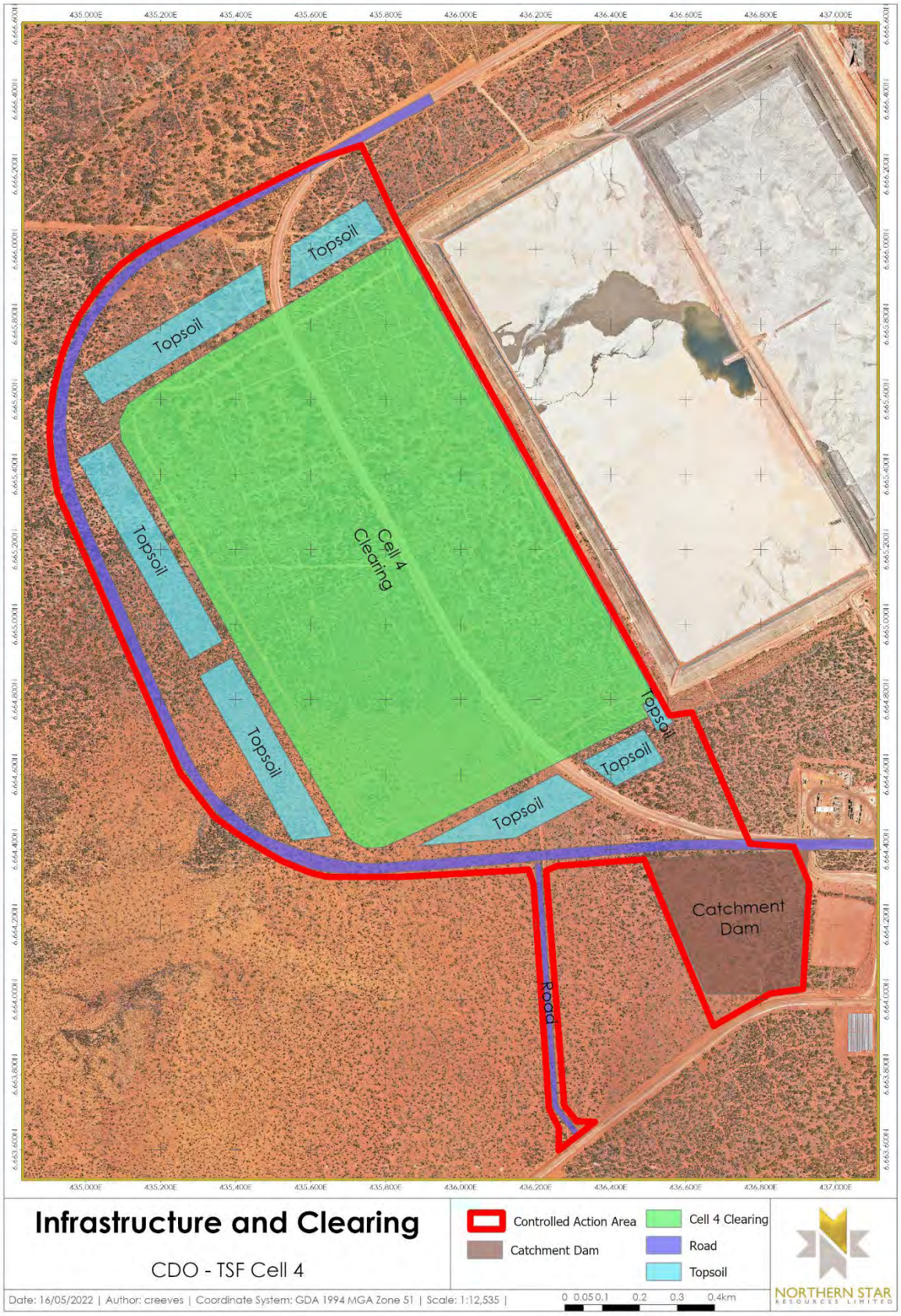

Figure 2: Layout of TSF Cell 4

2.3 Schedule for Construction Activities

Clearing for the construction of TSF Cell 4 and associated infrastructure will be prioritised to be undertaken outside of Malleefowl breeding season, between April and August, inclusive. This is to ensure mounds are not active during clearing activities and individuals can move into adjacent suitable habitat. However, if there are any unavoidable delays and if current tailings storage capacity is not adequate, clearing may be conducted with controls in place to ensure no impact to any Malleefowl.

Clearing is currently scheduled to occur no later than August 2022 to allow construction to commence in September 2022. Construction of Cell 4 is expected to take seven months (plus an additional 2 months to install miscellaneous items such as pipework, power, fencing, etc), with deposition of tailings material scheduled for January 2024. Operation of the facility will continue for the current life of mine (7+ years).

Table 2 provides a summary and timing of all phases of the proposed action including construction, operations and decommissioning/rehabilitation, outlining the activities associated with each phase. The anticipated timing and duration of each component as well as potential impacts during each phase.

Table 2: Schedule of all phases of the proposed action

Phase	Activity Description	Start Date	Completion Date	Duration
Construction	Clearing of impact area	August 2022	August 2022	1 month
	Construction of embankments	September 2022	April 2023	7 months
	Compaction & construction of roads	September 2022	October 2022	2 months
	Redirection of surface water flows through construction of drainage channels	September 2022	October 2022	2 months
Operations	Commence deposition of tailings into Cell 4	January 2024	January 2031	7 years
	Maintenance of infrastructure	January 2024	January 2031	7 years
	Twice daily inspections of pipelines during operation	January 2024	January 2031	7 years
	Road maintenance including dust suppression and surface grading	August 2022	January 2031	9 years
Decommissioning & Rehabilitation	Cease deposition and allow consolidation and drying of tailings material	January 2031	July 2031	6 months
	Reshape and batter slopes to	August 2031	January 2032	6 months
	Cap top surface with competent rock;	January 2032	March 2032	3 months
	Respread topsoil;	March 2032	April 2032	2 months
	Rip on the contour	April 2032	April 2032	1 month
	Seed with local native species	April 2032	April 2032	1 month
	Rehabilitation monitoring	September 2032	September 2042	10 years

2.4 Climate

The Goldfields region is arid to semi-arid with average annual rainfall decreasing from about 250mm in the south-west to 200mm in the north-east. The area experiences hot summers and mild winters with cold nights. Rainfall varies widely between years and droughts are common. Remnants of tropical cyclones occasionally bring heavy summer rain and can cause flooding to the area. The area transitions between desert summer and winter dominated rainfall and desert: non-seasonal bioclimatic (Alex Holm and Associates 2022). As Malleefowl have been recorded within the area of the surrounding Carosue Dam Gold Mine, it suggests that the climate supports Malleefowl occurrence.

2.5 Soils

The Carosue Dam is located within the Murchison IBRA region, in the East Murchison subregion. The East Murchison area is characterised as having internal drainage with soils that are typically shallow earthy loam overlaying red-brown hardpan, shallow stony loams on hills and red sand on sand plains (*Alexander Holm & Associates 2022*).

2.6 Regional Flora

The region lies within the Eremaean botanical province near the southern boundary of the Austin botanical district (Beard, 1990). The Eremaean Botanical Province is typified by plants from the families Fabaceae (*Acacia* spp., *Senna* spp.), Scrophulariaceae (*Eremophila* spp.), Chenopodiaceae (Samphires, Bluebushes, Saltbushes), Asteraceae (Daisies) and Poaceae (grasses). The Austin Botanical District is essentially the Mulga (*Acacia aneura*) region of Western Australia. *Acacia aneura* is a dominant or a significant component in most plant communities in this District. The region is often rich in ephemerals, which reduce to scrub on hills. The Austin Botanical District is also characterised by hummock grasslands, saltbush shrublands and *Tecticornia* shrublands (*Alexander Holm & Associates 2022*).

Lake Rebecca forms a major vegetation divide with characteristic *Acacia aneura* (mulga) low woodlands associated with red loams over siliceous hard pan to the north and low woodlands of mixed mulga and *Casuarina pauper* (black oak) and *Eucalyptus* species on alkaline and calcareous soils to the south. Spinifex hummock grassland with eucalypt overstory on sand plain is common. Halophytic vegetation occurs throughout the region on palaeodrainage systems, breakaways and on some stony and alluvial plains. Highly saline soils support *Atriplex* (saltbush), *Maireana* (bluebush) and *Tecticornia* (samphire) shrublands, while less saline soils support mulga with saltbush or bluebush understories.

2.7 Local Flora

Vegetation of the Carosue Dam Gold Mine consists of low open *Eucalyptus* woodland over *Acacia* and other mixed shrubs to *Casuarina* and *Acacia* woodland. Toward Lake Rebecca the vegetation becomes more halophytic and the overstorey disappears, leaving low halophytic shrubs with occasional sandy banks and drainage zones which support a wide range of species. Numerous flora surveys have been conducted in and around Carosue Dam.

A total of 534 flora taxa have been recorded across the Carosue Dam Project, including the occurrence of five species of conservation significance. These species represent 52 families, and 187 genera. The most common families represented throughout the project include Chenopodiaceae (78 taxa), Fabaceae (59 taxa), Asteraceae (49 taxa), Poaceae (48 taxa), Myrtaceae (43 taxa) and Scrophulariaceae (40 taxa).

Flora surveys across the Carosue Dam Project have highlighted that species composition and vegetation communities are typical of the area and not considered to be unusually diverse.

2.8 Malleefowl (*Leipoa ocellata*)

Malleefowl (*Leipoa ocellata*) are a stocky ground-dwelling bird, that rarely flies, belonging to the family Megopodiidae that build distinctive nests comprised of larger mounds built from soil and leaf litter to incubate their eggs. Breeding season usually begins in September when

egg laying begins and ends in late January. During this time the male bird remains at the mound constantly re-working it. Breeding pairs are monogamous, will pair for life and will breed in the same area using existing mounds. Chicks typically begin hatching in November, with most chicks emerging from mounds by January, however it has been noted that in some seasons hatching may continue until March (Benshemesh, 2007). Malleefowl (eggs and chicks) are threatened by predation, habitat clearing, isolation due to habitat fragmentation and increased wildfires.

2.9 Distribution and Habitat

Historically, Malleefowl have been found in semi-arid mallee shrublands and woodlands across southern Australia, however although the species is still found across its range, its remaining populations are highly fragmented due to extensive land clearing (Department of Parks and Wildlife, 2016). Malleefowl habitat is generally found in shrublands and low woodlands dominated by mallee. In Western Australia habitat generally consists of Acacia dominated shrublands and occasionally woodlands dominated by eucalypts. Habitat areas require a sandy substrate and abundance of leaf litter for the construction of mounds. Studies have found density of birds is greater in areas of higher rainfall, on more fertile soils and where shrub diversity is greatest. Habitats characterised by numerous food plants (especially leguminous shrubs and herbs), a dense canopy cover and open ground layer are generally associated with high breeding densities. Malleefowl also prefer long unburnt country (Benshemesh, 2007). Thick vegetative corridors are beneficial to Malleefowl that predominantly disperse on foot.

The surrounding area of the Carosue Dam has been surveyed and is considered to contain suitable habitat to support Malleefowl. A total of 152.6ha of suitable habitat for Malleefowl will be removed, however, the 4,276ha surrounding Carosue Dam operations, which includes the disturbance envelope, is covered by a unified land unit map, 368ha is considered to be habitat suitable for forage and cover and 2,143ha is considered to be critical habitat used for breeding and forage (Alexander Holm and Associates 2022).

At the broader land system scale, most nesting mounds are within Deadman land system characterised by level to gently undulating plains with casuarina-acacia shrublands which include the Malleefowl-favoured acacia shrublands of land units 4a and 4b Nesting mounds occur on footslopes of Lawrence and Leopold land systems characterised by low hills with eucalypt or acacia woodlands with halophytic under-shrubs which include basalt hill footslopes of land unit 2b. Nesting mounds also occur in favoured locations within the extensive Kirgella land system characterised by sandplain supporting spinifex and acacia/eucalypt shrublands which is dominated by spinifex sandplain of land unit 4d (Alexander Holm and Associates 2022).

Deadman, Kirgella, Lawrence and Leonora land systems occupy approximately 18,000ha within 10km of the disturbance envelope and provide potential habitat for Malleefowl. Kirgella land system, which extends up to 40km to the west and is contiguous with the disturbance envelope, occupies two thirds of the potential habitat (Alexander Holm and Associates 2022).

2.10 Conservation Status

The Malleefowl is one of three mound – building birds species is Australia and is recognized as a threatened species under State and Commonwealth legislation. The Malleefowl is listed as Vulnerable fauna under the EPBC Act. The species is also listed as Vulnerable under the *Biodiversity Conservation Act 2016* (WA).

3.0 Objective

The objective of the CEMP is to ensure impacts to Malleefowl and its habitat, from the expansion of the Carosue Dam Tailings Storage Facility Project are minimised. The key objectives and performance criteria have been detailed in Section 8 in Table 8.

4.0 Environmental Roles and Responsibilities

Table 3 identifies the roles and responsibilities relating to the implementation of this CEMP.

Table 3: Environmental roles and responsibilities

Role	Responsibility
Site General Manager	• Implementation and maintenance of the plan. • Undertake the assessment and review of the effectiveness of this management as required.
Site Environmental Advisors	• Maintain site records of surveys and any other relevant environmental data and implement monitoring programs. • Deliver fauna education and induction awareness training to field personnel. • Ensure pre-clearing surveys are conducted to ensure no malleefowl are breeding in the disturbance area. • Ensure a 'spotter' is present during clearing activities. • Liaise with stakeholders regarding feral animal control and fire management. • Record any incidents associated with construction activities and provide direction for remedial actions.
Project Managers/Supervisors	• Ensure the plan is being adhered to by all staff and contractors • Participate in compliance audits and inspections.
All Northern Star employees and Sub-contractors/temporary workers	• Adhere to the requirements in this management plan. • Report all incidents that involve impacts to fauna including Malleefowl.

5.0 Reporting

The reporting requirements for the CEMP are outlined in Section 8 Table 8.

6.0 Environmental Training

Environmental training will be provided to all relevant staff including temporary contractors prior to the commencement of clearing to ensure they understand the requirements of the plan. Training will be aimed at minimising impacts on the species and site environmental controls, understanding the roles and responsibilities of all personal in adhering to the requirements of the Management Plan and ensuring objectives are being achieved.

Training will be provided but not limited to the following formats:

- Site inductions
- Pre-start meetings

Records of staff and contractors completing site inductions will be maintained as per site training protocols.

7.0 Emergency Contacts and Procedures

During construction activities, if an emergency arises where objectives are not going to be met, or direct impacts to the Malleefowl/fauna or mound are likely then the Environmental team will be notified and corrective actions will be implemented.

7.0 Environmental Risks

A risk assessment for the construction activities identifies the key risks and potential impacts of the proposed activity on Malleefowl. This process allows identified risks to be evaluated and outlines mitigation measures and effectiveness of these measures. The Risk Assessment has been completed in accordance with the Australian/New Zealand standard 4360:1999 Risk Management. The risk assessment considers the likelihood of an impact event and the relative consequence of that event. The risk assessment is detailed in Table 7.

Table 4: Qualitative measures used for the determination of an event likelihood rating

Likelihood		Description
A	Almost Certain	Common or Frequent occurrence (e.g. once per day)
B	Likely	Is known to occur or "it's happened" (e.g. >once per month, but <once per day)
C	Possible	Could occur or "I've heard of it happening" (e.g. >once per year, but <once per month)
D	Unlikely	Not Likely to occur (e.g. <once per year)
E	Rare	Rare / practically impossible (e.g. very unlikely to ever occur)

Table 5: Qualitative measures used for the determination of an event consequence

Consequence		Description
1	Very Low	None or insignificant impact to MNES (Malleefowl) with no effect on ecosystem function.
2	Minor	Moderate to minor impact to MNES (Malleefowl) resulting in a minor, recoverable impact.
3	Moderate	Minor and short-term impact to MNES expected, resulting in a moderate, recoverable impact.
4	Major	Long-term impact to MNES expected, resulting in a major, recoverable impact.
5	Catastrophic	Irreversible impact to MNES expected.

Table 6: Risk Rating Matrix

		CONSEQUENCES				
LIKELIHOOD		Very Low **1**	Minor **2**	Moderate **3**	Major **4**	Catastrophic **5**
A	Almost Certain	**H** (11)	**H** (16)	**E** (20)	**E** (23)	**E** (25)
B	Likely	**M** (7)	**H** (12)	**H** (17)	**E** (21)	**E** (24)
C	Possible	**L** (4)	**M** (8)	**H** (13)	**E** (18)	**E** (22)
D	Unlikely	**L** (2)	**L** (5)	**M** (9)	**H** (14)	**E** (19)
E	Rare	**L** (1)	**L** (3)	**M** (6)	**M** (10)	**H** (15)

Matrix Legend:

E:	Extreme risk	Immediate action required, further reduction needed. If not possible, Country Manager or COO approval required
H:	High risk	Senior management attention needed
M:	Moderate risk	Management responsibility must be specified
L:	Low risk	Manage by routine procedure

Table 7: Identification and Management of risks associated with the proposed action

	Risk Pathway/Impact	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures	Likelihood	Consequence	Residual Risk	Justification for Residual Risk ranking	EMP or Procedure incorporating risk treatment
Direct Impact	Impacts on habitat use due to fragmentation	C	3	H13	The infrastructure to be constructed within the proposed impact area has been designed to directly abut existing TSF infrastructure, without gaps or creating satellite facilities, therefore fragmentation of habitat is unlikely. Malleefowl habitat and surrounding native vegetation is extensive and generally continuous throughout the region, therefore any potential impacts due to fragmentation is rated as low.	D	2	L5	The impact site is not located in a satellite location where it could potentially break a linkage between favourable habitat plots. It is located directly adjacent to existing infrastructure to minimise fragmentation of habitat.	CDO-ENV-023-SWP Clearing Management
	Reduction in habitat size due to clearing	C	3	H13	Disturbance will be limited to only what is necessary for safe construction and operation of the TSF and associated infrastructure. The facility has been designed to adjoin to abut the existing TSF facility which allows NSR to utilise the existing western wall of the paddock TSF and associated existing cleared areas (11.8ha) within the proposed development envelope, reducing disturbance footprints as far as practically possible. An internal Clearing Activity Permit will be issued by site Environmental personnel and signed off by operators and supervisors involved in the clearing. Disturbed areas will be rehabilitated progressively where possible and upon closure in line with the approved Mine Closure Plan. Implementation of NSR internal Clearing Management Safe Work Procedure. Total footprints of new TSF and miscellaneous infrastructure have been minimised wherever practical to reduce overall disturbance and minimise impacts to Malleefowl habitat. The reduction of habitat size from the proposal is rated as Low.	D	2	L5	Within the immediate 4,276ha surrounding Carosue Dam operations, which includes the disturbance envelope and is covered by a unified land unit map (Alexander Holm & Associates 2019), 368ha is considered to be habitat 'suitable' for forage and cover and 2,143 ha is considered to be 'critical' habitat used for breeding and forage. This habitat extends well beyond this confined area and highlights the limited impact footprint of this proposal. The proposed location of the TSF directly adjacent to the existing facility ensures that disturbance is minimised as far as practically possible.	CDO-ENV-023-SWP Clearing Management
	Reduction in population numbers due to removal of breeding mounds	D	3	M9	The most recent targeted survey conducted in December 2021 determined that the were no active mounds during the 2021 breeding season. It is unlikely there will be a reduction in Malleefowl population due to the removal of breeding mounds. The risk has been rated as Low. Pre-clearance surveys will be undertaken to identify the presence of Malleefowl and mounds in proposed clearing areas. Clearing activities will preferentially occur outside of breeding season. Clearing may however, only occur during breeding season if mounds have been confirmed to be non-active by a suitably qualified environmental specialist. All known active mounds will be avoided and flagged with appropriately sized buffers (50m). Active mounds will be monitored for a suitable period of time to ensure no impacts are sustained by individuals or their young. Clearing will only commence after positive confirmation that the mound is no longer active. Annual monitoring of the Malleefowl population in accordance with the National Malleefowl Monitoring Manual and in consultation with the DBCA and other best practice organisations.	D	2	L5	Malleefowl demonstrate resilience to disturbance in many examples, including at Carosue Dam where nesting mounds have been previously located <10m away from roadways and other infrastructure (outside of the proposed impact site). Proposed buffer zones of 50m are deemed sufficient by DMIRS in the recently approved Purpose Permit (CPS8000/2) amendment to minimise impacts to breeding mounds.	Clearing Permit CPS8000/2 CDO-ENV-051-Pla - Biodiversity Management
	Fauna injury or mortality due to vehicle strike	C	3	H13	Northern Star will continue to implement the following mitigation measures to prevent injury/mortality of Malleefowl at the site: Reduction in vehicle speed limits within the area. Clearing procedure outlines strategy required to allow potential fauna within the impact area to move into adjacent habitat areas;	D	3	M9	No Malleefowl have been hit by vehicles around the current TSF Haul Road or TSF area during Saracen or Northern Star's ownership of the project, therefore providing evidence that the likelihood of fauna strike is extremely low. Reduced	CDO-OHS-SA-003-PLA Carosue Dam Traffic Management Plan CDO-ENV-051-Pla - Biodiversity Management

	Risk Pathway/Impact	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures	Likelihood	Consequence	Residual Risk	Justification for Residual Risk ranking	EMP or Procedure incorporating risk treatment
					Additional Warning signs will be erected on transport corridors and around the construction site informing of Malleefowl potentially in the area. Implementation of the Haul Road Management Safe Work Procedure to reduce the incidence of vehicle strikes. All operators to report sightings of Malleefowl (live or dead) including mounds. All personnel will complete an environmental induction prior to commencing work to ensure procedures and management measures are understood.				speed limits during the construction phase of the project will further decrease this risk.	
	Displacement of adult birds due to habitat clearing	C	2	M8	Clearing will be conducted in accordance with the CEMP, which outlines procedures to allow birds and other fauna to move into adjacent areas of habitat. A total of 2500 ha of suitable Malleefowl habitat surrounds the impact area to support displaced birds. Within the immediate area an additional 4,276ha surrounding the impact site is over 2,500ha of suitable habitat to support displaced birds. Suitable habitat also extends far beyond this.	D	2	L5	Malleefowl are currently not reliant on the mounds within the development footprint which has been confirmed by the various Malleefowl surveys over the area- all mounds are inactive.	Construction Environmental Management Plan (CEMP) CDO-ENV-051-Pla - Biodiversity Management
	Potential entrapment leading to injury or death of terrestrial fauna, including the Malleefowl at the catchment dam.	C	3	H13	All operators to report sightings of Malleefowl (live or dead) during construction. Daily visual inspection will be undertaken to check for trapped fauna.	D	3	M9	The earthen dam will be constructed to capture any potential surface water flows. Standing water is not expected to be present within the dam and any surface water collected will be pumped out.	Construction Environmental Management Plan (CEMP)
	Increase risk from feral species through predation or competition with Malleefowl	C	3	H13	Northern Star will continue to implement the following mitigation measures to prevent predation on Malleefowl at the site: Predator control program implemented. Monitoring of feral animal activity. Staff training of feral animal and waste Management Avoid attraction of feral animals by implementing domestic waste management procedures. Waste and water sources fenced not available to feral animals. Putrescible rubbish (including food scraps) and other materials are disposed of into sealed 1 tonne bulka bags prior to burial to prevent feral animals and vermin from accessing the waste, allowing them to breed and increase in numbers. Carosue Dam have existing procedures for feral animal control on site and work closely with neighbouring pastoralists to undertake feral animal control in the surrounding area. It is unlikely there will be an increased risk in predation from the controlled action on Malleefowl. The risk is rated as Low.	D	3	M9	Evidence through sightings, scats and tracks suggest feral animal numbers in the area are low. Recent annual Malleefowl Monitoring to the east of the mine area showed no evidence of cats, little evidence of dogs and some evidence of rabbits. Baiting is carried out by neighbouring pastoralists frequently throughout each year.	CDO-ENV-024-SWP Weed and Feral Animal Control CDO-ENV-051-Pla - Biodiversity Management
Indirect Impacts	Noise from construction, vehicles, and general mine operations impacting Malleefowl movements in the area	C	2	M8	The proposed TSF Cell 4 and associated infrastructure is located within an active mining and processing area. The total footprints of new TSF and miscellaneous infrastructure have been minimised wherever practical to reduce overall disturbance and minimise impacts to Malleefowl. All mounds within the proposed development footprint are not active, therefore risks of mine operations impacting individuals of the species is negligible. It is unlikely that the addition of the controlled action is going to result in Noise/Light impacts to the Malleefowl. The following mitigation measures will be implemented: Project travel between dusk and dawn will be limited to essential travel only.	D	2	L5	Studies have demonstrated Malleefowl are extremely resilient to activity and disturbance near their habitat. An active Malleefowl population is present directly east of the mine area (outside of any potential impact area). There are many examples at Carosue Dam where Malleefowl have nested directly adjacent to roads and other mining infrastructure.	Construction Environmental Management Plan (CEMP)

	Risk Pathway/Impact	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures	Likelihood	Consequence	Residual Risk	Justification for Residual Risk ranking	EMP or Procedure incorporating risk treatment
					Lights will be strategically placed and designed to shine towards plant operations and minimise light exposure to the surrounding environment. Equipment design will specify compliance with Australian Standard noise limits					
	Increased occurrence of weeds, reducing quality of adjacent habitat suitable for Malleefowl.	D	1	L2	A Weed Management Procedure has been implemented on site which includes recording and mapping infestations in a database. All vehicles entering site must be cleaned prior to arrival and checked before they commence work. A Weed Hygiene Certificate is issued to confirm they are free of vegetative and soil material. It is unlikely that the occurrence of weeds will impact adjacent Malleefowl habitat. The risk has been rated as Low.	E	1	L1	The majority of the proposed disturbance will not be susceptible to weed infestations as the haul road will be compacted and trafficked consistently and the entire TSF footprint is not conducive to vegetation growth due to the hypersaline nature of the tailings. Topsoil stockpiles will be monitored in line with the remainder of Carosue Dam and weeds managed as required.	CDO-ENV-024-SWP Weed and Feral Animal Control
	Dust impacting surrounding vegetation suitable for Malleefowl.	D	2	L5	Dust generation from clearing activities and vehicle movement will be mitigated using water suppression via water cart as required during clearing and construction. The construction/clearing activities will only occur for a period of 9 months. It is unlikely that dust generated from the short-term project will impact surrounding vegetation suitable for Malleefowl. Therefore, the risk has been rated as Low. Dusting events are mitigated through clearing procedures, for example clearing must not be undertaken during high wind events.	E	2	L3	Dust suppression once applied is extremely effective due to the hypersaline nature of the water at Carosue Dam. The dust suppression forms a crust over the areas watered, therefore minimising dust generation to an acceptable standard.	CDO-ENV-035-SWP Haul Road Management
	Altered surface water flow impacting vegetation suitable for Malleefowl (e.g. water starvation or flooding)	D	2	L5	Intensive surface water studies have been conducted and appropriate water management infrastructure has been designed to ensure altered surface water flows do not negatively impact on vegetation suitable for Malleefowl. Therefore, it is unlikely that altered water resources will impact on vegetation suitable for Malleefowl. The risk is rated as Low.	E	2	L3	Surface water risks have been assessed and appropriate controls put in place through the design phase to ensure no issues occur during and after construction.	CDO_REP_ TSF4 Expansion Surface and Groundwater Report
	Hypersaline water from dust suppression affecting vegetation suitable for Malleefowl.	D	2	L5	Water carts are fitted with dribble bars rather than spray bars to ensure dust suppression is only applied to immediate area in need of suppression, therefore minimising risk of hypersaline water affecting surrounding vegetation. Sumps are dug in runoff v-drains to capture incidental hypersaline runoff from road watering activities. It is unlikely that hypersaline water will impact suitable Malleefowl habitat. The risk is rated Low.	E	2	L3	Frequent inspections are completed of roadside sumps to ensure they do not need to be dug out and for evidence of salt movement. This is regulated via Tenement Conditions under the Mining Act 1978.	CDO-ENV-035-SWP Haul Road Management
	An increased risk of fire due to construction equipment and activities impacting fauna and Malleefowl habitat.	C	4	E18	Various fire management practices and controls are implemented at the Carosue Dam minesite which contribute to the overall protection of the site and surrounding areas, these include: • Maintain fire breaks and implementation of NSR fire management procedures • Firefighting and suppression equipment located at site and on construction equipment/vehicles • All equipment and vehicles restricted to designated cleared access tracks/roads. • Staff training and awareness in the prevention and management of fires. • Consultation with relevant agencies (FESA, DBCA) in relation to prescribed burns and fire management.	D	3	M9	Bushfires are becoming more prevalent across the arid region.	Construction Environmental Management Plan (CEMP)

8.0 Environmental Management

Environmental management measures have been outlined in Table 8. These objectives and management measures are applicable during the clearing and construction phase of the project.

Table 8: Environmental Management Objectives, Controls and Reporting

Objectives	Performance Criteria	Management Measures	Reporting
Minimise the potential of vehicle strike causing injury or death to terrestrial fauna, including the Malleefowl.	No deaths of fauna/Malleefowl attributable to vehicle strike.	Malleefowl road traffic warning signs are erected on project specific transport corridors and around the construction site informing of Malleefowl in the area. Restricted vehicle speeds will be applied on clearing equipment. Suitably qualified fauna spotter to walk ahead of dozer during clearing.	Incidents and near misses are reported through INX InControl and will be included in the Annual Compliance Report to DCCEEW.
Minimise entrapment leading to injury or death of terrestrial fauna, including the Malleefowl.	No Malleefowl (adult or chick) death due to entrapment in water holding facilities.	All operators to report sightings of Malleefowl (live or dead) during construction. impacts to Malleefowl. Daily visual inspection will be undertaken to check for trapped fauna.	Visual Inspection Incident Reporting
Minimise requirements for clearing which results in habitat loss and fragmentation.	No unauthorised clearing and/or clearing outside approved clearing areas. No unauthorised clearing of active Malleefowl mounds.	Clearing activities will be kept to a minimum, with all native vegetation clearing to be undertaken in accordance with Clearing Permit CPS8000/2 and EPBC Approval 2021/9026. Pre-clearance surveys will be undertaken prior to clearing to identify and record the presence of Malleefowl and mounds in proposed clearing areas. A fauna spotter will be present during clearing and will stop work if Malleefowl are spotted in, or adjacent to, the disturbance area, Clearing activities will preferentially occur outside of breeding season. Clearing may however, only occur during breeding season if mounds have been confirmed to be non-active by a suitably qualified environmental specialist. All known active mounds will be avoided and flagged with appropriately sized buffers (50m). Active mounds will be monitored for a suitable period of time to ensure no impacts are sustained by individuals or their young. Clearing will only commence	An annual Clearing Permit Report is submitted to DMIRS as required under CPS8000/2. Information will also be included in the Annual Compliance Report to DCCEEW.

Objectives	Performance Criteria	Management Measures	Reporting
		after positive confirmation that the mound is no longer active. Staff training and awareness including an induction and Toolbox sessions.	
Minimise pollution from light and noise.	Compliance with industry requirements for noise and light emissions. Light emissions limited to project area.	Project travel between dusk and dawn will be limited to essential travel only. Lights will be strategically placed and designed to shine towards plant operations and minimise light exposure to the surrounding environment. Equipment design will specify compliance with Australian Standard noise limits.	
Minimise increases to predator abundance.	No increase in predator abundance No fauna/Malleefowl deaths due to predation.	Predator control program implemented if required Waste and water sources fenced not available to feral animals. Avoid attraction of both feral and native species to the project footprint by: • Implementing domestic waste management procedures • Feral animal control for the Project and coordination with regional programs in accordance with Northern Star Weed and Feral Animal Control Procedure. Staff training on waste and water management, including information on feral species.	
No increase in fire frequency or intensity.	No fires attributed to construction/mining and associated activities.	Maintain fire breaks and implementation of Northern Star fire management procedures Firefighting and suppression equipment located at site and on construction equipment/vehicles All equipment and vehicles restricted to designated cleared access tracks/roads Staff training and awareness in the prevention and management of fires.	Incidents are reported through INX InControl.

Objectives	Performance Criteria	Management Measures	Reporting
		Consultation with relevant agencies (FESA, DBCA) in relation to prescribed burns and fire management.	
Minimise potential impacts to terrestrial fauna, including the Malleefowl by training staff to increase awareness on the Identification, monitoring and management of Malleefowl.	All relevant staff and contractors to be trained through inductions/pre-start meetings on Malleefowl/fauna Management.	Staff training and awareness will be rolled out prior to construction to provide information on the Malleefowl (e.g. how to identify adults, chicks and mounds, conservation status, the importance of minimising impacts on the species and adherence to the CEMP to ensure impacts are minimised).	Records kept of training programs and participants.

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National Malleefowl Monitoring Manual: Edition: v2020_1 - (Revised June 2020)

Appendix C: Offset Proposal

Carouse Dam TSF Cell 4 Project

Offset Proposal

EPBC Act Referral: 2021/9026

2 August 2022

Contact:
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Document Control

Revision	Details of review or changes	Prepared by	Date	Document reference
0	Draft provided to DCCEEW for discussion	Kiera Mews	19/05/2022	Draft
1	Draft submitted to DCCEEW for validation	Kiera Mews & Larissa Byrne	2/06/2022	Draft
2	Final submission of document addressing DCCEEW request for further informtation	Kiera Mews & Larissa Byrne	15/07/2022	Final
3	Finalisation of Offset Calculator values in consultation with DCCEEW	Kiera Mews & Larissa Byrne	2/08/2022	Final

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both.

I am authorised to bind the approval holder to this declaration, and I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:_____

Full Name: John Albrecht_____

Position: Site Senior Executive_____

Organisation: _Northern Star (Carosue Dam) Pty Ltd_____

Date:__2 August 2022_____

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1 Introduction

1.1 Background

Northern Star (Carosue Dam) Pty Ltd (Northern Star) proposes to expand the Tailings Storage Facility (TSF) at the Carosue Dam Operations with the construction of TSF Cell 4 and associated infrastructure (the Project). The Carosue Dam Operations is located approximately 110km north-east of Kalgoorlie in the Pinjin region of the Eastern Goldfields. Carosue Dam was previously owned by Saracen Gold Mines Pty Ltd; however, in February 2021, a merger of equals between Northern Star Resources and Saracen Mineral Holdings was completed. Northern Star (Carosue Dam) Pty Ltd is a wholly owned subsidiary of ASX listed company Northern Star Resources Limited.

To continue processing operations into the future, Northern Star has developed a 10-year TSF permitting design which includes the construction of an additional cell adjacent to the existing TSF. The project occurs on existing mining tenure (M28/269 & M31/295) and will involve 217.3 ha of vegetation clearing within a development envelope of 229.1 ha. Of this, 100.1 ha is considered 'critical' Malleefowl (*Leipoa ocellata*) habitat (used for breeding and foraging), and 52.5 ha is considered 'suitable' Malleefowl habitat (used for foraging and cover). The project was referred to the Department of Climate Change Energy the Environmental and Water (DCCEEW)[1] (the Department) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as the development will involve clearing Malleefowl habitat, including the removal of inactive Malleefowl breeding mounds within the disturbance footprint.

Northern Star received formal notification from the Minister's delegate that the proposed action was a Controlled Action, to be assessed by Preliminary Documentation. The controlling provisions for the Controlled Action decision were:

- Listed threatened species and ecological communities (sections 18 & 18A of the EPBC Act).

The Department determined that the proposed action was likely to have a significant impact on Matters of National Environmental Significance (MNES). These included impacts on:

- Malleefowl (*Leipoa ocellata*) - Vulnerable.

Northern Star engaged a fauna consultant in July 2021 to critically assess the impacts of the proposed development on Malleefowl within and adjacent to the clearing envelope, with a subsequent breeding season survey conducted in December 2021. These reports have been attached within the Preliminary Documentation. Direct and Indirect impacts from the Project are:

- A total of 152.6 ha of suitable Malleefowl habitat will be cleared; and
- Seven inactive Malleefowl mounds will be removed, whilst three inactive mounds outside the disturbance area may be indirectly impacted.

To offset the residual impacts from the Project, an offset is proposed for the security, protection and management of habitat for Malleefowl. It is intended that EEL55, Freehold land owned by Northern Star, will be made subject to a conservation covenant, and a

[1] The Department of Agriculture Water and the Environment has now been changed to the Department of Climate Change, Energy the Environment and Water by the Administrative Arrangements Order made on 23 June 2022 and established on 1 July 2022.

Memorial will be registered against the title to ensure that successors in title are bound by the covenant.

1.2 Purpose of this Document

This Offset Proposal supports the submission of the Preliminary Documentation for the assessment of the controlled action under the EPBC Act, to offset the potential significant impacts to Malleefowl.

1.3 Objective of the Offset Proposal

The objectives of the Offset Proposal are to secure, protect, improve and manage Malleefowl habitat within the Goldfields region through use of a conservation covenant on Northern Star owned Freehold land. Improvement of habitat will occur through management measures and protective mechanisms.

It is intended that EEL55 will have a conservation covenant placed over it for the security, protection, and management of habitat suitable for Malleefowl to offset the direct and indirect impacts from the controlled action. The Offset Proposal aims to provide ecological outcomes through the implementation of management measures and maintain and improve habitat quality suitable for Malleefowl within EEL55 and the surrounding Goldfields Region.

The ecological outcomes intended through this proposal are:

- Place a conservation covenant over EEL55 to secure the protection of Malleefowl habitat and species.
- Provide and maintain protection of 800 ha of habitat and improve conservation outcomes for Malleefowl within EEL55 through the implementation of management measures and protective mechanisms.

1.4 Summary of Impact to Malleefowl Nesting Mounds

Of the 23 Malleefowl nesting mounds found within the Project area, a total of 13 Malleefowl nesting mounds identified within and adjacent to the project area were classed as long abandoned; they are of no significance for ongoing presence of Malleefowl and are highly unlikely to become active in the future. Therefore, any direct or indirect impacts are unlikely to be significant and, whilst have been considered, have not been included (Alexander Holm & Associates 2022a).

The impact to the remaining ten Malleefowl nesting mounds within and outside the development envelope have been provided in Table 1 and shown in Figure 1. It is likely that all ten Malleefowl nesting mounds will be directly or indirectly impacted by the proposed action (Alexander Holm & Associates 2022a).

A total of 152.6 ha of suitable Malleefowl habitat will be cleared for the controlled action.

Table 1: Impact on TSF expansion on Malleefowl nesting mounds

Nesting mound	Status	Impact
CDO02_001	Inactive abandoned	Removed – Direct Impact
CDO02_002	Inactive recent	Removed – Direct Impact
CDO02_003	Inactive recent	Removed – Direct Impact
CDO02_004	Inactive abandoned	Indirect Impact - 320m N of development
CDO02_005	Inactive recent	Removed – Direct Impact
CDO02_006	Inactive recent	Indirect impact - 40m W of development
CDO02_007	Inactive abandoned	Removed – Direct Impact
CDO02_008	Inactive recent	Indirect impact - 750m NW of development
CDO02_009	Inactive recent	Removed – Direct Impact
CDO02_010	Inactive abandoned	Removed – Direct Impact

Figure 1: Location of Malleefowl Mounds Impacted by the Controlled Action.

2 Proposed Offset Area

2.1 Land Tenure and Current Use

Land parcel EEL55 is located approximately 140 km south-west of the Project in the City of Kalgoorlie Boulder (Figure 2). The site is 800ha of Freehold land owned by Northern Star and holds a special land category 'Exempt East Location' (EEL). The title allows the owner of the location to retain mineral rights, therefore the provisions of the *Mining Act 1978 & Regulations 1981* do not apply. Exploration and mining, (including gold, silver and precious metals) with other parties is handled by agreement with the location owner rather than by statute with Department of Mines Industry Regulation and Safety (Department of Mines Industry Regulation and Safety (DMIRS) (2021).

Table 2: Land Category Description

Land Tenure	Owner	Description
Exempt East Location (EEL)	Northern Star Resources (2018)	Before 1899 in Western Australia, freehold land grants were generally made without expressly reserving minerals to the Crown. As a result, these minerals were owned by the freehold land owner. However, ownership of the "royal metals," including gold, remained vested in the Crown under common law as it applied to the Colony of Western Australia. By agreement dated 18 June 1890 between the Governor of the Colony of Western Australia and the Hampton Lands and Railway Syndicate, Limited (Syndicate), the Syndicate bought freehold title in certain Crown lands and was granted a permit to work all the metals reserved by the Crown on those lands, including gold. The agreement was subject to regulations to be made at a later date. In 1920, the regulations were made pursuant to the Mining on Private Property Act 1898 (1898 Act) and prescribed a regime for the Syndicate to manage gold mining operations on the Hamptons Land. The Hamptons Land includes East Location 55. Where it holds a freehold interest in Hampton Lands, Northern Star: • owns all the mineral resources (other than gold, silver and precious metals) in those lands, but has the right to exploit the gold resources and to regulate the mining of gold by third parties on those lands, through the applicable Hampton Lands regulations; • is not required to hold tenements and comply with the mining regime under the Mining Act 1978 (Mining Act) to conduct mining operations on those lands; and • otherwise has the same rights to use the land as other freehold landowners in the State and in particular is subject to environmental legislation.

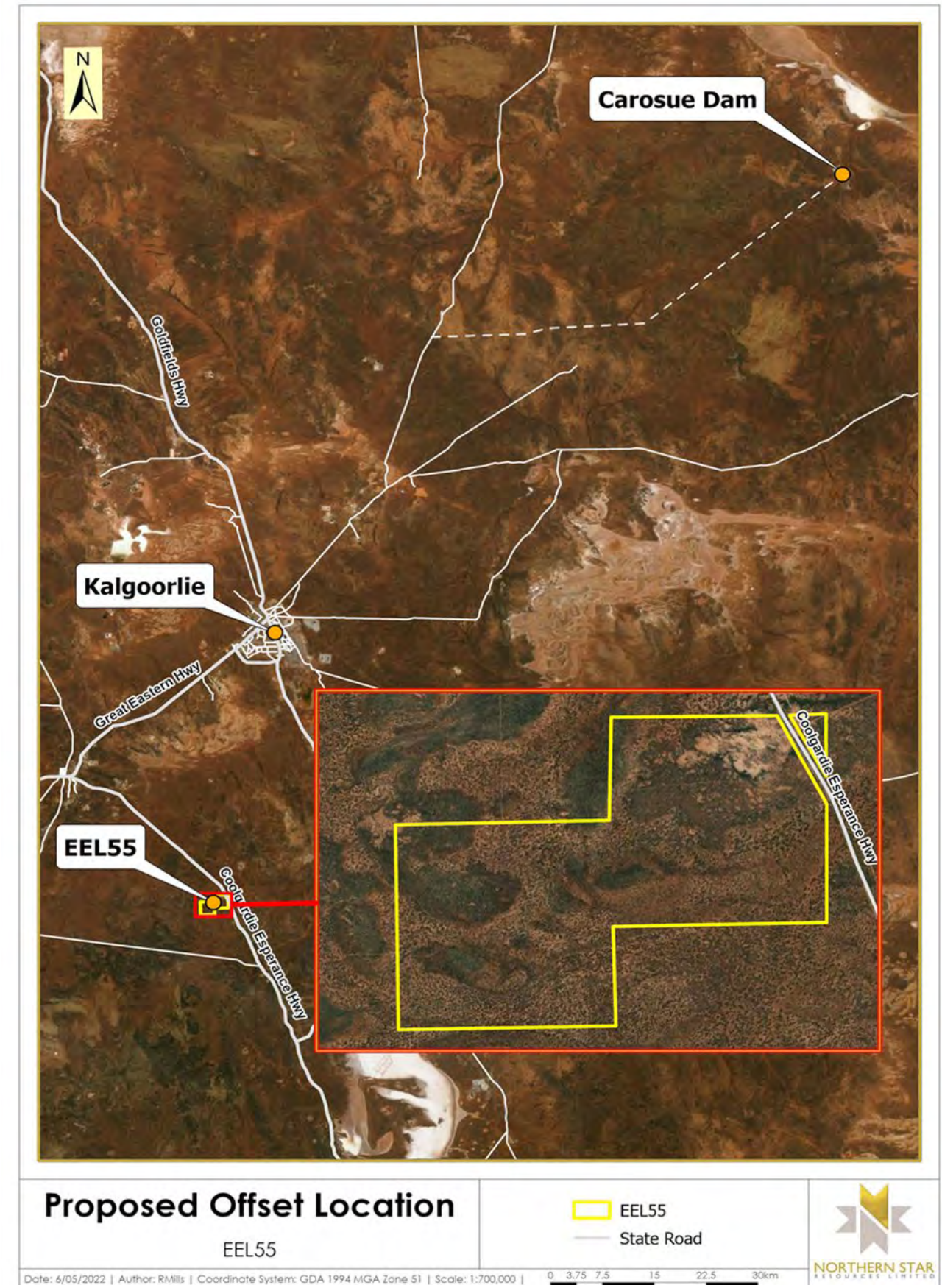

Figure 2: Proposed Offset Location

2.2 Surrounding Land Use

2.2.1 Mining

EEL55 is surrounded by mining and exploration tenure and is approximately 7km southwest from the Mount Marion Mine site which is located in Northern Star's EEL53. The mining sector in the Goldfields has had continual growth and diversification over the years and provides the largest contribution to the region's economic output and makes a vital contribution to the Western Australian and Australian economy (REMPLAN Economy 2022). Since Northern Star acquired EEL55 in 2018, no mineral resource development has commenced or been proposed by Northern Star in the short term. However, existing gold mineralisation within EEL55 may become more economic in the longer term with changing market conditions. Further drilling would be required to determine the full extent of gold resources. Northern Star understands further resource development drilling or mining of this resource will be precluded from EEL55 should it be accepted as an offset.

Further to this, as the surrounding area and region is dominant with mining and exploration activity, EEL55 may be suitable for future developments of other mineral commodities of economic value of interest to third parties with mining sector growth and diversification within the area. For example, approximately 6km to the west of EEL55 is Northern Star's EEL59 which has lithium mining rights over it. There is currently no formal protection and/or management over EEL55 for the purposes of conservation, to prevent mining and/or exploration activities.

Figure 3 highlights the extent of mining tenure surrounding EEL55 and identified mineral resources to date that have been developed and/or have the potential for future development. This includes mineral deposits and mining activity on Northern Star's other EELs. Therefore, there is a high likelihood for EEL55 to be suitable for mining development resulting in potential condition decline and/or a reduction in habitat quality without the inclusion of protective mechanisms.

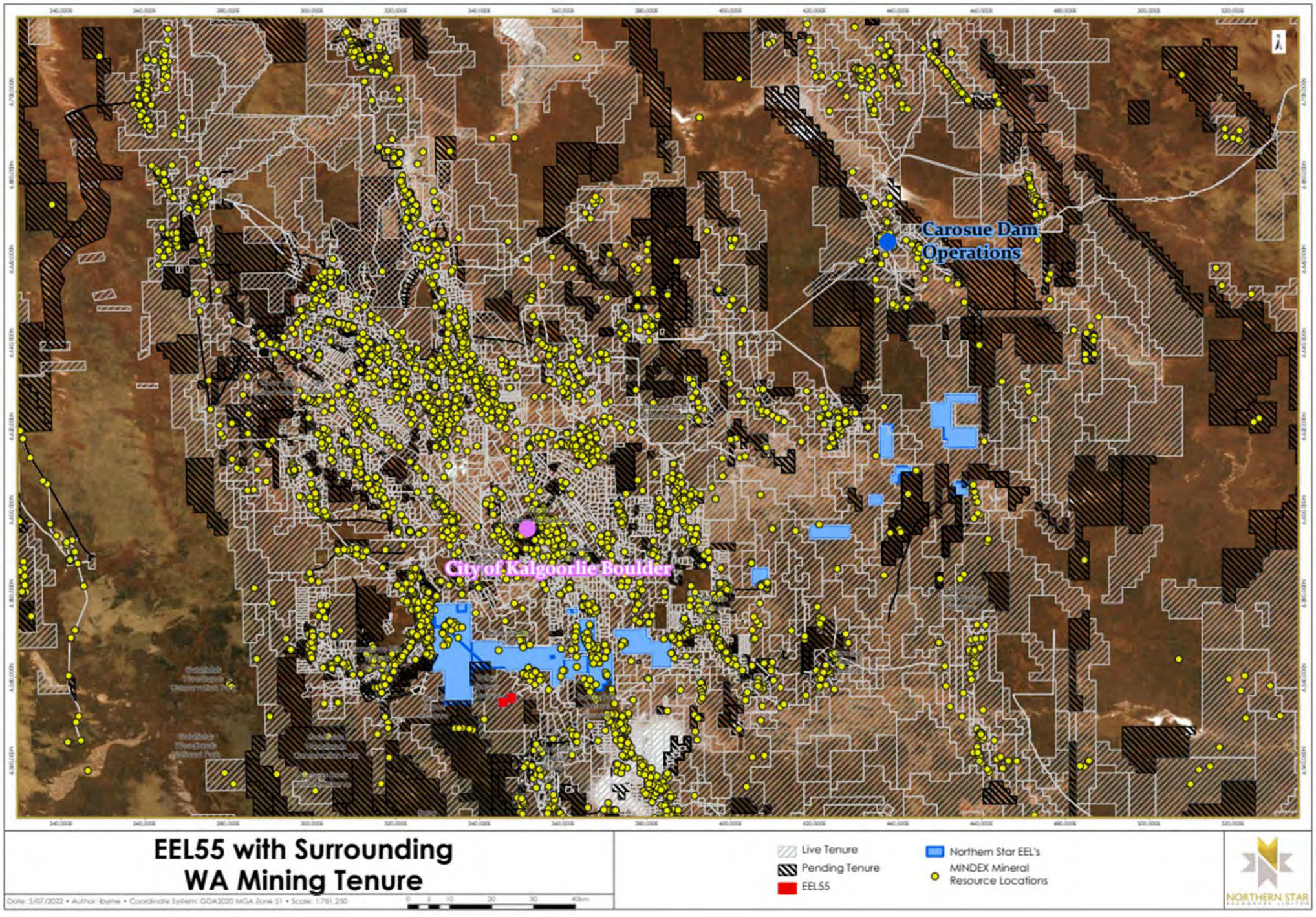

Figure 3: EEL55 and Surrounding Mining Tenure

2.2.2 Pastoral

The agriculture sector in the Goldfields has had continual growth and diversification over the years and pastoral stations are extensive throughout the Goldfields region (REMPLAN Economy 2022). Figure 4 indicates the extensive range of pastoral stations and pastoral licence agreement areas including and surrounding EEL55 which is dominated by livestock production.

The continued growth of the agricultural sector within the region, as well as the loss of pastoral land to mining, increases pressure for additional land for pastoral activity. EEL55 is subject to a pastoral licence agreement and consists of vegetation suitable as forage material for grazing livestock as outlined in Section 2.2.2.1, confirming the offset site is suitable for pastoral activity. There is a high likelihood of potential condition decline and/or a reduction in habitat quality through pastoral activity.

2.2.2.1 Pastoral Value of Flora Species

Flora species recorded during the surveys of EEL55 were reviewed for their palatability and vegetation suitability as forage material for grazing livestock, where information was available through various sources across a range of environments (Mitchell & Wilcox, 1994; Payne & Mitchell, 2002; Clunies-Ross & Mitchell, 2014; and Native Vegetation Council SA, 2017). Based on this information, dominant species recorded in EEL55 provide a suitable environment for livestock grazing (Table 3). Vegetation noted in EEL55 is common across pastoral lands within the Goldfields.

Table 3: Pastoral value of dominant flora species in EEL55

SPECIES	COMMON NAME	SPECIES VALUE*	DESCRIPTIONS
Acacia sp.		Variable	Most Acacia species are considered stability desirable, providing forage material for stock.
Atriplex vesicaria	Bladder saltbush	Desirable	This species is highly palatable. Bladder saltbush is a valuable source of feed for stock. In some instances high salt content limits its usefulness since it can contain up to 15% salt. It contains up to 12% of crude protein. The leaves tend to drop with moisture stress, but the plant responds quickly to rainfall.
Cratystylis microphylla		Unknown	
Dodonaea sp.		Variable	Dodonaea species provide suitable forage material.
Eremophila sp		Variable	Most Eremophila species provide desirable forage material for livestock.
Eucalyptus sp.		Undesirable	Generally considered unpalatable.
Grevillea sp		Desirable	Grevillea species can be palatable for stock and provide forage material.
Hakea sp.		Variable	Generally does not provide forage value for livestock.

SPECIES	COMMON NAME	SPECIES VALUE*	DESCRIPTIONS
Maireana georgei	Golden bluebush	Desirable	Golden bluebush is a valuable fodder shrub. It contains 13-26% crude protein and has a digestibility of 58-67%.
Maireana pyramidata	Sago bush	Desirable	It is not a highly preferred feed and other species are eaten before it. It is drought resistant, withstands heavy grazing well and is a valuable component of the pasture. The leaves contain up to 22% crude protein and have a digestibility of about 60%.
Maireana sedifolia	Pearl bluebush	Desirable/Intermediate	Pearl bluebush is considered palatable. It contains up to 20% crude protein and 10% salt and is eaten by stock if fresh water is available.
Maireana triptera	Three-winged bluebush	Intermediate	It is not very drought tolerant, and is less palatable than most bluebushes, but is eaten in some situations. It contains up to 18% crude protein when actively growing.
Melaleuca sp.		Unknown	
Olearia muelleri	Goldfields Daisy	Undesirable	This species has little forage value and is considered unpalatable.
Phebalium sp		Unknown	
Rhagodia drummondita	Lake-fringe rhagodia	Desirable	It is readily eaten by stock. It holds its leaves well during dry periods and is a good drought reserve. It is resistant to grazing.
Scaevola spinescens	Currant bush, maroon bush	Desirable	Currant bush is an important forage plant. The leaves contain up to 13% crude protein and are relished by stock. It is drought resistant and retains its leaves well into drought periods. It is a protected plant in the Goldfields where, under the name maroon bush, it is collected to make infusions to ease pain in cases of abdominal disease.
Scleroleana sp		Variable	Species is generally valuable as pastoral feed.
Senna artemisioides subsp. filifolia		Undesirable	This species is considered unpalatable.
Waitzia sp	Everlasting daisy	Desirable	Everlasting daisies are generally considered to be of good feed value.

**Species Value was determined using information gathered from sources and indicator value identifier from Payne & Mitchell, 2002 [Desirable, Undesirable, Intermediate and Stability desirable]). Descriptions are provided below.*

Species Indicator Value	Description
Desirable (Decreasers)	Species which decrease in numbers as grazing pressure increases. These are highly palatable preferred species.
Undesirable (Increasers)	Species that increase in number with grazing pressure. These are unpalatable species however can also include palatable species that are poisonous to livestock.
Intermediates	Species which may initially increase under grazing pressure, but being moderately or slightly palatable, later decrease under continued increasing grazing pressure.
Stability Desirable (No indicator value)	Species which are largely unaffected by grazing, and which usually only decrease in number after natural disturbance such a hail damage or fire. These species are not palatable or only slightly palatable (or out of reach of browsing animals). They confer stability on the landscape and contribute to important landscape functioning processes such as water retention and nutrient cycling.

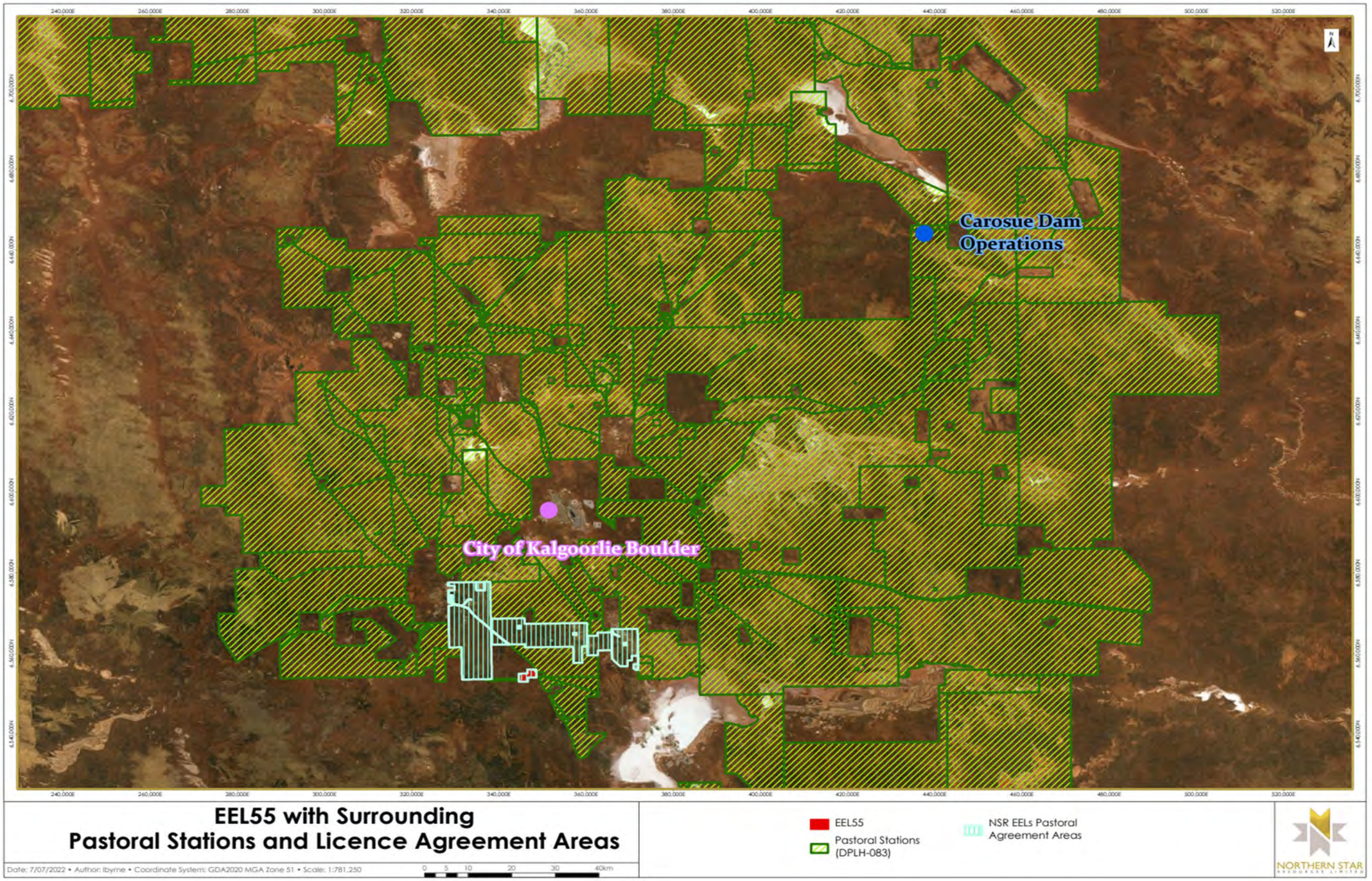

Figure 4: EEL55 and Surrounding Pastoral Stations

2.2.3 Other Environmental Assets

The proposed offset site is located within a continuous patch of vegetation and abuts the Department of Biodiversity, Conservation and Attractions (DBCA) managed Yallari Timber Reserve. The Scahill Timber Reserve is approximately 8km southwest from EEL55 (Figure 5). Both timber reserves are proposed State Forest Reserves (FNA 8892 and 8893) not yet endorsed, however are protected lands managed under DBCA. The securing of Malleefowl habitat within the offset area provides an important connection to/extension of surrounding environmental assets and potential Malleefowl populations within the broader region, improving conservation outcomes.

A total of 120 Malleefowl records within a 40km radius of EEL55 have been identified via a desktop survey (Figure 6).

Implemented management measures above current levels (no active management) of feral animal control, fire management and additional monitoring will improve the overall conservation outcomes for the offset area through continued species presence.

Monitoring of the population and analysis of results will add to the scientific knowledge base of the species that can lead to better management practices.

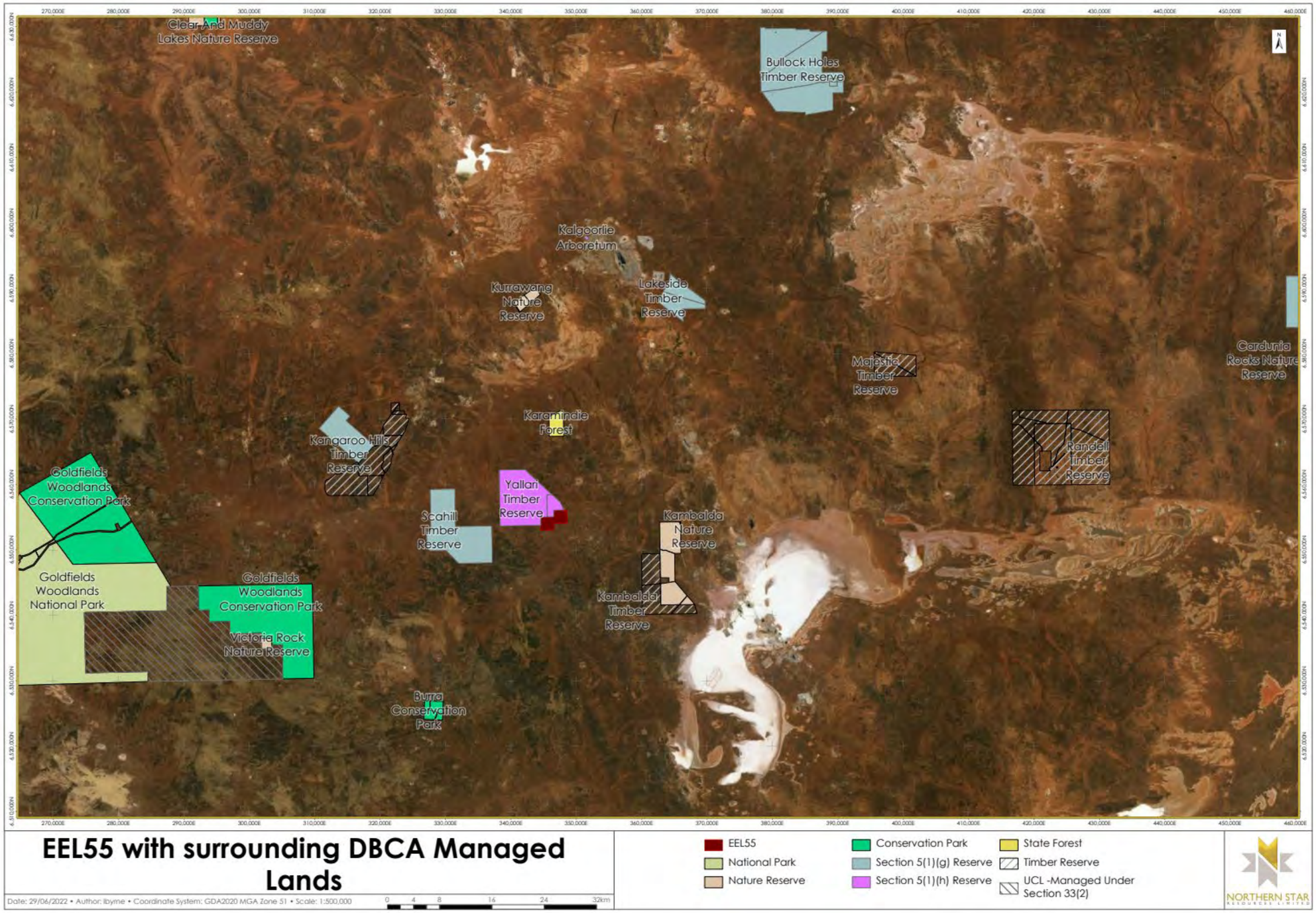

Figure 5: EEL55 and Surrounding DBCA Managed Lands

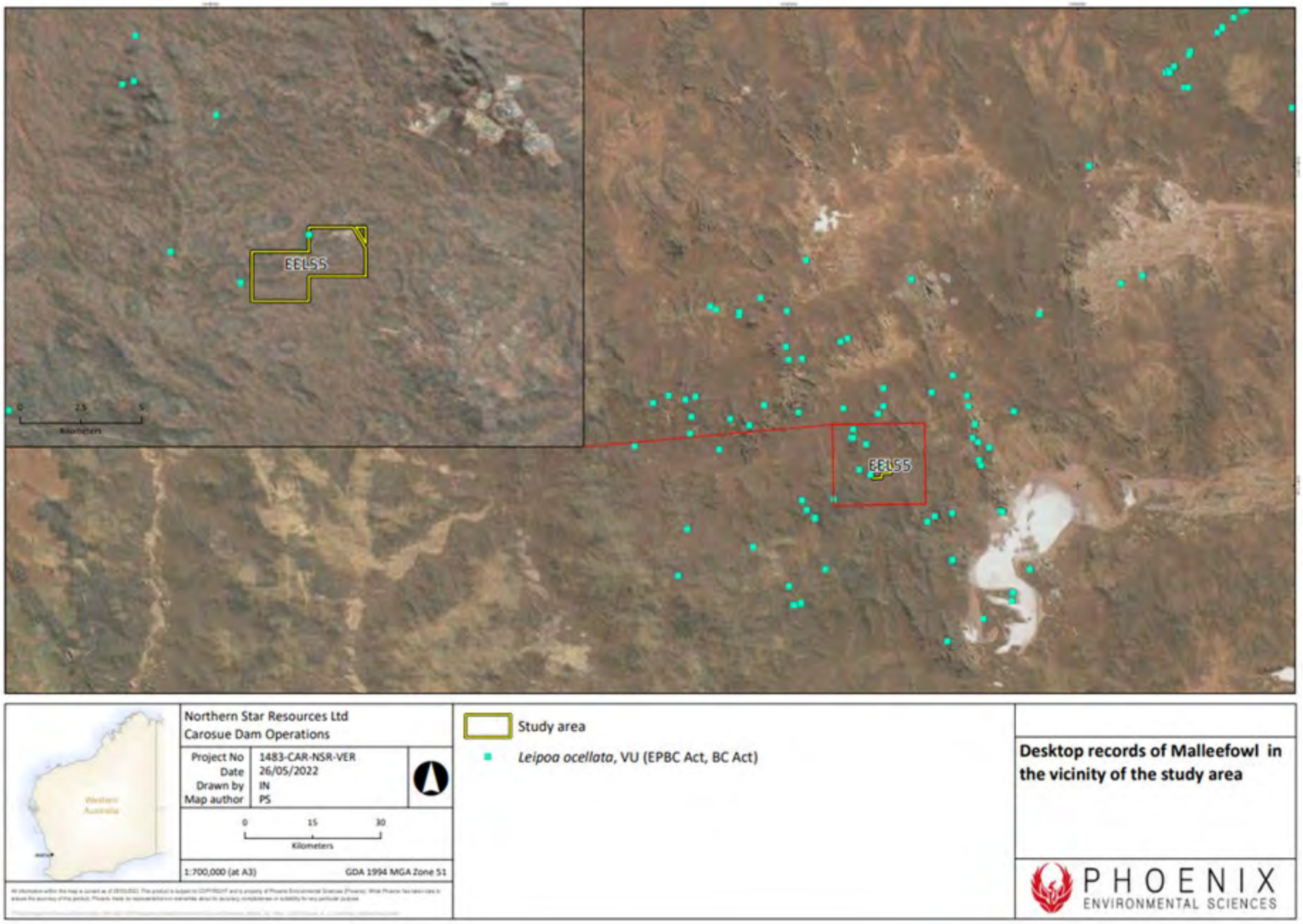

Figure 6: Records of Malleefowl in the vicinity of EEL55

2.3 Bioregional Context

The proposed offset site is located within the Murchison bioregion at the western edge of the Eastern Goldfields subregion (Phoenix Environmental Services 2022).

The Eastern Goldfields subregion is characterised by:

- subdued relief comprised of undulating plains interrupted by low hills and ridges in the west and a horst in the east
- playa lakes associated with the remnants of an ancient major drainage line
- calcretous earths that cover much of the plains and greenstone areas
- vegetation dominated by Mallees, Acacia thickets, shrubland heaths, Eucalyptus woodlands and dwarf samphire shrublands
- land use dominated by Unallocated Crown Land, Crown Reserves and grazing.

The proposed offset site is located within a continuous patch of vegetation and abuts the DBCA managed Yallari Timber Reserve.

2.4 Climate

The Goldfields region is arid to semi-arid with average annual rainfall decreasing from about 250mm in the south-west to 200mm in the north-east. The area experiences hot summers and mild winters with cold nights. Rainfall varies widely between years and droughts are common. Remnants of tropical cyclones occasionally bring heavy summer rain and can cause flooding. The area transitions between desert summer and winter dominated rainfall and desert: non-seasonal bioclimatic. Rainfall at the site1has averaged 270mm a year since 1970. Rainfall was exceptionally dry in 2019 (126mm), below average in 2020 (193mm) and above average in 2021 (317mm) (Alexander Holm & Associates 2022b).

2.5 Land Systems and Surface Geology

The Department of Primary Industries and Regional Development (DPIRD) undertakes land system mapping for Western Australia using a nesting soil-landscape mapping hierarchy. While the primary purpose of the mapping is to inform pastoral and agricultural land capability, it is also useful for informing biological assessments. Under this hierarchy, land systems are defined as areas with recurring patterns of landforms, soils, vegetation and drainage. EEL55 intersects two land systems, of which Mx41 is the most extensive and colluvium 38491 and Depot Granodiorite H dominated surface geology (Phoenix Environmental Services 2022).

Land Systems and Surface Geology within the EEL55 include:

Land systems:

- Mx41: Flat to undulating pediments marginal to unit AC1; granitic rock outcrop; some low escarpments
- Mx42: Broad flat to undulating valleys with isolated granitic, and

surface geology:

- Colluvium 38491: Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial

and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite

- Depot Granodiorite H: Hornblende granodiorite and tonalite with scattered microcline phenocrysts; mafic granite

2.6 Habitat Assessment

Phoenix Environmental Services (2022) has undertaken a fauna habitat assessment across EEL55 to determine the quality of Malleefowl habitat. Habitat type Eucalyptus woodland (405.5 ha, 50.7%) dominated the site followed by Acacia shrubland (309 ha, 38.6%), then Melaleuca shrubland (40.7 ha, 0.3%). A total of 1 ha was cleared land and 44.4 ha (5.5%) was attributed to a granite extrusion. Habitat structure was considered suitable across the site, with Acacia shrubland and Melaleuca shrubland providing highest suitability for Malleefowl (Phoenix Environmental Services 2022 and Alexander Holm & Associates 2022b).

EEL55 and the surrounding Timber Reserve are potentially important to the regional Malleefowl population. EEL55 was considered likely to contain Malleefowl populations based on the presence of suitable habitat and historic records within and/or immediately adjacent to the site. As a result, an additional targeted survey was conducted over EEL55 by Alexander Holm & Associates (2022b) to identify Malleefowl mounds and recent activity of Malleefowl to further demonstrate EEL55 suitability as an offset site (Section 2.6).

Based on these surveys, the resulting assessment of habitat quality for Malleefowl within EEL55 is detailed in Table 4.

The Malleefowl habitat assessment classified the study area as Medium to High suitability Malleefowl habitat, split between 'Low suitability' Eucalyptus woodland suitable for dispersal and foraging and 'High suitability' Acacia and Melaleuca shrubland suitable for breeding. Despite being classified as 'Low suitability', the proximity of this Eucalyptus woodland to 'High suitability' Critical breeding habitat within EEL55 and its connectivity to other areas of shrubland outside the site is important for dispersal in the region. The Eucalyptus woodland also contains isolated pockets of dense Melaleuca which provide more favourable conditions and in which two active Malleefowl mounds were recorded during the follow-up Malleefowl activity assessment (Alexander Holm & Associates 2022b (Figure 7).

Table 4: Habitat Summary within EEL55

Habitat type	Description	Extent in EEL55 (ha and %)	Contains suitable Malleefowl habitat	Representative photograph
Eucalyptus woodland	Tall, open *Eucalyptus* woodland tall, isolated *Acacia* shrubs over variably present shrubs of *Eremophila*, *Melaleuca*, *Senna*, *Maireana sedifolia* and *Phebalium* sp.. Contains suitable Malleefowl habitat.	405.5 (50.7)	Yes	
Acacia shrubland	Tall *Acacia* shrubland over variable mid open shrubland of *Dodonaea* sp., *Phebalium* and *Sclerolaena* sp., over low *Rhagodia*, *Senna*, and *Maireana* shrubs. Contains suitable Malleefowl habitat.	309.0 (38.6)	Yes	

Habitat type	Description	Extent in EEL55 (ha and %)	Contains suitable Malleefowl habitat	Representative photograph
Granite extrusion forbland	Large open granite extrusion with isolated *Acacia* and *Hakea* shrubs over forbland of *Helipterum roseum*, *Maireana* and *Sclerolaena* sp.. Does not contain suitable Malleefowl habitat.	44.4 (5.5)	No	
Melaleuca shrubland	*Melaleuca* shrubland over low scattered *Maireana sedifolia*, *Grevillea* and *Atriplex* sp. (saltbush), *Phebalium* and greybush. Contains suitable Malleefowl habitat.	40.7 (5.1)	Yes	
Cleared	Roads, agricultural infrastructure such as watering holes etc. Does not contain suitable Malleefowl habitat.	1.0 (0.1)	No	NA
	Total	**800.6**		

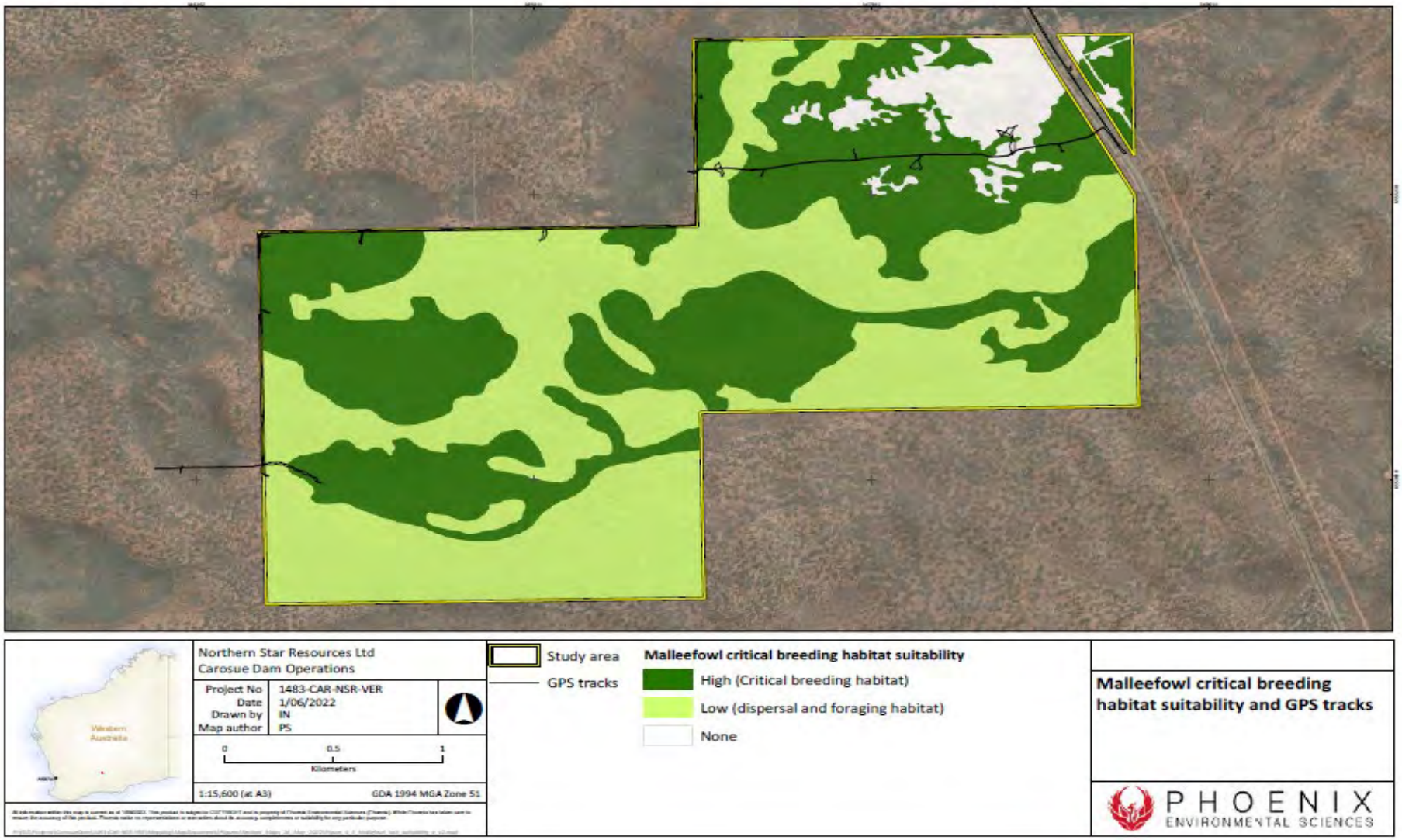

Figure 7: Malleefowl habitat suitability

2.6.1 Vegetation Condition

Vegetation condition for EEL55 was considered pristine, showing no signs of anthropogenic disturbance or damage. There was observed old drums and PVC piping left on the site from historical unauthorised access, however, was not seen to be impacting vegetation (Phoenix Environmental Services 2022).

2.7 Malleefowl Mounds and Malleefowl Activity

Phoenix Environmental Services (2022) has undertaken a fauna habitat assessment across EEL55 to determine the quality of Malleefowl habitat within the proposed offset which included a desktop review identifying 120 Malleefowl records within a 40km radius of the site. During the habitat assessment one degraded Malleefowl mound was recorded on the northwest boundary track of EEL55 situated within *Acacia* Shrubland (Table 5).

Further survey work undertaken by Alexander Holm & Associates (2022b) identified twelve nesting mounds of which two were active, one inactive recent, two inactive abandoned and seven long unused. Fresh tracks of one adult and one juvenile Malleefowl were found either within or nearby 'acacia shrubland' (Table 6).

Table 5: Single Malleefowl Mound observed by Phoenix Environmental Services (2022)

Site	Latitude	Longitude	Mound Status
NS026	-31.1220	121.3908	Long unused: Evidence of an extended period of inactivity such as dense shrubs or trees growing from hollow or mound very degraded/poorly formed. Highly unlikely to become Active in the future. 

Table 6: Malleefowl Mounds surveyed by Alexander Holm & Associates (2022).

Details	Photo	Details	Photo
EEL55_01 Outer rim: 3.85m Inner rim; 2.45m Depth: 0.26m Long unused		**EEL55_03** Outer rim: 3.7m Inner rim; 2.1m Depth: 0.13m Long unused	
EEL55_02 Outer rim: 3.12m Inner rim; 1.70m Depth: 0.12m Long unused		**EEL55_04** Outer rim: 2.80m Inner rim; 1.50m Depth: 0.12m Long unused	

EEL55_05

Outer rim: 4.00m
Inner rim; 2.67m
Depth: 0.30m
Long unused

EEL55_07

Outer rim: 4.20m
Inner rim; 2.35m
Depth: 0.26m
Inactive abandoned

EEL55_06

Outer rim: 4.45m
Inner rim; 2.45m
Depth: 0.41m
Active

EEL55_08

Outer rim: 3.70m
Inner rim; 2.65m
Depth: 0.30m
Long unused

EEL55_09

Outer rim: 4.35m
Inner rim; 1.80m
Depth: 0.41m
Active

EEL55_011

Outer rim: 5.30m
Inner rim; 3.45m
Depth: 0.31m
Long unused

EEL55_010

Outer rim: 4.55m
Inner rim; 2.00m
Depth: 0.33m
Inactive recent

EEL55_012

Outer rim: 5.00m
Inner rim; 2.75m
Depth: 0.18m
Long unused

2.8 Introduced Fauna

Table 7: Observed feral animal activity

Species	Record of Evidence	Comments
Cat (*Felis catus*)	scats/tracks	Recorded on the track (NS030) by Phoenix Environmental Services 2022 (Appendix C). Alexander Holm & Associates (2022b) confirmed presence of cat.
Dog/Dingo	tracks	Fresh tracks of wild dog/dingo were noted at several locations throughout the assessment by Alexander Holm & Associates 2022b (Appendix D).

2.9 Habitat Quality Assessment Score

A Habitat quality score for EEL55 was calculated using the three components laid out in the EPBC Act Offsets Assessment Guide (DSEWPC 2012b): Malleefowl stocking rate, Site condition and Site context.

These were combined in a framework that differentiates, describes and weights these components to derive a Habitat quality score out of a maximum value of ten. Scores for these components were calculated for each habitat type within each individual site. The framework gave a greater weighting to species presence, with Site context and Site condition each making up 30% of the total score and Malleefowl stocking rate making up the final 40%. The total score for each habitat type was then weighted based on the proportion of that habitat type within the offset site. These scores were then summed, resulting in an overall habitat score out of ten, which aligns with the EPBC Act Offset Assessment Guide (DSEWPC 2012b).

A summary of the habitat quality score for EEL55 is provided below in Table 8.

2.9.1 Site Condition

Factors rated for the Site condition component were:

- Vegetation condition (Keighery 1994)
    - Vegetation condition ratings were allocated a score out of five with Pristine rated as five and Completely Degraded as zero, then converted to a score out of three.
- Habitat structure (diversity of species present, habitat features present)
    - structure was allocated a score out of eight, based on the Malleefowl habitat assessments conducted at each site which was then converted to a score out of three.
- Feral predator activity
    - feral predator activity was allocated a score out of three with No predators detected rated as three and High predator activity as zero.

The combined score for vegetation condition, habitat structure and feral predator activity was converted to a score out of three and weighted so that vegetation condition and feral predators contributed 25% each and habitat structure

contributed 50% to the overall score. Habitat structure received a higher weighting than vegetation condition and predator presence as Malleefowl have been shown to utilise disturbed habitat provided the habitat structure remains suitable (Mount Gibson Mining Ltd 2012; Wheeler 2018). Chicks, juvenile and sub-adult birds are most at risk of mortality by feral predators such as cats and foxes which can be so significant as to limit recruitment of young Malleefowl into the breeding population (Priddel & Wheeler 1996). However, adult mortality to feral predators appears low (Priddel & Wheeler 1996) so the presence of feral predators is not significant enough to make the habitat unsuitable for Malleefowl, hence, its lower weighting.

2.9.2 Site Context

Factors rated for the Site context component were:

- movement patterns of Malleefowl
- extent and proximity of suitable habitat
- population or extent of Malleefowl.

These factors were collectively used to assign a score out of three based on assessments of aerial imagery, historical records of Malleefowl in the vicinity and the follow-up Malleefowl activity assessment for EEL55.

2.9.3 Malleefowl Stocking Rate

Malleefowl stocking rates were based on comprehensive Malleefowl presence data from the follow up Malleefowl activity assessment (Alexander Holm & Associates 2022b). A score out of four was assigned based on recent records from Holm (2022b) and historical records of Malleefowl obtained from DBCA records of Malleefowl activity which may include sightings, mounds and other secondary evidence:

- Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats
- Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats
- Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats
- no records of Malleefowl on site, within known range of Malleefowl, suitable habitat present
- site outside current known range of Malleefowl or habitat is unsuitable.

Table 8: Habitat quality assessment for offset site EEL55

Factor	Score	Condition/details	Habitat type				
			Eucalyptus woodland	Acacia shrubland	Granite extrusion	Melaleuca shrubland	Cleared
Site condition							
Vegetation condition	5	Pristine	4.7	4.8	5.0	5.0	0.0
	4	Excellent					
	3	Very good					
	2	Good					
	1	Degraded					
	0	Completely degraded					
		Score out of 3	2.8	2.9	3.0	3.0	0.0
Habitat structure - Diversity of habitat species present - Habitat features (Based on Malleefowl habitat assessment)	3	High suitability (score of 6-8/8)	2.0	3.0	0.0	3.0	0.0
	2	Medium suitability (score of 5/8)					
	1	Low suitability (score of 4/8)					
	0	Not suitable (score of 0-3/8)					
		Score out of 3	2.0	3.0	0.0	3.0	0.0
Feral Predator Activity	3	Not detected in targeted survey	0.0	1.0	2.0	3.0	3.0
	2	Low (one record within habitat)					
	1	Medium (Multiple records of single species or single records of more than one species)					
	0	High (Multiple records of more than one species)					
		Score out of 3	0.0	1.0	2.0	3.0	3.0
		Score out of 3	0.0	1.0	2.0	3.0	3.0
		Overall score out of 3 (weighted so Vegetation condition = 40% of total and Habitat structure = 60% of total)	1.7	2.5	1.3	3.0	0.8
Site context							
Movement patterns of Malleefowl Proximity of the site in relation to other suitable areas of habitat Overall population or extent of Malleefowl	3	Site is part of a regionally large contiguous suitable habitat; records on the site for Malleefowl within last 5 years; site is within known distribution of Malleefowl and has connectivity with protected areas.	3.0	3.0	1.0	2.5	1.0
	2.5	Site is part of a regionally significant contiguous suitable habitat; records on site or immediately adjacent (within 3 km) for Malleefowl within last 6-10 years; site is within known distribution of Malleefowl.					
	2	Site is part of a contiguous suitable habitat; Malleefowl records on site or adjacent (within 5 km) to site within last 6- 10 years; site is within known distribution of Malleefowl.					
	1.5	Site is part of a contiguous suitable habitat; Malleefowl records on or adjacent (within 10 km) to site within last 6-10 years; site is located within known distribution of Malleefowl.					
	1	Site is unsuitable or isolated from suitable habitat. Malleefowl records on site or in region (within 10 km) within last 10 years and Malleefowl are capable of migrating to site. Site is located within known distribution of Malleefowl.					
	0.5	Site is unsuitable or isolated from suitable habitat. Records on site or in region (within 10 km) within last 10 years and species are capable of migrating to site. Site is not located within known distribution of species.					
	0	Site is unsuitable or isolated from suitable habitat. No Malleefowl records on site or in region (within 10 km) within last 10 years and Malleefowl unlikely to migrate to site.					
		Score out of 3	3.0	3.0	1.0	2.5	1.0
Malleefowl stocking rate							
Known presence	4	Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats.	3.0	3.0	0.0	2.0	0.0
	3	Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats.					
	2	Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats.					
	1	No records of Malleefowl on site, within known range of Malleefowl, suitable habitat present.					
	0	Site outside current known range of Malleefowl or habitat is unsuitable.					
		Score out of 4	3.0	3.0	0.0	2.0	0.0

Factor	Score	Condition/details	Habitat type				
			Eucalyptus woodland	Acacia shrubland	Granite extrusion	Melaleuca shrubland	Cleared
Scores							
		Score out of 10 (before scaling)	7.7	8.5	2.3	7.5	1.8
		Habitat area (ha)	405.5	309.0	44.4	40.7	1.0
		Habitat area proportion	0.5	0.4	0.1	0.1	0.0
		Scaled score (score scaled to proportion of tenement)	3.9	3.3	0.1	0.4	0.0
		Final Habitat quality score out of 10					**7.7**

2.9.4 Summary of Offset Calculations

A summary of EEL55 offset calculations, as used within the EPBC Act Offsets Assessment Guide (DSEWPC 2012b) is provided in Table 9 with the proposal offset reaching/exceeding 100% offset requirements for Malleefowl. A risk-based approach was used to determine future quality and risk of loss without the offset and with the offset. The risk assessment in Section 4 provides more detail around the risks assessed, mitigation measures provided by the offset and aligns these to the relevant objectives outlined in the National Recovery Plan.

Table 9: EEL55 Offset Calculator

Site	Attribute	Value	Factors considered/Justification of value
Impact site	Impact area (ha)	152.6	The total clearing of native vegetation required for the Project.
	Quality (out of 10)	5	Habitat quality assessment at the impact site has been undertaken by Alexander Holm & Associates (2022a) and provided in Appendix A to the Preliminary Documentation.
	Adjusted impact area (ha)	76.30	Derived from factors considered for the DCCEEW impact calculator.
Offset site (EEL55)	Offset area (ha)	800	Based on factors considered for the DCCEEW offset calculator a total of 800 ha which contains 755.2 ha of suitable Malleefowl habitat, is expected to meet the 100% direct offset requirement.
	Start quality (out of 10)	8	Refer to Appendix C of this Offset Proposal. Habitat quality assessment has been undertaken by Phoenix Environmental Services 2022.
	Future quality without offset (out of 10)	7	Please refer to Section 2, of this Offset Proposal for additional details on land tenure, current use, surrounding land use and other environmental values. Northern Star's future planned land use for EEL55 includes a high potential for pastoral activities if not used as an offset site. As such there is a high risk of habitat degradation over the next 20 years under Pastoral Agreement. The neighbouring pastoral lease holder has the rights to carry out pastoral activities on EEL55. Confidential Agreements have been provided. Appendix B provides additional evidence on projected habitat decline from Pastoral Activity. The extent of mining tenure and activity surrounding the offset site infers a high likelihood for future resource development. As such there is a high risk of habitat degradation or decline. Currently EEL55 is not managed for unplanned and unmanaged fires which increases the risk of habitat loss of the site without fire management measures implemented through the Offset Proposal. EEL55 currently has no feral animal control practices and with evidence of feral cats and dogs recorded in the site. There is an increased risk of predation on Malleefowl impacting the future quality of the site.

Site	Attribute	Value	Factors considered/Justification of value
	Future quality with offset (out of 10)	9	Currently EEL55 is not protected to prevent habitat loss from mining and pastoral activities. Placing the land under conservation covenant will ensure the land is secured for conservation management which will maintain and improve the future habitat quality of the site and aim to provide improved conservation outcomes for the species. Refer to this document Section 3 Offset Area Management. *Management:* Predation is a major cause of mortality of Malleefowl (Benshemesh 2007). Cat and Dingo activity was recorded within EEL55 which poses a threat to the existing and any future Malleefowl that utilise EEL55. Baiting programs have shown to increase Malleefowl survival rates (Wheeler 2018), Therefore, implementing feral animal control within EEL55 will prevent predation on Malleefowl, potentially increasing survival rates of the species to enable breeding presence of the species to continue. As outlined in the Recovery Plan, fires are a major threat to the conservation of Malleefowl and the recovery of the area after a fire is very slow (Benshemesh 2007). Bushfire is becoming more prevalent within the Goldfields region, and currently no fire management exists over EEL55. Implementation of fire management within EEL55 will reduce the risk of habitat loss due to fire; therefore, habitat quality is expected to be maintained to provide improved conservation outcomes for the species. EEL55 is abutted by a Timber Reserve increasing protection of habitat connectivity that will be important for the dispersal of Malleefowl populations within the region. *Monitoring:* Improvement in future quality with the offset is centred around monitoring of the site to improve the knowledge base regarding Malleefowl trends within the offset site and wider region. Monitoring within the offset site will also allow for the implementation of adaptive management strategies to improve conservation outcomes for the species as more data and knowledge is gained. Integrated Management and monitoring measures implemented through this Offset Proposal directly contribute to the outcomes of the National Malleefowl Recovery Plan.
	Confidence in result (%)	55	Northern Star's confidence in result is 60%, for the following reasons: • Northern Star have been operating and managing land within the Goldfields region for over 10 years, with experienced employees and consultants across the business to successfully implement the Offset Proposal, including adaptive management strategies to achieve conservation objectives for the site. • Independent expert consultants have been used to ensure habitat quality values are based on scientific assessment. • Annual inspections and monitoring of the site will ensure required changes to management practices will be identified and implemented in a timely manner.

Site	Attribute	Value	Factors considered/Justification of value
			• Northern Star has undertaken additional literature review which supports the success of the integrated and diverse proposed management measures such as those proposed here. This literature review supports the anticipated raw gain through both averting a reduction and creating an increase in habitat quality. Northern Star will implement adaptive management measures if required to ensure condition improvements can be achieved. • Northern Star will legally secure the land for conservation by registering a conservation covenant over the whole of the land in perpetuity, binding both Northern Star as the current owner and any successors in title; • Northern Star will amend the existing Pastoral Licence to excise EEL55 from the Pastoral Licence, removing the prospect that pastoral activities could be undertaken on EEL55 and eliminating the risk of grazing; • Northern Star's approach to fire management confidently minimises the risk of fire to Malleefowl habitat; and • Northern Star is committed to managing predator risk through an initial site baiting program which will be monitored and managed throughout the twenty year monitoring period, and will be adapted to regional baiting or other proven measures if required. Even at 55%, which is conservative, the offset proposal meets the policy.
	Time over which loss is averted (max. 20 years)	20	Time over which loss is adverted has been set to maximum 20 years to ensure long term security and protection of the land.
	Time until ecological benefit	20	Ecological benefit would be realised through management actions (feral animal control and fire management), protective mechanisms (excluding grazing, exploration and mining) to minimise habitat quality decline, and monitoring programs to increase knowledge around the conservation of Malleefowl and habitat, directly contributing to the objectives of the National Recovery Plan.
	Risk of loss (%) without offset	0	Risk of loss refers to complete loss of habitat over the foreseeable future over the life of the offset (20 years) due to human activity. Consultation with DCCEEW has indicated this is what the department consider the risk of loss to be. Currently there are no formal protection mechanisms, mining tenure or mineral development proposals over EEL55.
	Risk of loss (%) with offset	0	Under formal protection and proposed management mechanisms, there is a high level of certainty that the offset site will provide improved conservation outcomes. Conservation covenant will protect land from risk of total loss.
	Confidence in result (%)	95	This number becomes redundant in the calculator if both risk of loss values are 0%.

Site	Attribute	Value	Factors considered/Justification of value
Summary	% of impact offset (%)	104.61	This meets the 100% offset requirement based on 755.2 ha of suitable Malleefowl habitat within the 800 ha Offset Site.

3 Offset Area Management

3.1 Land Tenure

It is intended that EEL55 will have a conservation covenant placed over it for the security, protection, and management of habitat suitable for Malleefowl to offset the direct and indirect impacts from the controlled action. As Northern Star own the Freehold land, management of the offset site (EEL55) will reside with Northern Star for a term of 20 years.

This Proposal includes the following:

- Security, protection and maintenance of 755.2 ha of Malleefowl habitat within 800 ha of EEL55
- Improvement and maintenance of Malleefowl Species stocking rate within EEL55

3.2 Management Measures

Northern Star will develop an Offset Management Plan outlining suitable management measures and associated criteria which will be implemented upon project commencement. The Offset Management Plan will be reviewed on an annual basis to ensure it incorporates new knowledge and is reviewed to ensure its effectiveness of the implemented management measures. Northern Star will coordinate the ongoing and adaptive management of the offset for a twenty-year term.

Preliminary management measures, completion criteria and associated monitoring have been outlined below in Table 10.

A summary of the overarching management measures includes, but is not limited to, the following:

- Place a conservation covenant over EEL55
- Exclusion of grazing
- Undertake additional targeted fauna surveys
- Feral animal management
- Bushfire prevention and management with the installation of firebreaks
- Clean-up of any rubbish found within the site
- Weed Management

3.2.1 Protection Mechanism

Several mechanisms exist to provide legal protection of land for the purposes of conservation. One method includes an Agreement to Reserve which involves the land being set aside for the protection and management of vegetation under Section 30B of *Soil and Land Conservation Act 1945*. Under this mechanism, Section 30E of the Act allows provision for the Agreement to be varied or discharged. Alternatively, a Conservation Covenant under the *Soil and Land Conservation Act 1945* can be applied to ensure the protection of the Offset site.

Northern Star has confirmation the Soil Commissioner of Western Australia is willing to enter into a conservation covenant under the *Soil and Land Conservation Act 1945* with regards to EEL55 should this be accepted by DCCEE as a suitable offset site (see Appendix E). This mechanism provides protection of the land in perpetuity and is irrevocable. This conservation covenant will protect the land from impacts through clearing and/or

degradation of the vegetation and habitat qualities over time, including grazing, mining and exploration disturbances.

3.2.2 Exclusion of Grazing

EEL55 is currently subject to a Pastoral Licence Agreement under which Northern Star has since 2015 granted a licence to the neighbouring pastoralist to use areas of land including EEL55 for pastoral activities until 30 June 2030 (Pastoral Licence). Northern Star is confident that it will be able to secure an agreement from the pastoralist to amend the Pastoral Licence to excise EEL55 from the Pastoral Licence, with the result that no rights to pastoral activities will remain on EEL55. Northern Star will secure this amendment to the Licence should EEL55 be accepted as an offset and put under a conservation covenant.

If it is not to become an environmental offset location, the rights under the Pastoral Licence will remain and are likely to lead to a reduced quality of habitat generally on EEL55.

The Pastoral Licence Agreement and the variation to the agreement has been supplied as a confidential Appendix (Appendix A – Confidential).

The impacts of grazing on native vegetation have been well documented in studies which have recognised grazing impacts were largely negative, even at low levels of grazing. Detrimental effects on vegetation structure and composition, leaf litter availability, and soil moisture content and soil structure through grazing practices are evident throughout Australia (Eldridge, D. et al., 2015). Each of these factors are important requirements for the breeding success of Malleefowl (Stenhouse, P and Moseby, K. 2022).

In its initial site assessments, Phoenix Environmental Services identified that land with active pastoral activity (grazing and livestock use) had low suitability for Malleefowl habitat due to degraded habitat structures, these areas also had fewer Malleefowl records, increased feral animals and invasive weed species (Phoenix Environmental Services 2022a). The grazing had altered the vegetation structure and composition rendering the sparsely vegetated areas unsuitable, having impacted key habitat attributes critical for Malleefowl survival (foraging and breeding) such as sandy substrate, leaf litter, and canopy. This also increased predation pressure due to increased open areas (Phoenix Environmental Services 2022a). In addition, studies have indicated the altered vegetation structure and composition from pastoral activity reduced the abundance and diversity of food resources (seeds, flowers, and fruits) of understory shrubs and herbs, an important attribute for ongoing presence of Malleefowl (Benshemesh 2007; Wheeler 2018; Parsons 2008). The reduced abundance of food resources increased time spent foraging resulting in prolonged exposure to predators (Greenslade 1992 and Wheeler 2018). Evidence stated above is potentially a contributing factor to why there are fewer Malleefowl records at sites with active Pastoral activity. This is consistent with other studies that indicated pastoral activity had profound eco-system changes and degradation, including altered vegetation structure and composition resulting in an increased predation risk (Hobbs 2001; Lunt et al. 2007; Benshemesh 2007; Saunder et al. 2003; Spooner & Lunt 2004).

Malleefowl have been shown to utilise disturbed habitat provided the habitat structure remains suitable (Wheeler 2018). Malleefowl presence was strongly related to habitat characteristics with high shrub and leaf litter with an abundance of native food shrubs Parsons (2008). Other studies strongly suggests that these habitat characteristics are negatively impacted by livestock grazing (Hobbs 2001; Pettit & Froend 2001; Saunder et al. 2003; Spooner & Lunt 2004), and thus livestock presence may result in a reduction in the quality of Malleefowl habitat and thus a decline in Malleefowl presence. Lewis et al 2012 indicated the removal of grazing had positive vegetation outcomes required for maintaining critical Malleefowl habitat. For these reasons, preventing impacts on habitat structure and composition from pastoral activity within the offset area will ensure the

integrity of the habitat features which are critical for Malleefowl will prevent any impact from grazing resulting in the decline in habitat quality over time.

Additional literature review has been provided to demonstrate habitat decline over time from Pastoral Activity (Appendix B).

3.2.3 Targeted Surveying & Monitoring

The occurrence and status of Malleefowl mounds is typically used as a proxy to identify the presence of Malleefowl occurrence (Saffer et al 2014). Alexander Holm & Associates (2022b) identified two active Malleefowl mounds as well as fresh tracks on EEL55; based on this information it may be inferred that two breeding pairs of Malleefowl are present at the site (Parvin et al 2021). As the site has not been previously managed for conservation, there is limited environmental and management data available to provide a more accurate assessment of Malleefowl densities and the extent of potential threats. Therefore, it is vital that additional targeted survey and monitoring is undertaken to address knowledge gaps in ecological and/or management knowledge.

The proposed monitoring techniques include the use of aerial LiDAR technology for mound identification over large-scale areas, on-ground surveys, mound monitoring, and camera monitoring programs. Monitoring will be conducted by qualified environmental personnel and, where required, be undertaken in accordance with the National Malleefowl Monitoring Manual. These techniques have been determined to be appropriate to identify Malleefowl mound status to determine occurrence of Malleefowl (Saffer et al 2014 & Parvin et al 2021& Nagle 2022) at the site, based on research and practical application at the Carosue Dam mine site.

Over time, monitoring will be adapted to account for any trends observed and will be used to determine effectiveness of management measures and to inform, if required, additional monitoring to account for other threatening factors. At a broader scale, it is proposed that monitoring data may be provided to other stakeholders (National Malleefowl Recovery Team, DBCA, Traditional Owners and other Conservation Groups). A broader knowledge base enables a deeper understanding of impacts from known threats to Malleefowl, regional population trends and effectiveness of management measures over time, leading to better conservation outcomes for the species.

Metrics used to determine effectiveness of the implemented measures will include, but not be limited to, the following:

- reduced evidence of feral animal activity
- the continuation of Malleefowl presence

An integrated approach using a variety of monitoring techniques locally and at the broader scale, along with the other proposed management measures at the site as outlined in this document, aims to reduce threats to Malleefowl and improve conditions for Malleefowl survival.

Research is continuously being undertaken to gain a deeper understanding of impacts from known threats to Malleefowl and its habitat. Research and fauna monitoring studies contribute to longitudinal data to determine population trends and effectiveness of management measures over time, leading to the best conservation outcomes for the species.

Information gained from the management and monitoring of the offset site contributes to a broader knowledge base around Malleefowl conservation, directly contributing to objectives outlined in the Malleefowl Recovery Plan and aims to improve information around current knowledge gaps and lack of long-term management data for the species. Knowledge gained from monitoring programs is also crucial to inform adaptive management strategies if required, and to provide evidence for the success of criteria outlined in the Offset Proposal.

As part of an adaptive management strategy, also detailed in the Offset Management Plan, additional targeted fauna surveys and ongoing flora and fauna monitoring conducted at the offset site will contribute to long-term scientific knowledge of the species. The offset area may also provide additional study sites creating opportunities for researchers to broaden knowledge on the effectiveness of an integrated management approach and adaptive management principles in relation to conservation outcomes for the species.

Northern Star have outlined the proposed monitoring program to support this Offset Proposal in Section 3.3. Proposed survey and monitoring programs on EEL55 incorporate a range of techniques including the use of LiDAR technology for mound identification over large-scale areas, on-ground surveys and mound monitoring, and camera monitoring programs.

This Offset also provides a greater potential for Northern Star to form partnerships and work in collaboration with relevant groups such as the National Malleefowl Recovery Team, Traditional Owners, Yongergnow Malleefowl Centre, DBCA, regional conservation groups and adjacent landowners.

3.2.4 Feral Animal Management

Feral animals are a known threat to biodiversity primarily through predation of, and competition with native fauna species (Department of Environment and Conservation 2013). Predation by feral animals (fox, cats, and dingos) is a key factor contributing to the decline of Malleefowl species due to mortality (Bode et al. 2011 and Benshemesh J 2007). Feral animals are known to take Malleefowl at all stages of the bird's life cycle, reducing recruitment of Malleefowl into populations (Benshemesh J 2007). Research indicates land managers should prioritise conservation efforts targeted at adult survivorship to have the greatest influence on population viability (Bode et al 2011). Broadscale aerial baiting has been successful in enhancing Malleefowl survival by reducing mortality rates from predation (Wheeler et al 2009). However, research indicates success in improving outcomes for Malleefowl is underpinned by incorporating other feral animal control methods like fencing, trapping and monitoring inclusive of frequent broadscale and localised baiting programs (Bode et al 2011; Priddel at al 1997 and Walsh et al 2012).

Wild dogs and feral cats within the Kalgoorlie area are in high numbers and widespread (GNRBA 2021 and Wynne 2011). Survey work undertaken on EEL55 recorded evidence of wild dog/dingo and cat activity. There is a high likelihood of predation risk to any existing Malleefowl population at the site, resulting in a reduction in stocking rates. Therefore, it is proposed that annual feral animal monitoring will be undertaken over EEL55 to include feral animal activity evidence such as scats, tracks, sightings, and fauna deaths. Feral animal activity will be analysed in combination with Malleefowl activity to determine the potential predation risks, and to verify the effectiveness of management measures. Based on our research, applying a diverse range of feral animal control methods provides better outcomes instead of one standalone technique.

Metrics used to determine effectiveness of the implemented measures will include but not limited to the following:

- reduced evidence of feral animal activity
- ongoing and/or increase in Malleefowl activity.

Recent studies (Nou 2021) noted there is scientific uncertainty regarding the effectiveness of baiting programs on Malleefowl but also that there are many factors affecting efficacy of baiting programs, including the type of bait used, and the intensity and extent of the programs. Northern Star will take these findings into consideration when planning predator control and implementing adaptive management measures should our predator control appear ineffective. The Nou (2021) study also noted the importance of implementing a range of management measures to achieve success. This Offset Proposal achieves this by focusing on a range of measures as outlined throughout this document. An integrated approach to feral animal control (including the benefits of excluding grazing as described in section 3.2.2), using a variety of control methods locally and at the broader scale, along with the other proposed management measures at the site aims to reduce threats to Malleefowl and improve conditions for Malleefowl survival.

Adaptive management will be triggered if monitoring indicates no changes in feral animal activity on baseline data, and/or an increase in feral animal activity. Additional adaptive management may include: doggers, trapping, broadscale baiting and a biosecurity fence. Site feral predator monitoring and controls will contribute to regional feral predator control programmes if required, in consultation with DBCA and other relevant stakeholders (such as the Goldfields Nullarbor Rangelands Biosecurity Association (GNRBA), adjacent landowners, and the Malleefowl Recovery Team) to determine the suitability of site feral animal control for inclusion into regional research projects to broadly mitigate and minimise predation impacts on Malleefowl within EEL55 and the broader region.

3.2.5 Bushfire Prevention

Malleefowl are found in semi-arid shrublands, and low woodlands dominated by mallee and acacias, and these habitats are highly prone to fire, potentially having lasting effects on Malleefowl populations (Benshemesh J 2007 and Parsons et. al. 2011). The habitat structure and condition at the offset site was considered suitable for Malleefowl and in pristine condition. A fire through the area would have the potential to remove all and/or parts of the vegetation including influencing the recovery of habitat structure and floristic composition post fire (Benshemesh J 2007). After fire, Malleefowl may not be active in the area for more than ten years, with the loss of suitable habitat structure and floristic composition (leaf litter, vegetation cover, soil gravel and food sources) (Benshemesh J 2007).

The Goldfields region is considered arid to semi-arid with low rainfall and high summer temperatures (Alex Holm and Associates 2022b). Climate change projections predict Western Australia can expect longer fire seasons, with around 40% more 'very high' fire danger days[2], increasing the risk of bushfire at EEL55 and in the wider region. Climate Change impacts of increased temperatures, periods of drought and an increased risk of wildfires adds additional pressure to the conservation of habitat for Malleefowl within the Goldfields region (Matthew et al 2020 and Parsons et al 2011).

Therefore, to minimise the impacts from climate change and subsequent increase in risk of bushfires, implementing proactive management practices to protect habitat quality are

[2] https://www.climatechangeinaustralia.gov.au/en/changing-climate/state-climate-statements/western-australia/. Accessed on 8 July 2022.

proposed. Fire management measures (installation and maintenance of fire breaks) and fire management in consultation with neighbouring stakeholders will be required. The integration of all management measures, inclusive with fire management, will preserve the habitat quality, structure and composition to protect the species from the impacts associated with climate change (Stenhouse and Moseby, 2022).

3.2.6 Integrated Management Strategies and Climate Change

Research has shown that the implementation of integrated management strategies provides the best outcomes in regard to managing key threats for the purposes of environmental protection and conservation of the Malleefowl. Often research focusses on managing one key threat at a time over a limited time period; however, it is suggested that the most effective management will involve a combination of measures tackling a variety of threats over a longer period of time to ensure the most beneficial conservation outcomes, especially in the face of uncertainty. On average, experts also agreed that a 'do nothing' approach to management would result Malleefowl population decline (Nou et al., 2021). The impact of a changing climate suggests that resulting drier conditions and more frequent fires will cause further declines in current Malleefowl populations, and to minimise the impacts from climate change, implementing proactive management practices to protect habitat quality will be required. These include a combination of practices aimed at increasing habitat quality for Malleefowl, including fire management and reducing pressure from grazing to preserve vegetation cover, increase food resources, retain soil moisture content, and protect the species from extreme temperatures (Stenhouse and Moseby, 2022).

Table 10: Fauna offset area Preliminary Management Measures and Completion Criteria

Ecological Objective	Risk	Management Measure	Completion Criteria	Performance Indicator	Monitoring (method, attributes frequency)	Timing
Secure the protection of habitat for Malleefowl	Loss or degradation of suitable habitat for Malleefowl due to Mining or Pastoral activities.	Application to place a conservation covenant over EEL55 to prevent future mining, exploration and pastoral activity.	Conservation covenant placed over EEL55.	Conservation covenant documentation obtained.	N/A	Application made within 1 year of commencement of the action
Improve abundance of Malleefowl within the area.	Conditions or habitat not suitable for Malleefowl.	Aerial survey using LiDAR analysis undertaken to determine the presence and abundance of Malleefowl mounds within the offset and surrounding areas. Additional targeted surveys undertaken across EEL55 to determine the ongoing status of Malleefowl activity. Malleefowl monitoring to be completed in line with the National Malleefowl Monitoring Manual. Adaptive management is triggered when Malleefowl activity and or mound status is reduced from baseline data.	Malleefowl active within EEL55.	Ongoing evidence of Malleefowl activity within the offset.	Initial aerial LiDAR analysis prior to or within 1 year of commencement of the action and every 5 years thereafter. Annual Malleefowl mound monitoring via ground survey and/or camera monitoring to record evidence of Malleefowl activity (scats, tracks, bird sightings, mound status).	For 20 years post commencement of the action
	Predation leading to Malleefowl mortality.	Predator management controls will be implemented. Monitoring within the offset site to record evidence of predator activity to inform adaptive management.	Implementation of a predator control program each year.	Reduced evidence of predator activity.	Annual inspection during monitoring to identify records of feral animal activity (scats, tracks sightings	For 20 years post commencement of the action

Ecological Objective	Risk	Management Measure	Completion Criteria	Performance Indicator	Monitoring (method, attributes frequency)	Timing
		Adaptive management is triggered when predator activity is unchanged or increased from baseline survey.			and feral animal deaths)	
Maintain habitat suitable for Malleefowl	Unplanned fire causing habitat loss and degradation	Firebreaks will be installed and maintained around the site in accordance with the *Bush Fires Act 1954*.	Firebreaks are established and maintained around EEL55.	Firebreaks are in good condition and easily accessible	Visual inspections of firebreak during annual monitoring	Installation within 1 year of commencement of the action. Maintenance for 20 years post commencement of the action
	Degradation of suitable habitat for Malleefowl	Clean-up of any rubbish found within the site	Site clean-up is completed.	No rubbish left on site	Visual inspections during annual monitoring	For 20 years post commencement of the action
		Fencing the boundary to exclude stock.	Fencing of site is complete.	Fence is installed and maintained to exclude stock.		
		Weed populations will be monitored and managed as required.	Weeds are managed in accordance with Northern Star's Weed Management Procedure.	Weeds do not contribute to a reduction in habitat quality.		

Ecological Objective	Risk	Management Measure	Completion Criteria	Performance Indicator	Monitoring (method, attributes frequency)	Timing
		Vegetation and habitat quality assessments will be undertaken over EEL55 to assess the ongoing habitat quality suitability of Malleefowl habitat.	Offset site maintains suitable breeding and foraging habitat for Malleefowl.	Habitat deemed suitable for Malleefowl	Biennially, for first 6 years and triennially thereafter.	For 20 years post commencement of the action

3.3 Monitoring

Ongoing monitoring of the offset site will be undertaken by Northern Star and will commence within one year post site approval. Monitoring is outlined in Table 11.

Table 11: Proposed Monitoring Activities at Offset Site

Monitoring Type	Description	Purpose	Methodology	Timeframes/ Frequency	Responsibility
Malleefowl monitoring	LiDAR imagery and analysis	Aerial survey to identify the occurrence of mounds within the offset site	Aerial imagery is captured using LiDAR technology. The imagery is then processed using data processing algorithms, machine learning and advanced cloud computing to identify potential Malleefowl mounds across a large area. Potential mounds identified in the LiDAR analysis will be ground-truthed to verify the data.	Prior to or within the first year & 5-yearly thereafter	External specialist consultants
	Malleefowl mound monitoring	Determine Malleefowl activity and mound status	Monitoring will be undertaken in accordance with the National Malleefowl Monitoring Manual (2020). This will involve on ground monitoring at the site to capture all required data. Consultation will be undertaken with the National Malleefowl Recovery Team regarding integration of information from monitoring into the National Database. Data will be collated and reported in the Annual Compliance Report.	Annually within Malleefowl breeding season (between September and January, inclusive).	Suitably qualified Northern Star personnel or external specialist consultants
Vegetation monitoring	Vegetation and habitat quality assessments	Assess habitat quality to monitor improvements to Malleefowl habitat over time	Methodology for vegetation and habitat quality assessments will be consistent with that used to assess the suitability of the Offset site for Malleefowl habitat and the same Habitat Quality Scoring System will be used to assess condition improvements over time.	Biennially, for first 6 years and triennially thereafter.	External specialist consultants
	Visual inspections for weeds	Weed presence and cover will be recorded during visual inspections	Weeds will be noted during Malleefowl mound monitoring with consultant to provide recommendation on management if required.	Annually, and within 6 months of fire.	Suitably qualified Northern Star personnel or external consultants will record weeds during Malleefowl mound monitoring
Predator inspections	Record evidence of feral animal activity during Malleefowl and vegetation monitoring	Early detection of increased risks of predation and timely management response	Feral animal presence/activity will be recorded during annual Malleefowl monitoring in accordance with the National Malleefowl Monitoring Manual (2020). Additional monitoring such as camera monitoring may be implemented during the annual Malleefowl monitoring to determine predator activity on or around active mounds, with the potential to be expanded if required. Evidence of feral animals and their impacts will be recorded in a database to capture trends over time and reported in the DCCEEW annual compliance report.	Annually	Suitably qualified Northern Star personnel or external consultants will record predator evidence during Malleefowl mound monitoring. Opportunistic sightings will also be recorded.
Infrastructure monitoring	Fire break inspection	Determine maintenance requirements of fire breaks	Visual inspections recorded on inspection forms during annual monitoring with photographs taken as required.	Annually	Suitably qualified Northern Star personnel

3.4 Reporting

Northern Star will submit an Annual Compliance Report to DCCEEW which will include a description of management measures and outcomes from monitoring conducted during the reporting period. This report will also address compliance with all approval conditions and any additional information requested by DCCEEW.

4 Risk Assessment

A risk assessment was completed by Northern Star's Environmental personnel in February 2022. The Risk Assessment has been completed in accordance with the Australian/New Zealand standard 4360:1999 Risk Management. The risk assessment considers the likelihood of an impact event and the relative consequence of that event. Table 14 assesses the risk of loss or reduction in quality of EEL55 without an offset and residual risk to the area with an offset to protect Malleefowl habitat.

Table 12 and Table 13 outline the various descriptions associated with the various levels of a potential occurrence. The risk matrix in Table 13 was used to rate risks identified during the workshop.

Table 14 summarises the findings of the assessment and presents measures that have been or will be undertaken to ameliorate risks.

Table 12: Qualitative measures used for the determination of an event likelihood rating

Likelihood		Description
A	Almost Certain	The event is expected to occur in most circumstances, once per week.
B	Likely	The event will probably occur in most circumstances, once per month.
C	Possible	The event could possibly occur at some time, once per year.
D	Unlikely	The event could possibly occur at some time but is unlikely, once every 5-10 years.
E	Rare	The event may occur in exceptional circumstances >10 years.

Table 13: Qualitative measures used for the determination of an event consequence

Consequence		Description
1	Very Low	None or insignificant impact to MNES (Malleefowl) with no effect on ecosystem function.
2	Minor	Moderate to minor impact to MNES (Malleefowl) resulting in a minor, recoverable impact.
3	Moderate	Minor and short-term impact to MNES expected, resulting in a moderate, recoverable impact.
4	Major	Long-term impact to MNES expected, resulting in a major, recoverable impact.
5	Catastrophic	Irreversible impact to MNES expected.

Table 14: Risk Ranking Matrix

		CONSEQUENCES				
LIKELIHOOD		Very Low **1**	Minor **2**	Moderate **3**	Major **4**	Catastrophic **5**
A	Almost Certain	**H** (11)	**H** (16)	**E** (20)	**E** (23)	**E** (25)
B	Likely	**M** (7)	**H** (12)	**H** (17)	**E** (21)	**E** (24)
C	Possible	**L** (4)	**M** (8)	**H** (13)	**E** (18)	**E** (22)
D	Unlikely	**L** (2)	**L** (5)	**M** (9)	**H** (14)	**E** (19)
E	Rare	**L** (1)	**L** (3)	**M** (6)	**M** (10)	**H** (15)

Matrix Legend:

E:	Extreme risk	Immediate action required, further reduction needed. If not possible, Country Manager or COO approval required
H:	High risk	Senior management attention needed
M:	Moderate risk	Management responsibility must be specified
L:	Low risk	Manage by routine procedure

Table 15: Risk Assessment of Loss or Reduction in Future Quality with and without Offset

Risk of loss or reduction in future quality without Offset	Risk Factors	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures to reduce risk of loss or reduction in future quality with Offset	Likelihood	Consequence	Residual Risk	Effectiveness/Confidence/Justification for Residual Risk ranking/Improvement in future offset quality	Objectives of Malleefowl Recovery Plan met
Unplanned fire causing habitat loss and degradation	• Fire is becoming a more common occurrence throughout the state. • Malleefowl populations are extremely susceptible to fire. • Increased risk of weed encroachment in areas disturbed by fire. • Increase predator activity post fire.	D	4	H14	• Firebreaks will be installed and maintained around the site. • Northern Star site emergency response teams have firefighting capability within the region. • DFES on standby to respond to fire event. • In the event of a fire event, weed and predator populations will be monitored and managed as required post the event.	E	4	M10	Fire is a major threat to Malleefowl populations and fires across Western Australia are being more prevalent and more severe in the wake of climate change. Implementation of fire management measures including fire breaks and quick emergency responses in relation to fires will help minimise impacts to the offset site and decrease the risk of loss.	Reduce Fire Threats
Presence of foxes, cats and wild dogs increasing risk of predation	• Predation by feral animals is a key threat to Malleefowl. • Evidence of cats have been noted during the site survey. • Baiting programs in the area are unknown and likely to have ceased. • Wild dogs are a known issue in the region and EEL55 is adjacent to an area known as a vermin cell (Goldfields Nullabor Rangelands Biosecurity Association) • Evidence of wild dogs were recorded during surveys on EEL55.	A	5	E25	• Monitoring within the offset site to record secondary evidence of cats or foxes and estimate frequency of occurrence of feral animals and risk to Malleefowl using camera traps. All sightings will be recorded by Northern Star. • Consultation with DBCA to implement effective feral animal control measures at the site.	C	3	H13	Monitoring presence of feral animals within the offset site will allow Northern Star to regularly assess risk to Malleefowl populations from this threat. Monitoring will also allow for targeted control measures and help assess success of control measures within the offset site. Implementing feral animal control such as adequate fencing and/or baiting programs will improve the future quality of the offset site by reducing predation leading to the decline of Malleefowl populations. Reducing the threat from predation directly contributes to a key objective outlined in the National Malleefowl Recovery Plan.	Reduce Predation
Land subject to pastoral licence agreements	• Land has previously been, and is currently subject to, a pastoral licence agreement allowing stock grazing on the land contributing to degradation in habitat quality. • Without an offset, pastoral leasing can occur in the future.	C	4	E18	• Placing land under a conservation covenant will protect the land from future pastoral activities that would contribute to habitat loss and degradation. • Excise of EEL55 from Pastoral Licence Agreement • Protection of the land through the offset will ensure pastoral activity cannot be undertaken. • Fence installed to exclude stock animals.	E	1	L1	If the offset property has a conservation covenant in place, there is no risk of grazing pressure.	Reduce the threat of grazing pressure on Malleefowl populations
Encroachment of weeds into site reducing habitat quality	• The Coolgardie-Esperance Hwy runs through the northwest corner of the site. This presents a risk of vehicles spreading weeds to the site if travelling through.	B	1	M7	• Weed populations will be monitored and managed as required.	D	1	L2	Weed management will reduce weed populations as far as reasonably practical.	Monitor Malleefowl and develop an adaptive management framework
Land disturbance through exploration or mining activities	• The Goldfields is a highly prospective area for exploration and mining	B	4	E21	• Placing land under a conservation covenant will protect the land from future mining or exploration activities that would contribute to significant habitat loss and degradation.	E	1	L1	Legal protection preventing mining or exploration from proceeding.	Reduce permanent habitat loss

Risk of loss or reduction in future quality without Offset	Risk Factors	Likelihood	Consequence	Risk	Actions to be implemented/Mitigation Measures to reduce risk of loss or reduction in future quality with Offset	Likelihood	Consequence	Residual Risk	Effectiveness/Confidence/Justification for Residual Risk ranking/Improvement in future offset quality	Objectives of Malleefowl Recovery Plan met
	• Much of the Goldfields is overlaid with Exploration, Miscellaneous and Mining tenure.									
Potential sale of property with unknown future land use	• New ownership may be for detrimental use of mining, exploration or pastoralism or other.	C	4	E18	• Placing land under a conservation covenant will protect the land from future mining, exploration or pastoral activities that would contribute to significant habitat loss and degradation.	E	1	L1	If the offset property has a conservation covenant in place, there is no risk of grazing, mining or other pressure.	Reduce the threat of grazing pressure on Malleefowl populations
Potential of Offset site failing	• There is a risk of the Offset Site not meeting the performance criteria outlined in the proposal.	C	3	H13	• A contingency has been outlined in the event the offset is not meeting the required criteria (see Section 5). • Monitoring programs will be conducted, and adaptive management implemented to address criteria not trending towards success. • Northern Star has been and will continue to engage with relevant Departments, conservation bodies, expert consultants, and key stakeholders to ensure success of the offset site.	E	3	M6	The Offset Proposal outlines robust management measures based on scientific research. The Offset Site meets the EPBC Offset Policy requirements.	Monitor Malleefowl and develop an adaptive management framework

5 Contingency Response and Corrective Actions

Monitoring programs will provide an indication of the effectiveness of management measures implemented at the offset site. If monitoring indicates performance criteria are not trending towards success, Northern Star will engage relevant specialists and undertake an investigation into the causes. The findings will drive the implementation of adaptive management measures which will be detailed, monitored and reported in the annual compliance report.

This Offset Proposal supports the requirement of other compensatory measures, if required.

In the event that EEL55 does not meet the offset completion criteria outlined in Table 10, even after the implementation of adaptive management measures, Northern Star may be required by DCCEEW to provide additional appropriate offsets. This includes providing additional direct offsets or indirect offsets, such as the ability to fund research on matters relevant to Malleefowl, for example.

6 Adaptive Implementation

The Offset Management Plan (OMP) will be implemented on commencement of the project. The OMP focuses on adaptive management principles and uses robust monitoring processes to critically evaluate the effectiveness of management practices implemented within the Offset site. Adaptive management promotes flexible decision-making which allows actions to be adapted in the face of uncertainty as management strategies are evaluated to inform improvements in conservation management into the future (Organ et al. 2012). Conservation outcomes for the Malleefowl would be improved by combining the efforts of research, management, and monitoring through an integrated approach (Walsh et al, 2012).

The Northern Star Offset Management Plan for EEL55 outlines the management measures that will be implemented as part of this Offset Proposal and associated completion criteria. Monitoring programs implemented through the Offset Proposal will assess the effectiveness of management strategies and inform and guide environmental practices to ensure conservation objectives for the offset are achieved. Completion criteria, threshold triggers

for adaptive management, remedial actions, and evidence to demonstrate compliance, is detailed in Section 4.0 of the Offset Management Plan.

Adaptive management strategies and performance against management criteria will be reported to DCCEEW in the annual compliance report.

7 Roles and Responsibilities

Roles and responsibilities are discussed throughout this proposal and are summarised in Table 16.

Table 16: Offset Proposal Roles and Responsibility

Role	Responsibility
DCCEEW	• Approval of Preliminary Documentation and Offset Proposal
Northern Star	• Place conservation covenant over EEL55 • Conduct LiDAR analysis over EEL55 prior to or within first year of offset approval • Consultation with DBCA for the implementation of effective feral animal control within the offset site. • Coordination of management measures at the offset site. • Implementation of monitoring programs as detailed in this proposal at the offset site. • Annual Compliance Report to DCCEEW outlining compliance with approval conditions and monitoring outcomes.

8 Alignment of Offset Strategy with Policy and Guidelines

The proposal aligns with the relevant government guidelines for offsets and recovery plans including:

- *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (DSEWPC 2012a)
- *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy Assessment Guide (DSEWPC 2012b)
- Department of Environment Environmental Management Plan Guidelines (2014)
- National Recovery Plan for Malleefowl (*Leipoa ocellata*) (Benshemesh J 2007)

8.1 Recovery Plan

The *National Recovery Plan for Malleefowl (Leipoa ocellata)* (Benshemesh J 2007) guides recovery of the species with the primary objective to secure existing populations across the species range and achieve de-listing of the species under the EPBC Act. Table 17 outlines how this Offset Proposal aligns with priority objectives and actions within the recovery plan and relevant threat abatement plans.

Table 17: Offset Proposal alignment with National Recovery Plan for Malleefowl (*Leipoa ocellata*) (Benshemesh J 2007)

Recovery Plan Objectives	Recovery Plan Priority Actions	Northern Star Offset Proposal
Reduce permanent habitat loss	Retain areas that support Malleefowl and protect them from incremental clearing, and report annually on clearing	The proposed offset site will be secured with a conservation covenant to protect the land from future clearing. The offset will be managed to reduce the risk of degradation and improve quality.
Reduce the threat of grazing pressure on Malleefowl populations	Remove goats and sheep from reserves Close or fence artificial sources of water in conservation reserves Erect adequate fencing to protect Malleefowl habitat Reduce rabbit numbers where they are abundant in or near Malleefowl habitat	A Pastoral Licence Agreement currently exists over EEL55. Grazing will be precluded at the offset site through exercising rights within the Agreement as well as a conservation covenant placed over EEL55. Fencing will be erected to exclude stock and no artificial water sources will be located within the reserve.
Reduce fire threats	Reduce the occurrence of large fires, and promote patchiness of fires, where Malleefowl conservation is a priority in large reserves Provide for access to and protection of small habitat remnants to prevent fire spreading to or from surrounding land	Firebreaks will be installed along fence line of offset area. Offset is located near operating Northern Star mine sites which have Emergency Response teams trained to respond to fires in the region. It is also located ~40km south-southwest of Kalgoorlie which also has fire response resources.
Reduce predation	Record and centralise details of predator control in or near areas where there are estimates of Malleefowl abundance Reduce predator numbers in small and isolated habitat remnants where Malleefowl densities have	Control of feral animals will be implemented. Northern Star has feral animal management procedures which will be applied to the Offset Site when required to ensure threats to

Recovery Plan Objectives	Recovery Plan Priority Actions	Northern Star Offset Proposal
	declined, and predator predation is a likely explanation for such declines Reduce fox numbers in large areas of native habitat where Malleefowl densities have declined, and predator predation is a likely explanation for such declines	Malleefowl through predation are minimised. Records will be kept of evidence of feral animals noted within the site. Where required Northern Star will work with DCBA regarding implementation of feral animal management.
Monitor Malleefowl and develop an adaptive management framework	Analyse and review monitoring data. Recommend improvements and develop site-specific management plans consistent with a national adaptive management design. Monitor and manage existing monitoring sites across Australia. Facilitate and standardise monitoring and coordinate national monitoring effort	Mounds identified within the Offset site will be assessed and recorded in accordance National Malleefowl Monitoring Manual (National Recovery Team, 2020) and provided to the National Malleefowl Monitoring Database.
Determine the current distribution of Malleefowl	Detail the distribution of Malleefowl in remote areas of South Australia and Western Australia by field surveys, and describe the habitats in which Malleefowl are found	Targeted Malleefowl surveys and records of opportunistic sightings on Northern Star tenements helps provide an understanding in Malleefowl distribution trends. A targeted intensive survey will be conducted during the first year of this proposal being approved.
Describe habitat requirements that determine Malleefowl abundance	Describe the habitat requirements and preferences of Malleefowl, with a view to identifying important habitat components that may underlie variations in breeding densities	Northern Star has conducted a number of flora and fauna surveys across their tenements. In areas of potential Malleefowl habitat targeted assessments are conducted, including the offset site. This data contributes to the understanding of habitat requirements and preferences throughout the Goldfields.
Facilitate communication between groups	Hold a national Malleefowl community forum every three years and support the national newsletter	Enhance communication between Northern Star and the National Malleefowl Recovery Team to ensure objectives continue to be in alignment. Where possible, a Northern Star representative will attend the national Malleefowl community forum.
Raise public awareness through education and publicity	Publicise the recovery effort, beneficial management practices, the contributions made by community groups, and the legislative protections afforded to the species at national and state level	Northern Star includes on site Malleefowl education for workers. Malleefowl management actions implemented on site are included in company reporting including the annual Northern Star sustainability report.

8.2 Offset Policy and Guidance

Detail regarding how the proposed offset package aligns with the principles of the EPBC Act Environmental Offsets Policy (DSEWPC 2012a) is described in Table 18.

Table 18: Offset alignment to EPBC Act Environmental Offsets Policy

Offsets Policy Principle (DSEWPC 2012a)	How the Offset Proposal satisfies the Offsets Policy Principle
1. The offset must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.	The protection and management of Malleefowl habitat through the offset package delivers an overall conservation outcome that improves the viability of the environmental aspect. • The location and scale of the offset area secures habitat in perpetuity, with the imposition of a Conservation Covenant under the *Soil and Land Conservation Act 1945*. This eliminates the risk of habitat loss on EEL55 due to clearing for, or degraded through, pastoral, mining, exploration, or other purposes. Further details regarding the factors affecting the long-term survival of Malleefowl as outlined in the National Recovery Plan for Malleefowl and how those are prevented by the proposed offset are set out in Table 17 in the Offset Proposal. • The security of Malleefowl habitat within EEL55 provides connectivity to an area of already protected land, namely the Yallari Timber Reserve to the northwest. This in an important connection, linking EEL55 to other Environmental Assets and potential Malleefowl populations within the broader region. • Implemented management measures above current levels (no active management) of feral animal control, fire management and additional monitoring will improve the overall conservation outcomes for EEL55 through continued species presence. Recent studies (Nou 2021) noted there is scientific uncertainty regarding the effectiveness of baiting programs on Malleefowl but there are many factors affecting efficacy of baiting programs, including the type of bait used, and the intensity and extent of the program. Northern Star will take these findings into consideration when planning predator control and implementing adaptive management measures should our predator control appear ineffective. This study also noted the importance of implementing a range of management measures to achieve success and mitigate the impacts of climate change. The offset proposal achieves this. • Monitoring of the population in accordance with the OMP (see Table 10 for further details) and analysis of those results will add to the scientific knowledge base of the species that can lead to better management practices. We note that the methodology for future surveys, timeframes, survey metrics and predator control measures are set out in section 4 of the attached OMP.

Offsets Policy Principle (DSEWPC 2012a)	How the Offset Proposal satisfies the Offsets Policy Principle
2. The offset must be built around direct offsets but may include other compensatory measures.	The proposed offset package is comprised of 100% direct offsets. However, the offset package supports the requirement of other compensatory measures if required. Northern Star will provide additional appropriate offsets if the completion criteria are not met after implementing adaptive management measures, such as funding research on matters relevant to Malleefowl. The proposed adaptive management process is set out in section 6.3 of the OMP. We note that the Offsets Policy states that direct offsets which secure existing unprotected habitat should be secured for at least the same duration as the impact on the protected matter arising from the action, not necessarily the action itself. The Offsets Policy provides that as a general guide, the best legal mechanisms for protecting land are intended to be permanent (lasting forever) and are secure (that is, they are difficult to change or alter). The conservation covenant will protect the site in perpetuity, and bind successors in title and, as such, will exist for the duration of the impact in accordance with the requirements of the Offsets Policy.
3. The offset must be in proportion to the level of statutory protection that applies to the protected matter.	The level of statutory protection (Vulnerable) has been used for classifying the EPBC Act Status within the Offsets Assessment Guide (the offset calculator) (DSEWPC 2012b). The guide takes into consideration the level of statutory protection for the protected matter. The offset proposed is consistent with DCCEEW policies. Statutory protection will be provided for the offset, being protection in perpetuity through a conservation covenant under the *Soil and Land Conservation Act 1945*.

Offsets Policy Principle (DSEWPC 2012a)	How the Offset Proposal satisfies the Offsets Policy Principle
4. The offset must be of a size and scale proportionate to the residual impacts on the protected matter.	Using the EPBC Act Offsets Assessment Guide, it is considered the proposed offset is proportionate to the final residual impact. The size and scale of the residual impact (quantum of impact loss of 76.3 ha) has been accounted for when implementing the EPBC Act Offsets Assessment Guide (DSEWPC 2012b). The guide takes this into consideration for the protected matter. A total of 755.2 ha of Malleefowl habitat within EEL55, including an existing active breeding population, will be protected to offset the clearing of habitat required for the construction of CDO TSF Cell 4. This provides an offset ratio of 1:10. We note that the Offsets Policy provides by way of example that an appropriate offset for the removal of foraging habitat for a listed threatened bird species would be protecting existing foraging habitat through registering a conservation covenant on the land. The impact site contains no Malleefowl population compared to the proposed offset site, which has a confirmed breeding population that will be protected and monitored through this proposal and OMP. The Offset Proposal provides an overall conservation benefit for the Malleefowl species using EEL55, particularly where the proposed offset actions directly correlate to, and adequately compensate for, the impacts on the attributes for the protected matter.
5. The offset must effectively account for and manage the risks of the offset not succeeding.	The risk of the offset site not fulfilling the objective for which it is designed for is considered low. Section 4 of the Offset Proposal includes a risk matrix which identifies potential risks associated with the offset site and outlines mitigation measures to be taken, if required. An adaptive management approach will be implemented to evaluate the effectiveness of the offset and whether the offset requirements have been achieved against the performance indicators set out in Tables 10 and 11 and in section 6 of the OMP. Review of management actions will be undertaken as required to ensure success as outlined in Section 6 of the OMP. Section 6.3 of the OMP outlines a contingency response in the case of the offset not succeeding.

Offsets Policy Principle (DSEWPC 2012a)	How the Offset Proposal satisfies the Offsets Policy Principle
6. The offset must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The proposed offset area is additional to current conservation estate in this region, which abuts EEL55 and provides habitat connectivity, and is not currently covered by any legally binding conservation mechanisms (i.e. conservation covenant) or the site closure plan. The conservation requirements imposed by the conservation covenant will continue to apply to the landowner and its successors in title. Without the offset, there is a good chance the offset area would be exposed to a risk of acquisition and use for pastoral and future exploration and mining activity, noting that there are several tenements in the surrounding area, as well as pastoral leases. EEL55 is currently subject to a pastoral licence agreement, pursuant to which the neighbouring pastoralist has been granted contractual rights to undertake grazing activities on EEL55. The pastoral licence agreement will be amended should the Offset Proposal be accepted and EEL55 put under a conservation covenant. The conservation covenant will prevent any future pastoral activities.

Offsets Policy Principle (DSEWPC 2012a)	How the Offset Proposal satisfies the Offsets Policy Principle
7. The offset must be efficient, effective, timely, transparent, scientifically robust and reasonable.	**Efficient and Timely** The proposal is comprised of a single direct offset containing existing good quality Malleefowl habitat. Current land tenure for EEL55 consists of Northern Star owned freehold land subject to a pastoral licence agreement. Immediately following approval of the proposal, the terms of the pastoral licence agreement will be amended and a conservation covenant will be registered. **Effective** The offset consists of existing Malleefowl habitat. Monitoring of the site will continue to assess habitat condition and identify any improvement measures such as weed and predator control, for example, to ensure the offset is effective. The effectiveness will be assessed against performance targets and success criteria set out in Tables 10 and 11 in section 4 of the OMP. Section 4 of the OMP sets out the management actions which are derived from recognised and appropriate practices and guidelines. Northern Star's commitments applicable if the offset fails to meet performance targets and/or success criteria are set out in section 6.3. **Transparent** Approvals documents and management plans associated with this proposal will be publicly available and monitoring will occur to demonstrate effectiveness with annual compliance reports provided to DCCEEW, providing transparency. Monitoring and management will also be outlined in the Carosue Dam Mine Closure Plan required by DMIRS. **Scientifically Robust** The proposed offset is based on ecological survey information for the impact and offset site and is considered to be scientifically robust and effective in protecting and improving the area of habitat as well as reducing risks of fragmentation within the Goldfields. The Offset Proposal addresses the key threatening processes for Malleefowl as outlined in the Recovery Plan for the species and incorporates scientific research into effective management of threats as referenced throughout the Offset Proposal. **Reasonable** The proposed offset is reasonable as determined by the offset calculator and objectives for the offset are achievable. The proposal provides an Offset Ratio of 1:10 which has been deemed reasonable in relation to the impact site (no active population, moderate vegetation quality, directly adjacent to active mining operations and highly disturbed areas, mining and pastoral land tenure) compared to the offset site (confirmed active breeding Malleefowl population, pristine vegetation and high habitat suitability, abuts DBCA reserve, freehold land owned by Northern Star).

Offsets Policy Principle (DSEWPC 2012a)	How the Offset Proposal satisfies the Offsets Policy Principle
8. The offset must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	Northern Star recognise that governance arrangements will be set by DCCEEW. Northern Star has environmental management systems in place which allow for monitoring, measurement, auditing, inspections, reporting, checking and review. The OMP sets out the management measures, outcome-based completion criteria and performance indicator for each ecological objective. Mounds identified within the Offset site will be surveyed annually in accordance with the National Mallleefowl Monitoring Manual (National Recovery Team, 2020) as outlined in Table 10 of the OMP.

9 Glossary of Terms

Term	Definition
Critical Habitat	Habitat for breeding and foraging
DBCA	Department of Biodiversity, Conservation and Attractions
Department and/or DCCEEW	Department of Climate Change Energy Environment and Water (Established 1 July 2022).
DFES	Department of Fire Emergency Services
DMIRS	Department of Mines Industry Regulation and Safety
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
EEL55	Exempt East Location 55
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
Malleefowl	Malleefowl *(Leipoa ocellata)*
MNES	Matters of National Environmental Significance
Northern Star	Northern Star (Carosue Dam) Pty Ltd
Offset Proposal	Refers to this document Carosue Dam TSF Cell 4 Project Offset Proposal EPBC Act Referral 2021/9096 15 July 2022.
OMP	Offset Management Plan
Preliminary Documentation	Refers to document Northern Star Resources Limited Carosue Dam TSF Cell 4 Project Preliminary Documentation EPBC Act Referral 2021/9026 15 July 2022
Suitable habitat	Habitat for foraging and cover
The Project	The construction of TSF Cell 4 and associated infrastructure

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Appendices

Appendix A Confidential Pastoral Licence Agreements

Appendix B Literature Review: Assessment of Potential Impacts of Livestock on Habitat Features Considered Critical to Malleefowl.

Memo

To: Northern Star Resources Ltd C/- Larissa Byrne

From: Phoenix Environmental Sciences C/- Caitlin Nagle

Date: 24/06/2022

Subject: Potential impacts of livestock on Malleefowl

1 INTRODUCTION

Northern Star Resources Ltd (Northern Star) recently referred a proposal for a new tailings storage facility cell at the Carosue Dam Project under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for impacts to several Inactive Malleefowl mounds. The Department of Agriculture, Water and Environment (DAWE) determined this to be a 'Controlled Action' with approval required through Preliminary Documentation and the requirement of an offset. Northern Star undertook surveys to develop a suitable offset proposal for presentation to DAWE. As part of this proposal, Northern Star was required to determine the future quality of prospective offset sites with and without the offset being implemented. The presence or exclusion of livestock was deemed as having a potential impact on the future quality of these sites for Malleefowl.

In June 2022, Norther Star engaged Phoenix Environmental Sciences (Phoenix) to assess whether livestock presence may impact the future quality of offset sites, with a focus on potential impacts to habitat characteristics considered critical to Malleefowl.

1.1 SCOPE OF WORK

The scope of work for this project was as follows:

- conduct a brief literature review to assess the impact, if any, of livestock on habitat quality, with a focus on habitat characteristics considered critical to Malleefowl
- conduct a review of Phoenix's biological database comparing habitat quality at sites with and without livestock presence
- prepare a brief report outlining the results of the literature and database review.

2 METHODS

2.1 LITERATURE REVIEW

The literature review included the analysis of research papers and publications that studied the impact of livestock and grazing on habitat quality, with a specific focus on the potential impacts to Malleefowl. The papers included were limited to those based on Australian research to ensure their relevancy to this report. Papers that were incorporated into this review included:

- Synergisms among Habitat Fragmentation, Livestock Grazing, and Biotic Invasions in Southwestern Australia (Hobbs 2001).
- The Threats to Malleefowl, Leipoa ocellata: An Appraisal of the "Usual Suspects", i.e., Predation by Foxes, Competition with Introduced Herbivores and Changed Fire Frequency (Wheeler 2018).
- National Recovery Plan for Malleefowl *Leipoa ocellata* (Benshemesh 2007)
- Malleefowl in the fragmented Western Australian wheatbelt: spatial and temporal analysis of threatened species (Parsons 2008).

- Changes in a remnant of salmon gum *Eucalyptus salmonophloia* and York gum *E. loxophleba* woodland, 1978 to 1997. Implications for woodland conservation in the wheat-sheep regions of Australia (Saunder *et al.* 2003).
- Conservation of the Mallee Fowl, *Leipoa ocellata* Gould (Megapodiidae) (Frith 1962).
- Does the integrity or structure of Mallee habitat influence the degree of Fox predation on Malleefowl (*Leipoa ocellata)* (Priddel et al. 2007).
- Grazing effects on plant cover, soil and microclimate in fragmented woodlands in souther-western Australia, implications for restoration (Yates *et al.* 2000).
- Long-term changes in the vegetation after the cessation of livestock grazing in Eucalyptus marginata (jarrah) woodland remnants (Pettit & Froend 2001)

2.2 PHOENIX DATABASE REVIEW

Phoenix site descriptions from with 200 km of the prospective offset sites were collated and analysed to determine patterns in habitat characteristics when livestock presence was or was not detected. Habitat characteristics deemed critical for Malleefowl were analysed, and included:

- leaf litter coverage
    - leaf litter availability is considered critical for Malleefowl nest production (Benshemesh 2007)
- tree and shrub cover
    - dense vegetation cover has been linked to higher abundance and breeding density of Malleefowl (Benshemesh 2007; Benshemesh 2020; Parsons 2008)
- presence of feral animals
    - research indicates feral animals such as foxes, cats and rabbits are one of the leading causes Malleefowl population decline due to predation and competition (Benshemesh 2007)
- presence of weed infestations
    - believed to be contributing factor to Malleefowl declines and an indication of reduced habitat quality (Dennings 1999; EPA 2016)

T-tests were performed to compared leaf litter cover and vegetation cover percentages at sites where livestock presence was or was not detected. The ratio of sites where weed infestations and feral animals were detected were compared for sites where livestock presence was or was not detected.

3 RESULTS AND DISCUSSION

The literature indicates that the prolonged use of native vegetation for livestock grazing results in profound eco-system changes and degradation, including altered vegetation structure and composition (Hobbs 2001; Lunt *et al.* 2007; Saunder *et al.* 2003; Spooner & Lunt 2004). The most obvious of these changes are in the understory composition, with the decline or exclusion of native shrubs and herbaceous perennials, and an increase in exotic cover (Hobbs 2001; Yates *et al.* 2000). Additionally, livestock grazing can result in reduced richness and abundance of native invertebrates (Greenslade 1992). This is particularly relevant to Malleefowl given that their diet, whilst variable, consists primarily of the seeds, flowers and fruits of shrubs, herbs, invertebrates, tubers and fungi (Benshemesh 2007). Trampling by livestock has also been shown to result in reductions in leaf lifer

(Hobbs 2001), an important ecological resource for Malleefowl when constructing their nests (Benshemesh 2007).

Several studies have focused specifically on the impact on livestock on Malleefowl. These studies have drawn varying conclusions as to the nature and severity of this impact. For example, both Frith (1962) and Wheeler (2018) suggest that Malleefowl deaths increase and breeding decreases when introduced herbivores are present. Frith (1962) attributed this directly to starvation as a result of competition with introduced herbivores. Conversely, Wheeler (2018) suggested that Malleefowl did not die of starvation as a result of direct competition, but instead that livestock grazing may result in reduced food availability, thus increasing the time Malleefowl spent foraging and consequently lengthening the time they spent exposed to predators. Benshemesh (2007) concluded that the impact of livestock on Malleefowl was two-fold in that firstly, the grazing of livestock denies Malleefowl food that may otherwise be available to them. Secondly, that the changes to the structure and diversity of the habitat as a result of livestock grazing potentially make the habitat less suitable for Malleefowl and more open, leaving them vulnerable to predation. Meanwhile, Priddel *et al.* (2007) found that while fox predation was the leading cause of decline in Malleefowl, habitat structure did not influence the level of predation. Parsons (2008) suggested that Malleefowl presence is more closely related to differences in habitat, rather than being directly influenced by management regimes such as grazing. However, the habitat characteristics that Parsons (2008) found to be most closely related to Malleefowl presence were high shrub and litter cover, and abundance of native food shrubs. Research strongly suggests that these habitat characteristics are negatively impacted by livestock grazing (Hobbs 2001; Pettit & Froend 2001; Saunder *et al.* 2003; Spooner & Lunt 2004), and thus livestock presence may result in a reduction in the quality of Malleefowl habitat and thus a decline in Malleefowl presence. A conclusion common across studies was that the presence of livestock likely results in habitat degradation, and that the severity of the degradation increases as the duration and density of livestock presence increases (Hobbs 2001; Pettit & Froend 2001; Saunder *et al.* 2003; Spooner & Lunt 2004).

In line with the results from the literature, the Phoenix site data indicated that the presence of weed infestations was 4.8 times higher at sites where livestock was recorded, compared to sites without livestock (19.6% and 4.1% of sites sampled, respectively) (Hobbs 2001; Yates *et al.* 2000). Similarly, feral species were detected at approximately 3.3 times more sites where livestock was recorded than at sites where no livestock were recorded (40.1% and 12.3% of sites sampled, respectively).

However, the Phoenix site data indicated that sites with livestock had significantly higher shrub cover than sites without livestock (average of 30.0% and 25.0% respectively, $P = < 0.001$). Conversely, sites with livestock had significantly lower tree cover than sites without livestock (average of 18.0% and 21.3% respectively, $P = <0.001$). This is likely indicative of the habitat preference of livestock, rather than habitat changes as a result of their presence. No significant difference was found in leaf litter, grass or herb cover percentage between sites with or without livestock ($P = > 0.1$).

4 CONCLUSION

Predation and habitat loss are recognised as key drivers of Malleefowl decline (Benshemesh 2007), and the literature indicates that the presence of livestock may contribute to and compound these issues. Livestock presence has a number of potential impacts on Malleefowl, including increased competition for resources, degradation and alteration of habitat, and indirectly increasing pressure from predation.

There is significant overlap between critical Malleefowl habitat and what is considered prime grazing habitat, which has led to much of the best Malleefowl habitat throughout the country being modified

by introduced herbivores (Benshemesh 2007). The extent of loss and degradation of Malleefowl habitat to date make areas of intact Malleefowl habitat vital, with the National Recovery Plan for Malleefowl recognising the importance of retaining and protecting these area (Benshemesh 2007).

Yours Sincerely,

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Appendix C Malleefowl Offset Site Survey EEL55

PHOENIX
ENVIRONMENTAL SCIENCES

Malleefowl Offset Site Survey of EEL55 for Northern Star Resources Ltd

Prepared for Northern Star Resources Ltd

May 2022

Final Report

Malleefowl Offset Site Survey of EEL55 for Northern Star Resources Ltd

Prepared for Northern Star Resources Ltd

Version history

Author/s	Reviewer	Version	Version number	Date submitted	Submitted to
C. Nagle, P. Strickland, S. Findlay	K. Crews	Draft for client comments	0.1	27-May-22	Kiera Mews

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Project codes: 1483-CAR-NSR-VER

EXECUTIVE SUMMARY

In 2021, Northern Star Resources Ltd (Northern Star) referred a proposal for a new tailings storage facility cell at the Carosue Dam Project (the Project) under the *Environmental Protection and Biodiversity Conservation* (EPBC) Act for impacts to several Inactive Malleefowl mounds. The Department of Agriculture, Water and Environment (DAWE) determined this to be a 'Controlled Action' with approval required through Preliminary Documentation and the provision of an environmental offset for the impacts to Malleefowl.

Northern Star are investigating options for suitable offsets regarding Malleefowl for Carosue Dam. Accordingly, in January 2022, Northern Star engaged Phoenix Environmental Sciences (Phoenix) to conduct targeted Malleefowl surveys and habitat quality assessments of several potential offset sites. The surveys were required to support the development of an offset proposal that meets the principles of the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a). This report deals with the survey of the most prospective potential offset site, EEL55, also referred to as the study area.

The scope of work for this project was as follows:

- conduct a desktop assessment and field survey of the study area in accordance with the National Malleefowl Monitoring Manual and other relevant guidelines
- prepare a targeted Malleefowl survey report outlining the extent, type and quality of Malleefowl habitat and determination of a Habitat quality score based on DAWE's "How to use the offsets Assessment Guide" and Environmental Offset Policy (2012)
- provide an Index of Biodiversity Surveys for Assessments data package and GIS spatial files obtained during survey, including mound locations and habitat mapping.

Prior to the field survey, a review of background environmental information for the study area was undertaken. It included assessments of aerial imagery to identify areas of potentially suitable habitat based on vegetation density and searches of several biological databases for historical records of Malleefowl in the vicinity of the study area.

The survey of EEL55 was undertaken in summer 2022, on the 2nd of February by zoologist Paula Strickland and botanist Shenade Findlay. Field methods included:

- Malleefowl habitat assessments to determine type, extent, and quality of habitat
- targeted surveys for signs of Malleefowl
- vegetation assessments to determine vegetation type and condition

Based on the results of the field survey, a follow-up Malleefowl activity assessment was conducted for EEL55 by Alexander Holm and Associates from 25 to 30 April 2022.

A Habitat quality score for EEL55 was calculated using the three components laid out in the EPBC Act Offsets Assessment Guide: Site condition, Site context and Malleefowl stocking rate. These were combined in a framework that differentiates, describes, and weights these components to derive a Habitat quality score out of a maximum value of ten.

EEL55 received a Habitat quality score of 7.7 out of ten. Habitat structure was considered Medium suitability on average across the site with the site split between areas of High suitability in *Acacia* shrubland and *Melaleuca* shrubland and Low suitability in *Eucalyptus* woodland. Feral predators were recorded in *Eucalyptus* woodland and *Acacia* shrubland habitats. Malleefowl have been recorded immediately adjacent (within 3km) to the site within the last 6 years and one old mound was found in the *Acacia* shrubland within the site during the initial survey. The follow-up Malleefowl activity assessment recorded an additional 15 mounds including two recently active mounds and fresh tracks within the site.

Based on the findings of this report, EEL55 represents a potentially suitable offset site for Malleefowl and appears to be suitable for inclusion into the Conservation Estate in accordance with Department of Biodiversity Conservation and Attraction's strategic criteria, including:

- evidence that the site supports a Malleefowl population
- the site contained habitat deemed critical for Malleefowl
- site contains vegetation that is not well represented in the reserve system and has suffered extensive clearing
- site will contribute to better management outcomes for the adjoining Yillari Timber Reserve.

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1 INTRODUCTION

In 2021, Northern Star Resources Ltd (Northern Star) referred a proposal for a new tailings storage facility cell at the Carosue Dam Project (the Project) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for impacts to several Inactive Malleefowl mounds. The Department of Agriculture, Water and Environment (DAWE) determined this to be a 'Controlled Action' with approval required through Preliminary Documentation and the provision of an environmental offset for the impacts to Malleefowl.

Northern Star are investigating options for suitable offsets regarding Malleefowl for Carosue Dam. Accordingly, in January 2022, Northern Star engaged Phoenix Environmental Sciences (Phoenix) to conduct targeted Malleefowl surveys and habitat quality assessments of several potential offset sites (Phoenix 2022a). The surveys were required to support the development of an offset proposal that meets the principles of the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a). This report deals with the survey of the most prospective potential offset site, EEL55, also referred to as the study area.

The Project is located 110 km north-east of Kalgoorlie, with the study area located approximately 42 km south of Kalgoorlie (Figure 1-1), within the South-western interzone botanical province.

The key aims of the surveys were:

1. provide a description of the proposed offset site, including location, size, current condition and relevant ecological/species habitat features, landscape context and cadastre boundaries of the offset sites, supported by mapping in accordance with DAWE (2021)
2. collect baseline survey information to determine the extent, type and quality of Malleefowl habitat at the offset sites that was conducted in accordance with the National Malleefowl Monitoring Manual (NMMM) (National Malleefowl Recovery Team 2020)
3. determine a Habitat quality score (0-10) in accordance with the EPBC Offsets Assessment Guide (DSEWPaC 2012b, c).

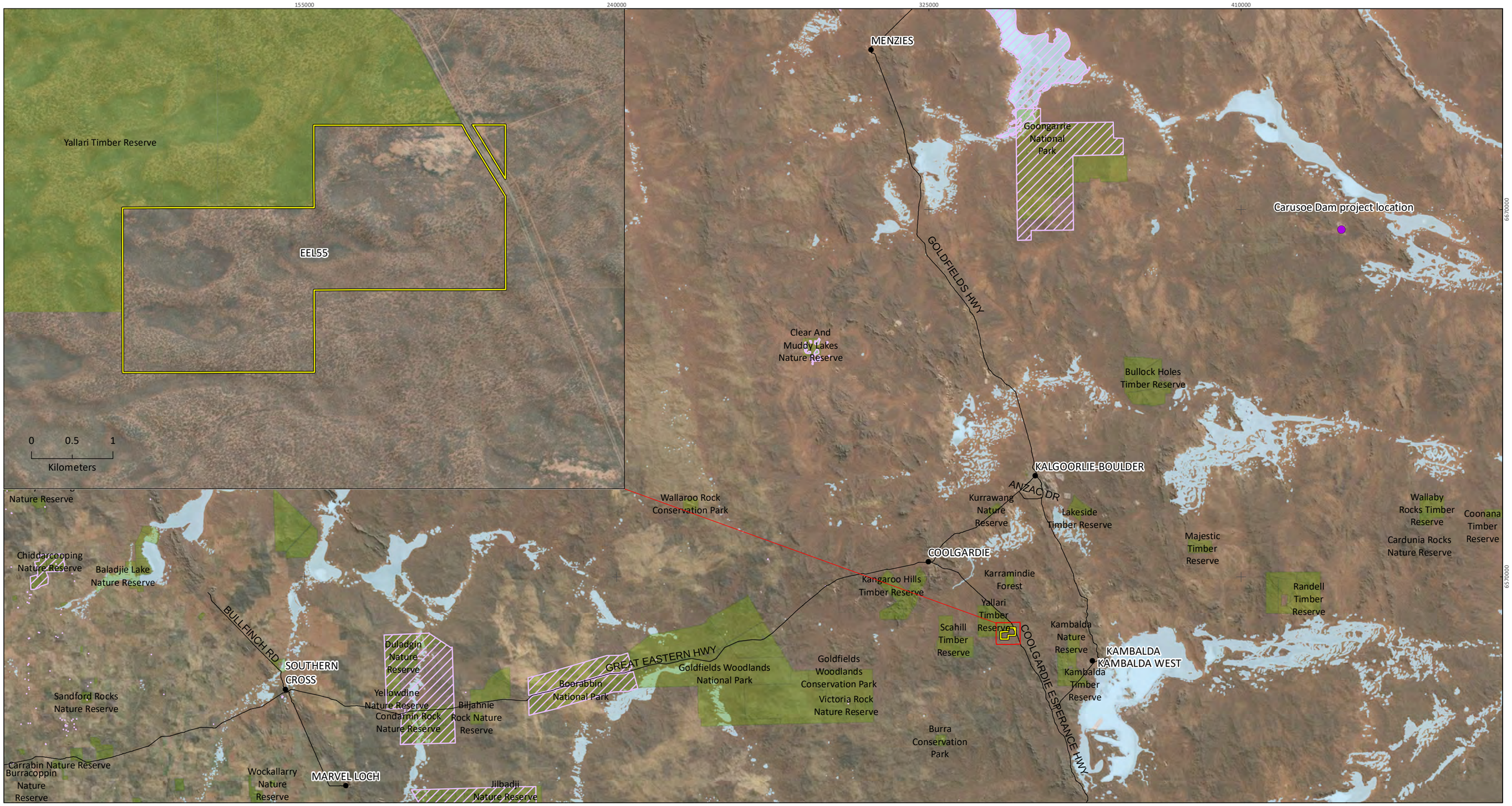
1.1 SCOPE OF WORK

The scope of work specific to EEL55 and this report was as follows:

- conduct a desktop assessment and field survey of the study area in accordance with the NMMM (National Malleefowl Recovery Team 2020) and other relevant guidelines
- prepare a targeted Malleefowl survey report outlining components listed in the aims above and determination of a Habitat quality score based on metrics outlined in the impact site survey (Holm in prep.)
- provide an Index of Biodiversity Surveys for Assessments (IBSA) data package and GIS spatial files obtained during survey, including mound locations and habitat mapping.

1.2 STUDY AREA

The study area had an area of approximately 800.6 ha (Figure 1-1).



Northern Star Resources Ltd
Carosue Dam Operations

Project No	1483-CAR-NSR-VER
Date	26/05/2022
Drawn by	IN
Map author	PS

0 25 50
Kilometers

1:1,000,000 (at A3) GDA 1994 MGA Zone 51

- Study area
- DBCA managed land
- Environmentally sensitive areas
- Lake
- Road
- Carusoe Dam project location

Figure 1-1

Project location and study area

PHOENIX ENVIRONMENTAL SCIENCES

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2 EXISTING ENVIRONMENT

2.1 INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA

The Interim Biogeographic Regionalisation of Australia (IBRA) classifies Australia's landscapes into large 'bioregions' and 'subregions' based on climate, geology, landform, native vegetation and species information (Department of the Environment and Energy 2016). The study area is located in the Eastern Goldfield subregion (COO3) of the Coolgardie bioregion (Figure 2-1).

The Eastern Goldfields subregion is characterised by (Cowan 2001):

- subdued relief comprised of undulating plains interrupted by low hills and ridges in the west and a horst in the east
- playa lakes associated with the remnants of an ancient major drainage line
- calcretous earths that cover much of the plains and greenstone areas
- vegetation dominated by Mallees, Acacia thickets, shrubland heaths, *Eucalyptus* woodlands and dwarf samphire shrublands
- land use dominated by Unallocated Crown Land, Crown Reserves and grazing.

2.2 LAND SYSTEMS AND SURFACE GEOLOGY

The Department of Primary Industries and Regional Development (DPIRD) undertakes land system mapping for WA using a nesting soil-landscape mapping hierarchy (Schoknecht & Payne 2011). While the primary purpose of the mapping is to inform pastoral and agricultural land capability, it is also useful for informing biological assessments. Under this hierarchy, land systems are defined as areas with recurring patterns of landforms, soils, vegetation and drainage (Payne & Leighton 2004). The study area intersects two land systems, Mx41 and Mx42 (

Table 2-1; Figure 2-2).

According to the Surface Geology of Australia 1:1,000,000 scale, Western Australia database (Stewart *et al.* 2008), the study area intersects two geological formations, colluvium 38491 and Depot Granodiorite (Table 2-2; Figure 2-2).

Table 2-1 Land systems and extent in study area

Land system	Description	Area (ha)	% of study area
Mx41	Flat to undulating pediments marginal to unit AC1; granitic rock outcrop; some low escarpments	448.1	56
Mx42	Broad flat to undulating valleys with isolated granitic rock outcrops and some low escarpments; some seasonal lakes and clay pans	352.5	44
	Total	**800.6**	**100**

Table 2-2 Surface geology of the study area, extent by deposit type

Surface geology	Abbreviation	Description	Area (ha)	% of study area
Colluvium 38491	Qrc	Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite	372.5	46.5
Depot Granodiorite	Agmd	Hornblende granodiorite and tonalite with scattered microcline phenocrysts; mafic granite	428.1	53.5
		Total	**800.6**	**100**

302800
331900
361000
390100
6569610
6540200
EEL55

Northern Star Resources Ltd
Carosue Dam Operations

Project No	1483-CAR-NSR-VER
Date	26/05/2022
Drawn by	IN
Map author	PS

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Kilometers

1:295,000 (at A3) GDA 1994 MGA Zone 51

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Study area

IBRA region and subregion

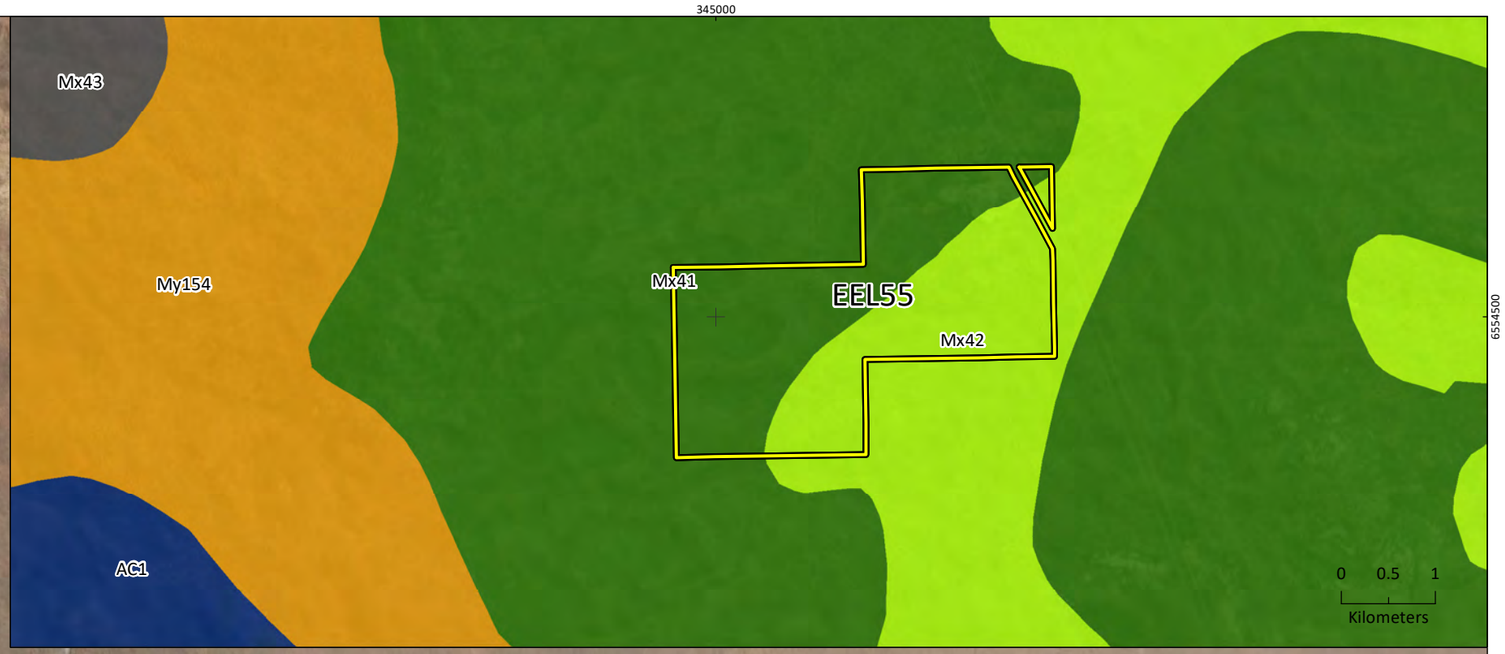
Coolgardie, Eastern Goldfield

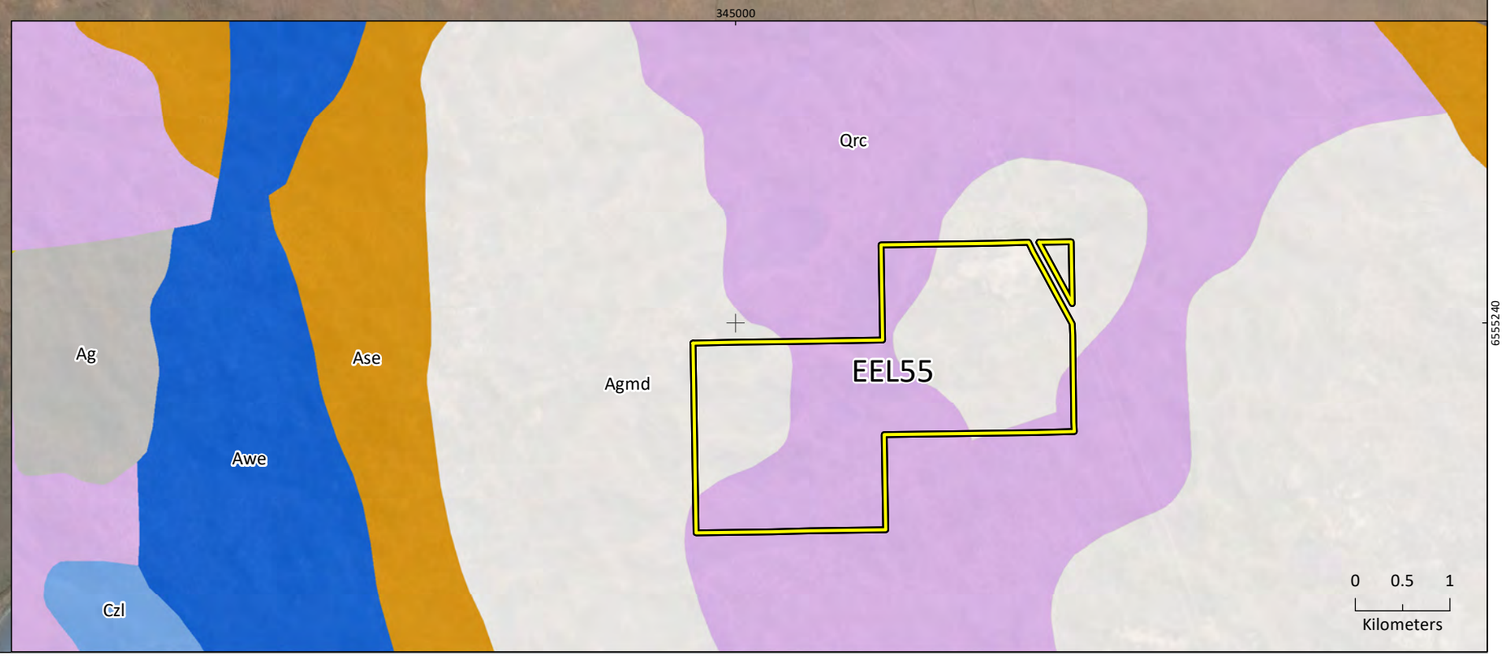
Coolgardie, Southern Cross

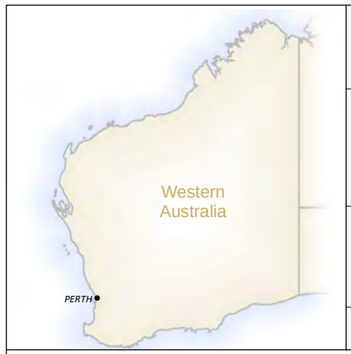
Figure 2-1

Study area in relation to IBRA bioregions and subregions

PHOENIX ENVIRONMENTAL SCIENCES







Northern Star Resources Ltd
Carosue Dam Operations

Project No	1483-CAR-NSR-VER
Date	26/05/2022
Drawn by	IN
Map author	PS

0 50 100
Kilometers

1:2,000,000 (at A3) GDA 1994 MGA Zone 51

Study area

Land system
- AC1
- Mx41
- Mx42
- Mx43
- My154

Surface geology
- Abe
- Ag
- Agmd
- Ase
- Awe
- Czl
- Qrc

Figure 2-2

Land systems and surface geology in the study area

PHOENIX ENVIRONMENTAL SCIENCES

P:\GIS\Projects\CarosueDam\1483-CAR-NSR-VER\Mapping\MapDocuments\Figures\Revised_Maps_26_May_2022\Figure_4_2_Land_systems_surface_geology_v2.mxd

2.3 CLIMATE

The Eastern Goldfields subregion is characterised by an arid to semi-arid climate with 200-300 mm of rainfall annually, sometimes falling in summer but usually winter (Cowan 2001).

The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and recent historic climate data is Kalgoorlie-Boulder Airport (no. 012038) located approximately 37 km north of EEL55 (BoM 2020). Kalgoorlie records the highest mean temperature (33.6°C) in January (lowest in July, 16.8°C) and the lowest minimum mean monthly temperature (5.1°C) in July (highest in January, 18.3°C) (BoM 2022) (Figure 2-3). Average rainfall is 265.6 mm with February and June recording the highest monthly averages (32.4 mm and 27.1 mm respectively; Figure 2-3).

Daily mean temperatures at Kalgoorlie-Boulder Airport (BoM 2022) in the twelve months preceding the field survey were relatively consistent with the long term average (Figure 2-3). Rainfall was higher than the long term average, with a total of 306.2mm falling in the 12 months preceding the survey (Figure 2-3).

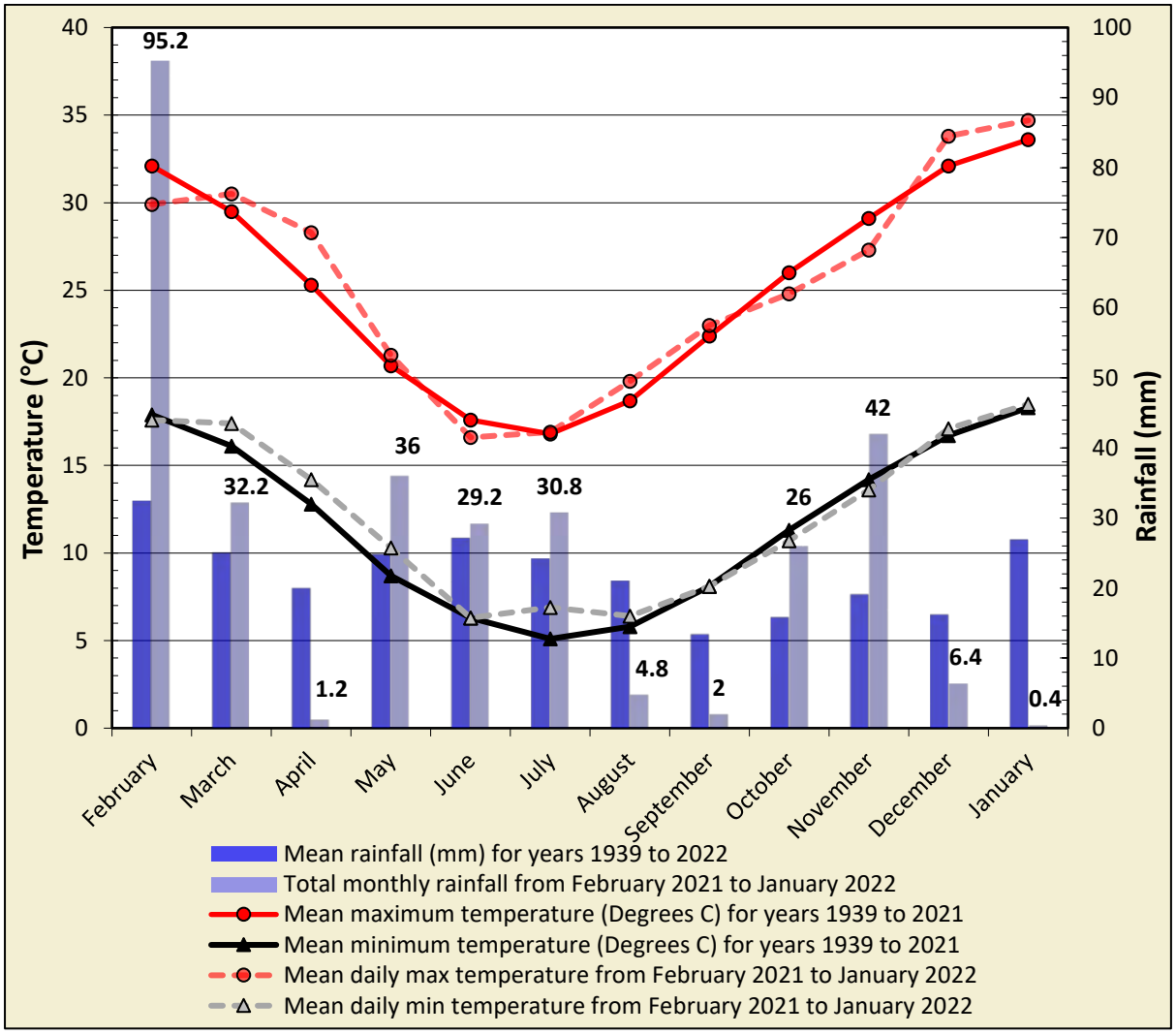


Figure 2-3 **Annual climate and weather data for Kalgoorlie-Boulder Airport (no. 012038) and mean monthly data for the 12 months preceding the survey (BoM 2022)**

2.4 CONSERVATION RESERVES AND ESAS

The nearest Environmentally Sensitive Area (ESA) is located approximately 45 km west-southwest of EEL55 which is abutted by Timber Reserves. No portion of the study area intersects any current or proposed conservation reserves (Figure 1-1).

3 METHODS

The survey was conducted with consideration to relevant survey guidelines and guidance, including:

- EPA Technical Guidance: Flora and vegetation surveys for Environmental Impact Assessment (EPA 2016)
- EPA Technical Guidance: Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)
- EPBC Offsets Assessment Guide (DSEWPaC 2012b, c)
- NMMM (National Malleefowl Recovery Team 2020).

3.1 DESKTOP REVIEW

A review of background environmental information for the study area was undertaken prior to the survey. It included assessments of aerial imagery to identify areas of potentially suitable habitat based on vegetation density and searches of several biological databases for historical records of Malleefowl in the vicinity of the study area (Table 3-1).

Table 3-1 Database searches conducted for the desktop review

Database	Target group/s	Search extent
Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap Database (DBCA 2022a)	Malleefowl records	Study area plus a 40 km buffer
Phoenix's biological database (Phoenix 2022b) - may include other clients records and previous desktop review data	Malleefowl records	Study area plus a 40 km buffer
DBCA Threatened and Priority Fauna database (DBCA 2022b)	Malleefowl records	Study area plus a 40 km buffer
EPBC Protected Matters Database (DAWE 2022)	Malleefowl records	Study area plus a 40 km buffer

3.2 FIELD SURVEY

3.2.1 Survey timing and personnel

The field survey of the study area was undertaken in summer 2022, on the 2nd of February by zoologist Paula Strickland and botanist Shenade Findlay. The primary purpose of the survey was to determine Malleefowl presence in the area which is not seasonal. Given that the survey was conducted shortly after the recommended monitoring period (October to early January), recent breeding activity could

still be reliably determined (National Malleefowl Recovery Team 2020). The NMMM also states that monitoring can be extended beyond mid-January if required.

3.2.2 Malleefowl survey

Field methods for the Malleefowl survey included:

- habitat assessment (see 3.2.2.1)
- Malleefowl habitat assessments (3.2.2.2)
- targeted searches (3.2.2.3).
- A total of 16 survey sites were sampled, 15 assessments and one site marking secondary evidence of Malleefowl (Figure 3-1; Appendix 1).

3.2.2.1 Habitat assessment

Initial habitat characterisation was undertaken using various remote geographical tools, including aerial photography (Google Earth®), land system maps and topographic maps. Habitats with the potential to support Malleefowl were identified based on their known habitats within the Coolgardie bioregion. Sites were primarily chosen to represent the best example of distinct habitats within the broader habitat associations of the study area, to allow delineation of habitat types. Habitat descriptions and characteristics were recorded at all survey sites (Figure 3-1; Appendix 3). This information was used to inform the habitat mapping of the study area.

3.2.2.2 Malleefowl habitat assessment

Assessment of the suitability of the potential offset sites to support Malleefowl was undertaken using a set of habitat and environmental variables considered critical to Malleefowl in Western and Central Australia, as described in the National Recovery Plan (Benshemesh 2007). Survey sites were assessed with a numerical score as a basis for mapping areas of suitable habitat in the study area. The score used is an unweighted sum of binary values (0 = absent, 1 = present) for the following attributes:

- sandy substrate (sand/sandy loam/sandy clay)
- litter (leaf litter forming distinct patches under trees/shrubs or - rarely in this area - continuous blanket over soil)
- canopy (tall shrubs or trees forming more or less continuous canopy, contributing to suitable ground microclimates and screen from aerial predators)
- level ground (ground approximately level, tending to prevent disturbance of soil and litter by rainfall runoff)
- mallee (presence of any mallee-form *Eucalyptus* sp.)
- *Melaleuca* (presence of any *Melaleuca* sp.)
- mulga s.l. (presence of any *Acacia* sp. of subgenus *Juliflorae*)
- *Triodia* (presence of any *Triodia* sp.).

Scores of four or greater (meaning a site contained at least 50% of features that comprise Critical Malleefowl habitat) are considered to represent potential Malleefowl habitat. Sites that attained a value of four or greater were applied to vegetation type polygons and the entire polygon (usually) assigned as potential Malleefowl habitat. Where two or more sites were assessed within a single polygon, the higher score was applied unless features of the lower-scored site(s) were more

representative. Where no site occurred within a polygon, polygons were classified based on scores for similar vegetation nearby and inspection of relative vegetation density. Scores of 4 and 5 were classified as Low to Medium suitability habitat while scores of six or more were classified as High suitability habitat (Critical breeding habitat). Sites scoring three or less were classified as Unsuitable.

3.2.2.3 Targeted searches

In areas where the habitat assessments indicated potential Malleefowl habitat, the team searched for signs of Malleefowl presence including tracks, scats, scraping and mounds. Searches were conducted on foot while walking to and from sites. Targeted searches were not conducted in areas that were deemed Unsuitable Malleefowl habitat. The potential offset sites were not comprehensively searched due to time constraints, so some signs of Malleefowl within the study area may not have been recorded, particularly in unsearched areas of suitable habitat.

Any new Malleefowl mounds found during fieldwork were GPS recorded, photographed and classified as either Active, Inactive or Long unused based on evidence of Malleefowl activity (Table 3-2). The Inactive classification was broken down into two sub-classes (sub-class 1 and sub-class 2) to provide a greater resolution on level of Malleefowl activity.

Table 3-2 Mound status classification

Mound status	Definition
Active	Currently being used by Malleefowl as an incubator for their eggs and are likely to contain eggs.
Inactive (sub-class 1)	Mound shows signs of recent Malleefowl activity, such as fresh scats, tracks or scrapings.
Inactive (sub-class 2)	No evidence of recent activity but mound remains well formed and in good condition for future use.
Long unused	Evidence of an extended period of inactivity such as dense shrubs or trees growing from hollow or mound very degraded/poorly formed. Highly unlikely to become Active in the future.

3.2.3 Flora and vegetation

Relevé locations were selected to sample the major vegetation types in the study area. A total of 15 relevés were sampled (Appendix 1).

Data recorded included:

- a geographic coordinate
- a list of the prominent flora species present
- description of vegetation – a broad description utilising the structural formation and height classes based on National Vegetation Information System (ESCAVI 2003) to level II (NVIS Technical Working Group 2017)
- habitat – a brief description of landform and habitat
- geology – a broad description of surface soil type and rock type
- disturbance history – a description of any observed disturbance including an estimate of time since last fire, weed invasions, soil disturbance, human activity and fauna activity

- Vegetation condition – using the condition scale in EPA (2016) for the South-west interzone Botanical Province
- height and percentage foliage cover (PFC) – a visual estimate of cover of total vegetation cover, cover of shrubs and trees >2 m tall, cover of shrubs <2 m, total grass cover and total herb cover
- photograph – a colour photograph of the vegetation.

3.2.3.1 Vegetation type mapping

Vegetation mapping was undertaken at a scale of 1:10,000 using NVIS sub-association level (L4) for structural descriptions (ESCAVI 2003)(Appendix 2). The vegetation descriptions from relevés from the survey were grouped according to similarity of community structure (i.e. canopy levels), species composition and combination of species and the prevalent community structure (i.e. woodland, shrubland, etc.). The vegetation boundaries were mapped utilising ArcGIS ESRI imagery and from vegetation boundaries recorded on GPS during the field survey.

3.2.3.2 Vegetation condition

The condition of vegetation was mapped across the study area based on the vegetation condition rating system for the South-west interzone botanical province, as defined by EPA (2016) (Table 3-3).

Table 3-3 Vegetation condition rating scale (EPA 2016)

Condition rating	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

3.3 FOLLOW-UP MALLEEFOWL ACTIVITY ASSESSMENT

Based on the results of the field surveys, a follow-up Malleefowl activity assessment was conducted for EEL55 by Alexander Holm and Associates from 25 – 30 April 2022 (Holm 2022). EEL55 was searched

on foot, with four persons traversing a total of 530 km of transects running north south and spaced 20 m apart. Nesting mounds were assessed according to the NMMM (National Malleefowl Recovery Team 2020), and any evidence of Malleefowl presence such as tracks were recorded. Mounds were recorded as (Holm 2022):

1. 'failed' - minor excavation and incomplete mound construction
2. 'long unused' - unlikely to have been used for at least 20 years
3. 'inactive abandoned' - unlikely to have been used for at least 5 to 10 years
4. 'inactive recent' - possibly used within the last 5 years
5. 'active' - used in the past few months by Malleefowl as an incubator for their eggs.

3.4 HABITAT QUALITY SCORE

A Habitat quality score for each potential offset site was calculated using the three components laid out in the EPBC Act Offsets Assessment Guide (DSEWPaC 2012c): Malleefowl stocking rate, Site condition and Site context. These were combined in a framework that differentiates, describes and weights these components to derive a Habitat quality score out of a maximum value of ten.

Scores for these components were calculated for each habitat type within each individual site, based on information collected as part of the desktop review, field survey and follow-up Malleefowl activity assessment for EEL55. The framework gave a greater weighting to species presence, with Site context and Site condition each making up 30% of the total score and Malleefowl stocking rate making up the final 40%. The total score for each habitat type was then weighted based on the proportion of that habitat type within the offset site. These scores were then summed, resulting in an overall habitat score out of ten, which aligns with the EPBC Act Offset Assessment Guide (DSEWPaC 2012c).

3.4.1 Site condition

Factors rated for the Site condition component were:

- Vegetation condition (Keighery 1994)
    - Vegetation condition ratings were allocated a score out of five with Pristine rated as five and Completely Degraded as zero, then converted to a score out of three
- Habitat structure (diversity of species present, habitat features present)
    - structure was allocated a score out of eight, based on the Malleefowl habitat assessments conducted at each site (see section 3.2.2.2), which was then converted to a score out of three
- Feral predator activity
    - feral predator activity was allocated a score out of three with No predators detected rated as three and High predator activity as zero.

The combined score for vegetation condition, habitat structure and feral predator activity was converted to a score out of three and weighted so that vegetation condition and feral predators contributed 25% each and habitat structure contributed 50% to the overall score. Habitat structure received a higher weighting than vegetation condition and predator presence as Malleefowl have been shown to utilise disturbed habitat provided the habitat structure remains suitable (Mount Gibson Mining Ltd 2012; Wheeler 2018). Chicks, juvenile and sub-adult birds are most at risk of mortality by feral predators such as cats and foxes which can be so significant as to limit recruitment of young Malleefowl into the breeding population (Priddel & Wheeler 1996). However, adult mortality

to feral predators appears low (Priddel & Wheeler 1996) so the presence of feral predators isn't significant enough to make the habitat unsuitable for Malleefowl hence its lower weighting.

3.4.2 Site context

Factors rated for the Site context component were:

- movement patterns of Malleefowl
- extent and proximity of suitable habitat
- population or extent of Malleefowl.

These factors were collectively used to assign a score out of three based on assessments of aerial imagery, historical records of Malleefowl in the vicinity and the follow-up Malleefowl activity assessment for EEL55.

3.4.3 Malleefowl stocking rate

Malleefowl stocking rates were based on comprehensive Malleefowl presence data from the follow-up Malleefowl activity assessment (Holm 2022). A score out of four was assigned based on recent records from Holm (2022) and historical records of Malleefowl obtained from DBCA records of Malleefowl activity which may include sightings, mounds and other secondary evidence:

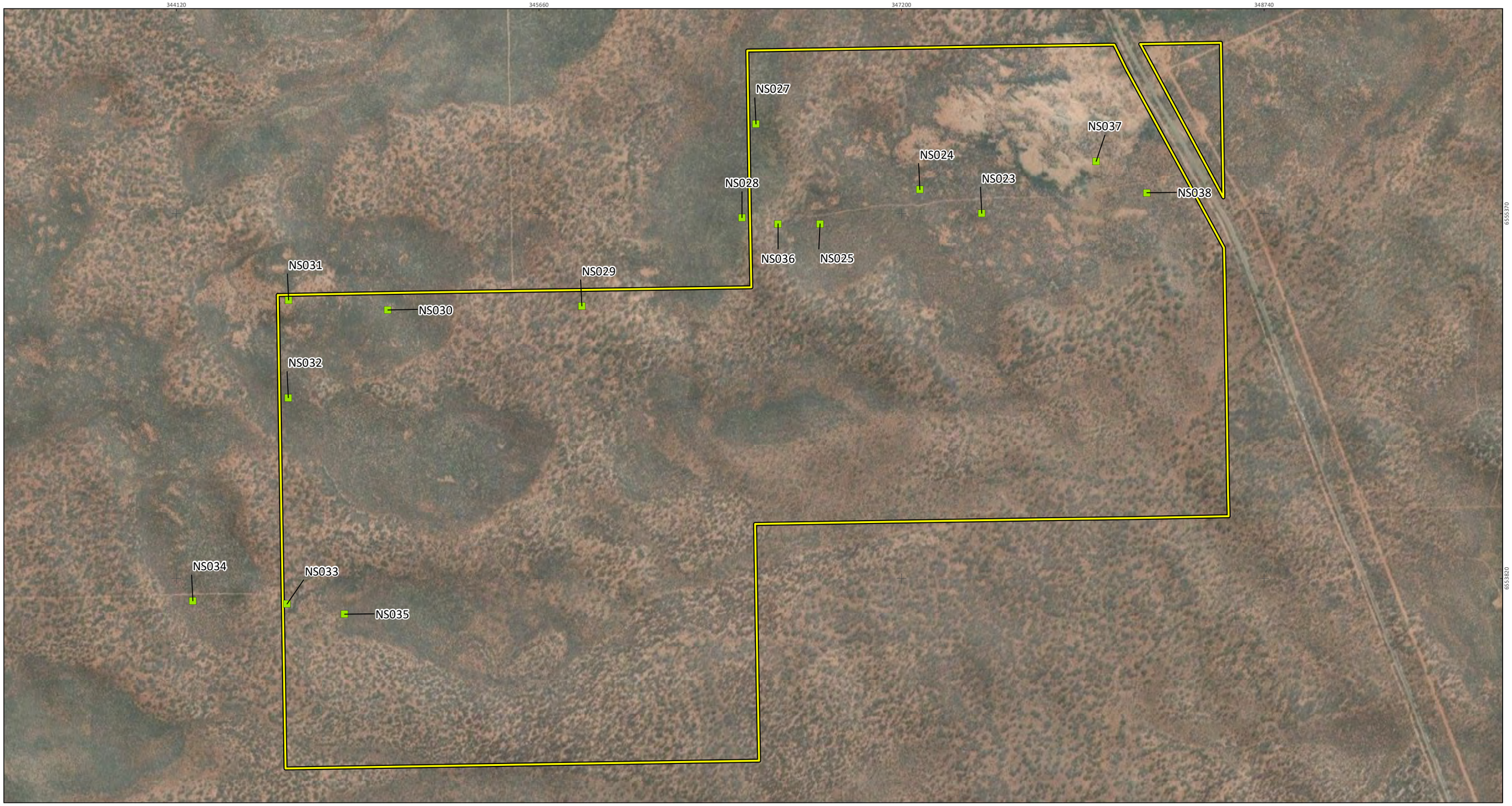
- Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats
- Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats
- Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats
- no records of Malleefowl on site, within known range of Malleefowl, suitable habitat present
- site outside current known range of Malleefowl or habitat is unsuitable.

3.5 PERSONNEL

The personnel involved in the survey are listed in Table 3-4. All survey work was carried out under Shenade Findlay's flora collection permit (FB62000173), issued by the DBCA.

Table 3-4 Survey personnel

Name	Qualifications	Role/s
Karen Crews	BSc Hons (Env. Biol.)	Project oversight and report review
Caitlin Nagle	MSc (Cons. Biol.)	Project management, reporting
Paula Strickland	MSc (Trop. Biol. and Cons. Biol.)	Field survey and reporting
Shenade Findlay	MSc (Cons. Biol.)	Field survey and reporting
Calum Woods	MSc (Cons. Biol.)	Vegetation analysis and mapping
Dr. Ikrom Nishanbaev	PhD (GIS)	GIS, mapping



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Carosue Dam Operations

Project No	1483-CAR-NSR-VER
Date	26/05/2022
Drawn by	IN
Map author	PS

0 0.5 1
Kilometers

1:15,600 (at A3) GDA 1994 MGA Zone 51

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Study area

Survey sites

Figure 3-1

Survey sites

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4 RESULTS

4.1 DESKTOP REVIEW

4.1.1 Malleefowl habitat and historical records

The assessment of aerial imagery for areas of dense vegetation that could potentially be suitable habitat for Malleefowl showed prospective habitat with several large patches of dense vegetation entirely obscuring the soil colour in the imagery (Figure 1-1). Those patches also showed connectivity to other dense vegetation in the vicinity of the potential offset sites.

The desktop review identified a total of 60 Malleefowl records within a 40 km radius of the study area (Figure 4-1). There was one record within EEL55, on the northwest boundary and two nearby records outside the study area, 400 m and 2.8 km west of the southwest boundary.

198000
262000
326000
390000
6621850
6551400

EEL55

EEL55

0 2.5 5
Kilometers

0 15 30
Kilometers

Western Australia

PERTH

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Carosue Dam Operations

Project No	1483-CAR-NSR-VER
Date	26/05/2022
Drawn by	IN
Map author	PS

1:700,000 (at A3) GDA 1994 MGA Zone 51

Study area

Leipoa ocellata, VU (EPBC Act, BC Act)

Figure 4-1

Desktop records of Malleefowl in the vicinity of the study area

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4.2 FIELD SURVEY

4.2.1 Malleefowl

4.2.1.1 Habitats

Four broadly defined fauna habitat types were mapped in the study area (Table 4-1; Figure 4-2):

- *Eucalyptus* woodland - tall open *Eucalyptus* woodland with tall, isolated *Acacia* shrubs over variably present low shrubs of *Senna artemisioides* subsp. *filifolia, Maireana sedifolia, Scaevola spinescens, Maireana pyramidata*, *Eremophila* sp.*, Olearia muelleri* and *Phebalium* sp.
- *Acacia* shrubland - tall *Acacia* shrubland over variable mid-open shrubland of *Dodonaea* sp., *Phebalium* sp. and *Scaevola spinescens* over low *Rhagodia drummondita*, *Senna artemisioides* subsp *filifolia, Olearia muelleri, Maireana triptera* and *Maireana georgei* shrubs
- Granite extrusion forbland - granite extrusion with isolated *Acacia* and *Hakea* shrubs over forbland of *Waitzia* sp., *Maireana* sp, *Scleroleana* sp.
- *Melaleuca* shrubland - *Melaleuca* sp. shrubland over low scattered *Scaevola spinescens, Olearia muelleri, Maireana sedifolia, Grevillea* sp. a*nd Atriplex vesicaria, Phebalium* sp. and *Cratystylis microphylla*

EEL55 was dominated by *Eucalyptus* woodland (50.7%) and *Acacia* shrubland (38.6%) with the remainder consisting of Granite extrusion forbland, *Melaleuca* shrubland and small cleared areas (Table 4-1). All habitats present within the study area were also present outside and many extended outside the study area.

Acacia shrubland, *Eucalyptus* woodland and *Melaleuca* shrubland contained habitat suitable for Malleefowl.

Table 4-1 Fauna habitats in the study area

Habitat type	Description	Extent in study area (ha and %)	Survey site/s	Representative photograph
Eucalyptus woodland	Tall, open *Eucalyptus* woodland tall, isolated *Acacia* shrubs over variably present shrubs of *Eremophila*, *Melaleuca*, *Senna*, *Maireana sedifolia* and *Phebalium* sp.. Contains suitable Malleefowl habitat.	405.5 (50.7)	NS029, NS033, NS036	
Acacia shrubland	Tall *Acacia* shrubland over variable mid-open shrubland of *Dodonaea* sp., *Phebalium* and *Sclerolaena* sp., over low *Rhagodia*, *Senna*, and *Maireana* shrubs. Contains suitable Malleefowl habitat.	309.0 (38.6)	NS023, NS024, NS025, NS027, NS028, NS030, NS031, NS032, NS034, NS038	

Habitat type	Description	Extent in study area (ha and %)	Survey site/s	Representative photograph
Granite extrusion forbland	Large open granite extrusion with isolated *Acacia* and *Hakea* shrubs over forbland of *Helipterum roseum*, *Maireana* and *Sclerolaena* sp.. Does not contain suitable Malleefowl habitat.	44.4 (5.5)	NS037	
Melaleuca shrubland	*Melaleuca* shrubland over low scattered *Maireana sedifolia*, *Grevillea* and *Atriplex* sp. (saltbush), *Phebalium* and greybush. Contains suitable Malleefowl habitat.	40.7 (5.1)	NS035	
Cleared	Roads, agricultural infrastructure such as watering holes etc. Does not contain suitable Malleefowl habitat.	1.0 (0.1)	NA	NA
	Total	**800.6**		

344350
345900
347450
349000
6553250
6553680

Western Australia
PERTH

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Drawn by	IN
Map author	PS

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Kilometers

1:15,700 (at A3) GDA 1994 MGA Zone 51

Study area

Malleefowl records

mound

Fauna habitat

- *Acacia* shrubland
- *Eucalyptus* woodland
- Granite extrusion forbland
- *Melaleuca* shrubland
- Cleared

Figure 4-2

Fauna habitats and Malleefowl records from the field survey

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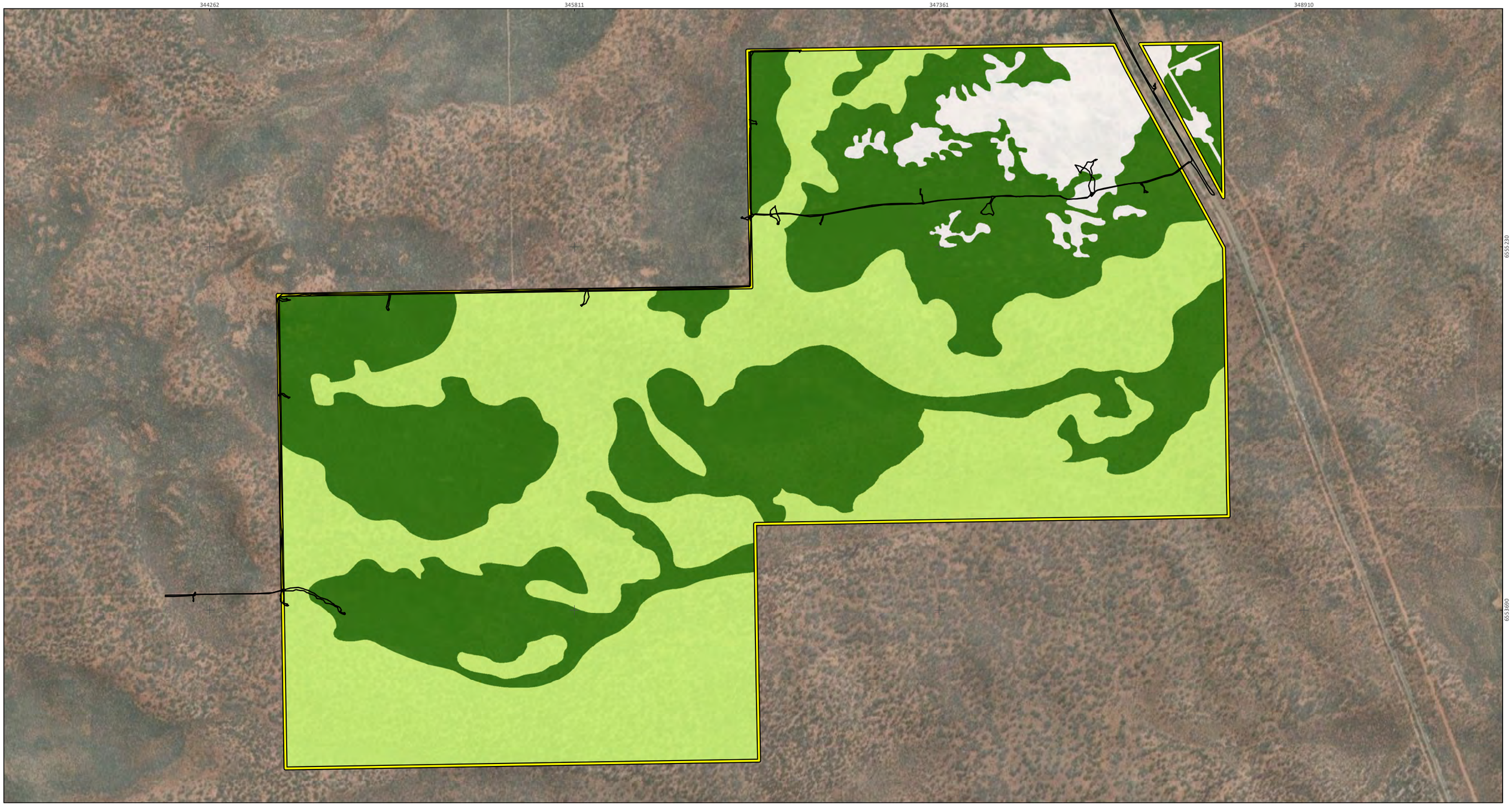
4.2.1.2 Malleefowl habitat assessment

The suitability for habitat to support Malleefowl was assessed at 15 locations (Table 4-2; Appendix 4). The habitat was found to be suitable to support the species in 14 (93.3%) of the assessed sites, with eight of the 14 suitable sites classified as High habitat suitability (score of six or more). High suitability sites were mostly located in the *Acacia* shrubland habitat, with one in *Eucalyptus* woodland (Table 4-2), in areas where the vegetation provided a consistent canopy cover. Malleefowl habitat suitability scores from assessed sites were used to extrapolate suitability for the entirety of the study area (Figure 4-3).

Table 4-2 Malleefowl habitat assessment scores for EEL55

Malleefowl habitat	Score	Habitat suitability	Survey sites	Habitat type	Total no. of sites	Total % of sites
No	0	Unsuitable				
	1					
	2					
	3		NS037	Granite extrusion forbland	1	6.7
Yes	4	Low	NS029, NS031, NS033	*Acacia* shrubland, *Eucalyptus* woodland	3	20.0
	5	Medium	NS023, NS024, NS038	*Acacia* shrubland	3	20.0
	6	High	NS025, NS027, NS028, NS030, NS032, NS034, NS036	*Acacia* shrubland, *Eucalyptus* woodland	7	46.7
	7		NS035	*Melaleuca* shrubland	1	6.7
	8					
				Total	**15**	**100**

344262
345811
347361
348910
6555230
6553690



Northern Star Resources Ltd
Carosue Dam Operations

Project No	1483-CAR-NSR-VER
Date	1/06/2022
Drawn by	IN
Map author	PS

0 0.5 1
Kilometers

1:15,600 (at A3) GDA 1994 MGA Zone 51

Study area
GPS tracks

Malleefowl critical breeding habitat suitability

High (Critical breeding habitat)
Low (dispersal and foraging habitat)
None

Figure 4-3

Malleefowl critical breeding habitat suitability and GPS tracks

PHOENIX ENVIRONMENTAL SCIENCES

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4.2.1.3 Targeted searches

One old, degraded Malleefowl mound previously noted in the desktop records was recorded on the northwest boundary track of EEL55 (NS026; Table 4-3; Figure 4-2). No other signs of Malleefowl presence were observed while walking to and from sites. As searches were not comprehensive, it is probable that additional signs of use by Malleefowl were not detected during the field survey, particularly in areas of densely vegetated suitable habitat.

The Malleefowl mound was in *Acacia* shrubland habitat, covering 309.01 ha (38.6%) of the study area, but *Eucalyptus* woodland and *Melaleuca* shrubland habitats were also considered to include habitat suitable for foraging and/or breeding for Malleefowl (Table 4-1).

Table 4-3 Malleefowl records from the study area

Site	Latitude	Longitude	Mound status	Photo
NS026	-31.1220	121.3908	Long unused	

4.2.2 Introduced fauna

One introduced species was recorded in the study area during the initial survey, from cat scat on the track near NS030. The follow-up Malleefowl activity assessment recorded five canine (unknown if feral dog or dingo) tracks and a cat track.

4.2.3 Flora and vegetation

4.2.3.1 Flora diversity

Diversity ranged from three (NS034) to 15 (NS037) taxa across relevés (Table 4-4; Appendix 5).

Table 4-4 Average flora species diversity per habitat by offset site

Habitat type	Diversity range
Eucalyptus woodland	6 - 9
Acacia shrubland	3 - 14
Granite extrusion forbland	15
Melaleuca shrubland	10
Average	**7.9**

4.2.3.2 Vegetation condition

Vegetation condition ranged from Pristine to Very Good, with 13 of 15 sites scoring Pristine showing no obvious signs of disturbance or damage caused by human activities since European settlement. One *Eucalyptus* woodland site scored Excellent and one *Acacia* shrubland site scored Very Good due to more obvious signs of damage such as vehicle tracks, evidence of feral animals and litter.

4.3 FOLLOW-UP MALLEEFOWL ACTIVITY ASSESSMENT

The follow-up Malleefowl activity assessment conducted at EEL55 determined that Malleefowl are active in the western section of the site (Holm 2022). The survey recorded 12 established mounds and four 'failed' mounds. Two of the mounds were classified as active, as they appeared to have been used to incubate eggs in the past few months and fresh tracks were noted nearby. One mound was classed as 'inactive recent', two as 'inactive abandoned' and seven as 'long unused'. Of the 12 established mounds located, seven were in *Acacia* shrubland, four in *Eucalyptus* woodland and one in *Melaleuca* shrubland. It was noted that the mounds recorded within *Eucalyptus* woodland were located in isolated pockets of dense *Melaleuca*, which provided more favourable conditions than the majority of the *Eucalyptus* woodland habitat which generally has low foliage cover at ground level.

4.4 HABITAT QUALITY SCORE

A summary of the Habitat quality score for EEL55 is provided in Table 4-5 and full details of scores per habitat type are provided in Appendix 6**.**

4.4.1 Site condition

Vegetation condition averaged across EEL55 was considered to be Pristine. Habitat structure was considered Medium suitability on average across the site, with the site split between areas of High suitability in *Acacia* shrubland and *Melaleuca* shrubland and Low suitability in *Eucalyptus* woodland. Feral predator activity was highest in *Eucalyptus* woodland and *Acacia* shrubland where signs of both feral cats and canines (unknown if feral dog or dingo) were detected during the initial survey and follow-up Malleefowl activity assessment. Canine sign was also recorded in the Granite extrusion forbland habitat.

4.4.2 Site context

EEL55 scored highly at 2.9 for Site context. There is continuous suitable habitat within and outside the site, including within the neighbouring DBCA managed Timber Reserve; there are Malleefowl records on site within the last five years; and the site is within the known distribution of the species and has connectivity with DBCA managed lands.

4.4.3 Malleefowl stocking rate

The presence of Malleefowl ranged from zero in areas of Unsuitable habitat (Granite extrusion forbland and cleared areas) to Recorded on site as active mounds and recent tracks were recorded in *Acacia* shrubland and *Eucalyptus* woodland habitats during the follow-up Malleefowl activity assessment.

Table 4-5 Habitat quality score summary

Factor	Score	Condition/details	Study area score
Site condition			
Vegetation condition	5	Pristine	4.8
	4	Excellent	
	3	Very good	
	2	Good	
	1	Degraded	
	0	Completely degraded	
		Score out of 3	2.9
Habitat structure - Diversity of habitat species present - Habitat features (Based on Malleefowl habitat assessment 3.2.2.2)	3	High suitability (score of 6-8/8)	2.3
	2	Medium suitability (score of 5/8)	
	1	Low suitability (score of 4/8)	
	0	Not suitable (score of 0-3/8)	
		Score out of 3	2.3
Feral predator activity	3	Not detected in targeted survey	0.7
	2	Low (one record within habitat)	
	1	Medium (multiple records of single species or single records of more than one species)	
	0	High (multiple records of more than one species)	
		Score out of 3	0.7

Factor	Score	Condition/details	Study area score
		Overall score out of 3 (weighted so Vegetation condition = 25% of total, Feral predators = 25% of total and Habitat structure = 50% of total)	2.0
Site context			
Movement patterns of Malleefowl Proximity of the site in relation to other suitable areas of habitat Overall population or extent of Malleefowl	3	Site is part of a regionally large contiguous suitable habitat; records on the site for Malleefowl within last 5 years; site is within known distribution of Malleefowl and has connectivity with protected areas	2.9
	2.5	Site is part of a regionally significant contiguous suitable habitat; records on site or immediately adjacent (within 3 km) for Malleefowl within last 6-10 years; site is within known distribution of Malleefowl	
	2	Site is part of a contiguous suitable habitat; Malleefowl records on site or adjacent (within 5 km) to site within last 6- 10 years; site is within known distribution of Malleefowl	
	1.5	Site is part of a contiguous suitable habitat; Malleefowl records on or adjacent (within 10 km) to site within last 6-10 years; site is located within known distribution of Malleefowl	
	1	Site is Unsuitable or isolated from suitable habitat. Malleefowl records on site or in vicinity (within 10 km) within last 10 years and Malleefowl are capable of migrating to site. Site is located within known distribution of Malleefowl	
	0.5	Site is Unsuitable or isolated from suitable habitat. Records on site or in vicinity (within 10 km) within last 10 years and species are capable of migrating to site. Site is not located within known distribution of species	
	0	Site is Unsuitable or isolated from suitable habitat. No Malleefowl records on site or in vicinity (within 10 km) within last 10 years and Malleefowl unlikely to migrate to site	
		Score out of 3	2.9
Malleefowl stocking rate			
Known presence	4	Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats	2.8
	3	Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats	

Factor	Score	Condition/details	Study area score
	2	Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats	
	1	No records of Malleefowl on site, within known range of Malleefowl, suitable habitat present	
	0	Site outside current known range of Malleefowl or habitat is unsuitable	
Score out of 4			2.8
Final Habitat quality score out of 10			**7.7**

4.5 SURVEY LIMITATIONS

The limitations of the Malleefowl offset site survey have been considered in accordance with EPA (2020) (Table 4-6).

Table 4-6 Consideration of potential survey limitations

Limitations	Relevant	Comments
Availability of contextual information at a regional and local scale	Yes	Malleefowl distribution in the Goldfields region is well known in general, but there is often limited information available at the local scale.
Competency/experience of the team carrying out the survey	No	The field team and report authors have sufficient experience in terrestrial biological surveys within the Goldfields region to satisfy EPA criteria and were competent in sampling the target faunal species.
Scope and completeness	Yes	All items in the original scope were achieved. Time constraints prevented comprehensive transect searches of EEL55 during the initial field survey. As such, signs of Malleefowl may not have been detected during the field survey; however, comprehensive searches of EEL55 were conducted as part of the follow-up Malleefowl activity assessment (Holm 2022).
Access within the study area	Yes	Vehicle access within the study area was often limited.
Timing, rainfall, season	No	Conditions during the survey were warm and dry.
Disturbance that may have affected the results of the survey	No	No substantial disturbances were present within the study area which could have significantly affected the results of the survey.

5 DISCUSSION

Most broad fauna habitat types occurring within the study area extend outside and are widespread in the region. Three of the four habitat types recorded, covering 94.4% of the study area, were found to be suitable for Malleefowl, dependant on their structure: *Acacia* shrubland, *Eucalyptus* woodland and *Melaleuca* shrubland, while Granite extrusion forbland was unsuitable. Fourteen of the 15 sites assessed were deemed as suitable habitat for Malleefowl, with eight of the 14 suitable sites scoring more than six to qualify as High suitability Critical breeding habitat.

The Malleefowl habitat assessment classified the study area as Medium to High suitability Malleefowl habitat, split between Low suitability *Eucalyptus* woodland suitable for dispersal and foraging and High suitability *Acacia* and *Melaleuca* shrubland suitable for breeding. Despite being classified as Low suitability, the proximity of this *Eucalyptus* woodland to High suitability Critical breeding habitat within EEL55 and its connectivity to other areas of shrubland outside the site is important for dispersal in the region. The *Eucalyptus* woodland also contains isolated pockets of dense *Melaleuca* which provide more favourable conditions and in which an active Malleefowl mound was recorded during the follow-up Malleefowl activity assessment (Holm 2022).

During the initial survey, a Long unused Malleefowl mound was identified in the desktop review and recorded in the field survey on the northwest border of the study area in dense *Acacia* shrubland habitat. There were two other records close to the study area, 400 m and 2.8 km west respectively, and four more within 10 km. The follow-up Malleefowl activity assessment recorded 16 mounds including the previously recorded Long unused mound and two sets of fresh tracks within the site (Holm 2022). Of the 16 mounds, 12 were established and four were 'failed' mounds. Two of the mounds were classified as active, as they appeared to have been used to incubate eggs in the past few months and fresh tracks were noted nearby. One mound was classed as 'inactive recent', two as 'inactive abandoned' and seven as 'long unused'. Of the 12 established mounds located, seven were in *Acacia* shrubland, four in *Eucalyptus* woodland and one in *Melaleuca* shrubland. The mounds recorded within *Eucalyptus* woodland habitat were all located in isolated pockets of dense *Melaleuca,* which provides the screening vegetation cover preferred by Malleefowl.

Introduced predators represent a critical threat to Malleefowl (Wheeler 2018), with mortality by foxes chiefly affecting juvenile and sub-adult birds (Priddel & Wheeler 1996) and cats targeting chicks and juveniles (Wheeler & Priddel 2009). Predation threat from dingos is largely unknown as most Malleefowl studies have been conducted in parts of south-eastern Australia where dingos are now rare due to exclusion fences and high intensity management for livestock protection (Benshemesh 1999). Signs of feral cats were recorded in the initial survey, and both cats and canines (unknown if feral dog or dingo) in the follow-up Malleefowl activity assessment, primarily in *Eucalyptus* woodland and *Acacia* shrubland habitats. While no signs of foxes were recorded during the field surveys, it is considered likely they are also in the study area, as records were returned in the desktop review (DAWE 2022) and they can be difficult to detect. Signs for a 1080 baiting program to control feral predators were observed at EEL55 but baiting has not recently taken place.

The Habitat quality score was high at 7.7 out of 10. The management of invasive predators such as cats and foxes in this area may also increase its value as an offset site, with intense predator management shown to increase Malleefowl survival rates (Wheeler 2018; Wheeler & Priddel 2009).

5.1 CONSIDERATION OF INCLUSION OF POTENTIAL OFFSETS INTO CONSERVATION ESTATE

Whilst the conservation covenant mechanism has not yet been determined at the time of preparation of this report, when considering the value of a potential offset, it is worth considering how it might

enhance the Conservation Estate currently managed by DBCA. Phoenix has been advised that the DBCA's strategic approach for additions to the Conservation Estate includes the acquisition of lands:

- containing significant flora and fauna values
- containing communities and/or habitat that are not well represented in the reserve system
- that contribute to better management outcomes for the existing reserves.

Based on the assessments of the five possible offset sites covered in this report, there is potential for all three of these criteria to be met by EEL55. EEL55 was considered likely to contain Malleefowl populations based on the presence of suitable habitat and historic records within and/or immediately adjacent to the sites. This was confirmed by the follow-up Malleefowl activity assessment (Holm 2022) which recorded recently active mounds and fresh tracks.

The *Acacia* shrublands within EEL55 represent Critical habitat for Malleefowl, and while widespread outside the site, this habitat has regionally suffered extensive degradation and fragmentation due to the expansion of mining and agriculture. The inclusion of EEL55 into the Conservation Estate (or its protection through a conservation covenant) would represent a significant contribution of this habitat type to the reserve system and to the overall protected habitat available to the species. The benefits would be amplified given that the site is abutted by the Yillari Timber Reserves, managed by DBCA. While this reserve may be utilised for timber collection, it would provide the potential offset site with increased habitat connectivity, landscape heterogeneity and structural complexity, contributing to conservation outcomes.

5.2 CONCLUSION AND RECOMMENDATIONS

Based on the findings of this report, EEL55 represents a potentially suitable offset site for Malleefowl. In addition, it appears to be suitable for inclusion into the Conservation Estate in accordance with DBCA's strategic criteria.

EEL55 and the surrounding Yillari Timber Reserves may be important to the regional Malleefowl population due to the presence of Critical breeding habitat and significant habitat connectivity.

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Appendix 1 Field survey site locations

Site name	Offset site	Latitude	Longitude
NS023	EEL55	-31.1257	121.4010
NS024	EEL55	-31.1247	121.3983
NS025	EEL55	-31.1260	121.3938
NS026	EEL55	-31.1220	121.3908
NS027	EEL55	-31.1221	121.3910
NS028	EEL55	-31.1257	121.3903
NS029	EEL55	-31.1290	121.3831
NS030	EEL55	-31.1290	121.3745
NS031	EEL55	-31.1286	121.3701
NS032	EEL55	-31.1323	121.3700
NS033	EEL55	-31.1402	121.3698
NS034	EEL55	-31.1401	121.3656
NS035	EEL55	-31.1407	121.3724
NS036	EEL55	-31.1260	121.3919
NS037	EEL55	-31.1237	121.4061
NS038	EEL55	-31.1250	121.4084

Appendix 2 NVIS hierarchy

Western Australia Current Practice			National Standard		
Hierarchy of terms	Brief description in WA	Indicative scale	NVIS Level	Description	NVIS structural/floristic components required
Vegetation formation	Structure and growth form – e.g. Forest, Woodland.	1:5 000 000	I	Class	Dominant growth form for the ecologically or structurally dominant stratum.
Vegetation sub-formation	Structural and dominant vegetation layer - Eucalypt Forest, Banksia Woodland.	1:2 500 000 I	II	Structural Formation	Dominant growth form, cover and height for the ecologically or structurally dominant stratum.
Vegetation association	Structural form and dominant species – e.g. Medium woodland; York gum (*Eucalyptus loxophleba*) & Wandoo.	1:1 000 000 to 1:250 000	III	Broad Floristic Formation	Dominant growth form, cover, height and dominant land cover genus for the uppermost or dominant stratum.
Vegetation complex	Structural and floristic description linked to geomorphology – e.g. Quindalup Complex.	1:250 000 to 1:100 000	IV	Sub-Formation	Dominant growth form, cover, height and dominant genus and Family for the three traditional strata. (i.e. Upper, Mid and Ground).
Vegetation type	Floristic definition by strata with structural detail. Often represented with a code and floristic description.	1:100 000 to 1:10 000	V	Association	Dominant growth form, height, cover and up to three species for the three traditional strata. (i.e. Upper, Mid and Ground).
Plant community	Basic unit of vegetation classification, site specific and highly localised with detailed floristics for each stratum.	1:10 000	VI	Sub-Association	Dominant growth form, height, cover and up to five species for all layers/ strata.
Floristic Community Type	Floristic composition definition; e.g. Northern banksia woodlands over herb rich shrublands on the Swan Coastal Plain.	No absolute scale			

Site details			
Site	**NS023**	**Position (WGS84)**	-31.125663, 121.401
Topography	plain	**Soil texture**	clay loam, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Scattered eucs and tall acacia over rhagodia on red brown sandy clay loam.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	65	**Litter distribution**	under vegetation
Tree cover (%)	40	**Litter depth(cm)**	1
Shrub cover (%)	30	**Litter cover (%)**	40
Grass cover (%)	1		
Herb cover (%)	1		

Site details			
Site	**NS024**	**Position (WGS84)**	-31.12472, 121.398262
Topography	plain	**Soil texture**	sandy clay, loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Tall acacia shrubland over rhagodia on red brown sandy clay loam.

Habitat	shrubland		
Disturbance	litter, vehicle tracks		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	even/continuous
Tree cover (%)	60	**Litter depth(cm)**	2
Shrub cover (%)	20	**Litter cover (%)**	80
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS025**	**Position (WGS84)**	-31.125971, 121.393793
Topography	plain	**Soil texture**	clay loam, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Acacia and melaleuca shrubland over rhagodia, eremophila and myrtaceae shrubs on red brown sandy clay loam.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	80	**Litter distribution**	even/continuous
Tree cover (%)	60	**Litter depth(cm)**	2
Shrub cover (%)	20	**Litter cover (%)**	70
Grass cover (%)	1		
Herb cover (%)	1		

Site details			
Site	**NS027**	**Position (WGS84)**	-31.122109, 121.391007
Topography	plain	**Soil texture**	sandy clay, clay loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Scattered mallee eucs and hakea over acacia shrubland over phebalium over low myrtaceae shrubs on red brown sandy clay loam.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	85	**Litter distribution**	even/continuous
Tree cover (%)	75	**Litter depth(cm)**	2
Shrub cover (%)	20	**Litter cover (%)**	80
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS028**	**Position (WGS84)**	-31.125698, 121.390316
Topography	plain	**Soil texture**	gravel, sandy clay, clay loam
Slope	negligible	**Rock type**	chert
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Acacia, allocasuarina and melaleuca shrubland over phebalium, myrtaceae, leucopogon shrubs on red brown sandy clay loam with gravel.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	under vegetation
Tree cover (%)	30	**Litter depth(cm)**	1
Shrub cover (%)	45	**Litter cover (%)**	60
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS029**	**Position (WGS84)**	-31.128986, 121.383123
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Euc woodland over clumps of melaleuca over olearia, phebalium and greybush shrubs on red brown clay loam.

Habitat	woodland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	65	**Litter distribution**	under vegetation
Tree cover (%)	50	**Litter depth(cm)**	2
Shrub cover (%)	30	**Litter cover (%)**	60
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS030**	**Position (WGS84)**	-31.129033, 121.374483
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Acacia, melaleuca and allocasuarina shrubland over phebalium, greybush and cyperaceae (dianella) on red brown clay loam. Cat scat on road.

Habitat	shrubland		
Disturbance	evidence of feral animals, vehicle tracks		
Vegetation condition	Excellent	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	even/continuous
Tree cover (%)	45	**Litter depth(cm)**	1
Shrub cover (%)	35	**Litter cover (%)**	80
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS031**	**Position (WGS84)**	-31.128597, 121.370075
Topography	undulating plain	**Soil texture**	sandy clay
Slope	negligible	**Rock type**	granite - outcropping
Soil colour	red-brown	**Rock cover (%)**	50

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Open acacia over myrtaceae shrubs on granite outcrop.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	35	**Litter distribution**	under vegetation
Tree cover (%)	20	**Litter depth(cm)**	1
Shrub cover (%)	15	**Litter cover (%)**	5
Grass cover (%)	1		
Herb cover (%)	1		

Site details			
Site	**NS032**	**Position (WGS84)**	-31.132335, 121.369993
Topography	plain	**Soil texture**	sandy clay, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Acacia and melaleuca shrubland with scattered allocasuarina over dianella and prostanther on red brown sandy clay loam.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	even/continuous
Tree cover (%)	50	**Litter depth(cm)**	1
Shrub cover (%)	30	**Litter cover (%)**	80
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS033**	**Position (WGS84)**	-31.140244, 121.3698
Topography	plain	**Soil texture**	sandy clay, clay loam
Slope	negligible	**Rock type**	none
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Open euc woodland over clumps of melaleuca over olearia and phebalium shubs on red brown sandy clay loam.

Habitat	open woodland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	70	**Litter distribution**	under vegetation
Tree cover (%)	65	**Litter depth(cm)**	2
Shrub cover (%)	10	**Litter cover (%)**	60
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS034**	**Position (WGS84)**	-31.140072, 121.365607
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	quartz
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Acacia and melaleuca shrubland over prostanther, eremophila, Alyxia on red brown clay loam with scattered quartz pebbles.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	under vegetation
Tree cover (%)	60	**Litter depth(cm)**	1
Shrub cover (%)	40	**Litter cover (%)**	60
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS035**	**Position (WGS84)**	-31.140665, 121.372351
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	ferrous - ironstone, quartz
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Scattered eucs over melaleuca and acacia shrubland over alyxia, eremophila, phebalium and exocarpos on red brown clay loam with scattered ironstone and quartz pebbles. Sort of cracking clay looking.

Habitat	shrubland		
Disturbance	none recorded		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	65	**Litter distribution**	under vegetation
Tree cover (%)	40	**Litter depth(cm)**	1
Shrub cover (%)	30	**Litter cover (%)**	50
Grass cover (%)	0		
Herb cover (%)	0		

Site details			
Site	**NS036**	**Position (WGS84)**	-31.125958, 121.391922
Topography	plain	**Soil texture**	sandy clay, sandy loam
Slope	negligible	**Rock type**	ferrous - ironstone, granite - rocks, quartz
Soil colour	red-brown	**Rock cover (%)**	5

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Open euc woodland over isolated melaleuca over phebalium, prostanther, scaevola over spinifex on red brown sandy clay loam with rocks and gravel.

Habitat	open woodland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	55	**Litter distribution**	
Tree cover (%)	35	**Litter depth(cm)**	2
Shrub cover (%)	25	**Litter cover (%)**	30
Grass cover (%)	10		
Herb cover (%)	0		

Site details			
Site	**NS037**	**Position (WGS84)**	-31.123728, 121.406126
Topography	undulating plain	**Soil texture**	sandy loam
Slope	gentle	**Rock type**	granite - bolders, granite - outcropping, quartz
Soil colour	red-brown, yellow	**Rock cover (%)**	70

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Isolated acacia and hakea on granite extrusion surrounded by forbland and bordered by shrubland.

Habitat	herbland / forbland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	15	**Litter distribution**	sparse
Tree cover (%)	0	**Litter depth(cm)**	1
Shrub cover (%)	2	**Litter cover (%)**	2
Grass cover (%)	5		
Herb cover (%)	10		

Site details			
Site	**NS038**	**Position (WGS84)**	-31.124967, 121.408366
Topography	plain	**Soil texture**	sandy clay, clay loam
Slope	negligible	**Rock type**	quartz
Soil colour	red-brown	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	02 Feb 2022	02 Feb 2022

Site description - visit 1 (02 Feb 2022)

Acacia shrubland over dodonaea, rhagodia, senna, bluebush, olearia, on red brown sandy clay loam with scattered quartz pebbles.

Habitat	shrubland		
Disturbance	vehicle tracks		
Vegetation condition	Pristine	**Fire age**	moderate (>5 years)
Total veg. cover (%)	65	**Litter distribution**	under vegetation
Tree cover (%)	35	**Litter depth(cm)**	1
Shrub cover (%)	30	**Litter cover (%)**	45
Grass cover (%)	1		
Herb cover (%)	1		

Appendix 4 Malleefowl habitat assessment scores

Site name	Offset site	Sand	Leaf litter	Canopy cover	Level ground	Mallee	Melaleuca	Mulga	Triodia	Score	Malleefowl habitat	Habitat suitability
NS023	EEL55	1	1	0	1	1	0	1	0	5	Yes	Medium
NS024	EEL55	1	1	1	1	0	0	1	0	5	Yes	Medium
NS025	EEL55	1	1	1	1	0	1	1	0	6	Yes	High
NS027	EEL55	1	1	1	1	1	0	1	0	6	Yes	High
NS028	EEL55	1	1	1	1	0	1	1	0	6	Yes	High
NS029	EEL55	1	1	0	1	0	1	0	0	4	Yes	Low
NS030	EEL55	1	1	1	1	0	1	1	0	6	Yes	High
NS031	EEL55	1	1	0	1	0	0	1	0	4	Yes	Low
NS032	EEL55	1	1	1	1	0	1	1	0	6	Yes	High
NS033	EEL55	1	1	0	1	0	1	0	0	4	Yes	Low
NS034	EEL55	1	1	1	1	0	1	1	0	6	Yes	High
NS035	EEL55	1	1	1	1	1	1	1	0	7	Yes	High
NS036	EEL55	1	1	0	1	1	1	0	1	6	Yes	High
NS037	EEL55	1	0	0	1	0	0	1	0	3	No	None
NS038	EEL55	1	1	1	1	0	0	1	0	5	Yes	Medium

Appendix 5 Diversity recorded for each relevé

Relevé	Offset site	Species diversity
NS023	EEL55	8
NS024	EEL55	4
NS025	EEL55	7
NS027	EEL55	8
NS028	EEL55	11
NS029	EEL55	6
NS030	EEL55	6
NS031	EEL55	6
NS032	EEL55	5
NS033	EEL55	6
NS034	EEL55	3
NS035	EEL55	10
NS036	EEL55	9
NS037	EEL55	15
NS038	EEL55	14

Appendix 6 Habitat quality assessment for offset site EEL55

Factor	Score	Condition/details	Habitat type				
			Eucalyptus woodland	Acacia shrubland	Granite extrusion	Melaleuca shrubland	Cleared
Site condition							
Vegetation condition	5	Pristine	4.7	4.8	5.0	5.0	0.0
	4	Excellent					
	3	Very good					
	2	Good					
	1	Degraded					
	0	Completely degraded					
		Score out of 3	2.8	2.9	3.0	3.0	0.0
Habitat structure - Diversity of habitat species present - Habitat features (Based on Malleefowl habitat assessment 3.2.2.2)	3	High suitability (score of 6-8/8)	2.0	3.0	0.0	3.0	0.0
	2	Medium suitability (score of 5/8)					
	1	Low suitability (score of 4/8)					
	0	Not suitable (score of 0-3/8)					
		Score out of 3	2.0	3.0	0.0	3.0	0.0
Feral predator activity	3	Not detected in targeted survey	0.0	1.0	2.0	3.0	3.0
	2	Low (one record within habitat)					
	1	Medium (multiple records of single species or single records of more than one species)					

Factor	Score	Condition/details	Habitat type				
			Eucalyptus woodland	Acacia shrubland	Granite extrusion	Melaleuca shrubland	Cleared
	0	High (multiple records of more than one species)					
		Score out of 3	0.0	1.0	2.0	3.0	3.0
		Overall score out of 3 (weighted so Vegetation condition = 25% of total, Feral predators = 25% of total and Habitat structure = 50% of total)	1.7	2.5	1.3	3.0	0.8
Site context							
Movement patterns of Malleefowl Proximity of the site in relation to other suitable areas of habitat Overall population or extent of Malleefowl	3	Site is part of a regionally large contiguous suitable habitat; records on the site for Malleefowl within last 5 years; site is within known distribution of Malleefowl and has connectivity with protected areas	3.0	3.0	1.0	2.5	1.0
	2.5	Site is part of a regionally significant contiguous suitable habitat; records on site or immediately adjacent (within 3 km) for Malleefowl within last 6-10 years; site is within known distribution of Malleefowl					
	2	Site is part of a contiguous suitable habitat; Malleefowl records on site or adjacent (within 5 km) to site within last 6- 10 years; site is within known distribution of Malleefowl					
	1.5	Site is part of a contiguous suitable habitat; Malleefowl records on or adjacent (within 10 km) to site within last 6-10 years; site is located within known distribution of Malleefowl					
	1	Site is Unsuitable or isolated from suitable habitat. Malleefowl records on site or in region (within 10 km) within last 10 years and Malleefowl are capable of migrating to site. Site is located within known distribution of Malleefowl					

Factor	Score	Condition/details	Habitat type				
			Eucalyptus woodland	Acacia shrubland	Granite extrusion	Melaleuca shrubland	Cleared
	0.5	Site is Unsuitable or isolated from suitable habitat. Records on site or in region (within 10 km) within last 10 years and species are capable of migrating to site. Site is not located within known distribution of species					
	0	Site is Unsuitable or isolated from suitable habitat. No Malleefowl records on site or in region (within 10 km) within last 10 years and Malleefowl unlikely to migrate to site					
Score out of 3			3.0	3.0	1.0	2.5	1.0
Malleefowl stocking rate							
Known presence	4	Malleefowl recorded on site annually for three consecutive years, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats	3.0	3.0	0.0	2.0	0.0
	3	Malleefowl recorded on site, includes evidence of active mounds and other signs of recent/current presence such as direct sightings of birds, fresh tracks and scats					
	2	Malleefowl previously recorded on site, no recent activity in mounds, sightings or tracks and scats					
	1	No records of Malleefowl on site, within known range of Malleefowl, suitable habitat present					
	0	Site outside current known range of Malleefowl or habitat is unsuitable					
Score out of 4			3.0	3.0	0.0	2.0	0.0

Factor	Score	Condition/details	Habitat type				
			Eucalyptus woodland	Acacia shrubland	Granite extrusion	Melaleuca shrubland	Cleared
Scores							
		Score out of 10 (before scaling)	7.7	8.5	2.3	7.5	1.8
		Habitat area (ha)	405.5	309.0	44.4	40.7	1.0
		Habitat area proportion	0.5	0.4	0.1	0.1	0.0
		Scaled score (score scaled to proportion of tenement)	3.9	3.3	0.1	0.4	0.0
Final Habitat quality score out of 10							**7.7**

Appendix D Assessment of Malleefowl Activity on EEL55

ASSESSMENT OF MALLEEFOWL ACTIVITY ON LOCATION EEL55.

NORTHERN STAR RESOURCES LIMITED

Alexander Holm & Associates

Natural Resource Management Services

May 7, 2022

Cover photograph: EEL55_09 an active Malleefowl nesting mound in dense acacia shrubland.

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1 Summary

Alexander Holm & Associates were contracted by Northern Star Resources (Northern Star) in April 2022 to systematically locate, record and map evidence of Malleefowl (*Leipoa ocellata*) within an 800ha area on Exempt East Location 55 (EEL55), 28km southeast of Coolgardie.

EEL55 is in the semi-arid Goldfields region of Western Australia. The area experiences hot summers and mild winters with cold nights. Rainfall varies widely between years and droughts are common. Rainfall on the site has averaged 270mm a year since 1970 with no clear winter or summer dominance. Rainfall was exceptionally dry in 2019 (126mm), below average in 2020 (193mm) and above average in 2021 (317mm).

Phoenix Environmental Sciences assessed and mapped habitat suitability for Malleefowl within EEL55 in January 2022. Four habitat types were identified: i) Eucalyptus woodland occupying 50.7% and rated suitable for forage and cover; ii) Acacia shrubland occupying 38.6% and rated suitable for breeding; iii) Granite extrusion forbland occupying 5.5% and rated unsuitable habitat and iv) Melaleuca shrubland occupying 5.1% and rated suitable for breeding.

The 800ha survey area was searched by four operators from April 25-30, 2022, involving 530km of traverse along north south traverses 20m apart. Nesting mounds were assessed according to the National Malleefowl Monitoring Manual and recorded as:

a) 'failed' as minor excavation and incomplete mound construction;

b) 'long unused' and unlikely to have been used for at least 20 years;

c) 'inactive abandoned' unlikely to have been used for at least 5 to 10 years;

d) 'inactive recent' possibly used within the last 5 years; and

e) 'active' as used in the past few months by Malleefowl as an incubator for their eggs.

Malleefowl are active in the western section of the 800ha assessment envelope. Twelve established nesting mounds and four 'failed' mounds were found during survey. Two nesting mounds appeared to have been used to incubate eggs in the past few months and fresh Malleefowl tracks were observed nearby. One of the 12 established nesting mounds was considered 'inactive recent', two 'inactive abandoned' and seven 'long unused'.

Of the twelve established mounds recorded, seven were located within 'acacia shrubland', four within 'eucalyptus woodland', one within 'melaleuca shrubland' and none in 'granite extrusion forbland'.

Phoenix Environmental Sciences (2022) rate 'acacia shrubland' and 'melaleuca shrubland' as suitable for Malleefowl breeding. Together these habitat types occupy approximately 350ha or 44% of the assessment envelope. Established nesting mounds were found at between 2.3 and 2.5 per 100ha in these two habitat types.

'Eucalyptus woodland' occupies 405ha, approximately 50% of the assessment envelope, and is rated suitable for dispersal and foraging. While most 'Eucalyptus woodland' has low foliage cover, isolated pockets of Melaleuca provide dense cover and the four nesting mounds found in this habitat were generally located in these favoured locations. Established nesting mounds were found at approximately 1 per 100ha in 'Eucalypt woodlands'.

Malleefowl appear to make little or no use of 'granite extrusion forbland' within the low granite outcrops which are restricted to 44ha of the assessment envelope and rated as unsuitable Malleefowl habitat by Phoenix Environmental Sciences (2022).

Fresh tracks of wild dog/dingo were noted at several locations throughout the assessment envelope and one set of cat tracks noted in a central location. Phoenix Environmental Sciences (2022) also noted cat scats during habitat survey in January 2022.

2 Scope of Works

Alexander Holm & Associates were contracted by Northern Star Resources (Northern Star) in April 2022 to systematically locate, record and map evidence of Malleefowl (*Leipoa ocellata*) within an 800ha area on Exempt East Location 55 (EEL55), 28km southeast of Coolgardie.

3 Background

3.1 Species and Habitat Information

3.1.1 Malleefowl (*Leipoa ocellata*)

Malleefowl are a stocky ground-dwelling bird belonging to the family Megopodiidae. This species builds distinctive mounds to incubate their eggs. Breeding season usually begins in September when egg laying begins and ends in late January. Chicks typically begin hatching in November, with most chicks emerging from mounds by January, however it has been noted that in some seasons hatching may continue until March (Benshemesh 2007).

3.1.2 Distribution and Habitat

Historically, Malleefowl have been found in semi-arid mallee shrublands and woodlands across southern Australia (Department of Parks and Wildlife 2016b), but their range has been greatly reduced, mostly attributed to extensive land clearing for agriculture (Department of Parks and Wildlife 2016b).

In Western Australia, Malleefowl habitat consists of acacia-dominated shrubland and woodland dominated by mallee eucalypts. Malleefowl require a sandy substrate and abundance of leaf litter for the construction of mounds (Department of Parks and Wildlife 2016a). Habitats characterised by numerous food plants (especially leguminous shrubs and herbs), a dense canopy cover and open ground layer are generally associated with high breeding densities. Malleefowl also prefer long unburnt country (Benshemesh 2007).

3.1.3 Conservation Status

The Malleefowl is recognized as a threatened species under State and Commonwealth legislation. The Malleefowl is listed as Vulnerable nationally under the EPBC Act 1999. The species is also listed as Vulnerable under the Biodiversity Conservation Act 2016 (WA).

3.1.4 Nesting mound characterisation

The National Monitoring Manual provides the following description of 'active' nesting mounds (National Malleefowl Recovery Team 2019) and three other categories for currently non-active nesting mounds are proposed.

The nesting mound categories used in this report are:

Active: Showing obvious signs of having been used over the 2021-2022 breeding season.

Inactive recent: Potentially used within the last 5 years. Mound well-formed, litter often still present, no evidence of inner crusting or growth of annual herbs or grasses.

Inactive abandoned: Likely unused for more than 5-10 years and possibly abandoned. Mound somewhat degraded, often crusted, annual herbs or grasses maybe present.

Long unused: Unlikely to have been used for at least 20 years. Evidence of an extended period of inactivity such as shrubs or trees growing from hollow or mound. Mound very degraded/poorly formed. Highly unlikely to become active in the future.

Failed: Minor excavation and incomplete mound construction.

3.2 Environmental Information

3.2.1 Location

Exempt East Location 55 (EEL55) is 28km southeast of Coolgardie within the Coolgardie Shire, bounded by the Yallari Timber Reserve in the North and West, Woolibar Station to the east and Unallocated Crown Land (UCL) to the south. The Coolgardie Esperance highway passes through the north east corner (Figure 1)

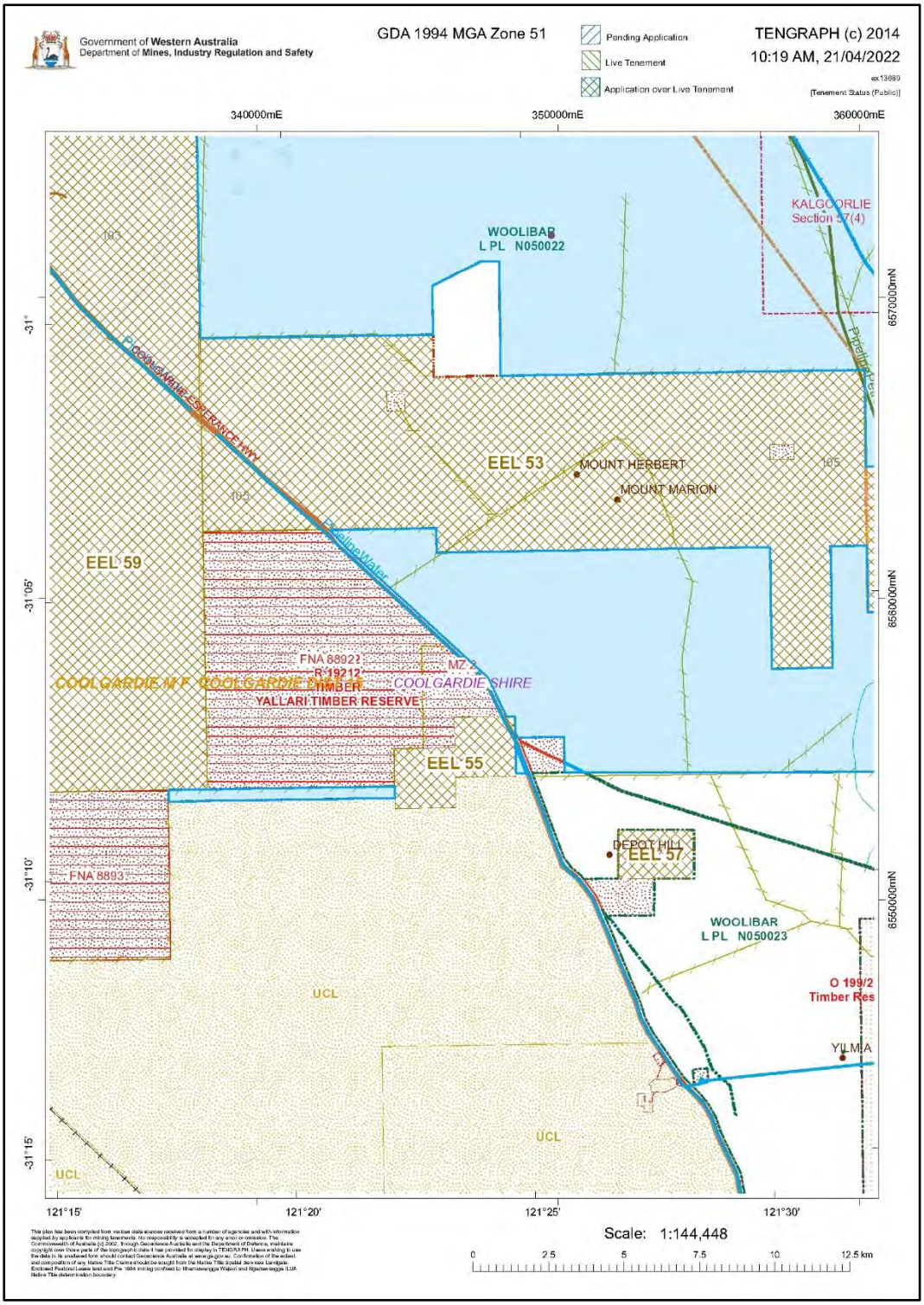

Figure 1: EEL55 in relation to surrounding land tenure

3.2.2 Climate

The Goldfields region is arid to semi-arid with average annual rainfall decreasing from about 250mm in the south-west to 200mm in the north-east. The area experiences hot summers and mild winters with cold nights. Rainfall varies widely between years and droughts are common. Remnants of tropical cyclones occasionally bring heavy summer rain and can cause flooding. The area transitions between desert summer and winter dominated rainfall and desert: non-seasonal bioclimatic (Beard 1990).

Rainfall at the site1 has averaged 270mm a year since 1970. Rainfall was exceptionally dry in 2019 (126mm), below average in 2020 (193mm) and above average in 2021 (317mm)(Figure 2).

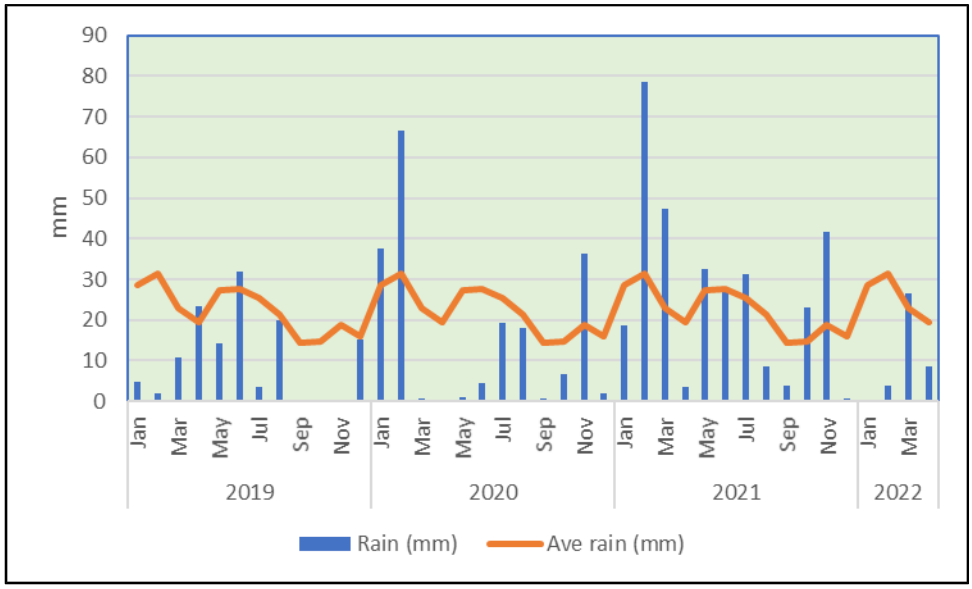

Figure 2: Monthly rainfall on site.

3.2.3 Landform vegetation and soil

The survey area is located within Eastern Goldfields subregion of Coolgardie bio-geographic region of Australia (COO3) (Cowan 2001).

The survey area consists of erosional and depositional landforms with the flat beds of salt lakes such as Lake Lefroy to the south east, occupying the lowest parts of the landscape. Landforms are mostly broad, level or gently inclined plains with loamy surfaces, gently undulating plains with lateritic gravel mantles and occasional low hills and ridges on greenstone, basalt and, less frequently, granite (Payne et al. 1998).

The area is rich in endemic acacias and eucalypts. Eucalypt woodland or low woodland with alkaline loamy earth soils characterize the region. These woodlands have shrub layers of Acacia and Eremophila species or chenopods (Atriplex and Maireana species). Red deep sands commonly occur adjacent to lakes and highly saline soils occur on salt lake margins (Payne et al. 1998).

[1] Get Point Data | LongPaddock | Queensland Government

3.2.4 Malleefowl habitat

Phoenix Environmental Sciences assessed and mapped habitat suitability for Malleefowl within EEL55 in January 2022 (Phoenix Environmental Sciences 2022).

Four habitats were identified:

Eucalyptus woodland: tall open Eucalyptus woodland with tall isolated Acacia shrubs over variably present low shrubs *of Senna artemisioides* subsp. *filifolia, Mariana sedifolia, Scaevola spinescens, Mairiana pyramidata, Eremophila* sp.*, Olearia muelleri* and *Phebalium* sp.

Area 405.5ha – 50.7%. Rated suitable for forage and cover.

Acacia shrubland: tall Acacia shrubland over variable mid open shrubland of *Dodonaea* sp., *Phebalium* sp. and *Scaevola spinescens* over low *Rhagodia drummondii*, *Senna artemisioides* subsp *filifolia, Olearia muelleri, Maireana triptera* and *Maireana georgei* shrubs

Area: 309.0ha – 38.6%. Rated suitable for breeding

Granite extrusion forbland: granite extrusion with isolated Acacia and Hakea shrubs over forbland of *Waitzia* sp., *Maireana* sp, S*cleroleana* sp.

Area: 44.4ha – 5.5%. Unsuitable habitat.

Melaleuca shrubland: *Melaleuca* sp. shrubland over low scattered *Scaevola spinescens*, *Olearia muelleri, Maireana sedifolia*, *Grevillea* sp. and *Atriplex vesicaria, Phebalium* sp. and *Cratystylis microphylla.*

Area: 40.7ha – 5.1%. Rated suitable for breeding

4 Assessment Methodology

4.1 Assessment personnel

The malleefowl survey was coordinated by Alexander Holm with three assistants.

Dr Holm is an ecologist with over 35 years experience in arid environments and Goldfield regions and an accredited environmental consultant with the Environmental Consultants Association of Western Australia. He has coordinated several surveys and habitat assessments for Malleefowl over the past 10 years.

The report was prepared by Dr Holm (Alexander Holm & Associates).

4.2 Timing of survey

The Malleefowl survey was conducted from April 25 to 30, 2022.

4.3 Targeted Malleefowl Survey

Operators searched the 800ha along gridlines 20m apart on a North South orientation using GPS devices to maintain position. A total of 530km was traversed. Approximately 8km of traverse was not recorded (Figure 2).

It is estimated that the search procedures were sufficient to locate 100% of nesting mounds in open habitat and 80-90% in closed habitat.

Located nesting mounds were recorded as:

a) 'failed' as minor excavation and incomplete mound construction;

b) 'long unused' and unlikely to have been used for at least 20 years;

c) 'inactive abandoned' unlikely to have been used for at least 5 to 10 years;

d) 'inactive recent' possibly used within the last 5 years (Section 3.1.4); and

e) 'active' as used in the past few months by Malleefowl as an incubator for their eggs.

Failed mounds were noted and coordinates recorded while other nesting mounds were photographed, measured and evidence of Malleefowl activity noted in accordance with the procedures outlined in the *National Malleefowl Monitoring Manual* referenced at item 9a (National Malleefowl Recovery Team 2019).

Other evidence of Malleefowl activity (disturbance of litter, tracks and sightings) was noted during traverse.

Evidence of Malleefowl predators (Dingo/dog; cat and fox) was noted during traverse.

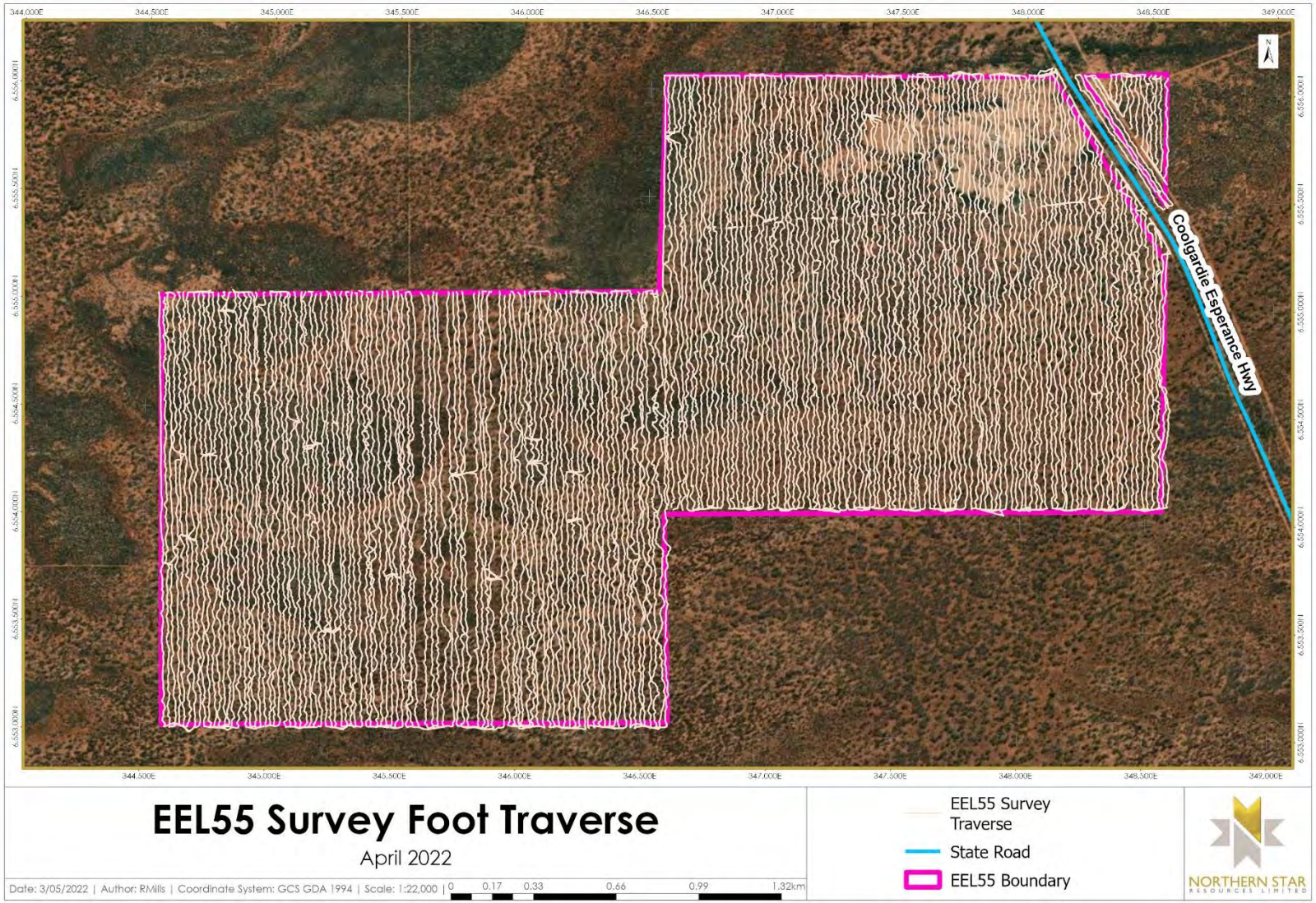

Figure 3: EEL55 800ha survey envelope and foot traverse 2022.

5 Survey Results

5.1 Malleefowl

Twelve established nesting mounds and four 'failed' mounds were found during survey.

Two of the established mounds were 'active', one 'inactive recent', two 'inactive abandoned' and seven 'long unused' (Table 1).

Of the twelve established mounds recorded, seven were located within 'acacia shrubland', four within 'eucalyptus woodland', one within 'melaleuca shrubland' and none in 'granite extrusion forbland'. All 'failed' mounds were in 'acacia shrubland' (Figure 4).

Fresh tracks of one adult and one juvenile Malleefowl were found either within or nearby 'acacia shrubland' (Figure 4).

Location details of all found Malleefowl mounds and tracks are provided in Appendix 1.

5.2 Predators

Fresh tracks of wild dog/dingo were noted at several locations throughout the assessment envelope and one set of cat tracks noted in a central location.

Table 1 Details of Malleefowl nesting mounds located during survey in April 2022

Discovery date	Mound number	Profile	Is the mound active?	Freshly scraped	Eggshell	Inner crust	Inner herbs/ shrubs	Rim height (m)	Depth (m)	Outer diameter (m)	Rim diameter (m)	Habitat unit	Mound status
27/04/2022	EEL55_01	1	N	N	N	N	N	0.27	0.26	3.85	2.45	ACA	5-10 Years
27/04/2022	EEL55_02	1	N	N	N	N	N	0.2	0.12	3.12	1.7	EUC	Long unused
27/04/2022	EEL55_03	1	N	N	N	Y	N	0.32	0.13	3.7	2.1	ACA	Long unused
27/04/2022	EEL55_04	1	N	N	N	Y	N	0.22	0.12	2.8	1.5	ACA	Long unused
28/04/2022	EEL55_05	1	N	N	N	Y	S	0.1	0.3	4	2.67	EUC	Long unused
28/04/2022	EEL55_06	3	Y	Y	Some	N	N	0.31	0.41	4.45	2.45	EUC	Active
28/04/2022	EEL55_07	1	N	N	Some	N	N	0.23	0.26	4.2	2.35	ACA	5-10 Years
28/04/2022	EEL55_08	1	N	N	N	Y	H	0.1	0.3	3.7	2.65	MEL	Long unused
29/04/2022	EEL55_09	3	Y	Y	Lot	N	N	0.63	0.41	4.35	1.8	ACA	Active
29/04/2022	EEL55_010	1	N	N	Some	N	N	0.66	0.33	4.55	2	ACA	<5 Years
29/04/2022	EEL55_011	1	N	N	N	Y	S	0.59	0.31	5.3	3.45	ACA	Long unused
29/04/2022	EEL55_012	1	N	N	N	Y	H	0.15	0.18	5	2.75	EUC	Long unused

Table 2: Photographs of Malleefowl nesting mounds located during survey in April 2022

Details	Photo	Details	Photo
EEL55_01 Outer rim: 3.85m Inner rim; 2.45m Depth: 0.26m Long unused		**EEL55_03** Outer rim: 3.7m Inner rim; 2.1m Depth: 0.13m Long unused	
EEL55_02 Outer rim: 3.12m Inner rim; 1.70m Depth: 0.12m Long unused		**EEL55_04** Outer rim: 2.80m Inner rim; 1.50m Depth: 0.12m Long unused	

Details	Photo	Details	Photo
EEL55_05 Outer rim: 4.00m Inner rim; 2.67m Depth: 0.30m Long unused		**EEL55_07** Outer rim: 4.20m Inner rim; 2.35m Depth: 0.26m Inactive abandoned	
EEL55_06 Outer rim: 4.45m Inner rim; 2.45m Depth: 0.41m Active		**EEL55_08** Outer rim: 3.70m Inner rim; 2.65m Depth: 0.30m Long unused	

Details	Photo	Details	Photo
EEL55_09 Outer rim: 4.35m Inner rim; 1.80m Depth: 0.41m Active		**EEL55_011** Outer rim: 5.30m Inner rim; 3.45m Depth: 0.31m Long unused	
EEL55_010 Outer rim: 4.55m Inner rim; 2.00m Depth: 0.33m Inactive recent		**EEL55_012** Outer rim: 5.00m Inner rim; 2.75m Depth: 0.18m Long unused	

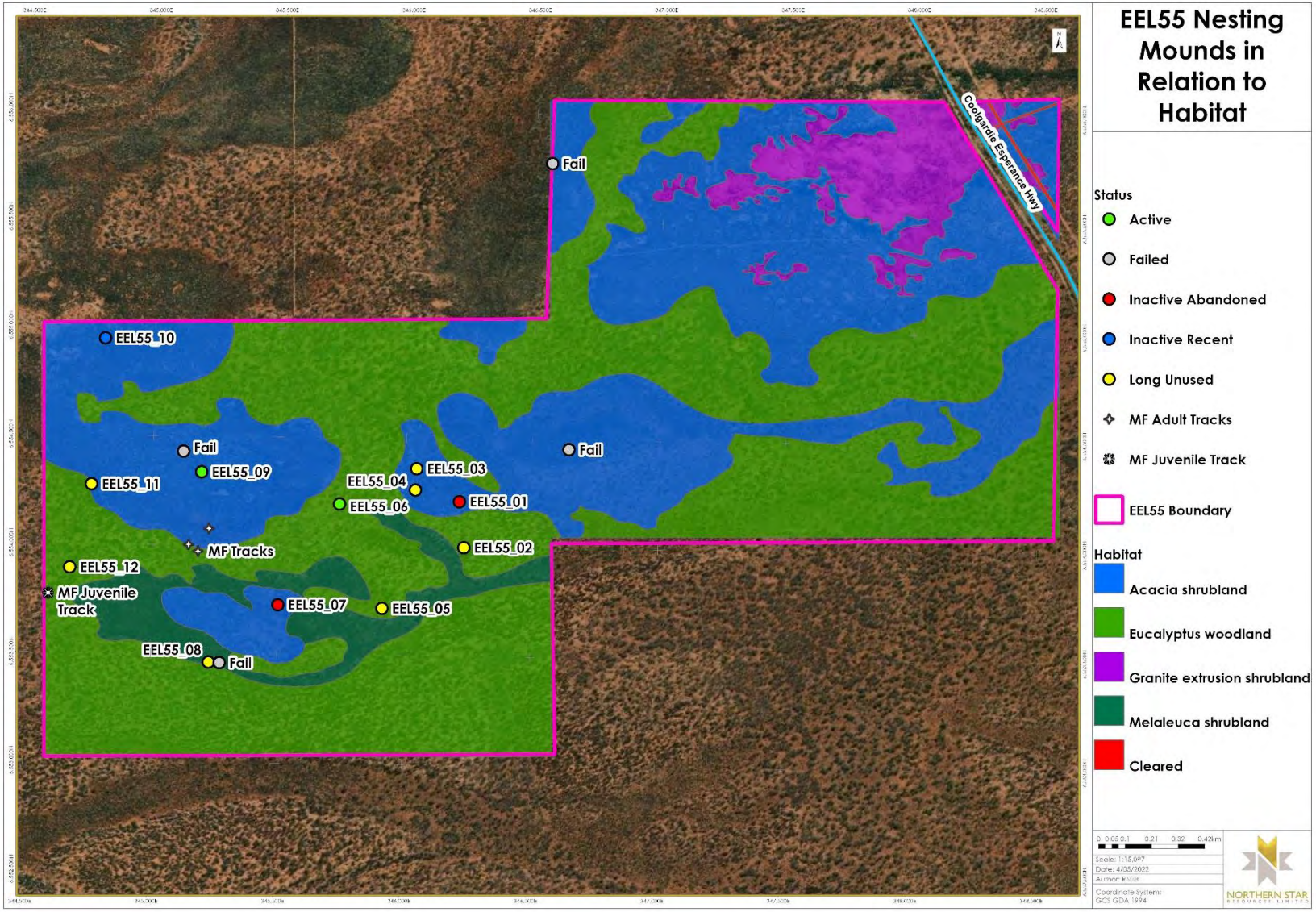

Figure 4: Location of Malleefowl nesting mounds and tracks in relation to habitat.

6 Discussion

Malleefowl are active in the western section of the 800ha assessment envelope. Two nesting mounds appeared to have been used in the past few months and fresh Malleefowl tracks were observed nearby.

Of the twelve established mounds recorded, seven were located within 'acacia shrubland', four within 'eucalyptus woodland', one within 'melaleuca shrubland' and none in 'granite extrusion forbland'. Phoenix Environmental Sciences (2022) rate 'acacia shrubland' and 'melaleuca shrubland' as suitable for Malleefowl breeding. Together these habitat types occupy approximately 350ha or 44% of the assessment envelope and equates to between 2.3 and 2.5 established nesting mounds per 100ha. 'Eucalyptus woodland' occupies 405ha, approximately 50% of the assessment envelope, and is rated suitable for dispersal and foraging. While most 'Eucalyptus woodland' has low foliage cover, isolated pockets of Melaleuca provide dense cover and the four nesting mounds found in this habitat were located in these favoured locations. Established nesting mounds were found at approximately 1 per 100ha.

Malleefowl appear to make little or no use of 'granite extrusion forbland' within the low granite outcrops which are restricted to 44ha of the assessment envelope and rated as unsuitable Malleefowl habitat by Phoenix Environmental Sciences (2022).

Fresh tracks of wild dog/dingo were noted at several locations throughout the assessment envelope and one set of cat tracks noted in a central location. Phoenix Environmental Sciences (2022) also noted cat scats during habitat survey in January 2022.

7 References

Beard, J.S. (1990). Plant Life of Western Australia. Kenthurst NSW: Kangaroo Press

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Phoenix Environmental Sciences (2022). Malleefowl Offset Site Survey for Northern Star Resources Ltd: 142.

Disclaimer

Within the limitation imposed by the scope of review, the data assessment and preparation of the report have been undertaken in a professional manner and in accordance with generally accepted practices using a degree of care ordinarily exercised by professional environmental consultants. No other warranty, expressed or implied, is made.

Appendix 1: Locations of Malleefowl nesting mounds and tracks

Mound ID	Zone	Northing	Easting	Mound status
EEL55_01	51J	346213	6554213	5-10 Years
EEL55_02	51J	346233	6554002	Long unused
EEL55_03	51J	346042	6554362	Long unused
EEL55_04	51J	346038	6554264	Long unused
EEL55_05	51J	345913	6553718	Long unused
EEL55_06	51J	345739	6554196	Active
EEL55_07	51J	345501	6553729	5-10 Years
EEL55_08	51J	345231	6553462	Long unused
EEL55_09	51J	345191	6554335	Active
EEL55_10	51J	344802	6554946	<5 Years
EEL55_11	51J	344757	6554274	Long unused
EEL55_12	51J	344676	6553891	Long unused
Fail	51J	345273	6553459	Fail
Fail	51J	345119	6554430	Fail
Fail	51J	346559	6555772	Fail
Fail	51J	346643	6554458	Fail
MF Track	51J	345144	6554001	Adult
MF Track	51J	345182	6553971	Adult
MF Track	51J	345224	6554076	Adult
MFJV Track	51J	344592	6553771	Juvenile

Appendix E Confirmation of Protective Mechanism

Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Our Ref: fA642159
Enquiries:
Telephone: 9368 2382
Date: 30 June 2022

Northern Star Resources Ltd
Larissa Byrne
Environmental Advisor
Level 1 / 388 Hay St
Subiaco WA 6008

Dear Larissa

RE: Potential Conservation Covenant - EEL55 COT Volume 2625 Folio 387.

Thankyou for advising our office of your intention to Covenant whole or part of EEL55 in relation to EPBC Referral 2021/9026.

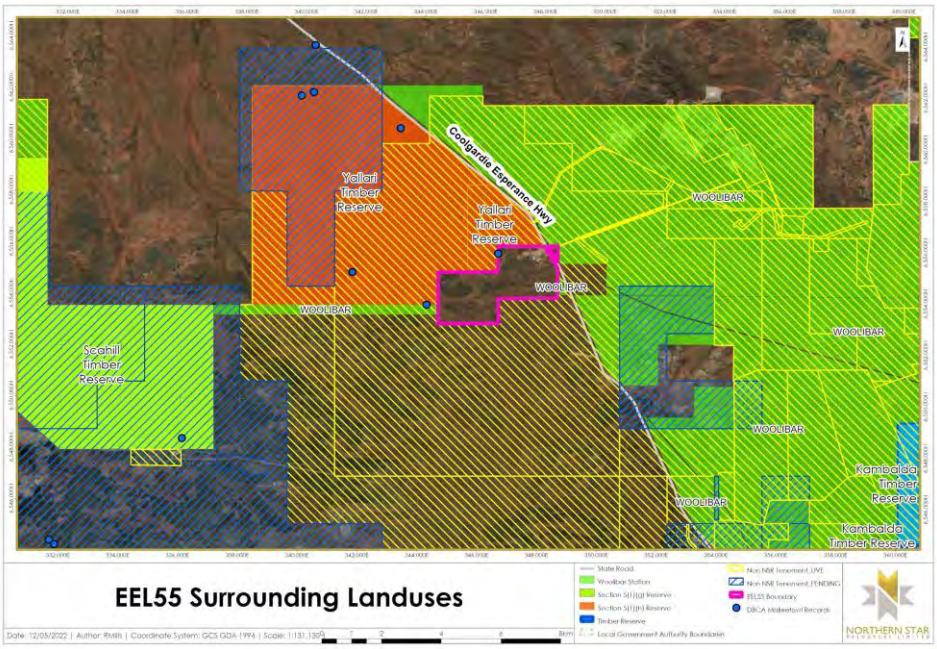
I have undertaken a desktop review of the area (as defined in your maps attached) and can confirm that it would be appropriate for you to apply for a Conservation Covenant under the *Soil and Land Conservation Act 1945* to protect native vegetation for the mitigation and prevention of land degradation.

As discussed, you may also like to consider alternative protection arrangements, such as via the Department of Biodiversity, Conservation and Attractions (DBCA), who manage the neighboring reserves.

Should you wish to proceed, please forward an application form and a copy of any relevant EPBC conditions to this office.

Yours sincerely

Jodie Ferdinando
Project Officer
OFFICE OF THE COMMISSIONER
OF SOIL AND LAND CONSERVATION


Coolgardie Esperance Hwy
Yallari Timber Reserve
Yallari Timber Reserve
WOOLIBAR
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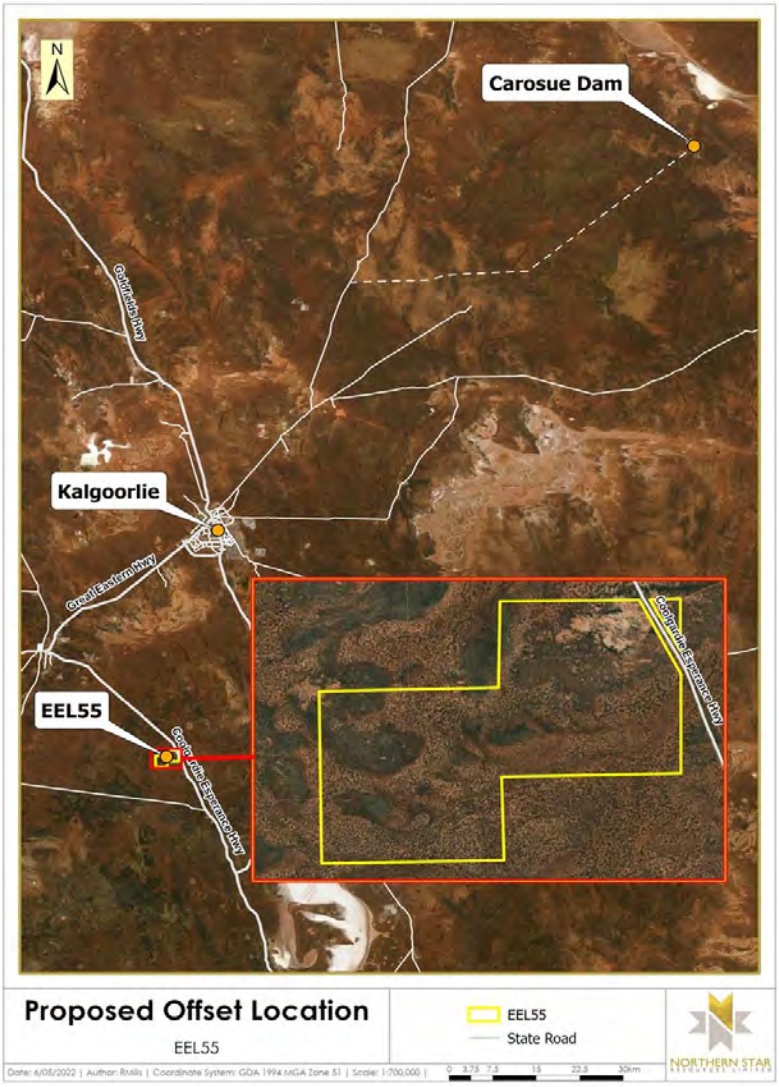
Scahill Timber Reserve
Kambalda Timber Reserve
Kambalda Timber Reserve
EEL55 Surrounding Landuses
NORTHERN STAR


N
Carosue Dam
Goldfields Hwy
Kalgoorlie
Great Eastern Hwy
EEL55
Coolgardie Esperance Hwy
Coolgardie Esperance Hwy
Proposed Offset Location
EEL55
EEL55
State Road
NORTHERN STAR

Appendix D: Northern Star Resources Environmental Policy

ENVIRONMENTAL POLICY

Northern Star Resources Limited (Northern Star or the Company) has a duty of care and legal obligation to protect the environment, and is committed to managing its activities in an environmentally responsible manner. Through effective management practices, the Company aims to ensure its activities have a minimum impact on the environment.

The Company's success in environmental management is underpinned by its belief that business can and must be conducted in an environmentally sustainable manner, together with a desire that future generations have the right to enjoy and experience the world as it is today. This overriding commitment to the environment is demonstrated through our Environmental Management System.

Northern Star will drive our approach to environmental care by:

- Implementing and maintaining an Environmental Management System to identify, assess and minimise environmental risk at all stages of its operations as a fundamental part of its long-term strategy.
- Monitoring our environmental footprint, and setting and measuring annual targets for improved environmental performance.
- Complying with all applicable legal and statutory requirements as a minimum standard, and ensuring prompt and transparent reporting of any non-compliances.
- Engaging stakeholders on their concerns, aspirations and values regarding the development, operation and closure aspects of our projects.
- Minimise the environmental impacts of our operations through the efficient use of natural resources, the reduction of input materials and waste, and the minimisation of dust and emissions of gases.
- Pursuing biodiversity understanding through baseline assessments and regular monitoring to enhance the ability for biodiversity protection.
- Providing information, instruction, training and supervision to enable everyone to understand and comply with their environmental obligations and responsibilities.
- Ensuring managers and supervisors are authorised and accountable for taking remedial action in the event of an environmental non-compliance.
- Not compromising first world standards when exploring, building and operating in developing countries or regions.
- Communicating this policy and environmental performance in an open, transparent and accurate manner.

As a minimum, Northern Star will honour its duty of care obligations under all applicable legislation and will work to standards which at least meet or exceed these legal obligations.

Each and every person at Northern Star has a duty of care to ensure they work in a manner which complies with the Company's environmental policies and procedures, and they act in a manner that reflects our Code of Conduct and STARR Core Values.

The Environment Policy applies to all people employed by Northern Star, its subsidiaries, any contractors or visitors interacting in or with our business.

Northern Star encourages the participation and feedback of everyone in all matters relating to the environment, and commits to provide adequate resources to enable ffective implementation of this policy.