ATLAS-CAMPASPE
Mineral Sands Project
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B 〉 FAUNA ASSESSMENT

CRISTAL Resource Strategies

AMBS Reference: 110951

8 May 2013

Australian museum
BUSINESS SERVICES

Ray Roberts
Cristal Australia Mining Limited
4463 Benetook Avenue
Thurla VIC 3496

Dear Ray,

Altas-Campaspe Mineral Sands Project – Proposed Surface Development Footprint

I understand that, upon careful consideration of the potential surface development impacts, Cristal Mining has advised that the mine plan has been refined to avoid a Malleefowl nesting mound and two Cobar Greenhood Orchid locations recorded during surveys. Given this commitment was made immediately prior to the finalisation of this report, and resulted in a change to the proposed surface development area, the figures within the main body of the report were amended to reflect this change. It should be noted however, that the figures in Appendix C of this report (Seven Part Tests) have not been updated, on the basis that at the scale presented, the relevant changes would have been immaterial. For clarity, the figures in the main body of this report provide the accurate representation of the proposed mine plan.

Yours sincerely,

Glenn Muir
Senior Project Manager, *Ecology*

Atlas-Campaspe Mineral Sands Project

Fauna Assessment

Prepared by Australian Museum Business Services
for Cristal Mining Australia Limited

Final Report

May 2013

AMBS Reference 110951

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Executive Summary

The Atlas-Campaspe Mineral Sands Project (the Project) would involve the open-cut mining of two deposits located approximately 80 kilometres (km) north of the township of Balranald and 135 km south-west of Ivanhoe. Mining would be undertaken consecutively in each deposit over a period of about 20 years. The Project would also involve the development of supporting infrastructure for the mine (access roads, administration buildings, accommodation, etc.) and the construction of a facility at Ivanhoe for the loading of materials onto trains (the Ivanhoe Rail Facility). Material would be trucked from the mine site to Ivanhoe along a Mineral Concentrate Transport Route (MCTR) and the Project would involve the widening of approximately 37 km of existing public roads between the mine site and Hatfield. The proposed MCTR between Hatfield and the Ivanhoe Rail Facility would be along existing roads and would not involve road widening or re-alignment works.

This report presents a study of terrestrial fauna potentially impacted by the Project, performed by Australian Museum Business Services (AMBS) and commissioned by Cristal Mining Australia Limited. The purpose of the study is to consider the potential impacts of the Project on terrestrial fauna, in particular, threatened species listed on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or NSW *Threatened Species Conservation Act 1995* (TSC Act). The study included a desktop investigation, fauna surveys, an assessment of potential impacts and proposed mitigation measures and a consideration of a proposed offset area.

The desktop investigation examined existing databases and literature to identify terrestrial fauna that may be affected by the Project. This included threatened species lists for the Catchment Management Authority (CMA) subregion; searches of the Australian Museum, Birdlife Australia, the Commonwealth Department of Sustainability, Environment, Water Populations and Communities and the NSW Office of Environment and Heritage (OEH) databases; data from recent surveys performed in Mungo National Park provided by OEH; a review of fauna survey reports from the "Balranald Mineral Sands Project" (located approximately 10 km to the south of the Project) and a review of scientific literature, reference works and spatial information such as aerial imagery and vegetation maps. Database searches were performed for the Atlas-Campaspe Mine and MCTR and another set for the Ivanhoe Rail Facility study area, because the two areas are located approximately 135 km apart and are located within different CMA subregions. The locations of all threatened fauna previously recorded within a 20 km radius of the Project area were mapped and an assessment was made of the likelihood of occurrence of threatened fauna within the Project area and the likely extent of impacts from the Project on those threatened fauna. The literature review found no reports of systematic fauna studies undertaken in the Project area or immediate surrounds prior to the surveys by AMBS.

Field surveys of the Project area and surrounding lands were performed over several periods from May 2011 to September 2012. Most of the targeted fauna survey work within the Atlas-Campaspe Mine footprint was completed between November 2011 and January 2012 and within the Ivanhoe Rail Facility footprint during October 2012. The Atlas-Campaspe Mine study area had received good rainfall during the preceding year and again in November 2011 and conditions for detection of a wide range of fauna were good. A range of survey techniques were used, including pitfall traps, Elliott A traps, funnel traps, harp traps, hair tubes, remote cameras, diurnal bird surveys, waterbird surveys, reptile searches, frog searches, call playback, scat, sign and track searches, Malleefowl transects, nocturnal spotlighting and the use of ANABAT detectors.

The survey techniques and effort employed at each site varied depending on the habitat type, presence of particular habitat resources (e.g. if waterbodies were not present no amphibian or waterbird searches were conducted) and the types of fauna likely to be present.

The search of literature and database records for threatened fauna near the Atlas-Campaspe Mine study area and MCTR provided a list of 55 animal species that are listed as threatened on the EPBC Act and/or TSC Act, including two species of frog, six species of reptile, 37 species of bird and ten species of mammal. This list includes species that have been previously recorded within 20 km of the Atlas-Campaspe Mine study area and MCTR roadworks footprint, species that are known or predicted to occur in the South Olary Plain Murray Basin Sands (Part B) subregion of the Lower Murray-Darling Basin CMA Region, and species that were predicted by the EPBC Act Protected Matters database to have potential habitat within 10 km of the Project area. Of these, 40 species were considered to have potential to occur in the Project area or immediate surrounds, including 25 species of bird, six species of reptile and nine species of mammal. Five migratory bird species listed under the EPBC Act have been recorded within a 20 km radius of the Atlas-Campaspe Mine and MCTR footprints, and searches of the EPBC Act Protected Matters database returned an additional five bird species that were predicted to have potential habitat.

The search of database records for threatened fauna near the Ivanhoe Rail Facility study area provided a list of 48 animal species that are listed as threatened on the EPBC Act and/or TSC Act, including one species of frog, two species of reptile, 37 species of bird and eight species of mammal. This list includes species that have been previously recorded within 20 km of the Ivanhoe Rail Facility study area, species that are known or predicted to occur in the Darling Depressions (Part B) subregion of the Lachlan CMA Region and species that were predicted by the EPBC Act Protected Matters database to have potential habitat within 10 km of the Project area. Five of these species are additional to the species known or considered likely to occur in the Atlas-Campaspe Mine study area and the MCTR roadworks footprint. This includes four species of bird and one species of mammal. Database searches within a 20 km radius of the Ivanhoe Rail Facility and searches of the EPBC Protected Matters database did not return any additional migratory species, but one additional species was recorded during surveys of the Ivanhoe Rail Facility study area, the Great Egret.

Field surveys recorded a total of 228 animal species in the Atlas-Campaspe Mine, MCTR roadworks footprint and surrounds, including three species of frog, 43 species of reptile, 146 species of bird and 36 species of mammal. Nine of the animal species recorded are exotic and include the House Mouse, Dog/Dingo, European Red Fox, Feral Cat, Brown Hare, European Rabbit, European Cattle, Goat and Sheep. All these exotic species were common or abundant, with the exception of the Brown Hare, European Cattle and the Sheep, which were rare.

Threatened fauna species recorded in the Atlas-Campaspe Mine study area and MCTR and close surrounds, were the Bardick, Jewelled Gecko, Mallee Worm-lizard, Spinifex Slender Blue-tongue, Australian Painted Snipe, Chestnut-backed Quail-thrush, Bush Stone-curlew, Freckled Duck, Gilbert's Whistler, Hooded Robin, Little Eagle, Major Mitchell's Cockatoo, Malleefowl, Pied Honeyeater, Redthroat, Regent Parrot, Spotted Harrier, Varied Sittella, White-fronted Chat, South-eastern Long-eared Bat (also known as Corben's Long-eared Bat), Inland Forest Bat, Little Pied Bat, Yellow-bellied Sheathtail-bat and Southern Ningaui. Probable records of the Western Pygmy-possum were also obtained (from hairs found in scats and identified to genus and a probable nest) and a possible record of the Long-haired Rat was obtained from a hair sample identified to genus. The Stripe-faced Dunnart and Bolam's Mouse were recorded during surveys of the south-east of Mungo National Park.

Field surveys also recorded a total of 67 animal species in the Ivanhoe Rail Facility study area and/or surrounds, including two species of frog, one species of reptile, 59 species of bird and 5 species of mammal. Three of the animal species recorded are exotic and include the Fox, Pig and Goat. All these exotic species were abundant or evidence of them obvious. Threatened fauna species recorded in the surrounds included the White-fronted Chat, Little Eagle and Major Mitchell's Cockatoo.

Two threatened species, Rufous Fieldwren and Diamond Firetail, were also opportunistically recorded along roads some distance from the Project area.

Fauna habitat types present in the Project area and/or surrounds were Linear Dune Mallee, Sandplain Mallee, Belah-Rosewood Woodland (for both the Atlas-Campaspe Mine and surrounds and the Ivanhoe Rail Facility study area and surrounds) Black Box Woodland (for both the Atlas-Campaspe Mine and surrounds and the Ivanhoe Rail Facility study area and surrounds), Ephemeral Wetland (for both the Atlas-Campaspe Mine and surrounds and the Ivanhoe Rail Facility study area and surrounds), Acacia Woodland/Shrubland, Sandhill Pine Woodland, Chenopod Shrubland, Chenopod Shrubland Depressions, Grass and Herbland Depressions, Disturbed Shrubland, Native Grassland(Ivanhoe Rail Facility study area and surrounds only) and Cleared Land. The majority of the Atlas-Campaspe study area contained mallee or belah communities and these extended for some distance into the surrounding landscape to the north, south and west. A matrix of habitats associated with clay soils and landscape depressions (Black Box Woodland and degraded Yarran Shrubland) occurred east of the mallee, including some areas located within the Atlas-Campaspe study area. Further east, along the MCTR from the Atlas-Campaspe Mine to Balranald-Ivanhoe Road, the landscape was dominated by Chenopod Shrublands and depressions. The majority of the Ivanhoe Rail Facility study area and surrounds contained Belah-Rosewood/Acacia Woodland communities interspersed by Native Grasslands/Sparse Acacia /Chenopod Shrub communities. Slightly east of the study area is an Ephemeral Wetland associated with a Black Box Woodland which has a lignum understorey.

The condition of these habitat types was generally consistent across the Project area and surrounding landscape, however the condition of the habitat type varied. Communities such as the Cleared Land were highly disturbed; communities located close to depressions that fill with water after rain (such as Black Box Woodland) had the ground layers disturbed; and Belah-Rosewood Woodland and Sandplain Mallee were affected by grazing. The Linear Dune Mallee communities within the study area were in relatively good condition.

The Project area and surrounds contained a range of habitat features that provide resources for fauna, including tree hollows, spinifex, decorticating bark, fallen timber, and food plants. Two ephemeral wetlands were located and smaller depressions were scattered throughout.

The main impact of the Project on these fauna and their habitats would be the loss of habitat as a result of the excavation of the mine pits and the associated stockpiles and other Project requirements. This would include the loss of approximately 1,575 hectares (ha) of Mallee and 2,035 ha of Belah-Rosewood Woodland, smaller amounts of Acacia Woodland/Shrubland (200 ha) and Black Box Woodland (50 ha). About 98 ha (mostly Chenopod Shrubland) would be cleared for the MCTR. Other potential impacts considered were the loss of individuals from local populations, loss of hollow-bearing trees, removal of dead wood and dead trees, loss of habitat connectivity, alteration to hydrology, edge effects, and dust and other pollution. The potential for increased risk of wildfire and for introduction/increase of feral animals or pathogens was also considered; however, the risk of these occurring would be considerably lessened with appropriate management.

The Project incorporates a number of features, mitigation and management strategies that would minimise the impacts and risks to fauna. These include designing the mine footprint to avoid an area of Ephemeral Wetland, undertaking mining progressively over 20 years, post-mine rehabilitation using plant species characteristic of the local area, pre-clearance surveys, salvage and relocation of habitat features such as hollows and logs to rehabilitation areas, and management of water, dust, weeds, feral animals, stock and fire risk. Once mining is complete, the land levels along the main flow paths would be restored to levels that allow cross drainage to occur.

The Project also incorporates an offset located adjacent to Mungo National Park. The offset would conserve in perpetuity some 16,270 ha of native vegetation communities in similar condition to that of the Project area and 270 ha of Cleared Land that would be allowed to regenerate, with assisted revegetation if natural regeneration fails. The majority of the proposed offset area comprises mallee, with Belah-Rosewood Woodland, Black Box Woodland, Acacia Woodland/Shrubland and Ephemeral Wetland also represented. At least 19 threatened fauna have been recorded in the proposed offset area, including some species not detected within the Project area.

Sixteen threatened fauna species were recorded in the Project area, however it was conservatively considered that up to 45 species of threatened fauna listed under the TSC Act (and up to five species under the EPBC Act) could be impacted to some extent by the Project. These potential impacts range in type and severity, from loss of areas of potential habitat for some species with no nearby records to the direct loss of known breeding habitat for others which are present. Assessments of significance were performed for all threatened species considered potentially and likely to be affected by the Project. The conclusion of these assessments for the majority of these species was that the impacts are not likely to be 'significant'. Many species and their habitats are well represented in the surrounding landscape, including in the proposed offset area. The species considered to have the greatest level of impact as a result of the Project were the Malleefowl, South-eastern Long-eared Bat (also known as Corben's Long-eared Bat) and Western Pygmy-possum. Impacts on these species were considered to be significant according to the assessment criteria set out in the legislation.

Notwithstanding the above, the establishment and appropriate management of the proposed offset area has the potential to conserve and improve extensive areas of known or potential habitat for these species in the locality. This is because management of the proposed offset area would include a number of measures that could result in alleviating threatening processes and improving habitats. These measures include exclusion of stock, feral animal control, implementation of an ecologically sensitive fire regime, closure of artificial watering points and weed control. The overall size of the proposed offset area is more than three times the size of the total area of habitat that would be cleared by the Project and it contains more Linear Dune Mallee, Sandplain Mallee, Belah-Rosewood Woodland, Black Box Woodland and Acacia Woodland/ Shrubland than would be cleared by the Project. In particular, it contains approximately 16,440 ha of potential habitat for the Malleefowl, approximately 15,325 ha of potential habitat for the Western Pygmy-possum and approximately 15,830 ha of potential habitat for the South-eastern Long-eared Bat (also known as Corben's Long-eared Bat).

In view of the above it is considered that the Project meets the standard in the requirements of the Director-General of the New South Wales Department of Planning and Infrastructure for the Project because fauna biodiversity in the region would be maintained and improved in the medium to long-term.

Contents

Figures

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1 Introduction

1.1 Background

This report presents the aims, methods, results and conclusions of a study of the terrestrial fauna associated with an area in south-west New South Wales (NSW) that is the subject of a Development Application. The study was performed by Australian Museum Business Services (AMBS) and was commissioned by Cristal Mining Australia Limited (Cristal Mining), formally known as Bemax Resources Limited (Bemax). The development proposal is known as the Atlas-Campaspe Mineral Sands Project (the Project). The Project would involve the mining of two mineral sands deposits (the Atlas and Campaspe deposits), the construction and operation of associated infrastructure, and post-mining rehabilitation. The Project would also involve the construction and operation of a rail load out facility at Ivanhoe (the Ivanhoe Rail Facility).

This report contains an assessment of the potential impacts of the Project on terrestrial fauna in accordance with relevant Commonwealth and NSW planning and environmental legislation. The Project has been declared a State Significant Development (SSD) by the Director-General of the NSW Department of Planning and Infrastructure (DP&I) and will be assessed using the SSD pathway of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The DP&I will be the consenting authority for this Project.

A Preliminary Environmental Assessment of the Project (Bemax, 2012a) was submitted to the DP&I in March 2012. The DP&I issued Director-General's Requirements (DGRs) for the environmental assessment of the Project.

A Referral to the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities in relation to the Project (Bemax, 2012b) was submitted on 4 July 2012. The Project was declared a 'controlled action' for the purposes of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Objectives and scope

The primary aim of this assessment is to consider the potential impacts of the Project on terrestrial fauna (in particular, fauna of conservation significance) based on the DGRs. Fauna of conservation significance are defined in this report as threatened species and populations listed on the Schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or are listed as matters of national environmental significance by the EPBC Act. The specific objectives of this assessment are to consider the:

- terrestrial fauna known or predicted to occur in the area that would be affected by the Project, including fauna of conservation significance;
- potential impacts of the Project on terrestrial fauna;
- proposed impact avoidance and mitigation measures; and
- proposed offset.

The scope of this assessment includes:

- a 'desktop' assessment of existing survey reports and other data regarding the terrestrial fauna of the study area;
- field surveys of the terrestrial fauna within the study area;
- descriptions and maps of the broad fauna habitat types within the study area, including an assessment of condition;
- a list of fauna species observed during surveys of the study area, including introduced and threatened species;
- the identification of fauna species and populations of conservation significance likely to be affected by the Project;
- an assessment of the potential impacts of the Project on native fauna;

- assessments of the likely magnitude, nature and significance of impacts of the Project on fauna species and populations of conservation significance;
- a discussion of impact avoidance and mitigation measures proposed as part of the Project; and
- presentation of a proposed offset in relation to the Project.

There are no fauna species listed under the *NSW Fisheries Management Act 1999* (FM Act) that are relevant to this Project.

1.3 Location

The majority of the study area is located within the Balranald Local Government Area (LGA) (Figure 1) and Lower Murray-Darling Catchment Management Authority (CMA). It is covered by the Pooncarie 1:250,000 and Turlee 1:100,000 topographical survey sheets. The Ivanhoe Rail Facility is within the Central Darling LGA and the Lachlan CMA.

The Atlas-Campaspe Mine is situated approximately 80 kilometres (km) north of the township of Balranald and 135 km south-west of Ivanhoe (Figure 1). It is located on leasehold land (Wampo and Boree Plains Stations) currently used for agriculture (mainly grazing, with some cropping). The study area in this location incorporates the proposed extent of surface development and surrounds (Figure 2).

The proposed mineral concentrate transport route (MCTR) is from the Atlas-Campaspe Mine to the Ivanhoe Rail Facility (Figures 1 and 2). This component of the Project would involve improvements (including widening and some re-alignment) to a 37 km section of existing public roads, extending from the south-eastern end of the Atlas-Campaspe Mine to the Balranald-Ivanhoe Road near the locality of Hatfield (Figure 3). The proposed MCTR between Hatfield and the Ivanhoe Rail Facility would be along existing roads and would not involve road widening or re-alignment works (Figure 1).

The Ivanhoe Rail Facility is located approximately 4.5 km south-west of Ivanhoe, on the northern edge of the Orange-Broken Hill railway (Figure 4).

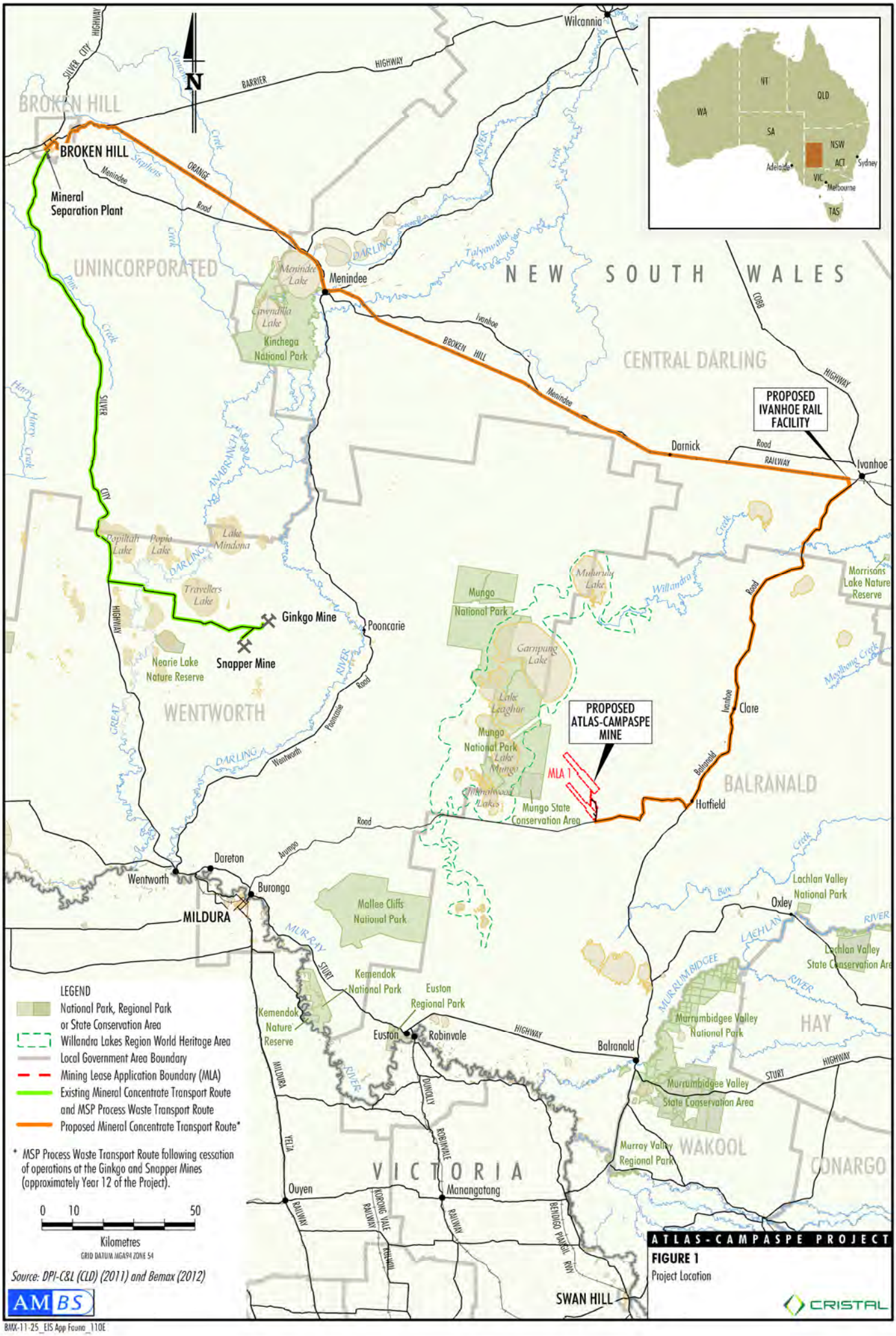
Nearby conservation areas include Mungo National Park to the west of the Atlas-Campaspe Mine, a private conservation area on Boree Plains adjoining the National Park to the east and another private conservation area to the south on Wampo Station (Figure 2). The private conservation areas have been established as Southern Mallee Land Use Agreements.

1.4 Proposed development

1.4.1 Overview

The Project would involve two main development components (Figure 1):

1. Construction and development of infrastructure for mining operations at the Atlas and Campaspe deposits (the proposed Atlas-Campaspe Mine) (Figures 2 and 3).
2. Construction and operation of the Ivanhoe Rail Facility (the proposed Ivanhoe Rail Facility) (Figure 4).


BROKEN HILL
Mineral Separation Plant
Wilcannia
Menindee
Menindee Lake
Kinchega National Park
UNINCORPORATED
NEW SOUTH WALES
CENTRAL DARLING
PROPOSED IVANHOE RAIL FACILITY
Darnick
Ivanhoe
Ginkgo Mine
Snapper Mine
Pooncarie
Nearie Lake Nature Reserve
WENTWORTH
Mungo National Park
Gampung Lake
Lake Leaghur
Lake Mungo
Mungo State Conservation Area
PROPOSED ATLAS-CAMPASPE MINE
MLA 1
Hatfield
Clare
BALRANALD
Morrisons Lake Nature Reserve
Dareton
Wentworth
Buronga
MILDURA
Mallee Cliffs National Park
Kemendok National Park
Kemendok Nature Reserve
Euston Regional Park
Euston
Robinvale
Balranald
Oxley
Lachlan Valley National Park
Lachlan Valley State Conservation Area
Murrumbidgee Valley National Park
Murrumbidgee Valley State Conservation Area
HAY
Murray Valley Regional Park
WAKOOL
CONARGO
VICTORIA
Ouyen
Manangatang
SWAN HILL
LEGEND
National Park, Regional Park or State Conservation Area
Willandra Lakes Region World Heritage Area
Local Government Area Boundary
Mining Lease Application Boundary (MLA)
Existing Mineral Concentrate Transport Route and MSP Process Waste Transport Route
Proposed Mineral Concentrate Transport Route*
* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).
0 10 50
Kilometres
GRID DATUM MGA94 ZONE 54
Source: DPI-C&L (CLD) (2011) and Bemax (2012)
AMBS
ATLAS-CAMPASPE PROJECT
FIGURE 1
Project Location
CRISTAL
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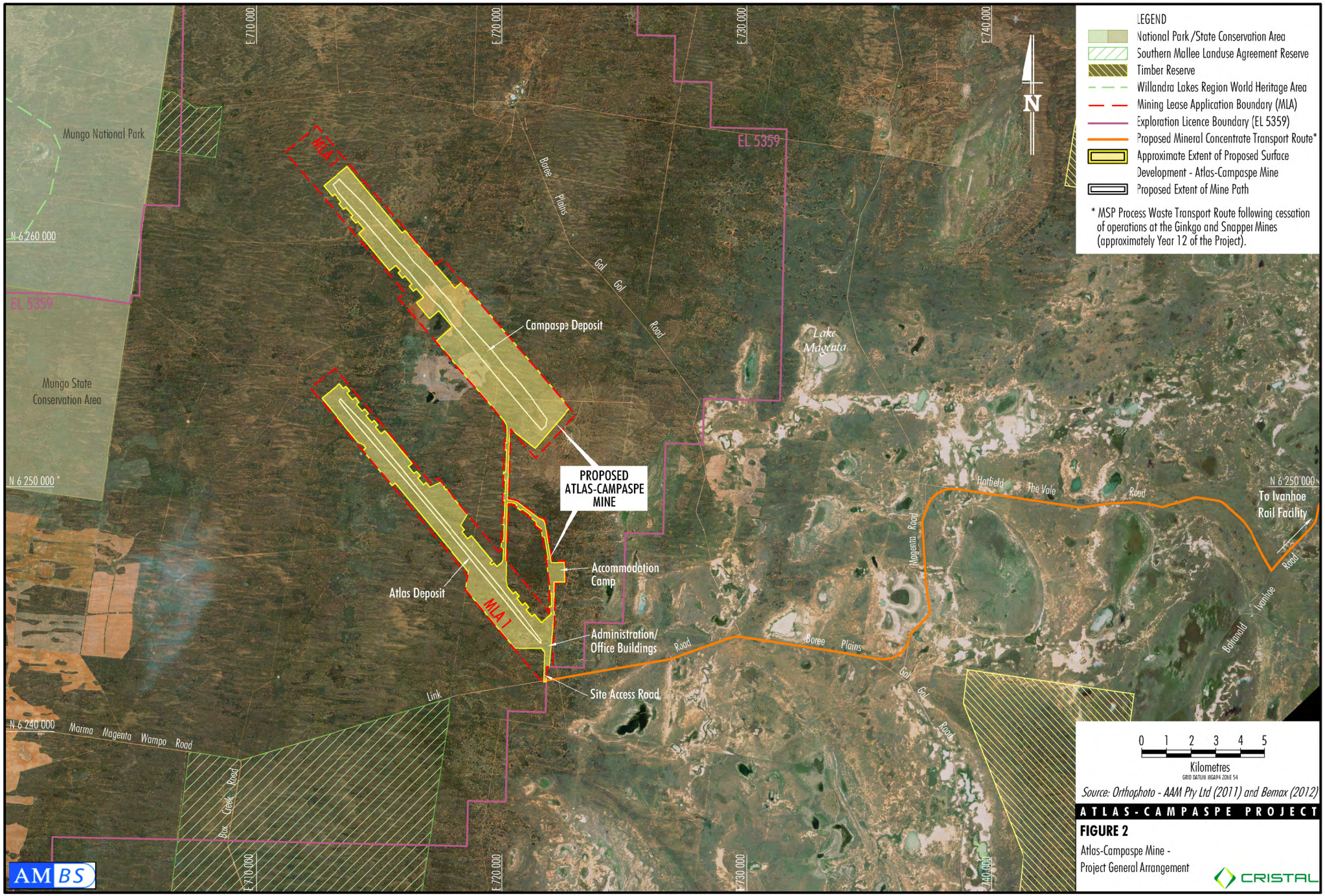

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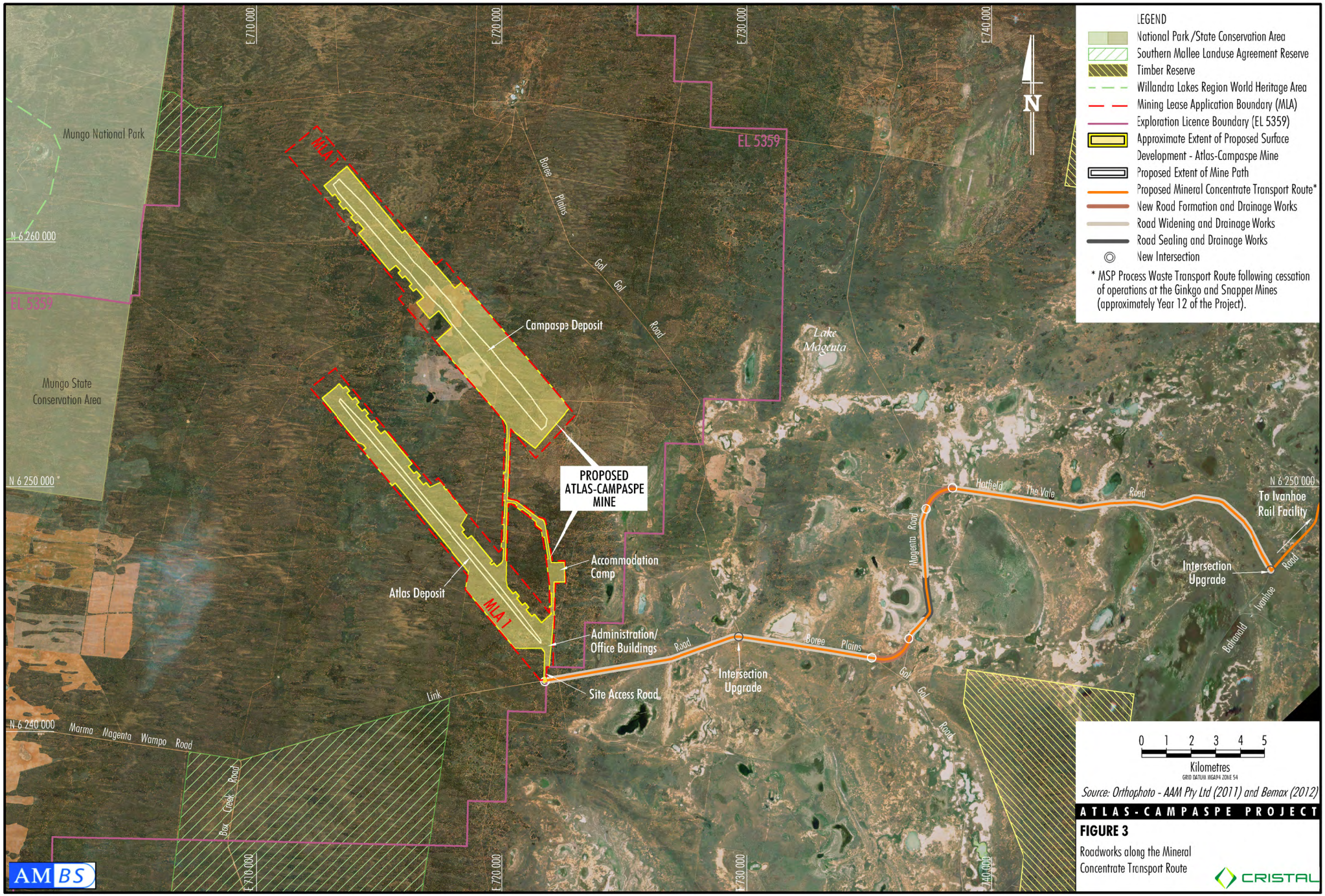

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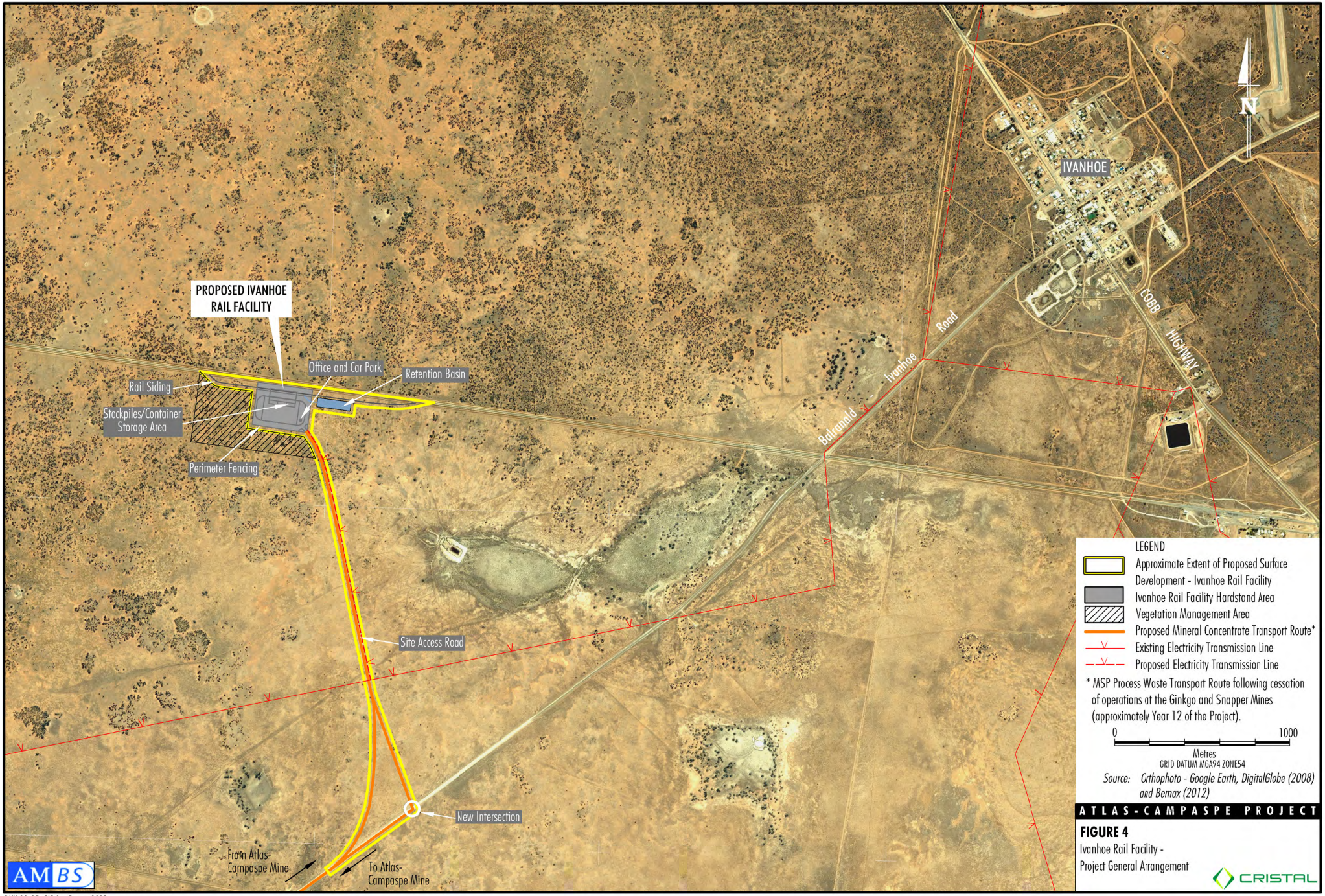

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The proposed life of the Project is approximately 20 years, commencing approximately 1 July 2013 or upon the grant of all required approvals.

The activities associated with the two main development components of the Project are summarised in Sections 1.4.2 and 1.4.3.

1.4.2 Atlas-Campaspe Mine

The main activities associated with the development of the Atlas-Campaspe mine would include:

- ongoing exploration activities;
- sequential development and operation of two separate mineral sands ore extraction areas within the Mining Lease Application (MLA) 1 area;
- use of conventional mobile equipment to mine and place mineral sands ore into dry mining unit(s)[1] at a maximum ore production rate of up to 7.2 million tonnes per annum;
- mineral processing infrastructure including the primary gravity concentration unit, salt washing facility and a wet high intensity magnetic separation circuit;
- mineral concentrate stockpiles and materials handling infrastructure (e.g. towers and stackers);
- progressive backfilling of mine voids with overburden behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path;
- placement of sand residues and coarse rejects (and the Broken Hill Mineral Separation Plant [MSP] process wastes[2]) following mineral processing to either the active mining area (behind the advancing ore extraction area) or in sand residue dams;
- development of a groundwater borefield at the Atlas deposit and localised dewatering systems (bores, spearfields and trenches) at both the Atlas and Campaspe deposits, including associated pump and pipeline systems;
- reverse osmosis plant to supply the salt washing facility and potable water;
- progressive development of water storage dams, sediment basins, pumps, pipelines and other water management equipment and structures;
- administration/office buildings, car parking facilities, workshop and stores;
- on-site accommodation camp;
- sewage treatment plant;
- diesel powered generators, electricity distribution station and associated internal electricity transmission lines;
- site access road, internal access roads and haul roads;
- roadworks along the proposed MCTR to the Ivanhoe Rail Facility;
- transport of mineral concentrates along the MCTR to the Ivanhoe Rail Facility;
- road transport of MSP process waste[2] in sealed storage containers from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine for subsequent unloading, stockpiling and placement behind the advancing ore extraction areas;
- development of soil stockpiles and laydown areas;
- monitoring and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

[1] Mining would use conventional open pit methods and would not involve dredge mining.

[2] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

1.4.3 Ivanhoe Rail Facility

The main activities associated with the construction and operation of the Ivanhoe Rail Facility would include:

- development of a rail siding for:
  - loading of train wagons with mineral concentrate for rail transport to the MSP via the Orange - Broken Hill railway; and
  - unloading of MSP process waste in sealed storage containers (transported via the Orange - Broken Hill railway) from train wagons[3]);
- site access road and internal haul roads/pavements;
- hardstand areas for mineral concentrate and MSP process waste[3] unloading, stockpiling/container storage and loading;
- a retention basin, drains, pumps, pipelines and other water management equipment and structures;
- site office and car parking facilities;
- extension to existing 11 kilovolt powerline;
- monitoring, landscaping and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

Further details regarding the Project are provided in Section 2 in the Main Report of the Environmental Impact Statement (EIS).

1.5 Definitions

Atlas-Campaspe Mine study area - the survey area for the Atlas-Campaspe Mine. The area covers the MLA and encompasses the approximate extent of proposed surface development at the Atlas-Campaspe Mine.

Atlas-Campaspe Mine footprint - the approximate extent of proposed surface development at the Atlas-Campaspe Mine.

Atlas footprint - the approximate extent of proposed surface development associated with mining of the Atlas deposit.

Campaspe footprint - the approximate extent of proposed surface development associated with mining of the Campaspe deposit.

Clearing - the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation so as to result in the loss, or long-term modification of the structure, composition and ecological function of stand or stands.

Composition (in relation to ecological communities) - both the plant and animal species present, and the physical structure of an ecological community. While many ecological communities are identified primarily by their vascular plant composition, an ecological community consists of all plants and animals as defined under the TSC Act and the FM Act that occur in that ecological community.

Direct impacts - those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of a plant(s) and the removal of suitable habitat.

Ecological function - the ecological processes/interactions that occur within an ecological community.

[3] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

Endangered Ecological Community (EEC) - an ecological community facing a high risk of extinction in the near future as defined under the TSC Act and EPBC Act.

Extent - the physical area removed and/or the compositional components of the habitat and the degree to which each is affected.

Habitat - the area occupied, or periodically or occasionally occupied, by any threatened species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles.

Indirect impacts - when Project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas.

Ivanhoe Rail Facility footprint - the approximate extent of proposed surface disturbance at the Ivanhoe Rail Facility.

Ivanhoe Rail Facility study area - the study area for the Ivanhoe Rail Facility.

Life cycle - the series or stages of reproduction, growth, development, ageing and death of an organism.

Likely - a real or not remote chance or possibility.

Locality - the ecological community or species that occurs within the study area. Same meaning ascribed to local population of a species or local occurrence of an ecological community if the ecological community or local population of a species on the study area forms part of a larger contiguous area of that ecological community, and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.

Local occurrence - the extent of the ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.

Local population - the population that occurs in the study area. The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.

MCTR - proposed mineral concentrate transport route.

MCTR roadworks footprint - roadworks along the mineral concentrate transport route.

MLA - Mining Lease Application Area.

Native vegetation - plant communities, comprising primarily indigenous species, the composition and structure of which reflects the interactions between plant species, between plants and fauna and with the environment.

Proposed offset area - the area proposed for the offset.

Plant community - an assemblage of plant species occupying a particular area. The composition of a plant community is the assemblage of plant species that occur in the community. Plant communities are dynamic and subject to change, either endogenous as in some successions, or in response to external factors such as seasonal variation, longer term changes in climate (drought-wet cycles) or disturbances such as fire or storm (NSW Scientific Committee, 2001).

Project area - the approximate extent of proposed surface development at the Atlas-Campaspe Mine and Ivanhoe Rail Facility.

Risk of extinction - the likelihood that the local population (of a threatened species, or the local occurrence of an ecological community) would become extinct either in the short-term *or* in the long-term as a result of direct or indirect impacts on the viability of that population, and/or the function of the ecological community.

Significant - important, notable or of consequence having regard to its context or intensity.

Stratum (plural strata) - a more or less distinct layer within a stand of vegetation (e.g. ground layer, understorey, canopy, emergent).

Structure - the structure of a plant community is the three dimensional distribution of biomass within the community (the strata).

Viable - the capacity to successfully complete each stage of the life cycle under normal conditions.

1.6 Authorship and acknowledgements

Fauna survey work was undertaken by George Madani, Ben Lewis, Dr Ulrike Kloecker, Narawan Williams, Dr Martin Schulz, Glenn Muir, Mark Semeniuk, Dr Terry O'Dwyer, Melina Budden, David James, Tom O'Sullivan and Nick Shuter. Identification of ultrasonic microbat calls was undertaken by Dr Martin Schulz, Narawan Williams and Greg Ford. Identification of scats and hair tube samples was undertaken by Barbara Triggs (Dead Finish Pty Ltd) and Georgeanna Story (Scats Alive). Data management was undertaken by Ulrike Kloecker and Terry O'Dwyer with assistance with data entry provided by Laura Sothern. This report was prepared by Glenn Muir, Belinda Pellow, Melina Budden, Mark Semeniuk, David James, Dr Martin Schulz, Dr Terry O'Dwyer, Dr Ulrike Kloecker and James Bevan.

2 Existing Environment

2.1 Regional setting

2.1.1 Bioregion

The Atlas-Campaspe Mine is located within the Murray-Darling Depression Bioregion, which occurs in south-western NSW, north-western Victoria and south-eastern South Australia. The Project area is located within the north-eastern portion of the bioregion (NSW), which contains few town centres. The Ivanhoe Rail Facility is located near the boundary of the adjacent Riverina Bioregion. The Murray-Darling Depression Bioregion includes the catchments of the Murray, Murrumbidgee, Lachlan, Darling, Barwon and Yanda Rivers.

The Murray-Darling Depression Bioregion is bordered to the north by the Broken Hill Complex Bioregion, with the Cobar Peneplain to the northeast and the Riverina Bioregion to the east. The Murray-Darling Depression Bioregion also borders the Darling Riverine Plains Bioregion to the north-west.

Conservation-oriented mechanisms, such as nature reserves, national parks, conservation reserves and historic sites occupy 421,082 hectares (ha) or 5.25 percent (%) of the bioregion (NSW Office of Environment and Heritage [OEH], 2011a). National parks and nature reserves (under the NSW *National Parks and Wildlife Act 1974* [NPW Act]) make the greatest contribution to the area conserved, occupying 279,343 ha, or about 3.48% of the bioregion. The Willandra Lakes Region World Heritage Area, which occupies approximately 240,000 ha or almost 3% of the bioregion, is included on the internationally recognised World Heritage List. About 10% of the Willandra Lakes Region World Heritage Area is in Mungo National Park.

2.1.2 Catchment Management Authority Region

The Atlas-Campaspe Mine is located within the Lower Murray-Darling CMA, which has an area of some 6.3 million hectares and extends from Broken Hill in the north to the Murray River in the south, and from the South Australian border in the west to the Murray/Murrumbidgee junction in the east (Lower Murray-Darling CMA, 2012). The Ivanhoe Rail Facility is located in the Lachlan CMA, which has an area of some 8.7 million hectares and extends westwards from the Great Dividing Range and adjoins the Lower Murray-Darling Catchment (Lachlan CMA, 2012).

The Murrumbidgee, Lachlan and Darling Rivers are significant regional surface water features. The Murrumbidgee, at its closest point, is located approximately 64 km southeast of the Atlas-Campaspe Mine and the Darling River some 81 km to the west. The Murrumbidgee, Lachlan and Darling Rivers drain generally south to the Murray River.

The Willandra Lakes Region World Heritage Area extends from between Spring Hill and Mulurulu (approximately 50 km north of Boree Plains), south-west to Mungo Station (33 km west of Boree Plains) and further south to Prungle (68 km south-west of Boree Plains) (Commonwealth Department of Sustainability, Environment, Water, Population and Communities [SEWPaC], 2008).

2.2 Geology

A number of large scale ridges and basins form the pre-Tertiary basement profile, over which the relatively flat lying Tertiary and Quaternary sediments of the Murray Basin have formed within which the Atlas-Campaspe Mine is located (GEO-ENG, 2013). The main structural feature of the area is the Ivanhoe Block, which is defined by the south-west to north-east trending Iona and Neckarboo basement ridges. In the west of the Ivanhoe Block, the Willandra Trough exists as a basement low between the ridges and continues to the north-east as the Willandra Creek Depression and is generally associated with the Willandra Lakes Region World Heritage Area. The Atlas-Campaspe Mine is located in the east of the Ivanhoe Block.

2.3 Soils

2.3.1 Atlas-Campaspe Mine

The Atlas-Campaspe Mine study area contains the following land systems (Walker, 1991):

- Arumpo;
- Bulgamurra;
- Mandelman;
- Marona; and
- Wilkurra.

The following soil types associated with these land systems occur within the study area:

- dunes of deep siliceous and brownish sands and earthy or calcareous sands;
- sandplains of solonised brown soils and calcareous red earths, or highly calcareous salinized brown soils;
- swales of highly calcareous solonised brown soils and texture-contrast soils;
- depressions of grey cracking clays;
- lakes of saline, gypseous or calcareous clays; and
- lunettes and dunes of deep earthy sands.

2.3.2 MCTR study area

The MCTR study area contains the following land systems (Walker, 1991):

- Hatfield;
- Marma;
- Mulurulu;
- Wilkurra; and
- Youhl.

The following soil types associated with these land systems occur within the study area:

- dunes with deep brownish sands;
- plains and flats with highly calcareous salinized brown soils or red sandy earths, or solonised brown soils and red and brown texture-contrast soils;
- depressions or floodplains or grey cracking clays;
- lakebeds of grey clacking clays and red texture-contrast soils;
- lunettes of saline or compact clays, or calcareous red earthy sands and red earths; and
- levees of red and yellow texture-contrast soils and grey cracking clays.

2.3.3 Ivanhoe Rail Facility

The Ivanhoe Rail Facility study area contains the Hatfield and Manara land systems (Walker, 1991).

The following soil types associated with these land systems occur within the study area:

- plains of solonised brown soils, red and brown texture-contrast soils and red earths;
- dunes of deep brownish sands; and
- depressions of grey clays.

2.4 Landform

Development of landforms within the Murray Basin is strongly related to climatic variation and interactions between fluctuating saline groundwater and surface geomorphic processes. Processes of Aeolian dune fields, groundwater discharge complexes, gypseous sediments, clay lunettes and bed-load channel sands were activated by glacial aridity. Sand availability has been the dominant controlling factor in the distribution of dune fields, with climatic conditions initiating and reactivating the dune fields. Wetter inter-glacial periods provided vegetation-stabilised landforms, suspended load channel sediments and sand-dominated lunettes (Kingham, 1998).

The Atlas-Campaspe Mine area primarily comprises semi-arid vegetation occurring on Tertiary and recent age (60 million years ago to present) sediments. The geomorphology of the area consists primarily of Aeolian dune fields and sandplains overlaying clay. Soils are of red and orange sands in the dune fields and sandplains to grey, brown or red calcareous clay sediments that underlie the sand deposits and are exposed in low-lying areas and depressions (Porteners *et al*., 1997). The dunes, which occupy a considerable proportion of the area, are relatively low in height, with gentle slopes; however, some higher steep-sided dunes occasionally occur. The sandplains consist of a thin 'veneer' of sand overlaying the clays.

2.5 Climate

Long-term, monthly-average daily maximum and minimum temperatures from the Pooncarie Mail Agency, Balranald (RSL) and Ivanhoe Post Office meteorological stations show that temperatures are warmest from November to March and coolest in the winter months of June, July and August (Table 1) (Bureau of Meteorology [BoM], 2012).

The long-term average annual rainfall at meteorological stations proximal to (i.e. less than 50 km) the Atlas-Campaspe Mine varies from approximately 268 millimetres (mm) at the Pooncarie (Top Hut) meteorological station to approximately 323 mm at the Oxley (Walmer Downs) meteorological station (Table 1).

Average monthly rainfall is relatively uniform throughout the year and no seasonal variation is obvious (Table 1).

Based on an analysis by Evans & Peck (2012) of the Hatfield (Clare) meteorological station rainfall data (which has 140 years of complete records), the data shows that long-term droughts are a feature of the climate of the area. In particular (Evans & Peck, 2012):

- an extended drought occurred between about 1880 and 1900;
- a further extended drought occurred between about 1930 to 1950;
- since 1950, rainfall has generally been above the long-term average with the exception of droughts in the late 1960's and from 2000 to the end of 2009; and
- rainfall has been significantly above average since 2010 with 650 mm of rainfall in that year and 440 mm in 2011, which is evident by water ponding in low-lying areas surrounding the Atlas-Campaspe Mine site.

Table 1: Average climate statistics.

Period of Record	Average Daily Temperature (°C)[1] [Minimum-Maximum]			Average Monthly Rainfall (mm)[1]									Average Monthly Evaporation (mm)[1,2]	
	Pooncarie Mail Agency [47029]	Balranald (RSL) [49002]	Ivanhoe Post Office [49019]	Hatfield (Clare) [49008]	Euston (Turlee) [49111]	Hatfield (The Vale) [49047]	Hatfield (Benikie) [49049]	Pooncarie (Mulurulu) [47024]	Pooncarie (Top Hut) [47018]	Oxley (Walmer Downs) [49055]	Ivanhoe (Kilfera) [49063]	Ivanhoe Post Office [49019]	Menindee Post Office [47019]	Mildura Airport [76031]
	1882-2012	1879-2012	1884-2012	1873-2012	1960-2012	1924-2012	1876-2012	1882 - 2012	1920-2012	1922-2012	1872-2012	1884-2012	1968-2012	1965-2012
January	33.4-38.5	29.5-38.1	29.5-39.5	25.6	33.1	28.0	23.6	24.0	22.9	28.2	20.7	30.0	332.6	328.6
February	31.8-37.0	28.6-37.1	30.1-38.4	25.9	22.7	24.7	25.0	22.7	27.0	29.4	29.0	28.4	268.3	274.0
March	27.6-33.4	25.3-33.8	26.3-37.6	27.4	21.2	24.1	22.1	23.2	20.1	24.9	24.5	29.8	225.1	229.4
April	22.9-30.0	16.3-28.6	22.1-31.2	21.5	20.1	20.4	18.9	19.1	16.7	23.0	19.4	19.1	143.1	141.0
May	18.8-23.4	16.4-23.3	17.1-23.6	29.0	24.9	25.5	27.9	29.0	22.7	29.1	27.7	27.1	85.3	83.7
June	14.8-18.5	13.2-20.0	14.8-19	26.1	20.2	24.0	25.6	25.7	19.7	26.6	27.6	26.6	57.7	57.0
July	16.0-19.6	12.4-21.0	13.7-19.5	22.9	25.1	21.6	21.6	21.8	23.5	26.1	20.1	22.9	64.7	62.0
August	16.8-21.4	14.7-25.4	15.8-23.4	24.0	25.8	23.7	24.0	23.8	22.5	26.1	22.7	23.5	99.5	93.0
September	20.5-24.7	16.9-24.9	18.5-25.8	22.9	24.8	21.2	22.7	23.4	19.7	22.8	22.4	22.2	147.0	138.0
October	23.3-28.9	19.8-30.0	21.9-30.2	26.6	28.1	28.2	27.2	26.7	29.1	31.9	25.6	28.6	212.2	201.5
November	27.2-33.9	23.4-32.8	25.2-35.1	23.7	25.9	25.0	23.2	23.2	19.3	26.1	25.3	24.0	260.4	255.0
December	30.9-35.4	24.5-34.9	29.5-37.1	22.0	22.9	22.5	21.8	23.7	20.8	26.4	20.6	26.1	319.9	310.0
Average Annual	**25.1-26.9**	**22.1-26.6**	**24.8-28.1**	**299 [297.6]**	**300 [294.8]**	**286 [288.6]**	**281 [283.6]**	**282 [286.3]**	**268 [264]**	**323 [320.6]**	**284.0 [285.6]**	**306 [308.3]**	**2,208.0 [2,215.8]**	**2,190.0 [2,173.2]**

[1] Source: BoM (2012).

[2] As measured by Class A Evaporation Pan.

°C = degrees Celsius.

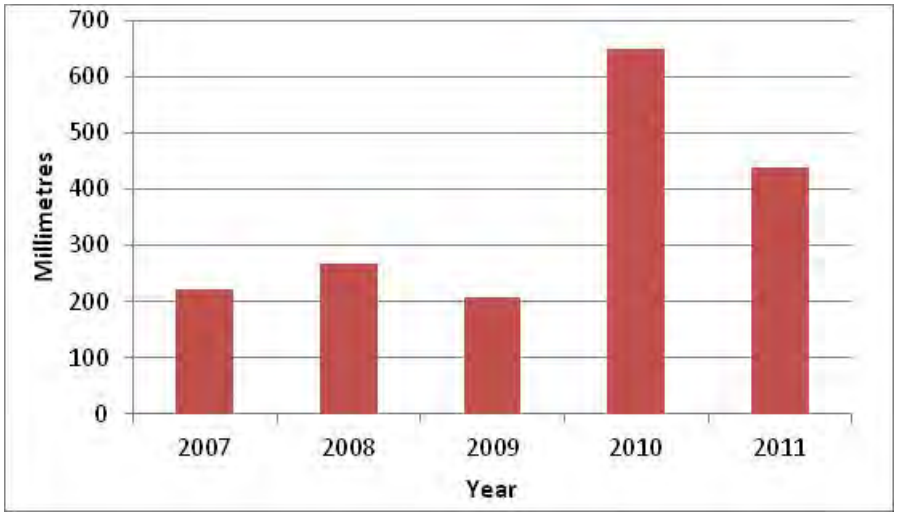
*Monthly rainfall provided as total of rounded average figures and [total of average raw figures]

The above is also supported by the fact that the nearest BoM meteorological station to the Atlas-Campaspe Mine site (Euston [Turlee]) recorded its highest daily total of 110 mm on 14 January 2011 in 53 years of record (BoM, 2012).

Based on an analysis by Evans & Peck (2012) of the Menindee DWR Depot meteorological station daily pan evaporation data recorded since 1968), and use of monthly potential evapotranspiration derived from the electronic spatial data on the BoM dataset Climatic Atlas of Australia - Evapotranspiration, the following conclusions were made (Evans & Peck, 2012):

- Net open water evaporation in excess of 1.5 metres (m) per year can be expected. Accordingly, any runoff collected in the shallow depressions that characterise the landscape can be expected to evaporate rapidly.
- Potential evapotranspiration from vegetation exceeds the average rainfall in each month. Under these conditions, vegetation is under continual water stress and actual evapotranspiration is governed by the ability of vegetation to access moisture deep in the soil profile.

As shown in Graph 1, over the two years prior to this assessment (2010 and 2011), the region received approximately double the annual average rainfall. In comparison, in the preceding three years (i.e. 2007, 2008 and 2009) only 222 mm, 266 mm and 207 mm of rainfall was recorded, respectively (Graph 1) (BoM, 2012). This resulted in ideal conditions during the survey period.



Source: BoM, 2012

Graph 1: Annual rainfall in the years preceding the field surveys - Hatfield (Clare) meteorological station.

Long-term evaporation records are available from the Menindee Post Office and Mildura Airport meteorological stations, which have recorded an average annual evaporation of approximately 2,208 and 2,190 mm, respectively (Table 1).

The highest monthly-average evaporation is in January (332.6 and 328.6 mm at Menindee Post Office and Mildura Airport, respectively) (Table 1). The lowest monthly evaporation is in June (57.7 and 57.0 mm for Menindee Post Office and Mildura Airport, respectively) (Table 1).

Based on the available datasets, measured monthly-average evaporation exceeds the measured monthly-average rainfall in all months (Table 1).

2.6 Vegetation

The vegetation of the Project area and surrounds is described in detail in the *Atlas-Campaspe Mineral Sands Project - Flora Assessment* (AMBS, 2013).

The vegetation of the Atlas-Campaspe Mine area and surrounds largely corresponds to landforms and soils, and varies from mallee communities located on sand dunes and plains to Belah-Rosewood and Black Box (*Eucalyptus largiflorens*) communities on clay soils. The majority of the Atlas-Campaspe Mine area contains mallee and belah, with Black Box being a minor component. A number of other plant communities are represented in smaller amounts, such as degraded Acacia Shrublands and land that has been cleared for agriculture (AMBS, 2013).

The majority of the MCTR study area is located on low-lying areas with vegetation primarily comprising Chenopod Shrublands, with smaller amounts of Sandhill Pine Woodland present in some locations (AMBS, 2013).

The vegetation of the Ivanhoe Rail Facility study area and surrounds also corresponds to the landforms and soils, with the area comprising primarily plains and clay depressions. As with the Atlas-Campaspe Mine study area, the clay soils are dominated by a Black Box community, with Belah-Rosewood/Acacia Woodland and Native Grasslands on the plains.

2.7 Hydrology

The Atlas-Campaspe Mine is located within the Benanee basin of the lower Murray River system in NSW. The Benanee basin borders the upstream effluent creeks of the Lachlan River basin, Darling and Murrumbidgee River basins and the downstream Murray River basin. The Benanee basin is made up of a number of ill-defined creeks, streams and ephemeral lakes that contribute negligible inflows to the Murray River (NSW Office of Water, 2012).

The Atlas-Campaspe Mine site is located approximately mid-way between two ill-defined drainage systems (Evans & Peck, 2012):

- the Willandra Creek and Willandra Lakes system (to the north and west of the Atlas-Campaspe Mine site) - this system contains numerous dry lakes (Mulurulu, Gorpung, Learhur, Mungo and Chibnalwood) which drain from north-east to south-west; and
- the Arumpo Creek and Prungle Lakes system (to the east and south of the Atlas-Campaspe Mine site) - this system also drains from north-east to south-west.

The regional surface drainage in the vicinity of the Atlas-Campaspe Mine occurs by overland flow from north-east towards the south-west. The Atlas-Campaspe Mine site contains no defined water courses other than a few minor drainage lines that drain from the south-eastern end of the Campaspe deposit towards a relic lake depression (Evans & Peck, 2012).

The Project is located in a region with a semi-arid climate of low and sporadic rainfall and high evaporation. Long-term droughts are a feature of the climate of the region (Evans & Peck, 2012). Rainfall has been significantly above average since 2010 with 650 mm of rainfall in that year and 440 mm in 2011, which is evident by water ponding in low-lying areas surrounding the Atlas-Campaspe Mine site (Evans & Peck, 2012) and within the mine site.

There are no permanent surface water features at the proposed Atlas-Campaspe Mine (i.e. no groundwater window lakes fed by the deep underlying saline groundwater system) (GEO-ENG, 2013).

Where sandy layers occur, the upper layer (sand) drains fast down to lower layer (clay). Water collects on the clay and persists after rain on numerous clay-based run-on depressions and gilgai. A series of such depressions occurs in an approximately north-south direction to the south-east of the Campaspe footprint (Evans & Peck, 2012). Two large clay-based depressions are located in the close surrounds; one on the very edge of and partially within (9 ha) the Campaspe footprint and one approximately 2.5 km to the south-south-east of the Campaspe footprint. Both depressions are located on or beside the 'local topographic low point' or area in which surface flow would disperse into and collect during significant rain events (Evans & Peck, 2012). Any runoff from the mine areas that filled the local depressions would flow predominantly in a south-south-easterly direction, following a series of large basin-like depressions that can be over 20 m in depth (Evans& Peck, 2012).

Temporary ponding of rainfall occurs in localised topographic depressions where rainfall runoff is concentrated and the surficial soils have low permeability. These locations are isolated and do not contribute to any significant surface water system. Drainage from these locations is limited due to the low-permeability surface soils and the majority of the water eventually dissipates by evaporation (GEO-ENG, 2013).

The review of available baseline hydrogeological data indicates localised temporal surface ponding due to limited drainage, and underlying saline groundwater aquifers at moderate to significant depths (GEO-ENG, 2013). There are no existing permanent surface water features at the proposed Atlas-Campaspe Mine (i.e. no groundwater window lakes fed by the deep underlying saline groundwater aquifer). Therefore, no impacts on any surface water baseflows are predicted as a result of mining at the Atlas-Campaspe Mine (GEO-ENG, 2013).

The groundwater table is associated with the underlying saline groundwater systems (ranging from approximately 10 m to 30 m below ground level) and generally sits within the shallow Shepparton Formation or underlying Loxton-Parilla Sands (GEO-ENG, 2013). The region is characterised by low-gradient groundwater flow from east to west (GEO-ENG, 2013).

The Ivanhoe Rail Facility study area is located approximately 22 km north on Willandra Creek. Temporary ponding of rainfall occurs in localised topographic depressions located 0.5 km to the east between the study area and the Balranald-Ivanhoe Road. Groundwater is not a factor relevant to the Ivanhoe Rail Facility as no groundwater is proposed to be extracted at the facility.

2.8 Fire history

The only fires known to have occurred within the Atlas-Campaspe Mine and surrounding area are extensive fires during 1974-75 and a more recent, smaller fire to the north of the Atlas-Campaspe Mine. In 1974-75 large fires burnt out much of the mallee vegetation in the Balranald, Wentworth, Central Darling and Cobar Shires (NSW National Parks and Wildlife Service [NPWS], 2006; Noble, 1989). A smaller fire that occurred in the mallee to the north of the study area occurred about 10-12 years ago (Caretaker Boree Plains station, pers. comm.) and its approximate extent can still be seen on satellite imagery.

2.9 Land use

2.9.1 Current land use

The land where the Atlas-Campaspe Mine is proposed to be developed has been used for sheep and cattle grazing for the past 100 years. Some sections of land have also been cropped, and feral goats (*Capra hircus*) are periodically herded and sold for their meat. In the past properties have been fenced using local timbers, primarily Cypress Pine for fence posts. Water is obtained through bores to groundwater aquifers to maintain stock numbers and rough tracks have been cut to facilitate vehicular access to tanks and fencing.

In 2011 a drilling program located within Exploration Licence 5359, was undertaken focusing on the Atlas and Campaspe MLAs. Drill lines were established across the survey area using a small front end loader 4WD tractor with a scrub blade to push aside vegetation (Bemax, 2011). Drill lines were placed to avoid removal of large trees. Use of a raised bucket to push the vegetation aside prevented disturbance to the rootstock of the vegetation (Bemax, 2011). A path of between 6-8 m wide and up to 300 m in length was cleared depending on the section.

The 203,000 ha Gol Gol Station (including Lake Mungo) was established in the 1860s. The property was purchased by the NSW NPWS in 1978, and now forms part of Mungo National Park and the Willandra Lakes World Heritage Area.

The Ivanhoe Rail Facility study area is currently being used for cattle grazing. Sections of this area have been cleared in the past.

2.9.2 Current tenure

Land on which the Atlas-Campaspe Mine is proposed to be developed consists of leasehold tenure as Western Lands Leases through the NSW *Western Lands Act 1901*. The MCTR roadworks footprint occurs on land consisting both freehold and leasehold land. A travelling stock route is located to the south of the Atlas-Campaspe Mine area.

Land on which the proposed Ivanhoe Rail Facility is to be developed consisted of leasehold tenure as Western Lands Leases through the *Western Lands Act 1901*.

3 Methods

3.1 Desktop review

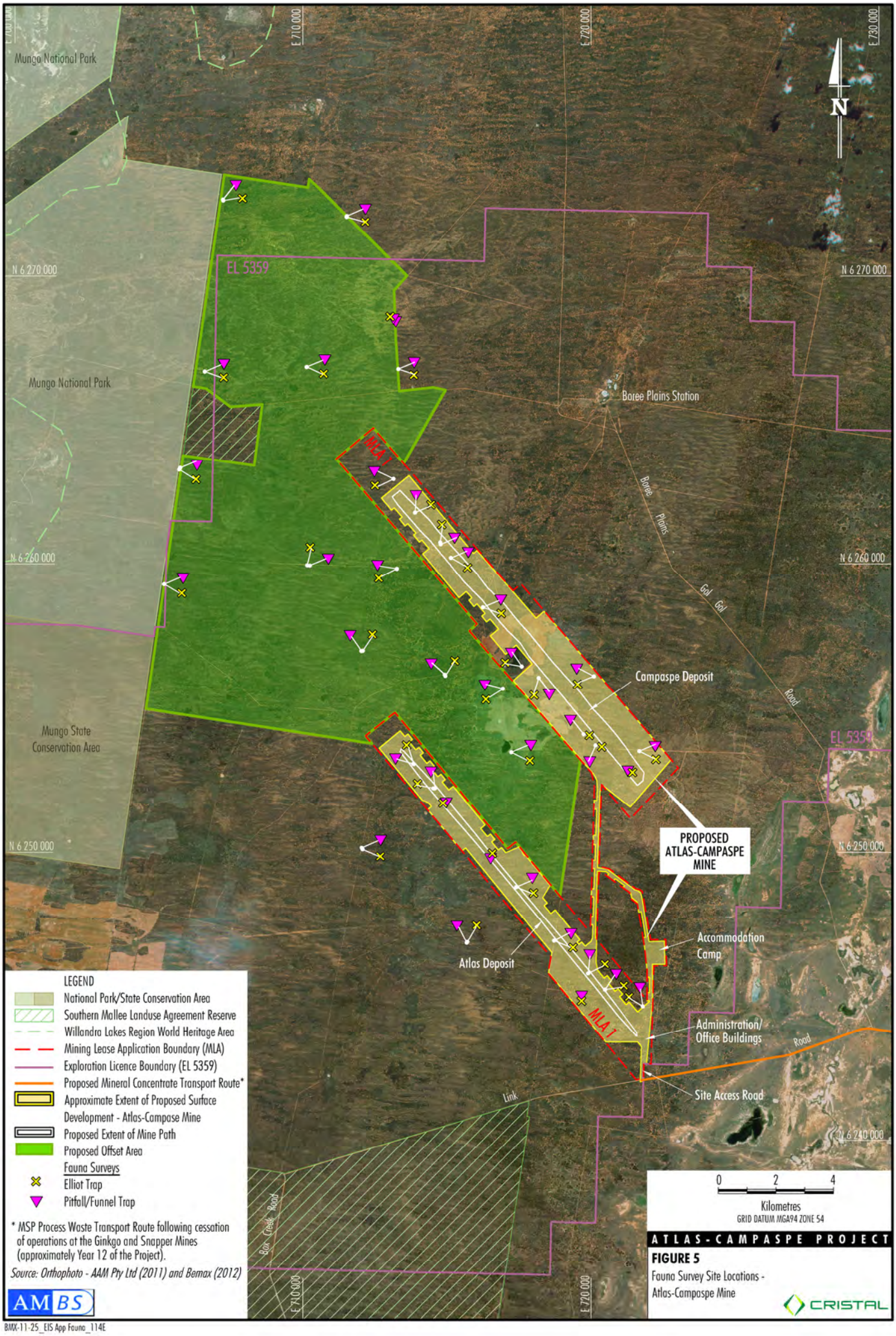
A desktop investigation was carried out to identify terrestrial fauna and terrestrial fauna habitat that may be affected by the Project. This included:

- a list of the threatened species known and predicted to occur within the Lower Murray-Darling Basin CMA subregion (South Olary plain, Murray Basin Sands [Part B]) (OEH, 2012a);
- a list of the threatened species known and predicted to occur within the Lachlan CMA subregion (Darling Depression [Part B]) (OEH, 2012b);
- a search of the Australian Museum database for records of threatened fauna within a 20 km radius of the Project area (Australian Museum, 2012);
- a search of the Birdlife Australia database for records of threatened bird species within a 20 km radius of the Project area (Birdlife Australia, 2012);
- a search of the SEWPaC Protected Matters database for matters of national environmental significance listed under the EPBC Act known or predicted to occur within a 20 km radius of the Project area (SEWPaC, 2012a);
- a search of the OEH Atlas of NSW Wildlife database for records of threatened fauna species listed under the TSC Act within a 20 km radius of the Project area (OEH, 2012c);
- vegetation maps of the area (AMBS, 2013);
- topographic maps of the area;
- aerial photographs and satellite imagery;
- data from OEH surveys of Mungo National Park (OEH, 2012d); and
- scientific literature, reference books, field guides, recovery plans, threatened species profiles (OEH, 2012e; SEWPaC, 2012b) and other available information regarding terrestrial fauna that may occur within the Project area and surrounds.

The locations of all threatened fauna previously recorded within a 20 km radius of the Project area were mapped. An assessment was made of the likelihood of occurrence of threatened fauna within the Project area and the likely extent of impacts from the Project on those threatened fauna, based on the habitats present and the information listed above.

3.2 Field survey techniques and effort

The study area was surveyed over several periods from May 2011 to May 2012. Surveys were performed by one zoologist in May 2011, four zoologists in November 2011 and January 2012, one zoologist in February 2012, four zoologists in March 2012, six zoologists in April 2012 and four zoologists in May 2012. Survey locations are shown in Figures 5 to 12. The timing and general area for each survey is provided in Table 2.



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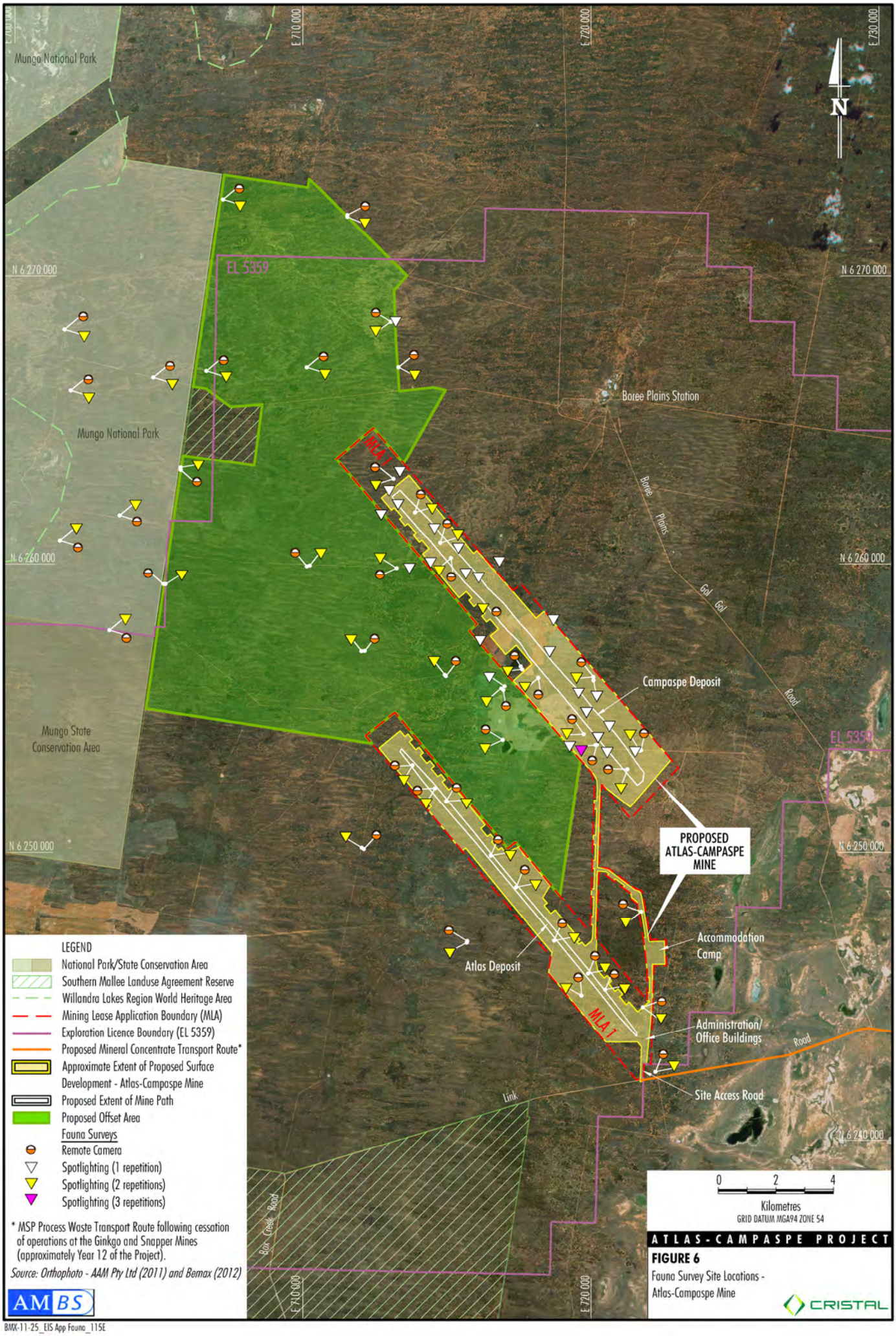
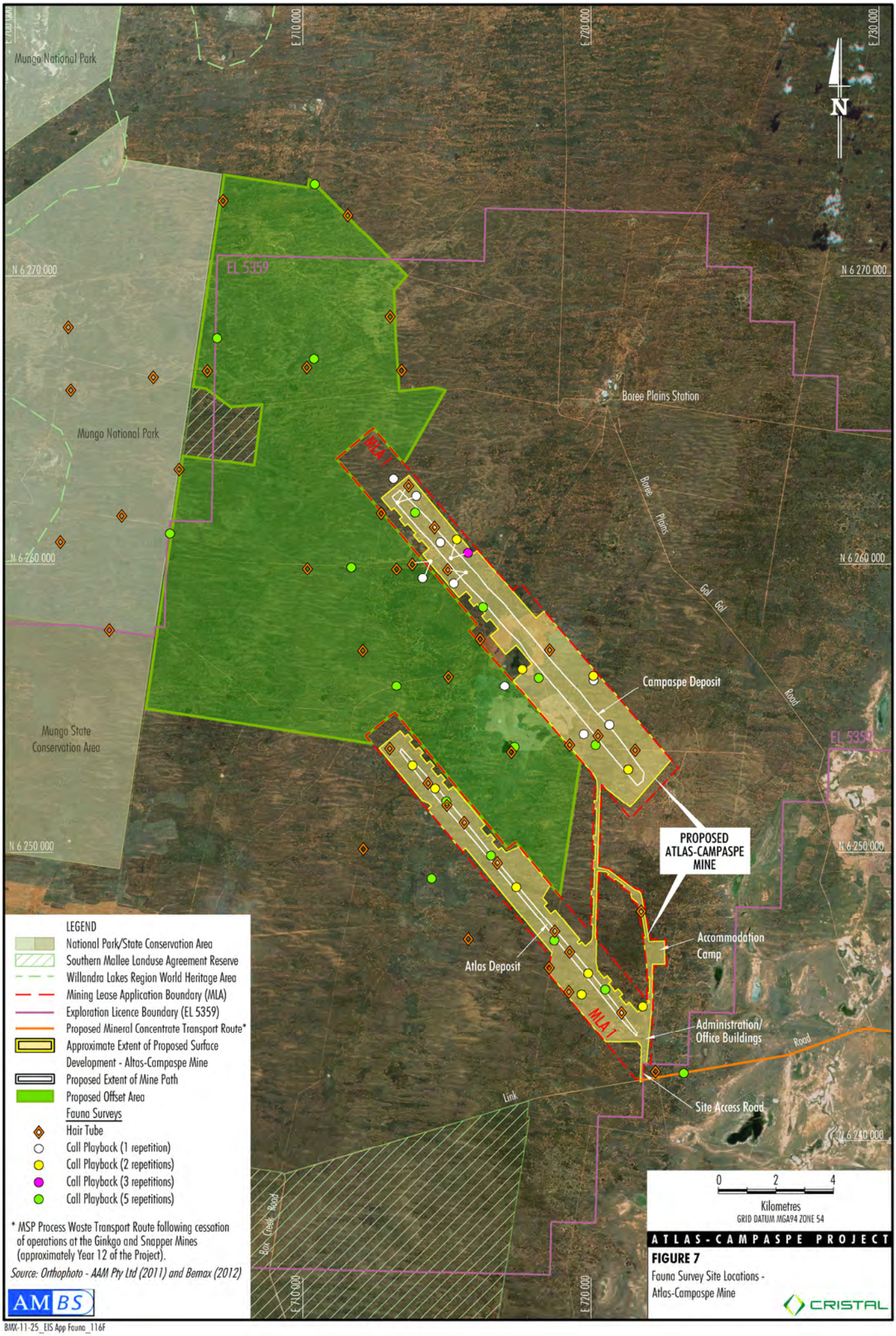

Mungo National Park
E 710 000
E 720 000
E 730 000
N
N 6 270 000
EL 5359
Boree Plains Station
Mungo National Park
MLA 1
Boree Plains Road
N 6 260 000
Gol Gol Road
Campaspe Deposit
Mungo State Conservation Area
EL 5359
N 6 250 000
PROPOSED ATLAS-CAMPASPE MINE
Accommodation Camp
Atlas Deposit
MLA 1
Administration/ Office Buildings
Road
Site Access Road
Link
N 6 240 000
Box Creek Road
E 710 000
E 720 000
LEGEND
National Park/State Conservation Area
Southern Mallee Landuse Agreement Reserve
Willandra Lakes Region World Heritage Area
Mining Lease Application Boundary (MLA)
Exploration Licence Boundary (EL 5359)
Proposed Mineral Concentrate Transport Route*
Approximate Extent of Proposed Surface Development - Atlas-Campaspe Mine
Proposed Extent of Mine Path
Proposed Offset Area
Fauna Surveys
Remote Camera
Spotlighting (1 repetition)
Spotlighting (2 repetitions)
Spotlighting (3 repetitions)
* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).
Source: Orthophoto - AAM Pty Ltd (2011) and Bemax (2012)
AMBS
0 2 4
Kilometres
GRID DATUM MGA94 ZONE 54
ATLAS-CAMPASPE PROJECT
FIGURE 6
Fauna Survey Site Locations - Atlas-Campaspe Mine
CRISTAL
BMX-11-25_EIS App Fauna_115E



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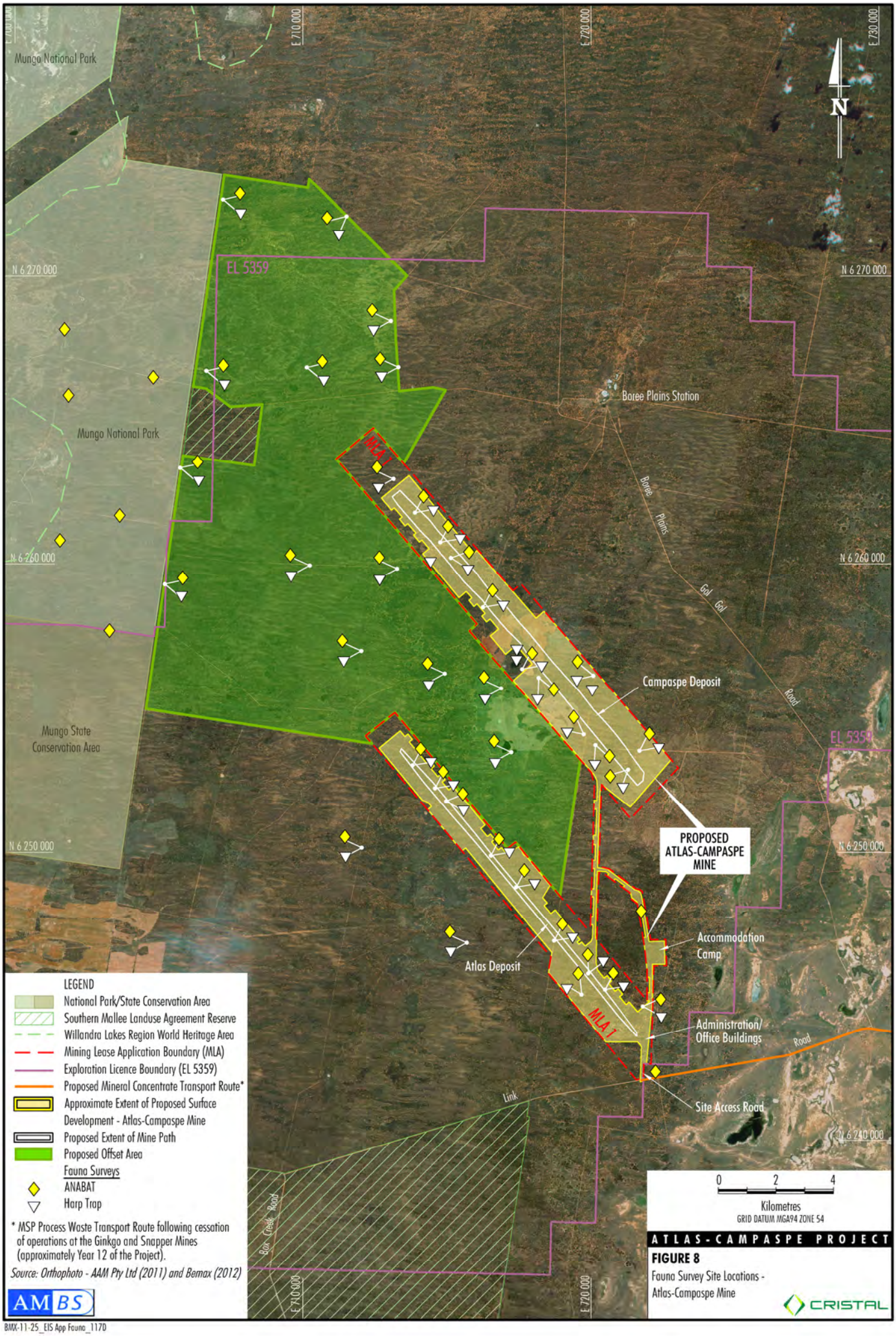
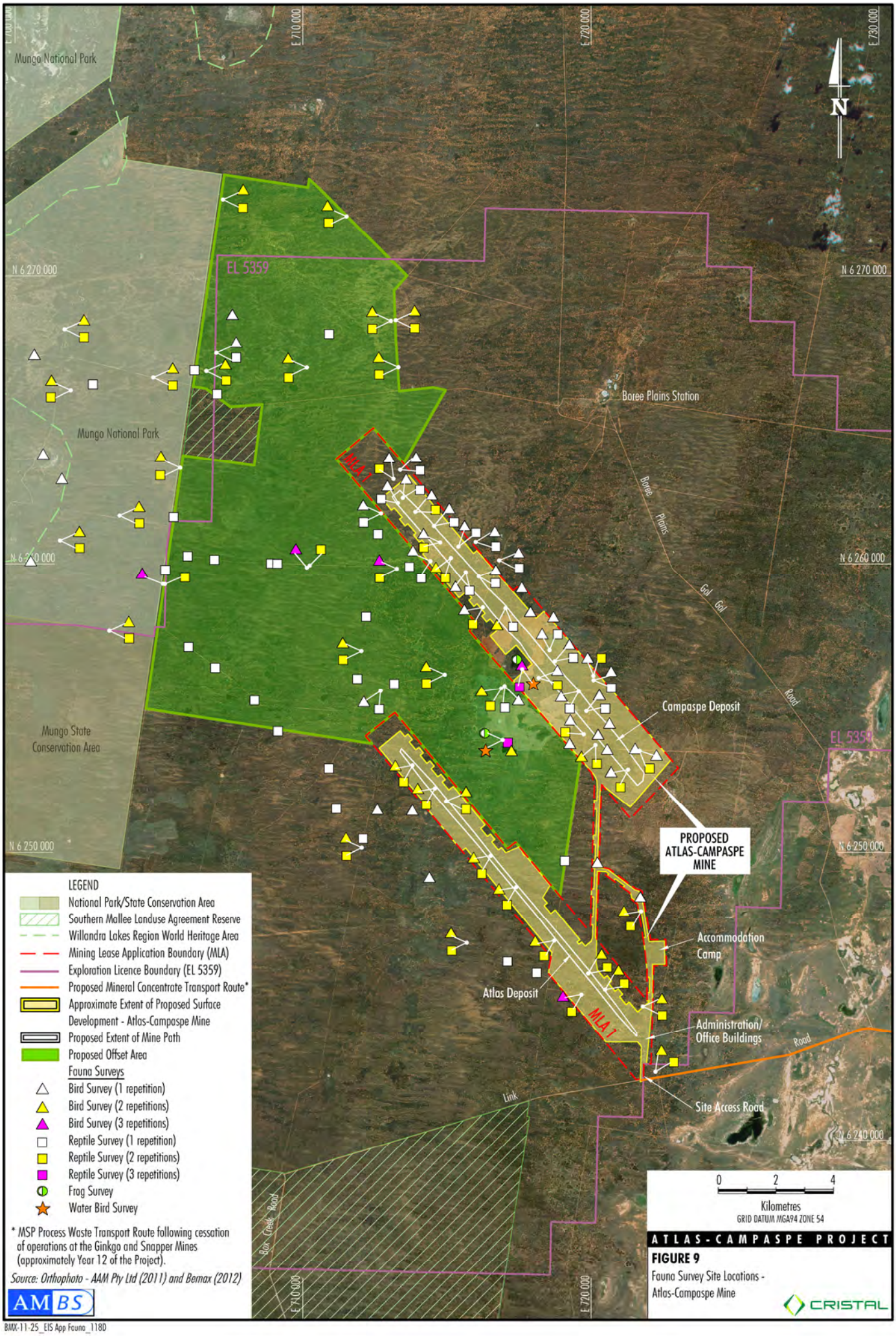
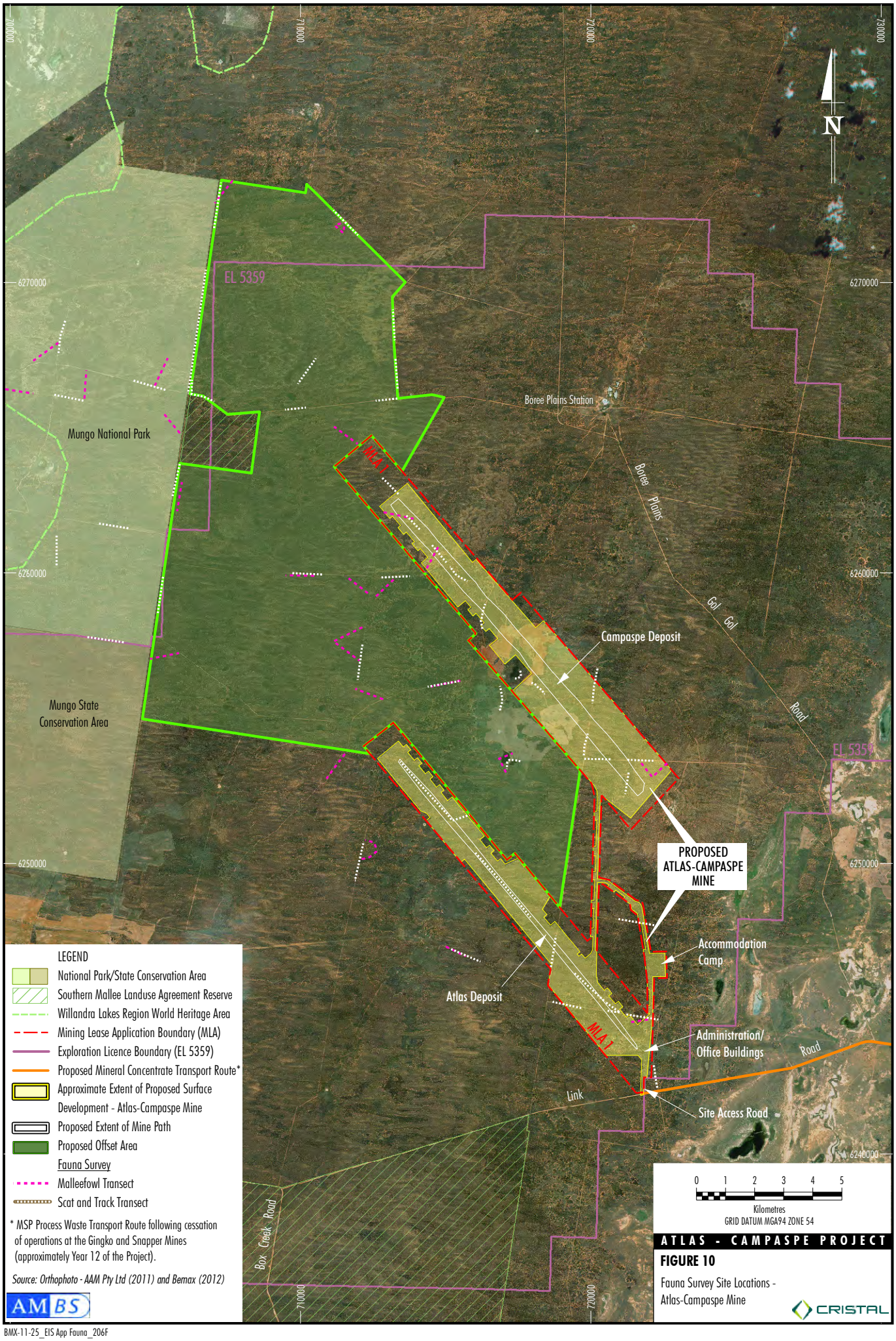
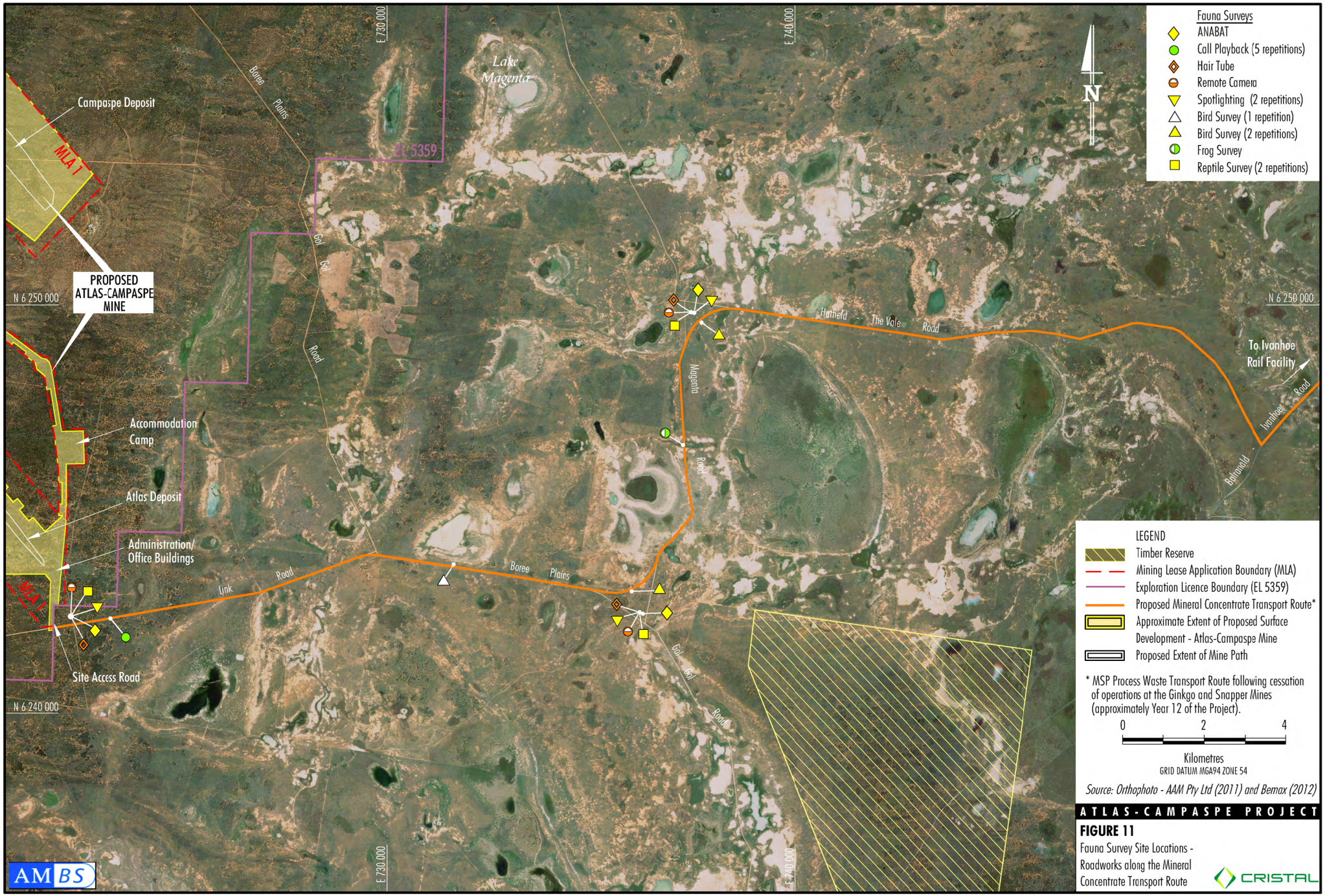

Mungo National Park
E 710 000
E 720 000
E 730 000
N
N 6 270 000
EL 5359
Boree Plains Station
Mungo National Park
MLA 1
Boree Plains Road
N 6 260 000
Gol Gol Road
Campaspe Deposit
Mungo State Conservation Area
EL 5359
N 6 250 000
PROPOSED ATLAS-CAMPASPE MINE
Accommodation Camp
Atlas Deposit
MLA 1
Administration/ Office Buildings
Road
Link
Site Access Road
N 6 240 000
Box Creek Road
E 710 000
E 720 000
LEGEND
National Park/State Conservation Area
Southern Mallee Landuse Agreement Reserve
Willandra Lakes Region World Heritage Area
Mining Lease Application Boundary (MLA)
Exploration Licence Boundary (EL 5359)
Proposed Mineral Concentrate Transport Route*
Approximate Extent of Proposed Surface Development - Atlas-Campaspe Mine
Proposed Extent of Mine Path
Proposed Offset Area
Fauna Surveys
ANABAT
Harp Trap
* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).
Source: Orthophoto - AAM Pty Ltd (2011) and Bemax (2012)
AMBS
0 2 4
Kilometres
GRID DATUM MGA94 ZONE 54
ATLAS-CAMPASPE PROJECT
FIGURE 8
Fauna Survey Site Locations - Atlas-Campaspe Mine
CRISTAL
BMX-11-25_EIS App Fauna_117D



BMX-11-25_EIS App Fauna_118D



BMX-11-25_EIS App Fauna_206F



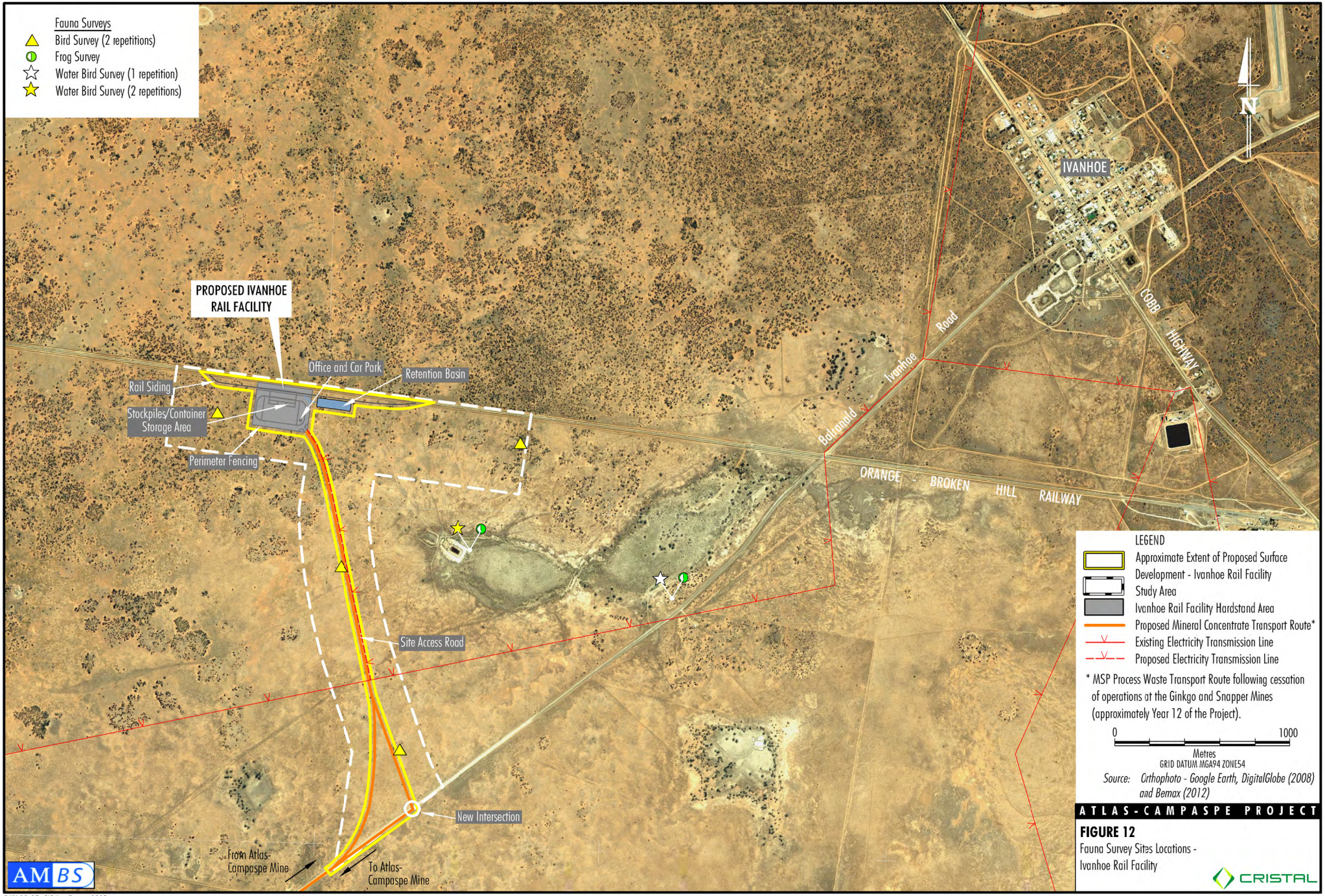
ATLAS-CAMPASPE PROJECT

FIGURE 11

Fauna Survey Site Locations - Roadworks along the Mineral Concentrate Transport Route

CRISTAL

BMX-11-25_EIS App Fauna_119D



ATLAS-CAMPASPE PROJECT

FIGURE 12

Fauna Survey Sites Locations - Ivanhoe Rail Facility

CRISTAL

BMX-11-25_EIS App Fauna_123E

Table 2: Fauna survey periods.

Survey Period	Study Area	Purpose of Survey
11th - 17th May 2011	Atlas-Campaspe Mine.	Scoping survey and preliminary fauna surveys.
8th - 19th November 2011	Atlas-Campaspe Mine (Campaspe footprint section).	Targeted fauna surveys using a range of techniques.
24th - 30th November 2011	Atlas-Campaspe Mine (Campaspe footprint section).	Targeted fauna surveys using a range of techniques.
3rd - 12th January 2012	Atlas-Campaspe Mine (Atlas footprint section).	Targeted fauna surveys using a range of techniques.
15th - 19th February 2012	Proposed offset area and surrounds.	Scoping survey.
28th March - 3rd April 2012	Proposed offset area and surrounds.	Targeted fauna surveys using a range of techniques.
17th - 24th April 2012	Proposed offset area and surrounds, MCTR.	Targeted fauna surveys using a range of techniques; habitat assessments.
10th - 18th May 2012	Proposed offset area and surrounds, Mungo National Park.	Targeted fauna surveys using a range of techniques.

Data regarding weather conditions during the survey period are presented in Table 3. During May 2011 minimum temperatures ranged from -0.1 to 11°C, while maximum temperatures were between 14.8 to 19.1°C. During the November 2011 surveys minimum temperatures ranged from 9.6 to 24.3°C, while maximum temperatures were between 22.1 to 38.6°C. January 2012 was warmer, with minimum temperatures ranging from 11.8 to 23°C, while maximum temperatures were between 24.4 to 41.2°C. During February and March 2012 minimum temperatures ranged from 10.7 to 24.2°C, while maximum temperatures were between 22.0 to 40.0°C. April and May were slightly cooler, with minimum temperatures ranging from 2.8 to 18.9°C, while maximum temperatures were between 15.6 to 32.4°C.

The data obtained from the weather stations indicate that there was rainfall during the November surveys and little rainfall during the other survey periods, and this is mostly consistent with the conditions encountered during the surveys. Outside of the survey periods, there was heavy rainfall during the period 28 February 2012 to 1 March 2012 and flooding of the site throughout much of March. It is important to note that the weather shown in Table 3 is a combination of weather data obtained from townships up to 97 km from the study area, as no weather station occurs in close vicinity to the study area. Consequently, some of the data are not fully reflective of the actual weather conditions present during survey periods. This is particularly apparent for the estimated rainfall during February and early March when as much as 96 mm fell in a day, and the rainfall experienced during November, which included a very heavy downpour over 10-11 November).

Table 3: Climate data for the survey periods.

Date	Temperature (°C) min/max Balranald RSL*	Temperature(°C) min/max Pooncarie Mail Agency*	Rainfall (mm) Pooncarie (Tarcoola)*	Rainfall (mm) Oxley (Walmer Downs)*	Moon phase†
11/05/2011	5.7/14.8	6/16	0	0	1st Quarter 47%
12/05/2011	9.6/17.8	9.6/18.8	0	0	Waxing Gibbous 58%
13/05/2011	9.7/18	11/19.1	0	2.6	Waxing Gibbous 69%
14/05/2011	5/15.5	5.3/17	0	0	Waxing Gibbous 80%
15/05/2011	3.6/16.3	3/18.1	0	0	Waxing Gibbous 88%
16/05/2011	0.3/17	1.9/NA	0	0	Waxing Gibbous 95%
17/05/2011	-0.1/17	NA/19.02	0	0	Waxing Gibbous 99%
8/11/2011	19.3/30	21.8/31	0	1	Waxing Gibbous 91%
9/11/2011	18.5/34	20.2/35	0	↓	Waxing Gibbous 95%
10/11/2011	13.7/24.2	13/26.8	0	44.02	Waxing Gibbous 98%
11/11/2011	9.6/27	11/29.5	0	0	Full 100%
12/11/2011	10.8/30.5	13/32.2	0	0	Waning Gibbous 99%
13/11/2011	17/32.1	17.3/35.8	0	0	Waning Gibbous 97%
14/11/2011	17.1/NA	17.8/33	0	0	Waning Gibbous 93%
15/11/2011	NA/33.02	14.4/37	0	0	Waning Gibbous 88%
16/11/2011	10.92/22.6	20.2/26.8	0	0	Waning Gibbous 80%
17/11/2011	14/31.6	14/34.2	0	0	Waning Gibbous 72%
18/11/2011	20.2/35.8	18.5/37.8	0	0	Waning Gibbous 62%
19/11/2011	22.1/31.4	23.4/37.8	0	0	3rd Quarter 51%
20/11/2011	15/24.7	14.8/24.4	0	4	Waning Crescent 40%
21/11/2011	10.1/24.4	13.5/27	0	0	Waning Crescent 29%
22/11/2011	13.1/22.9	11.2/25	0	0	Waning Crescent 19%
23/11/2011	11.6/25.1	12.1/26.8	0	0	Waning Crescent 11%
24/11/2011	11.6/24.2	14.4/22.1	0	0	Waning Crescent 4%
25/11/2011	14.8/27.4	15.5/29.2	1	14	Waning Crescent 1%
26/11/2011	13.7/23.3	14.4/24.3	0	6	New 0%
27/11/2011	13.9/28.2	11.8/32.5	0	1	Waxing Crescent 2%
28/11/2011	14/34.2	15.6/36.5	0	0	Waxing Crescent 7%
29/11/2011	21.4/37	24.3/38.6	8.4	0	Waxing Crescent 14%
30/11/2011	16.2/23	17.5/25.6	0	0	Waxing Crescent 22%
3/01/2012	22.5/40.7	23/41.2	0	0	Waxing Gibbous 62%
4/01/2012	21.4/31.2	23/34.4	0	0	Waxing Gibbous 71%
5/01/2012	14.2/29.8	18/33.8	0	0	Waxing Gibbous 79%
6/01/2012	13.2/30.2	16/33.6	0	0	Waxing Gibbous 86%
7/01/2012	15.6/37.7	18.6/37.4	0	0	Waxing Gibbous 92%
8/01/2012	21.2/28.2	22/30	3	4.4	Waxing Gibbous 97%
9/01/2012	13.1/24.4	14.4/28	0	0	Waxing Gibbous 99%
10/01/2012	14.6/25	15.3/26.4	0	0	Full 100%
11/01/2012	14.2/NA	14/26.1	0	0	Waning Gibbous 98%
12/01/2012	NA/NA	11.8/27.2	0	0	Waning Gibbous 94%
15/02/2012	18.3/36.0	17.5/37.8	0	0	3rd Quarter 52%
16/02/2012	22.6/35.0	24.2/37.4	0	0	Waning Crescent 41%
17/02/2012	16.8/35.0	21.0/38.2	0	0	Waning Crescent 30%
18/02/2012	17.4/36.2	21.3/39.8	0	0	Waning Crescent 20%
19/02/2012	19.6/35.3	23.8/40.0	0	0	Waning Crescent 12%
28/02/2012	22.4/27	23.2/25	32	0	Waxing Crescent 27%
29/02/2012	17.7/22.0	20.4/24.0	21	0	Waxing Crescent 36%
01/03/2012	16.9/23.2	15.5/22.8	52	44	1st Quarter 45%
28/03/2012	10.7/NA	12.2/29	0	0	Waxing Crescent 20%
29/03/2012	NA/NA	11.8/31.1	0	0	Waxing Crescent 29%
30/03/2012	NA/30.8	14.3/31.6	0	0.6	Waxing Crescent 38%
31/03/2012	15.8/33.5	18.0/34.8	2	0	1st Quarter

Date	Temperature (°C) min/max Balranald RSL*	Temperature(°C) min/max Pooncarie Mail Agency*	Rainfall (mm) Pooncarie (Tarcoola)*	Rainfall (mm) Oxley (Walmer Downs)*	Moon phase†
01/04/2012	13.4/25.8	14.8/26.9	0	0	Waxing Gibbous 57%
02/04/2012	10.6/30.9	12.8/32.4	0	0	Waxing Gibbous 68%
03/04/2012	16.3/29.3	18.9/31.0	1	0	Waxing Gibbous 77%
17/04/2012	12.1/27.2	12.8/30.8	0	0	Waning Crescent 28%
18/04/2012	11.8/27.0	12.2/27.9	0	0	Waning Crescent 13%
19/04/2012	17.0/21.0	12.8/28.3	0	0	Waning Crescent 7%
20/04/2012	13.7/26.0	11.9/29.5	0	8	Waning Crescent 3%
21/04/2012	12.6/25.7	12.5/28.4	0	0	Waning Crescent 1%
22/04/2012	15.9/27.0	13.7/28.2	0	0.4	New Moon 0%
23/04/2012	9.7/21.7	12.2/23.0	0	0	Waxing Crescent 1%
24/04/2012	5.0/15.6	8.0/17.8	1	1	Waxing Crescent 5%
10/05/2012	10.3/24	11.4/27.0	0	0	Waning Gibbous 84%
11/05/2012	7.3/19.0	11.5/25.0	0	0	Waning Gibbous 74%
12/05/2012	NA/NA	7.9/18.1	0	0	Waning Gibbous 64%
13/05/2012	NA/15.8	6.1/17.0	0	0	3rd Quarter 53%
14/05/2012	4.2/17.8	7.6/18.4	0	0	Waning Crescent 43%
15/05/2012	4.3/18.6	6.6/19.0	0	0	Waning Crescent 33%
16/05/2012	4.6/20.1	2.8/20.8	0	0	Waning Crescent 24%
17/05/2012	2.9/20.0	2.8/21.4	0	0	Waning Crescent 17%
18/05/2012	3.6/22.9	4.5/23.0	0	0	Waning Crescent 10%

* Source: BoM (2012). Balranald RSL weather station is 80 km south-southeast of the Project and the Pooncarie Mail Agency weather station is 80 km north-west. Pooncarie (Tarcoola) weather station is 80 km north-west and Oxley (Walmer Downs) weather station is 70 km south-east of the Project.

† Source: Willy Online Pty Ltd (2012).

A range of survey techniques were used, including pitfall traps, Elliott A traps, funnel traps, harp traps, hair tubes, remote cameras, diurnal bird surveys, waterbird surveys, Malleefowl (*Leipoa ocellata*) transects, reptile searches, frog searches, call playback, scat and track searches, nocturnal spotlighting, opportunistic sightings and the use of ANABAT detectors.

The survey techniques and effort employed at each site varied depending on the vegetation community, presence of particular habitat resources (e.g. if waterbodies were not present no amphibian or waterbird searches were conducted) and the types of fauna likely to be present. Methods and survey effort are summarised in Tables 4, 5, 6 and 7.

Table 4: Fauna survey techniques and effort for the Atlas-Campaspe Mine study area.

Survey Technique	Sites	Number Deployed per Site	Survey Effort/Description
Elliott A Traps	22	25	Traps were checked every morning for four days (100 trap nights at each site). Each trap contained universal bait, cotton wool or leaf litter. Spacing between traps was approximately 20 m depending on habitat.
Funnel Traps	22	4	Two funnel traps were paired 1 m in from each end of a 30 m polyethylene drift fence. Traps were checked every morning for four days (16 trap nights at each site).
Hair Tubes	21	10	Hair tubes were left *in-situ* for 10 days as a minimum and longer when survey periods enabled it (100 trap nights at each site, as a minimum). Hair tubes were baited with universal bait. Spacing between funnels was 20 m. Hair tubes were placed in trees and on the ground.
Pitfall Traps	22	6	Three buckets (400 mm diameter x 280 mm deep) and three pipes (150 mm diameter x 600 mm deep) were equally spaced along a 30 m polyethylene drift fence. Traps were checked each morning for four days (24 trap nights per site). Leaf litter and bark were placed inside the traps along with a small piece of polystyrene as a flotation device in case of rain.
Diurnal Bird Census (3 repetitions)	3	n/a	Standard searches (3 x 20 minutes) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Bird Census (2 repetitions)	13	n/a	Standard searches (2 x 20 minutes) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Bird Census (1 repetition)	36	n/a	Standard searches (1 x 20 minutes) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Malleefowl Transects	4	n/a	Transect surveys were performed in Malleefowl habitat (predominantly Linear Dune Mallee with some Sandplain Mallee). Four people formed a human chain spaced 30 m apart and walked through suitable habitat for a minimum of 1 km searching for Malleefowl tracks or mounds.
Waterbird Survey	1	n/a	Four waterbird surveys (1 hour each) were performed in drainage depressions within the study area.
Diurnal Reptile Search (3 repetitions)	1	n/a	Active searches of potential reptile habitat were performed for 90 person minutes at each standard fauna site (3 x 30 minute searches) during appropriate weather conditions.
Diurnal Reptile Search (2 repetitions)	22	n/a	Active searches of potential reptile habitat were performed for 60 person minutes at each standard fauna site (2 x 30 minute searches) during appropriate weather conditions.
Diurnal Reptile Search (1 repetition)	18	n/a	Active searches of potential reptile habitat were performed opportunistically, as a minimum for 30 person minutes (15 minute searches with 2 people) during appropriate weather conditions. If time allowed, 60 minute searches were conducted.
Nocturnal Call Playback (5 nights)	8	n/a	Call playback for Barking Owl (*Ninox connivens*) was performed five times at each site. Call playback for Bush Stone-curlew (*Burhinus grallarius*) was performed at least twice at each site.
Nocturnal Call Playback (3 nights)	1	n/a	Call playback for Barking Owl was performed five times at each site. Call playback for Bush Stone-curlew was performed at least twice at each site.
Nocturnal Call Playback (2 nights)	9	n/a	Call playback for Barking Owl was performed five times at each site. Call playback for Bush Stone-curlew was performed at least twice at each site.
Nocturnal Call Playback (1 night)	8	n/a	Call playback for Barking Owl was performed five times at each site. Call playback for Bush Stone-curlew was performed at least twice at each site.
Nocturnal Spotlighting (3 repetitions)	1	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 120 person minutes at each site (3 x 20 min searches with two people).

Survey Technique	Sites	Number Deployed per Site	Survey Effort/Description
Nocturnal Spotlighting (2 repetitions)	22	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 80 person minutes at each site (2 x 20 min searches with two people).
Opportunistic Nocturnal Spotlighting (1 repetition)	21	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed opportunistically for 40 person minutes at selected sites with suitable habitat (1 x 20 min searches with two people).
Nocturnal Frog Search	1	n/a	Two nocturnal spotlighting searches of 30 minutes each were performed at the wetland in the study area.
Harp Trapping	22	2	Harp traps were erected for two nights at two different locations within each site for two days (four trap nights at each site). Traps were checked each morning.
Harp Trapping	4	1	Harp traps were erected for two nights (two trap nights at each site). Traps were checked each morning.
ANABAT	23	2	ANABATS were left overnight for 2 nights at two different locations within each site for 2 days (4 trap nights at each site).
Remote Cameras	23	1	All cameras were pointed at a bait station (universal bait) and left *in-situ* for 10 to 14 days on average. Cameras placed in Atlas Mine study area were in place for a longer period due to restricted access during heavy rain events.
Scats and Tracks	23	n/a	Two people walked for a minimum of 1 km along a track nearby each fauna trapping site. Observations of tracks were made and predator-scats were collected for analysis. Additional opportunistic track searches were carried out in some locations.
Opportunistic Observations	n/a	n/a	Opportunistic observations of fauna not detected during the targeted surveys described above were recorded, including observations taken while driving between sites and to and from the study area.

Table 5: Fauna survey effort and techniques for the mineral concentrate transport route study area.

Survey Technique	Sites	Number Deployed per Site	Survey Effort/Description
Hair Tubes	3	10	Hair tubes were left *in-situ* for 10 days as a minimum and longer when survey periods enabled it (100 trap nights at each site, as a minimum). Hair tubes were baited with universal bait. Spacing between funnels was 20 m. Hair tubes were placed on the ground.
Diurnal Bird Census (2 repetitions)	3	n/a	Standard searches (2 x 20 minute) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Bird Census (1 repetition)	1	n/a	Standard searches (1 x 20 minute) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Reptile Search	3	n/a	Active searches of potential reptile habitat were performed for 60 person minutes at each site (2 x 30 minute searches) during appropriate weather conditions (i.e. warm, sunny weather between 10.00 am to 2.00 pm).
Nocturnal Call Playback	1	n/a	Call playback for Barking Owl was performed five times at each site.
Nocturnal Frog Search	1	n/a	One opportunistic nocturnal spotlighting search of 30 minute performed along the road in Chenopod Shrubland.
Nocturnal Spotlighting	3	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 80 person minutes at each site (2 x 20 minute searches with 2 people).
Remote Cameras	3	1	All cameras were pointed at a bait station (universal bait) and left *in-situ* for a minimum of 14 days.
Scats and Tracks	3	n/a	Observations and scat collections made opportunistically during other surveys.
Opportunistic Records	n/a	n/a	Opportunistic observations of fauna were recorded throughout the study area and surrounds.

Table 6: Fauna survey effort and techniques for the Ivanhoe Rail Facility study area and surrounds.

Technique	Sites	Number deployed per site	Survey Effort/Description
Frog Survey (2 repetitions)	2	n/a	Frog surveys (2x 30 minutes) consisted of mainly call identification with some additional spotlighting. Surveys were performed at the wetland near the Black Box Woodland to the east of the Ivanhoe Rail Facility study area. All species observed or heard were identified.
Diurnal Bird Census (2 repetitions)	4	n/a	Standard searches (2 x 20 minutes) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Waterbird Survey (2 repetitions)	1	n/a	Waterbird surveys (2 x 1 hour each) were performed on the edge of the wetland associated with the Black Box Woodland to the east of the Ivanhoe Rail Facility study area.
Waterbird Survey (1 repetitions)	1	n/a	Waterbird surveys (1 x 1 hour each) were performed on the edge of the wetland associated with the Black Box Woodland to the east of the Ivanhoe Rail Facility study area.
Opportunistic Records	n/a	n/a	Opportunistic observations of fauna were recorded throughout the Ivanhoe Rail Facility study area and surrounds.

Table 7: Fauna survey techniques and effort for the proposed offset area and surrounds.

Technique	Sites	Number deployed per site	Survey Effort/Description
Elliot A Traps	16	25 or 10	Traps were checked every morning for four days. Each trap contained universal bait, cotton wool or leaf litter. Spacing between traps was approximately 10 m depending on suitable habitat. Ten traps were deployed at five sites and 25 traps were deployed at 11 sites.
Funnel Traps	17	4	Two funnel traps were paired 1 m in from each end of a 30 m polyethylene drift fence. Traps were checked every morning for four days (16 trap nights at each site).
Hair Tubes	14	20	Hair tubes were left *in-situ* for 10 days as a minimum and longer when survey periods enabled it (200 trap nights at each site, as a minimum). Hair tubes were baited with universal bait. Spacing between funnels was 20 m. Hair tubes were placed in trees and on the ground.
Pitfall Traps	17	6	Three buckets (400 mm diameter x 280 mm deep) and three pipes (150 mm diameter x 600 mm deep) were equally spaced along a 30 m polyethylene drift fence. Traps were checked each morning for four days. Leaf litter and bark were placed inside the traps along with a small piece of polystyrene as a flotation device in case of rain.
Nocturnal Frog Search	1	n/a	Two nocturnal spotlighting searches of 30 minutes each were performed at the wetland near the Black Box Woodland site. All species observed or heard were identified. Call playbacks were also performed for Southern Bell Frogs (*Litoria raniformis*).
Diurnal Bird Census (3 repetitions)	3	n/a	Standard searches (3 x 20 minutes) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Bird Census (2 repetitions)	14	n/a	Standard searches (2 x 20 minutes) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Bird Census (1 repetition)	3	n/a	Standard searches (1 x 20 minutes) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Reptile Search (3 repetitions)	1	n/a	Active searches of potential reptile habitat were performed for 90 person minutes at each site (3 x 30 minute searches) during appropriate weather conditions (i.e. warm, sunny weather between 10.00 am to 2.00 pm).
Diurnal Reptile Search (2 repetitions)	16	n/a	Active searches of potential reptile habitat were performed for 60 person minutes at each site (2 x 30 minute searches) during appropriate weather conditions (i.e. warm, sunny weather between 10.00 am to 2.00 pm).
Diurnal Reptile Search (1 repetition)	27	n/a	Active searches of potential reptile habitat were performed for 60 person minutes at each site (1 x 30 minute searches) during appropriate weather conditions (i.e. warm, sunny weather between 10.00 am to 2.00 pm).

Technique	Sites	Number deployed per site	Survey Effort/Description
Malleefowl Transects	15	n/a	Surveys were performed in Malleefowl habitat (predominantly Linear Dune Mallee with some Sandplain Mallee). Four people formed a human chain spaced 30 m apart and walked through suitable habitat for 1 km searching for Malleefowl tracks or mounds.
Waterbird Survey	1	n/a	Two waterbird surveys (1 hour each) were performed at a wetland that occurs within the study area.
Nocturnal Call Playback (5 nights)	8	n/a	Each session included an initial listening period (10 minutes) followed by call broadcast of Barking Owl. Each broadcast was for 5 minutes followed by 5 minutes of listening. A 10 minute spotlighting session was conducted following the final listening period. All species observed or heard were recorded. Five nights of broadcasts were performed at each site. Call playback for Bush Stone-curlew was performed at a sub-sample of four sites within the study area.
Nocturnal Call Playback (1 night)	1	n/a	Each session included an initial listening period (10 minutes) followed by call broadcast of Barking Owl. Each broadcast was for 5 minutes followed by 5 minutes of listening. A 10 minute spotlighting session was conducted following the final listening period. All species observed or heard were recorded. Five nights of broadcasts were performed at each site.
Spotlighting (2 repetitions)	16	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 80 person minutes at each site (2 x 20 minute searches with 2 people). All species observed or heard were identified and recorded.
Spotlighting (1 survey)	3	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 40 person minutes at each site (1 x 20 minute searches with 2 people). All species observed or heard were identified and recorded.
Harp Trapping	16	2	Harp traps were erected for two nights at two different locations within each site for two days (four trap nights at each site). Traps were checked each morning.
ANABAT	16	2	ANABATS were left overnight for two nights at two different locations within each site for two days (four trap nights at each site).
Remote Cameras	16	1	All cameras were pointed at a bait station (universal bait) and left *in-situ* for a minimum of 14 days.
Scats and Tracks	18	n/a	Two people walked for a minimum of 1 km along a track nearby each fauna trapping site. Observations of tracks were made and predator-scats were collected for analysis. Additional opportunistic track searches were carried out in some locations.
Opportunistic Records	n/a	n/a	Opportunistic observations of fauna were recorded throughout the study area and surrounds.

3.3 Potentially occurring threatened fauna and survey techniques

A number of threatened species listed under the TSC Act and EPBC Act were identified as known or with potential to occur within the study area and surrounds based on the results of database searches (see Section 3.1). The survey methods used and the species that were targeted by these methods are indicated in Table 8. The methods are consistent with NSW and Commonwealth survey guidelines for threatened species (NSW Department of Environment and Conservation [DEC], 2004; DECCW, 2009; Department of Environment, Water, Heritage and Arts [DEWHA] 2010a; 2010b; 2010c; 2011a; 2011b).

Table 8: Threatened fauna potentially occurring in the study area and survey techniques.

Group	Scientific Name	Common Name	Survey Technique
Frogs	*Neobactrachus pictus*	Painted Frog	Pitfall traps, nocturnal spotlighting
	Litoria raniformis	Southern Bell Frog	Pitfall traps, nocturnal spotlighting, call playback
Reptiles	*Strophurus elderi*	Jewelled Gecko	Pitfall traps, nocturnal spotlighting, funnel traps, diurnal reptile searches
	Delma australis	Marbed-faced Delma	Pitfall traps, diurnal reptile searches, funnel traps
	Aprasia inaurita	Mallee Worm-lizard	Pitfall traps, diurnal reptile searches, funnel traps
	Cyclodomorphus melanops elongates	Spinifex Slender Blue-tongue	Pitfall traps, diurnal reptile searches, funnel traps
	Tiliqua occipitalis	Western Blue-tongue	Pitfall traps, diurnal reptile searches, funnel traps
	Echiopsis curta	Bardick	Pitfall traps, diurnal reptile searches, funnel traps
Birds	*Leipoa ocellata*	Malleefowl	Malleefowl transects, track and scat searches
	Anseranas semipalmata	Magpie Goose	Waterbird census
	Stictonetta naevosa	Freckled Duck	Waterbird census
	Oxyura australis	Blue-billed Duck	Waterbird census
	Botaurus poiciloptilus	Australasian Bittern	Waterbird census
	Falco hypoleucos	Grey Falcon	Diurnal bird census, opportunistic surveys
	Lophoictinia isura	Square-tailed Kite	Diurnal bird census, opportunistic surveys
	Hamirostra melanosternon	Black-breasted Buzzard	Diurnal bird census, opportunistic surveys
	Circus assimilis	Spotted Harrier	Diurnal bird census, opportunistic surveys
	Hieraaetus morphnoides	Little Eagle	Diurnal bird census, opportunistic surveys
	Ardeotis australis	Australian Bustard	Diurnal bird census, opportunistic surveys
	Grus rubicund	Brolga	Waterbird census, opportunistic surveys
	Burhinus grallarius	Bush Stone-curlew	Nocturnal spotlighting, call playback
	Rostratula australis	Australian Painted Snipe	Waterbird census
	Limosa limosa	Black-tailed Godwit	Waterbird census
	Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland species)	Diurnal bird census, opportunistic surveys
	Lophochroa leadbeateri	Major Mitchell's Cockatoo	Diurnal bird census, opportunistic surveys
	Glossopsitta porphyrocephala	Purple-crowned Lorikeet	Diurnal bird census, opportunistic surveys
	Polytelis anthopeplus monarchoides	Regent Parrot	Diurnal bird census, opportunistic surveys
	Ninox connivens	Barking Owl	Nocturnal spotlighting, call playback
	Amytornis textilis modestus	Thick-billed Grass-wren	Diurnal bird census, opportunistic surveys
	Hylacola cautus	Shy Heathwren	Diurnal bird census, opportunistic surveys
	Calamanthus campestris	Rufous Fieldwren	Diurnal bird census, opportunistic surveys, call playback
	Pyrrholaemus brunneus	Redthroat	Diurnal bird census, opportunistic surveys, call playback

Group	Scientific Name	Common Name	Survey Technique
	Lichenostomus cratitius	Purple-gaped Honeyeater	Diurnal bird census, opportunistic surveys
	Manorina melanotis	Black-eared Miner	Diurnal bird census, opportunistic surveys
	Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Diurnal bird census, opportunistic surveys
	Certhionyx variegates	Pied Honeyeater	Diurnal bird census, opportunistic surveys
	Epthianura albifrons	White-fronted Chat	Diurnal bird census, opportunistic surveys, wetland census
	Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Diurnal bird census, opportunistic surveys
	Petroica phoenicea	Flame Robin	Diurnal bird census, opportunistic surveys
	Drymodes brunneopygia	Southern Scrub-robin	Diurnal bird census, opportunistic surveys
	Cinclosoma castanotum	Chestnut-backed Quail-thrush	Diurnal bird census, opportunistic surveys, malleefowl transects, remote cameras
	Daphoenositta chrysoptera	Varied Sittella	Diurnal bird census, opportunistic surveys
	Pachycephala inornata	Gilbert's Whistler	Diurnal bird census, opportunistic surveys
	Stagonopleura guttata	Diamond Firetail	Diurnal bird census, opportunistic surveys
Mammals	*Ningaui yvonneae*	Southern Ningaui	Pitfall trapping, hair tubes, predator scats
	Cercartetus concinnus	Western Pygmy-possum	Pitfall trapping, hair tubes, remote cameras, predator scats
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Harp trap, ANABAT
	Nyctophilus corbeni	South-eastern Long-eared Bat (also known as Corben's Long-eared Bat)	Harp trap, ANABAT
	Chalinolobus picatus	Little Pied Bat	Harp trap, ANABAT
	Vespadelus baverstocki	Inland Forest Bat	Harp trap, ANABAT
	Pseudomys bolami	Bolam's Mouse	Pitfall trapping, hair tubes, remote cameras, Elliot A traps, predator scats
	Rattus villosissimus	Long-haired Rat	Pitfall trapping, hair tubes, remote cameras, Elliot A traps, predator scats

Any *Neobactrachus* specimens observed or trapped were photographed, including detail of characteristic body parts such as, but not restricted too, the groin (for presence of a fold of skin from the knees to the groin), the webbing between the toes, and the feet (for potential presence of a black inner metatarsal tubercle). The photographs were provided to Dr Arthur White for confirmation of identification.

3.4 Field surveys in Mungo National Park

Approval to perform fauna surveys in the south-eastern area of Mungo National Park (that part of the National Park that adjoins the proposed offset area) was obtained from the OEH Area Manager. Pitfall trapping had previously been performed by OEH and the range of survey techniques was primarily limited to observational techniques and hair tubes. Survey techniques and effort are described in Table 9. Survey locations are shown on Figures 5 to 12.

Table 9: Fauna survey techniques and effort for Mungo National Park.

Technique	Sites	Number Deployed per site	Survey Effort/Description
Hair Tubes	6	8	Hair tubes were left *in-situ* for 5 nights (40 trap nights at each site). Hair tubes were baited with universal bait. Spacing between funnels was 20 m. Funnels were placed in trees and on the ground.
Diurnal Bird Census (2 repetitions)	6	n/a	Standard searches (2 x 20 minute) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Bird Census (1 repetition)	5	n/a	Standard searches (1 x 20 minute) were performed within 3 hours of dawn. All birds observed or heard were recorded.
Malleefowl Transects	5	n/a	Transect surveys were performed in Malleefowl habitat (predominantly Linear Dune Mallee with some Sandplain Mallee). Two people formed a human chain spaced 30 m apart and walked through suitable habitat for at least 1 km searching for Malleefowl tracks or mounds.
Diurnal Reptile Search (2 repetitions)	6	n/a	Active searches of potential reptile habitat were performed for 60 person minutes at each standard fauna site (2 x 30 minute searches) during appropriate weather conditions (i.e. warm, sunny weather between 10.00 am to 2.00 pm).
Diurnal Reptile Search (1 repetition)	1	n/a	Active searches of potential reptile habitat were performed for 30 person minutes at each standard fauna site (1 x 30 minute searches) during appropriate weather conditions (i.e. warm, sunny weather between 10.00 am to 2.00 pm).
Nocturnal Spotlighting	6	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 80 person minutes at each site (2 x 20 minute searches with two people). All species observed or heard were identified and recorded.
ANABAT	6	1	ANABATS were left overnight for two nights.
Remote Cameras	6	1	All cameras were pointed at a bait station (universal bait) and left *in-situ* for a minimum of 14 days.
Scats and Tracks	6	n/a	Two people walked for a minimum of 1 km along a track nearby each fauna trapping site. Observations of tracks were made and predator-scats were collected for analysis. Additional opportunistic track searches were carried out in some locations.
Opportunistic Records	n/a	n/a	Opportunistic observations of fauna were recorded throughout the study area and surrounds.

3.5 Survey limitations

Field survey sites were located to cover as much of the Project area and surrounds as possible. Access to much of the Atlas-Campaspe MLA area was available during surveys in winter, spring and summer. These surveys were designed to comply with the DEC (now OEH) guidelines (DEC, 2004). Surveys of the area around the Atlas-Campaspe Mine footprint, including the proposed offset, were intensive, but not as intensive as the surveys within the Project area and access to some parts of the area surrounding the Project area was limited by a lack of vehicle tracks, overgrown vegetation, fallen trees, etc. Extreme weather conditions (heavy rain and flooding) prevented surveys of the proposed offset from being undertaken at particular times. As such portions of the proposed offset were not viewed on-ground, and fauna habitats in these areas were assessed on the basis of vegetation mapping and aerial photographs.

In addition, some seasonal differences in fauna activity between the Project area and the proposed offset were noted (e.g. microbat activity in the Project area was greater than that observed in some parts of the proposed offset) with the difference attributed to seasonal temperature differences. However, the majority of the threatened species detected within the Project area were also detected within the proposed offset or in other locations around the Project.

Field surveys for the Ivanhoe Rail Facility study area and surrounds did not include a full fauna survey due to restrictions in time availability and expected minor levels of impact. As such a full biodiversity list for the area was not collected. Threatened biota was primarily assessed using data collected from habitat assessments. Habitat features within the nearby surrounds of the study area were also recorded, and used for comparative purposes with the habitats of the Project area, assisting with the assessment of potential impacts.

3.6 Assessment of impacts

The potential impacts of the Project on fauna of conservation significance were considered in three phases. The first phase considered the likely potential impacts of the Project on fauna and their habitat. This consideration included direct and indirect impacts. A discussion of these potential impacts is presented in Section 5.

The second phase used the results of the database searches, fauna surveys and habitat assessments to determine whether a particular threatened fauna species was likely to occur within the Project area, utilise habitats within the Project area on occasion, or be influenced by indirect impacts of the Project. The results of this assessment are presented in Appendix B.

Where threatened fauna were considered likely to occur within the Project area, utilise habitats within the Project area on occasion or be influenced by indirect impacts of the Project, the significance of the potential impacts of the Project on those fauna was assessed. The significance of potential impacts on relevant threatened fauna species listed on the schedules of the TSC Act were assessed by application of the Seven Part Test in accordance with section 5A of the EP&A Act and the *Threatened species assessment guidelines - the assessment of significance* (NSW Department of Primary Industries [DPI], 2008). The significance of potential impacts on relevant matters of national environmental significance (threatened species and migratory species) was assessed in accordance with the EPBC Act Policy Statement *Significant Impact Guidelines 1.1 Matters of National Environmental Significance* (DEWHA, 2009).

3.7 Mitigation measures and proposed offset area

The Project would include a range of measures to reduce or mitigate potential impacts and also includes an offset. Mitigation measures were considered in Section 6 and the offset strategy is considered in Section 7.

4 Results

4.1 Desktop review

4.1.1 Threatened species

The search of literature and database records for threatened fauna in the vicinity of the Atlas-Campaspe Mine study area and MCTR provided a list of 55 animal species that are listed as threatened on the EPBC Act and/or TSC Act, including two species of frog, six species of reptile, 36 species of bird and 11 species of mammal (Appendix B). This list includes species that have been previously recorded within 20 km of the Atlas-Campaspe Mine study area and MCTR roadworks footprint, species that are known or predicted to occur in the CMA subregion and species that were predicted by the EPBC Act Protected Matters database to have potential habitat within 10 km of the Project area.

The search of database records for threatened fauna previously recorded within 20 km of the Ivanhoe Rail Facility study area provided a list of 48 animal species that are listed as threatened on the EPBC Act and/or TSC Act, including one species of frog, two species of reptile, 37 species of bird and eight species of mammal. This list includes species that have been previously recorded within 20 km of the Ivanhoe Rail Facility study area, species that are known or predicted to occur in the CMA subregion and species that were predicted by the EPBC Act Protected Matters database to have potential habitat within 10 km of the Project area. Based on known habitats in the study area, 24 species are known or considered likely to occur in the Ivanhoe Rail Facility or immediate surrounds, including one species of reptile, 18 species of bird, and five species of mammal.

Five migratory bird species listed under the EPBC Act have been recorded within a 20 km radius of the Project area and searches of the EPBC Act Protected Matters database returned an additional five bird species that were predicted to have potential habitat.

The lists of these threatened species are presented in Appendix B, together with information about each species regarding whether there are previous records from the area, whether the species was detected during fauna surveys, whether there is potential habitat for the species within the Project area and an assessment of the likelihood that the species would be affected by the Project.

Forty of the species listed in Appendix B Table 1 are known or considered to potentially to occur in the Project area or immediate surrounds relating to the Atlas-Campaspe Mine study area, including 25 species of bird, six species of reptile and nine species of mammal. These species are considered further in Section 5.7.

4.1.2 Threatened populations

No threatened fauna populations are predicted to occur within the locality of the Project area.

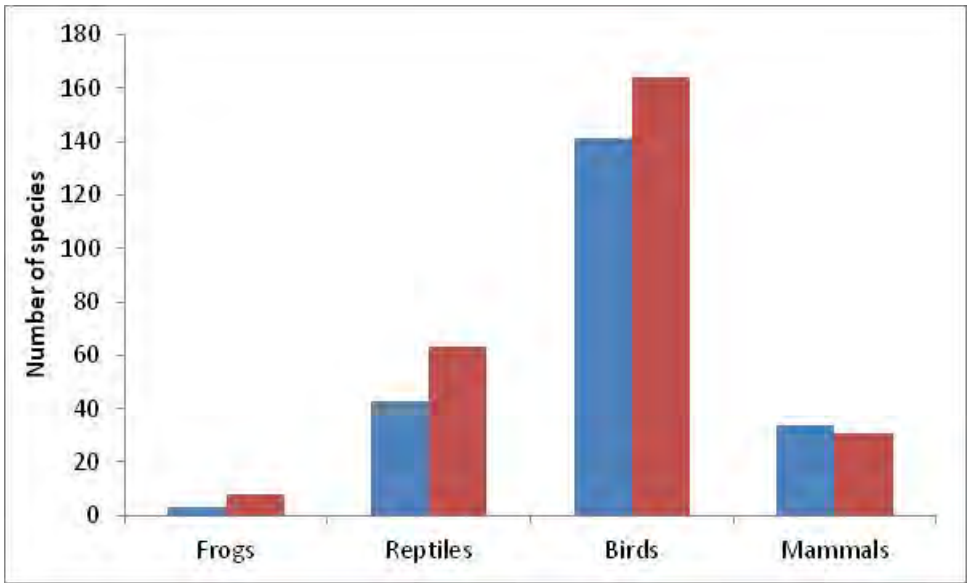
4.1.3 Listed migratory species

Ten species of bird that are listed as migratory under the EPBC Act are predicted as having potential to occur, or have database records within a 20 km radius of the Project area (Appendix E). Three of these species have been recorded within the Atlas-Campaspe Mine area or surrounds during recent surveys and one species within the Ivanhoe Rail Facility study area or surrounds (Appendix A).

4.2 Fauna recorded in the Project area, surrounds and/or the proposed offset area

4.2.1 All fauna

A total of 219 animal species have been recorded within the Atlas-Campaspe Mine study area, MCTR study area and/or the proposed offset area. This includes three species of frog, 43 species of reptile, 140 species of bird and 33 species of mammal. A total of 67 animal species have been recorded within the Ivanhoe Rail Facility study area and surrounds. This includes two species of frog, one species of reptile, 59 species of bird and 5 species of mammal. A complete list of these species is provided in Appendix A. The results of the fauna surveys demonstrate that, with the possible exception of frogs, there is good representation of species diversity across all faunal types within the study areas, when compared with the Lower Murray-Darling biodiversity surveys (Val *et al.*, 2001) (Graph 2).



Graph 2: Comparison of species richness in the Project area (blue columns) versus the Lower Murray-Darling area (red columns).

Note: Lower Murray-Darling data from Val *et al*., (2001). Project area data does not include the Ivanhoe Rail Facility study area and surrounds due to limited targeted fauna survey effort undertaken.

4.2.2 Exotic fauna

Nine of the animal species known to occur in the Atlas-Campaspe Mine study area, MCTR study area and/or the proposed offset area are exotic, all of which are mammalian (Appendix A). These species include the House Mouse, Dog/Dingo, Red Fox, Cat, Brown Hare, European Rabbit, European Cattle, Goat and Sheep. All these exotic species were common or abundant, with the exception of the Brown Hare, European Cattle and Sheep, which were uncommon.

4.2.3 Threatened fauna

Twenty-eight threatened fauna species were recorded during the recent surveys of the Atlas-Campaspe Mine Study Area, MCTR and surrounds. An additional six species that were not recorded during the recent surveys have been previously recorded in the surrounding area (Australian Museum, 2012; Birdlife Australia, 2012; OEH, 2012c). Three threatened fauna species were recorded during the recent surveys of the Ivanhoe Rail Facility study area (Appendix A). An additional eight species that were not recorded during the recent surveys have been previously recorded in the surrounding area (Australian Museum, 2012; Birdlife Australia, 2012; OEH, 2012c).

Threatened species recorded during surveys for the Atlas-Campaspe Mine Study Area, MCTR and surrounds are listed in Table 10, together with the source of the records. The locations of these threatened species records are shown on Figures 13 to 19. Threatened species recorded during surveys for the Ivanhoe Rail Facility and surrounds are listed in Table 11, together with the source of the records. The locations of these threatened species records are shown on Figure 20.

4.2.4 Listed migratory species

Three listed migratory species were recorded during the surveys of the Atlas-Campaspe Mine, MCTR and surrounds; the Rainbow Bee-eater (*Merops ornatus*), Malleefowl (*Leipoa ocellata*) and the Australian Painted Snipe (*Rostratula australis*) (Appendix A). One migratory species was recorded during surveys of the Ivanhoe Rail Facility study area and surrounds; the Great Egret (*Ardea alba*).

With the exception of the Malleefowl, all these migratory species undertake at least in part, large scale movements throughout Australia. These movements may be in response to changing foraging resources, water availability, or breeding patterns. The Malleefowl is generally a sedentary species, with established pairs and individuals usually remaining in the same area throughout the year. Small scale movements may occur during the non-breeding period (Benshemesh, 1992; Booth, 1987; Frith, 1959). Additional information for each migratory species is provided in Table 12.

4.3 Fauna recorded in Mungo National Park

The fauna reported in Section 4.2 above include a total of 106 animal species that were recorded within Mungo National Park by AMBS during the surveys (2011-2012). This includes 16 species of reptile, 70 species of bird and 20 species of mammal. A complete list is provided in Appendix A. Ten of these fauna species are listed as threatened under the TSC Act and/or EPBC Act. The locations of these threatened species records are shown on Figures 13 to 18. The smaller number of records from Mungo National Park is likely a result of the reduced survey effort in comparison to the other areas associated with the Project.

All 16 of the reptile species (including one threatened species) and two of the mammal species (including one threatened species) were also recorded by OEH during systematic surveys of small terrestrial vertebrates of Mungo National Park. The OEH survey results include 16 species (none threatened) that were not recorded by AMBS. Most of those require habitat that was not present in the area surveyed by AMBS.

Five of the animal species recorded within Mungo National Park are exotic, namely the House Mouse, Red Fox, Cat, European Rabbit and Goat (Appendix A).

Table 10: Threatened fauna species recorded in the Atlas-Campaspe Mine Study Area, MCTR and surrounds during AMBS surveys and suitable habitat units within the study area for each species.

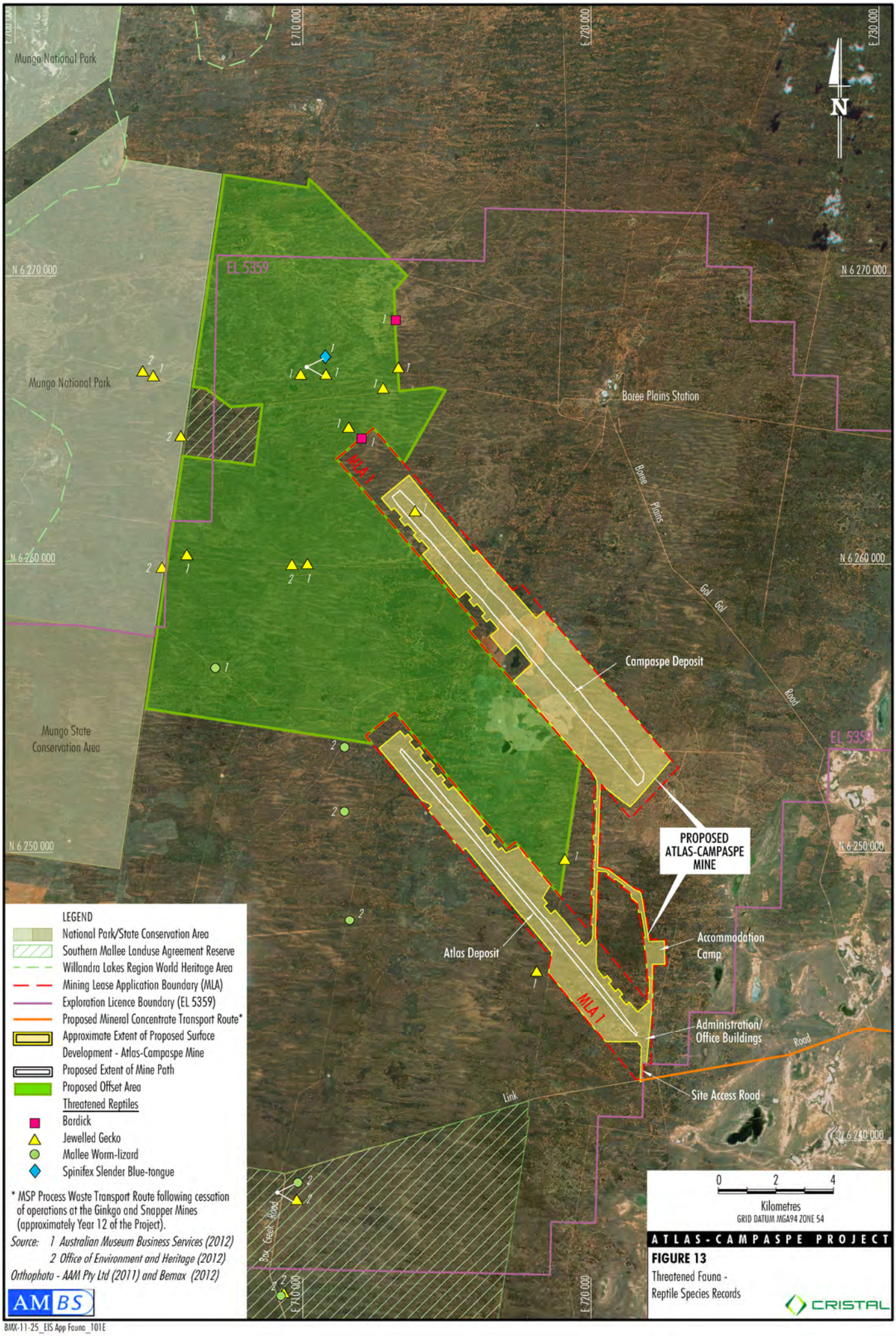
Scientific Name	Common Name	Conservation Status		Recorded in Project Area and Surrounds and Presence of Habitat	Habitat within Project Area and Surrounds
		TSC Act	EPBC Act		
Reptiles					
Echiopsis curta	Bardick	E	-	Individuals were recorded in two locations; within the MLA and to the north of the MLA, on the border of the proposed offset (Figure 13). Potential habitat present within the Project area and surrounds.	Breeding and foraging habitat in Linear Dune Mallee.
Strophurus elderi	Jewelled Gecko	V	-	Species recorded in one location in the Campaspe footprint (Figure 13). Recorded from eight locations in the proposed offset area and one within Mungo National Park (Figure 13). There are also numerous database records from the proposed offset area and Mungo National Park (Figure 13) (OEH, 2012c). There is an abundance of key habitat available within the Project area and surrounds.	Breeding and foraging habitat Linear Dune Mallee and some portions of Sandplain Mallee with mature spinifex.
Aprasia inaurita	Mallee Worm-lizard	E	-	Species was observed in one location in the proposed offset area (Figure 13). There are also numerous database records outside of, but nearby to the Project area (Figure 13) (OEH, 2012c). There is an abundance of key habitat available within the Project area and surrounds.	Breeding and foraging habitat in Sandplain Mallee and Linear Dune Mallee.
Cyclodomorphus melanops elongatus	Spinifex Slender Blue-tongue	E	-	Recorded from one location outside of the Project area but within the proposed offset area (Figure 13). Potential habitat present within the Project area and surrounds.	Breeding and foraging habitat in Linear Dune Mallee.
Birds					
Leipoa ocellata	Malleefowl	E	V	Footprints recorded within the MLA, the proposed offset area and close surrounds (Figures 14 and 15). Two mounds were detected within the MLA, four mounds from the proposed offset area, and one mounds from the close surrounds (Figures 14 and 15)[4]. Two sightings have also been recorded (Figures 14 and 15) and there are three database records from surrounding areas (Figures 14 and 15) (OEH, 2012c). Key habitat is available within the Project area and surrounds.	Breeding and foraging habitat in Linear Dune Mallee and Sandplain Mallee. Secondary foraging habitat in Cleared Land, shrubland, Mulga Woodland and Belah-Rosewood.
Stictonetta naevosa	Freckled Duck	V	-	Several individuals (maximum of 30 at any one time) were recorded on three occasions in one location within MLA (Figure 14) in the Ephemeral Wetland. Potential habitat present within the Project area and surrounds.	Potential breeding and foraging habitat in Ephemeral Wetland and depression habitat.

4 The mine plan has been refined to avoid a Malleefowl nesting mound and two Cobar Greenhood Orchid locations recorded during surveys. Given this commitment was made immediately prior to the finalisation of this report, and resulted in a change to the proposed surface development area, figures within the main body of this report (such as Figure 15) were amended to reflect this change. It should be noted however, that the figures in Appendix C of this report (Seven Part Tests) have not been updated, on the basis that at the scale presented, the relevant changes would have been immaterial. For clarity, the figures in the main body of this report provide the accurate representation of the proposed mine plan.

Scientific Name	Common Name	Conservation Status		Recorded in Project Area and Surrounds and Presence of Habitat	Habitat within Project Area and Surrounds
		TSC Act	EPBC Act		
Circus assimilis	Spotted Harrier	V	-	Recorded in one location within MLA and one location in the close surrounds (Figure 14). There is potential habitat available within the Project area and surrounds.	Potential breeding habitat in Black Box Woodland, Belah-Rosewood Woodland, Sandplain Mallee and Linear Dune Mallee. Foraging habitat in, cleared areas, disturbed shrubland, Mulga Woodland, Sandhill Pine Woodland, Grass and Herbland Depressions and Chenopod Shrubland.
Hieraaetus morphnoides	Little Eagle	V	-	Recorded from one location within the Atlas footprint and two in the proposed offset area (Figure 14). There are also numerous database records from the proposed offset area, Mungo National Park and surrounds (Figure 14) (Birdlife Australia, 2012).	Potential breeding and foraging habitat in Black Box Woodland, Sandplain Mallee , Linear Dune Mallee and Belah-Rosewood Woodland. Foraging habitat only in cleared areas, shrubland, Acacia Woodland/ Shrubland, Sandhill Pine Woodland and Chenopod Shrubland.
Burhinus grallarius	Bush Stone-curlew	E	-	One individual was heard calling during call playback surveys within the Atlas footprint (Figure 14). The individual may have been calling from a location up to 1 km to the south-west of the call playback location. There is potential habitat present within the Project area and surrounds.	Potential breeding and foraging habitat in Belah-Rosewood Woodland, Black Box Woodland, and Acacia Woodland/Shrubland. Potential foraging habitats may include Shrubland and Cleared Land, mainly where these abut more structured woodlands.
Rostratula australis	Australian Painted Snipe	E	V	Recorded from one location (10 individuals) in the MLA, outside of the Campaspe footprint (Figure 14). There is potential habitat present within the Project area and surrounds.	Breeding and foraging habitat in Ephemeral Wetland, Grass and Herbland Depressions and Chenopod Shrubland Depressions.
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Recorded from 10 locations within the MLA and 15 locations in the proposed offset area, six locations in Mungo National Park and five locations in the close surrounds (Figure 14). Numerous database records in the surrounding area (Figure 14) (Birdlife Australia, 2012). Potential habitat present within the Project area and surrounds.	Breeding and foraging habitat in Black Box Woodland. Potential breeding habitat in Linear Dune Mallee and Sandplain Mallee. Foraging habitat in Acacia Woodland/Shrubland, Chenopod Shrubland Depressions, Chenopod Shrubland, Sandplain Mallee, Linear Dune Mallee, Belah-Rosewood Woodland, Sandhill Pine Woodland, Shrubland and Cleared Land.
Polytelis anthopeplus monarchoides	Regent Parrot	E	V	Recorded in one location to the west of the Atlas footprint (Figure 14). Distribution is generally restricted to within 30 km of the Murray River. Only rare vagrants are found beyond this area.	Marginal foraging habitat in Sandplain Mallee, Linear Dune Mallee and perhaps cropland with seeds. No breeding habitat.
Pyrrholaemus brunneus	Redthroat	V	-	Recorded in five locations adjacent to the MCTR roadworks footprint (Figures 14 and 19). There is potential habitat present along MCTR.	Breeding and foraging habitat in Chenopod Shrubland and Chenopod Shrubland Depressions.
Certhionyx variegatus	Pied Honeyeater	V	-	Recorded in one location within the Atlas footprint and one location within the proposed offset area (Figure 16). Several database records from Mungo National Park and surrounds (Figure 16 and Appendix B).There is potential habitat available within the Project area and surrounds.	Breeding and foraging habitat in Linear Dune Mallee, Sandplain Mallee, Black Box Woodland and Acacia Woodland/Shrubland. Foraging habitat in Chenopod Shrubland and Chenopod Shrubland Depressions.

Scientific Name	Common Name	Conservation Status		Recorded in Project Area and Surrounds and Presence of Habitat	Habitat within Project Area and Surrounds
		TSC Act	EPBC Act		
Epthianura albifrons	White-fronted Chat	V	-	Recorded in four locations within the proposed offset area (Figure 16) and in one location adjacent to the MCTR (Figure 19) Identified in several database records from the Mungo National Park (Figure 16) There is potential habitat available within the Project area and surrounds.	Breeding and foraging habitat in Black Box Woodland, Ephemeral Wetland, Chenopod Shrubland and Chenopod Shrubland Depression habitat. Foraging habitat in Cleared Land.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Recorded from six locations within the MLA or Atlas-Campaspe Mine footprint, four from the surrounds and six locations within the proposed offset area (Figure 16). There are also numerous database records from the proposed offset area and the Mungo National Park (Figure 16) (OEH, 2012c; Birdlife Australia, 2012). Potential habitat available within the Project area and surrounds.	Breeding and foraging habitat in Black Box Woodland, Acacia Woodland/Shrubland, Linear Dune Mallee and Sandplain Mallee. Potential foraging habitat in Shrubland and Cleared Land close to more structured vegetation.
Cinclosoma castanotum	Chestnut-backed Quail-thrush	V	-	Recorded from 14 locations within the MLA or Atlas-Campaspe Mine footprint, 36 locations in the proposed offset area, nine locations in the Mungo National Park and more within the close surrounds (Figure 16). There are also numerous database records of the species in the Mungo National Park, proposed offset area and close surrounds (Figure 16) (OEH, 2012c; Birdlife Australia, 2012). Within the Project area and surrounds there is an abundance of key habitat available.	Breeding and foraging habitat in Linear Dune Mallee, Sandplain Mallee and Mulga Woodland.
Daphoenositta chrysoptera	Varied Sittella	V	-	Recorded in five locations within the Campaspe footprint and three locations within the proposed offset area (Figure 16). Several database records from the Mungo National Park and surrounds (Figure 16) (OEH, 2012c; Birdlife Australia, 2012). There is potential habitat available within the Project area and surrounds.	Breeding and foraging habitat in Black Box Woodland, Linear Dune Mallee, Sandplain Mallee, Acacia Woodland/Shrubland and Belah-Rosewood Woodland.
Pachycephala inornata	Gilbert's Whistler	V	-	Records from two locations outside of the Atlas-Campaspe Mine footprint and one location within the proposed offset area (Figure 16). Potential habitat exists within the Project area.	Breeding and foraging habitat in Linear Dune Mallee, Belah-Rosewood Woodland and Sandplain Mallee.
Mammals					
Ningaui yvonneae	Southern Ningaui	V	-	Recorded in three locations within MLA and two locations within the proposed offset area (Figure 17). Several database records from the Mungo National Park and surrounds (Figure 17) (OEH, 2012c). There is an abundance of key habitat available within the Project area and surrounds.	Breeding and foraging habitat in Linear Dune Mallee. Potential breeding and foraging habitat in Sandplain Mallee where spinifex is present.
Cercartetus concinnus	Western Pygmy-possum	E	-	Recorded in three locations (probable records) within the Atlas footprint (Figure 17). Several database records from the Mungo National Park, proposed offset area and surrounds (Figure 17) (OEH, 2012c; Australian Museum, 2012). There is an abundance of key habitat available within the Project area and surrounds.	Potential breeding and foraging habitat present in Linear Dune Mallee, Sandplain Mallee and Belah-Rosewood Woodland.

Scientific Name	Common Name	Conservation Status		Recorded in Project Area and Surrounds and Presence of Habitat	Habitat within Project Area and Surrounds
		TSC Act	EPBC Act		
Sminthopsis macroura	Stripe-faced Dunnart	V	-	Recorded in one location in Mungo National Park (Figure 17).	Potential breeding and foraging habitat present in Acacia Woodland/Shrubland Linear Dune Mallee, Sandplain Mallee and Belah-Rosewood Woodland.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Recorded in five locations and possibly recorded in six locations within Atlas-Campaspe Mine footprint (Figure 18). Recorded in five locations and possibly recorded in a further three locations within the proposed offset area (Figure 18). There is potential habitat available within the Project area and surrounds.	Potential breeding and foraging habitat in Black Box Woodland, Sandplain Mallee , Linear Dune Mallee and Belah-Rosewood Woodland. Foraging habitat only in cleared areas, shrubland, Acacia Woodland/Shrubland, Sandhill Pine Woodland, Cleared Land, Chenopod Shrubland depressions, Grass and Herbland Depressions and Chenopod Shrubland.
Nyctophilus corbeni	South-eastern Long-eared Bat (also known as Corben's Long-eared Bat)	V	V	Recorded in eight locations within the Atlas-Campaspe MLA and nine locations in the proposed offset area (Figure 18). The species was also recorded in the surrounding area. There are also numerous database records from the proposed offset area, the Mungo National Park and surrounds (Figure 18) (OEH, 2012c). There is also a record along the MCTR. There is potential habitat available within the Project area and surrounds.	Potential breeding and foraging habitat in Black Box Woodland, Sandplain Mallee , Linear Dune Mallee and Belah-Rosewood Woodland. Foraging habitat only in Sandhill Pine Woodland.
Chalinolobus picatus	Little Pied Bat	V	-	Recorded in 21 locations within the Atlas-Campaspe Mine footprint, twelve locations in the proposed offset area and three locations in the close surrounds (Figure 18). Several database records from the Mungo National Park and surrounds (Figure 18) (OEH, 2012c).There is potential habitat available within the Project area and surrounds.	Breeding and foraging habitat in all habitat types except Cleared Land.
Vespadelus baverstocki	Inland Forest Bat	V	-	Recorded in 10 locations within MLA, nine locations in the proposed offset area and one locations in the close surrounds (Figure 18). Several database records from the Mungo National Park, proposed offset area and surrounds (Figure 18).There is potential habitat available within the Project area and surrounds.	Breeding and foraging habitat in Linear Dune Mallee, Sandplain Mallee, Sandhill Pine Woodland, Black Box Woodland and Belah-Rosewood Woodland. Foraging habitat only in Acacia Woodland/Shrubland and shrubland.
Pseudomys bolami	Bolam's Mouse	E	-	Recorded from one location in the Mungo National Park (Figure 17). Several records from within 20 km (Appendix B). There is potential habitat available within the Project area and surrounds.	Breeding and foraging habitat in all habitat types except Cleared Land.
Rattus villosissimus	Long-haired Rat (possible)	V	-	A hair possibly belonging to this species was recorded in one location in Atlas footprint (Figure 17). The hair could only be identified to a genus level however there are several records from within 20 km (Australian Museum, 2012). There is potential habitat available within the Project area and surrounds.	Potential breeding and foraging habitat in all habitat types during extended wet periods.



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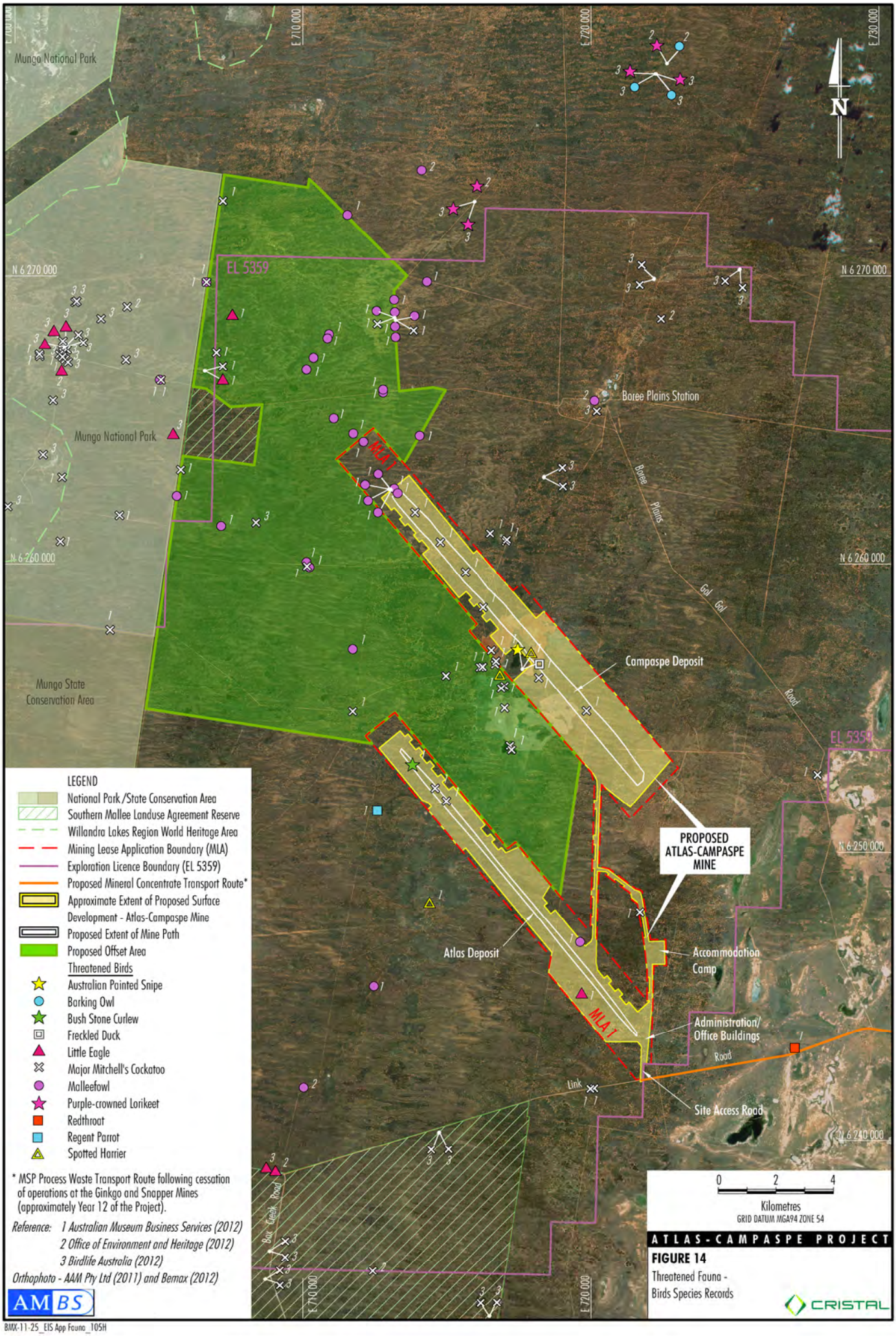

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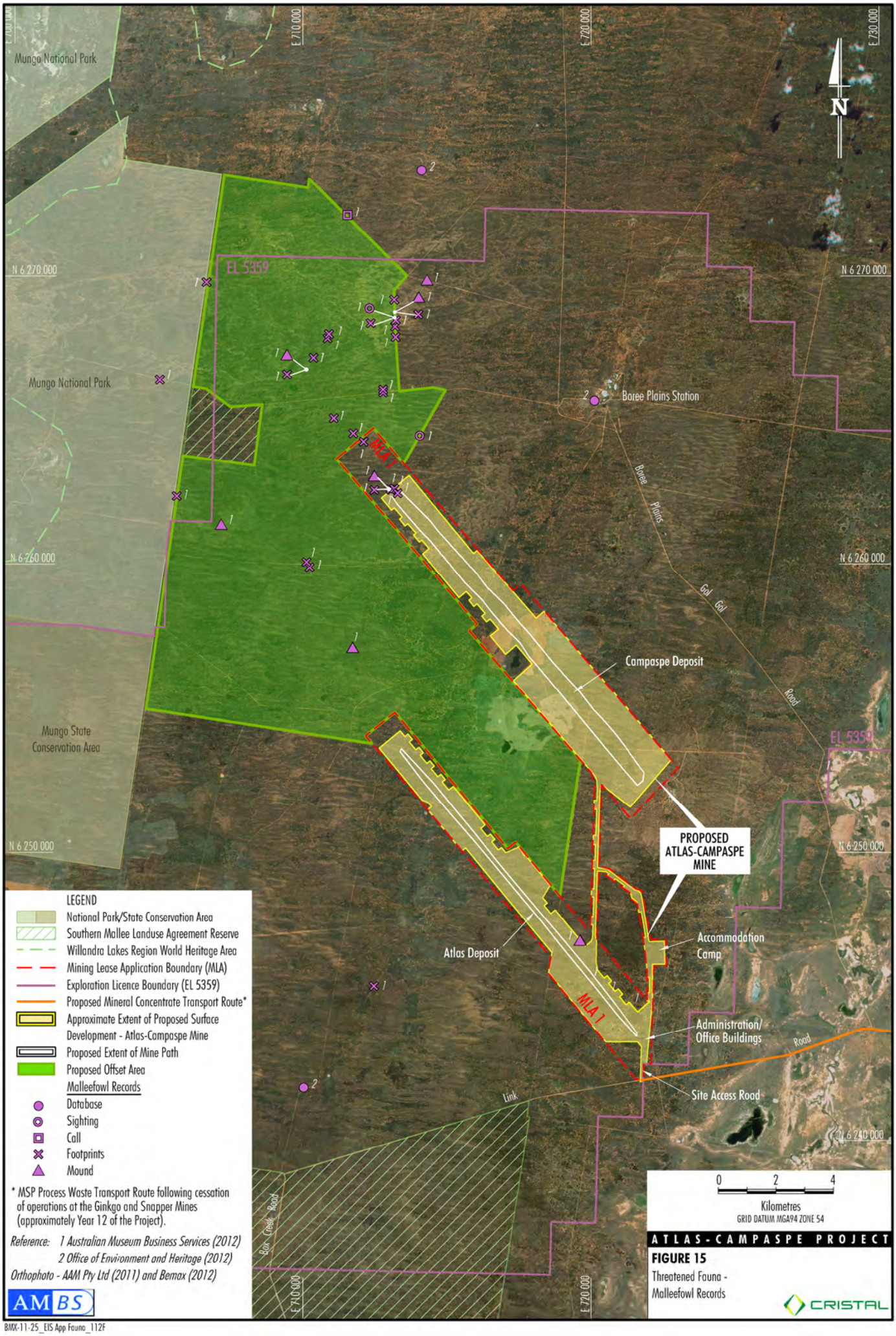

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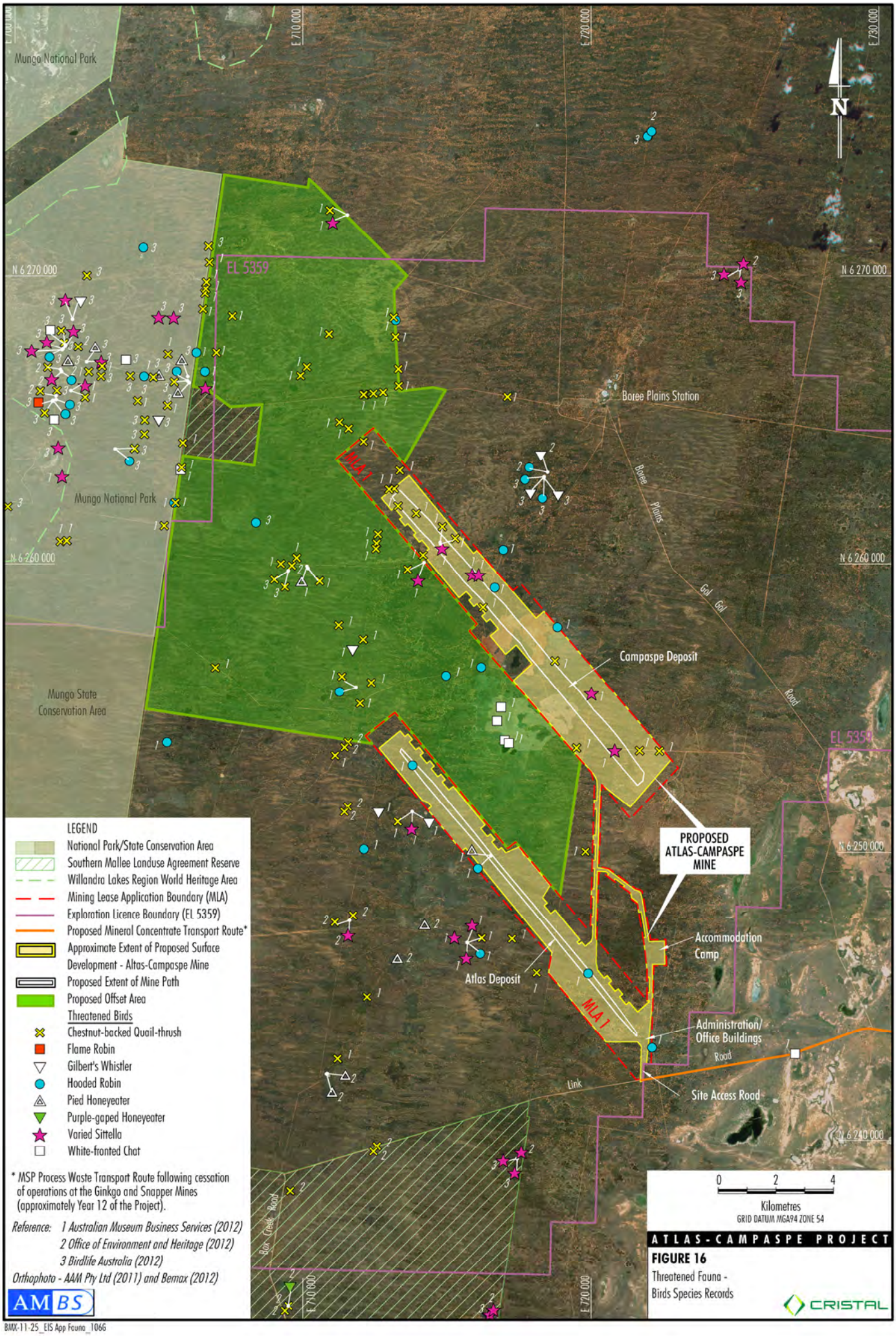
Mungo National Park
E 710 000
E 720 000
E 730 000
N
N 6 270 000
EL 5359
Boree Plains Station
MLA 1
Boree Plains Road
Gol Gol Road
N 6 260 000
Campaspe Deposit
Mungo State Conservation Area
PROPOSED ATLAS-CAMPASPE MINE
N 6 250 000
Accommodation Camp
Atlas Deposit
Administration/ Office Buildings
Road
Link
Site Access Road
N 6 240 000
Box Creek Road
E 710 000
E 720 000
LEGEND
National Park/State Conservation Area
Southern Mallee Landuse Agreement Reserve
Willandra Lakes Region World Heritage Area
Mining Lease Application Boundary (MLA)
Exploration Licence Boundary (EL 5359)
Proposed Mineral Concentrate Transport Route*
Approximate Extent of Proposed Surface Development - Altas-Campaspe Mine
Proposed Extent of Mine Path
Proposed Offset Area
Threatened Birds
Chestnut-backed Quail-thrush
Flame Robin
Gilbert's Whistler
Hooded Robin
Pied Honeyeater
Purple-gaped Honeyeater
Varied Sittella
White-fronted Chat
* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).
Reference: 1 Australian Museum Business Services (2012)
2 Office of Environment and Heritage (2012)
3 Birdlife Australia (2012)
Orthophoto - AAM Pty Ltd (2011) and Bemax (2012)
AMBS
0 2 4
Kilometres
GRID DATUM MGA94 ZONE 54
ATLAS-CAMPASPE PROJECT
FIGURE 16
Threatened Fauna - Birds Species Records
CRISTAL
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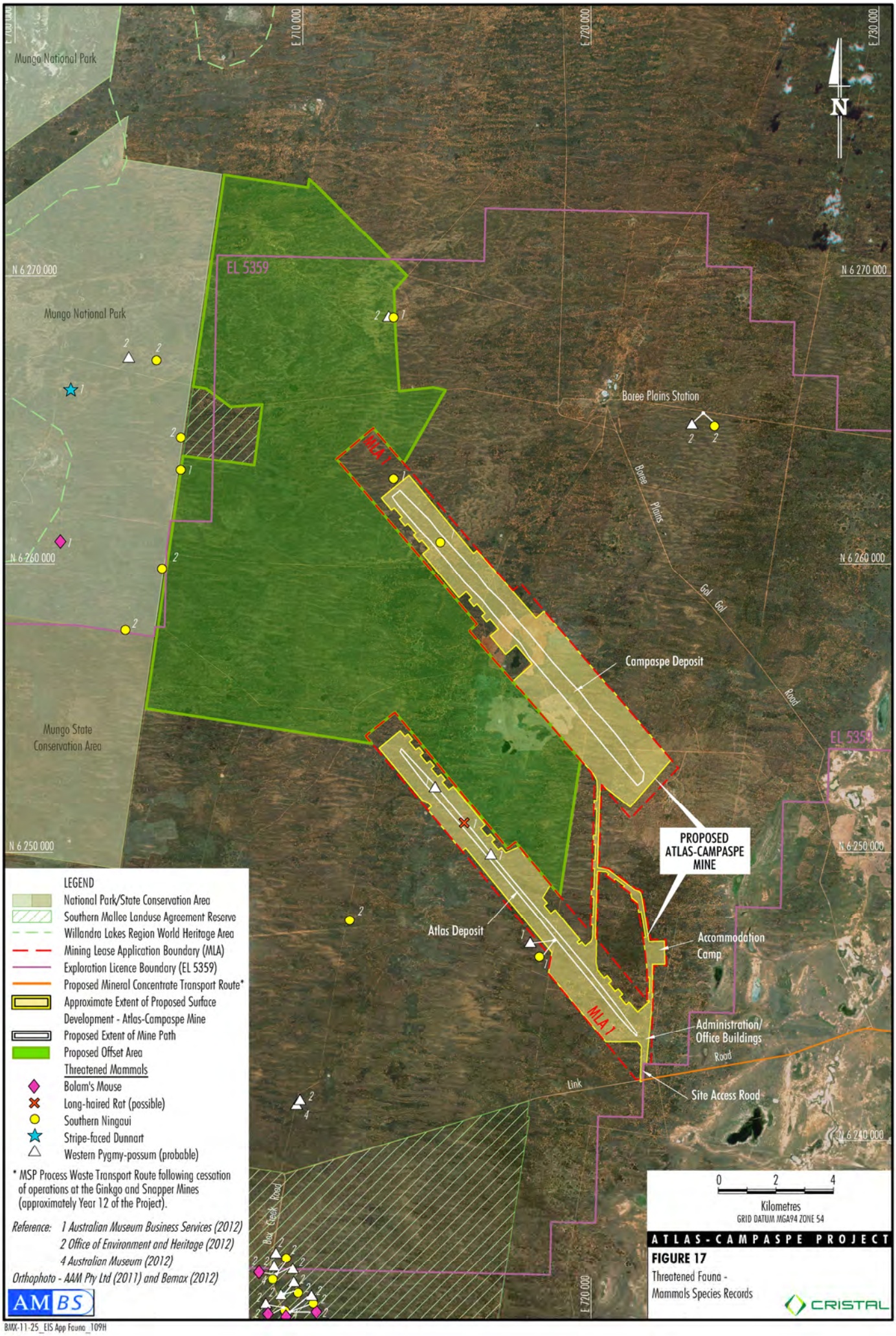

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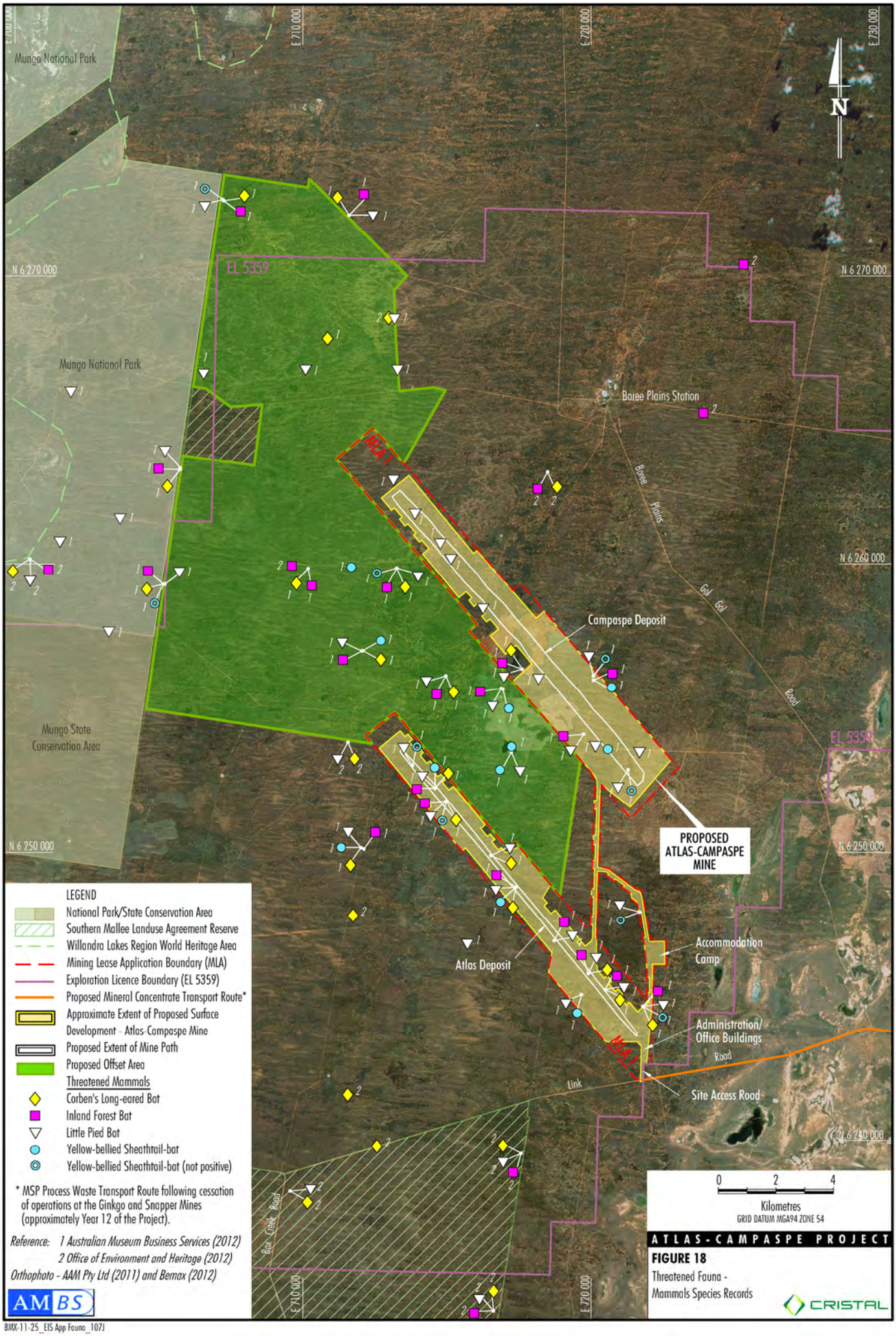

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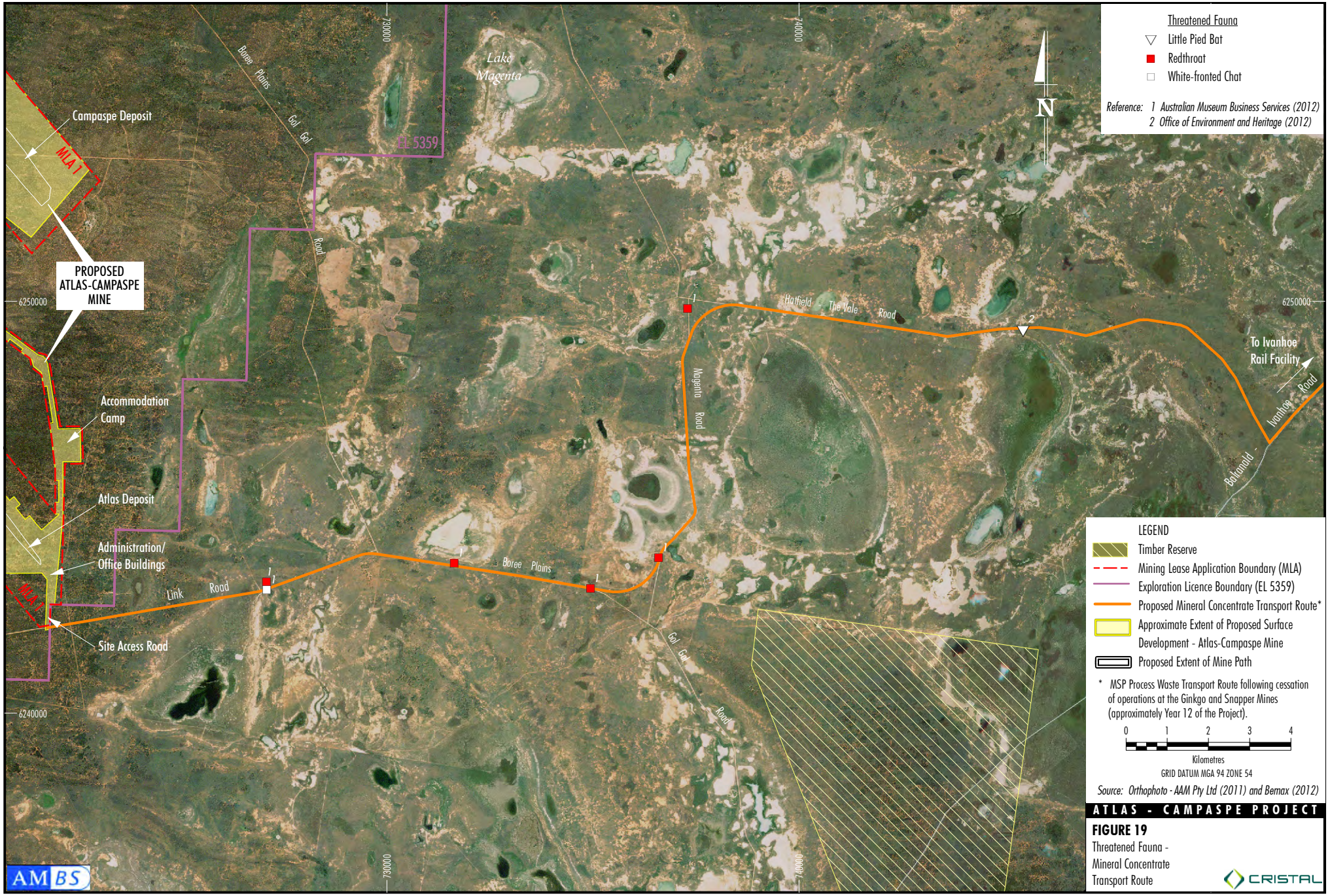


ATLAS - CAMPASPE PROJECT

FIGURE 19

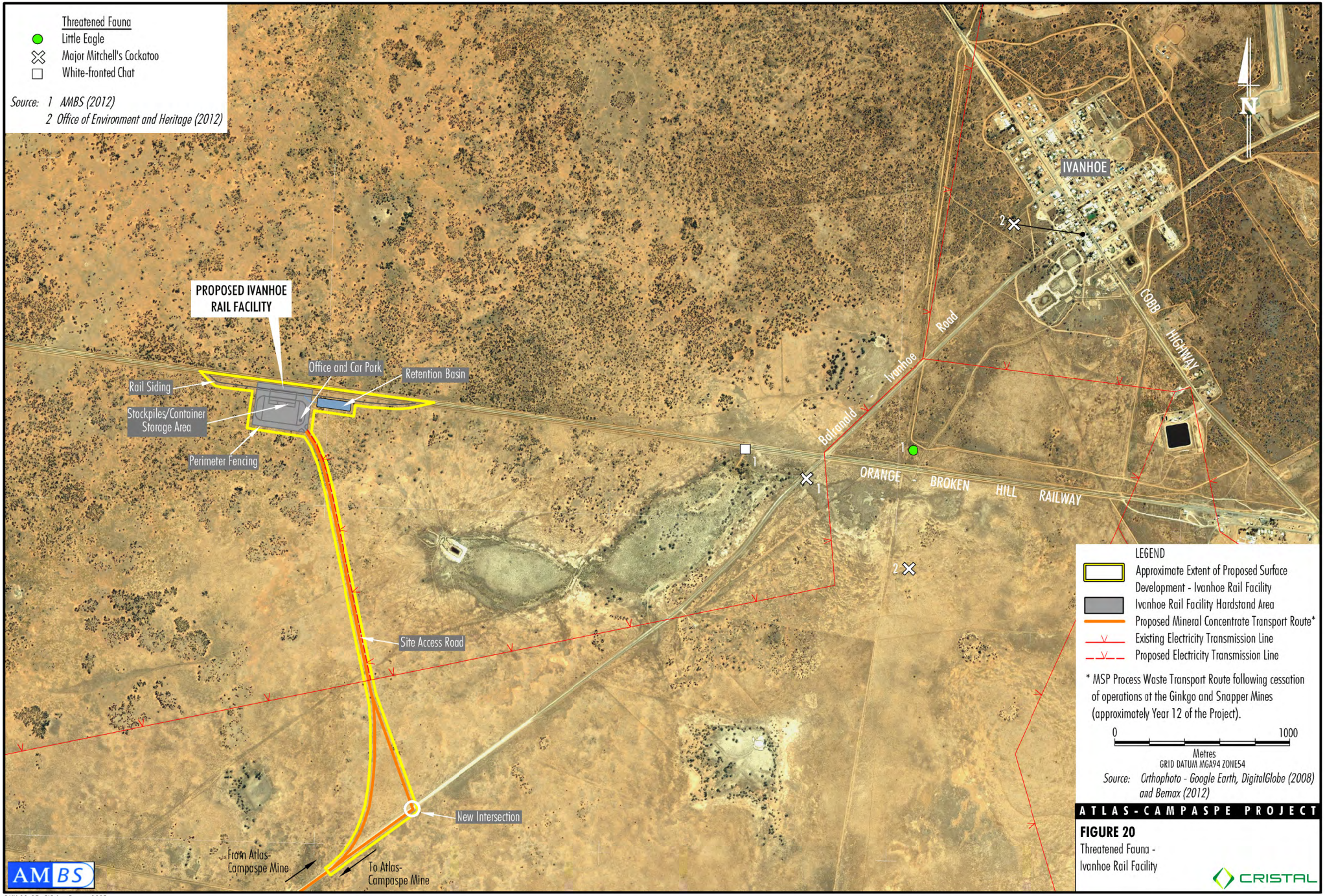
Threatened Fauna - Mineral Concentrate Transport Route

CRISTAL

BMX-11-25_EIS App Fauna_212E

Table 11: Threatened fauna species recorded in the Ivanhoe Rail Facility and surrounds during AMBS surveys and suitable habitat units within the study area for each species.

Scientific Name	Common Name	Conservation Status		Recorded in Project Area and Surrounds and Presence of Habitat	Habitat within Project Area and Surrounds
		TSC Act	EPBC Act		
Birds					
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Recorded from one location alongside of the Black Box Woodland to the east of the Ivanhoe Rail Facility study area (Figure 20). There are also two database records for this species to the east of the Ivanhoe Rail Facility study area (OEH, 2012c) (Figure 20).	Breeding and foraging habitat in Black Box Woodland. Foraging habitat in Belah-Rosewood Woodland, Native Grassland and Cleared Land.
Hieraaetus morphnoides	Little Eagle	V	-	Recorded from one location outside of the Ivanhoe Rail Facility study area (Figure 20). There are no database records from the surrounds.	Potential breeding and foraging habitat in Black Box Woodland. Foraging habitat only in cleared areas, Belah-Rosewood Woodland and Native Grassland.
Epthianura albifrons	White-fronted Chat	V	-	Recorded in one location outside of the Ivanhoe Rail Facility study area (Figure 20), within the Black Box Woodland/ Ephemeral Wetland. There are no database records from the surrounds (Figure 20).	Breeding and foraging habitat in Black Box Woodland, Ephemeral Wetland to the east of the study area and edges of the Native Grassland within the Project area.



ATLAS-CAMPASPE PROJECT

FIGURE 20

Threatened Fauna - Ivanhoe Rail Facility

CRISTAL

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Table 12: Migratory patterns for species recorded in the Project area or surrounds.

Common name	Scientific name	Migratory patterns
Rainbow Bee-eater	*Merops ornatus*	The movement patterns are complex and are not fully understood. Populations that breed in southern Australia move north after breeding, and remain there for the duration of the Australian winter. Populations that breed in northern Australia are considered to be resident, and in many northern localities the Rainbow Bee-eater is present throughout the year (Emison *et al*., 1987; Lane, 1963; Morris *et al*., 1981; Saunders & Ingram, 1995; Serventy, 1948; Serventy & Whittell, 1976). Potential habitat in the Project area would be used on occasion by this species.
Malleefowl	*Leipoa ocellata*	The species is sedentary. Established pairs and individuals usually remain in the same area throughout the year, and pairs tend to breed in the same general area for many years in succession (Benshemesh, 1992; Booth, 1987; Frith, 1959). Some small-scale movements may occur during the non-breeding period, when pairs may wander away from their nesting mounds and at times congregate into small flocks (Frith, 1959; 1962). Potential habitat in the Project area would be used regularly by this species.
Australian Painted Snipe	*Rostratula australis*	Potential habitat in the Project area would be used on occasion by this species. The movements of the species are poorly known, but it is thought to be migratory (NPWS, 1999). Sightings of individuals are erratic, and the species is likely to be nomadic in response to suitable conditions, such as flooding (NPWS, 1999).
Great Egret	*Ardea alba*	The species is dispersive, and in parts of its range, migratory (Geering *et al*., 1998; Marchant & Higgins, 1990). In Australia, multi-directional post-breeding movements of up to 280 km have been recorded (McKilligan, 2005). The species undertakes some regular seasonal movements, mostly to and from breeding colonies, and towards the coast in the dry season (Marchant & Higgins, 1990). There is circumstantial evidence of individuals migrating north to winter in tropical northern Australia (Geering *et al*., 1998; McKilligan, 2005), consistent with changes in the availability of suitable wetland habitat. Potential habitat in the Project area would be used on occasion by this species.

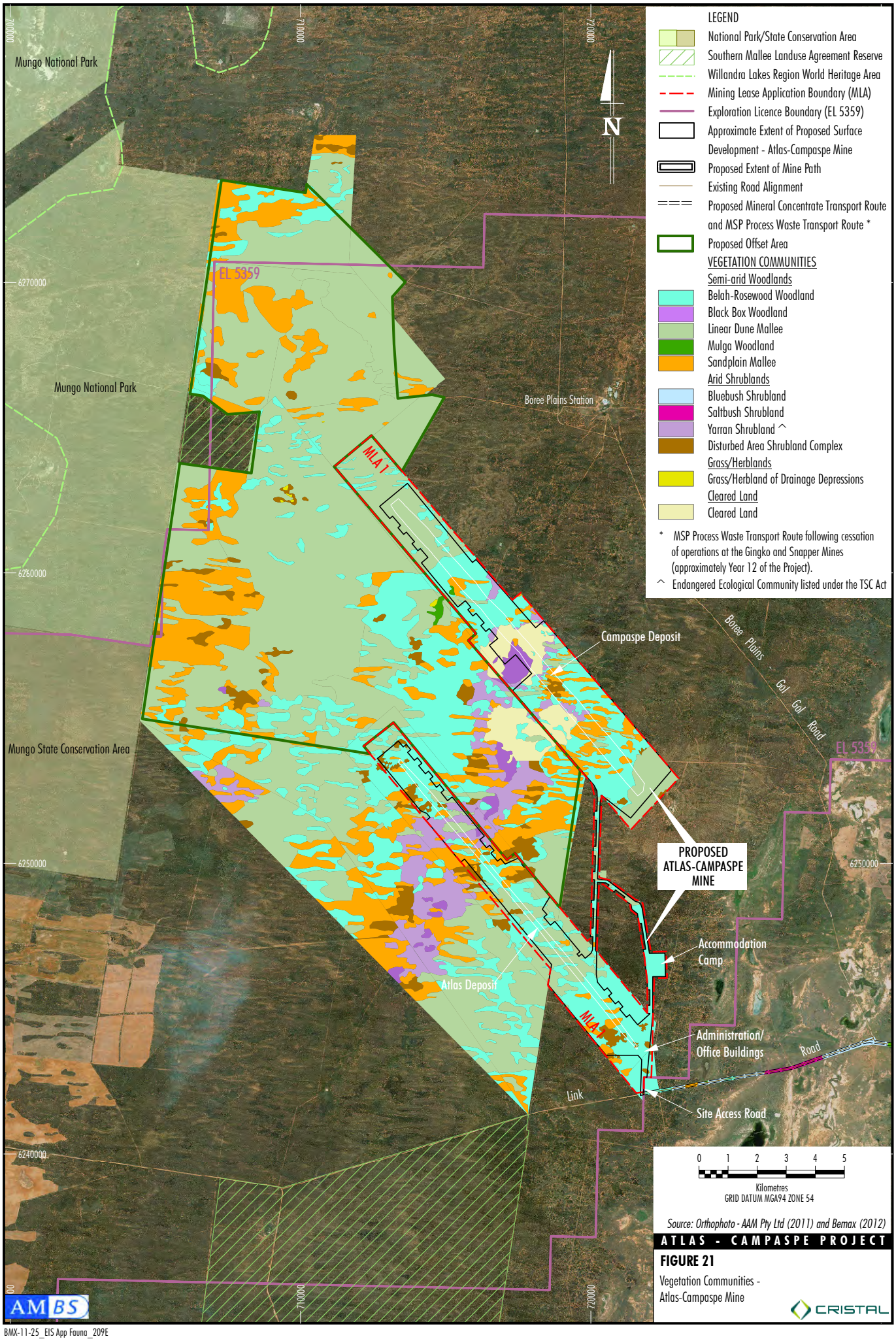
4.4 Fauna habitat

4.4.1 Broad habitat types (description and condition)

Classification of broad fauna habitat types was based on information from a combination of sources, including:

- the vegetation mapping and classification from AMBS (2013) (Figures 21 to 23);
- descriptions and classifications of vegetation from Benson *et al.* (2006);
- descriptions and classifications of broad vegetation types from Keith (2006); and
- habitat assessment data and fauna survey results for this report.

Some vegetation communities from the AMBS (2013) report were combined to create a single broad fauna habitat type based on the structural features of the vegetation and the availability of similar fauna habitat resources within these vegetation communities. The broad habitat types and corresponding vegetation communities according to Benson *et al.* (2006) and Keith (2006) are described in Table 13.



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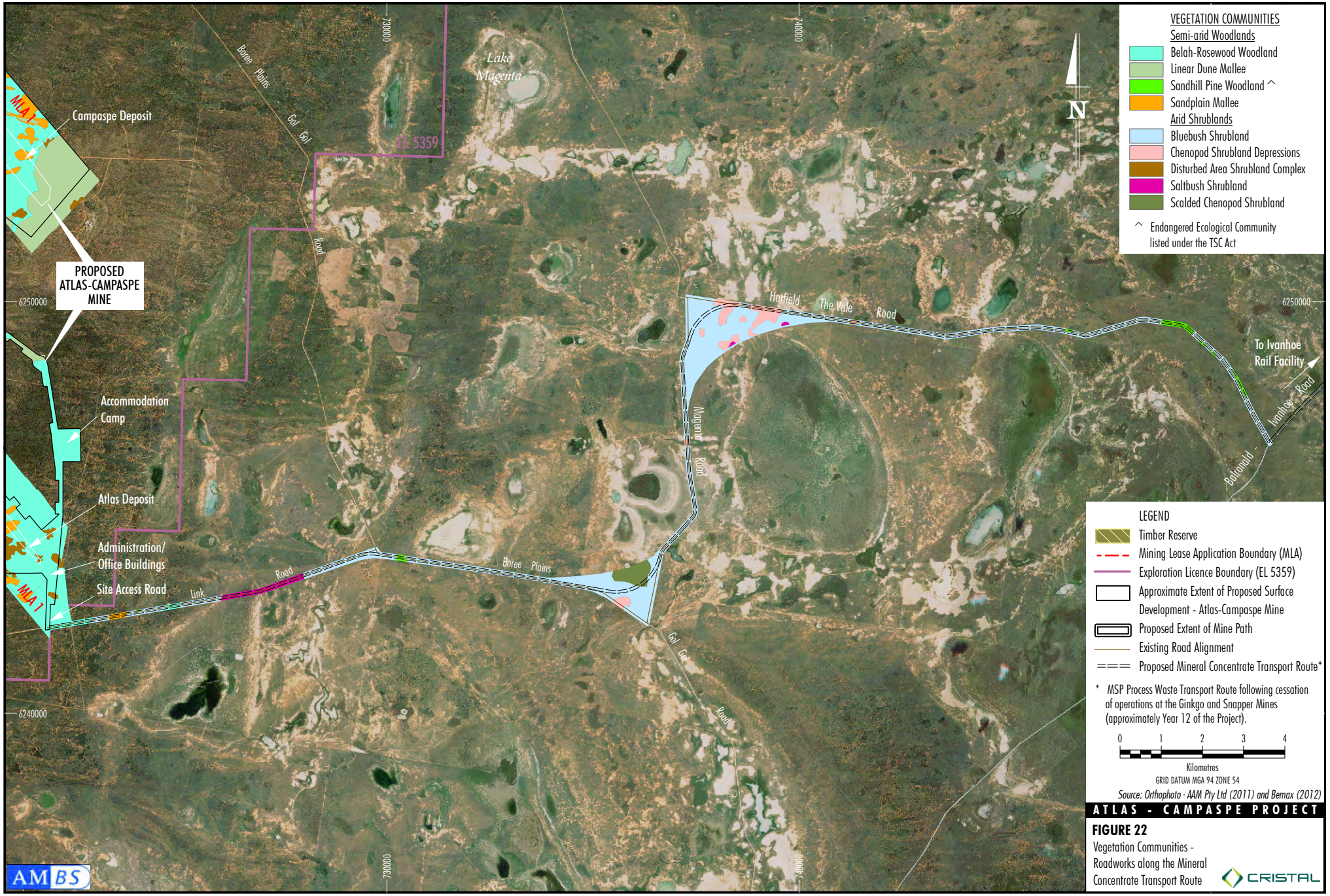

ATLAS - CAMPASPE PROJECT

FIGURE 22

Vegetation Communities - Roadworks along the Mineral Concentrate Transport Route

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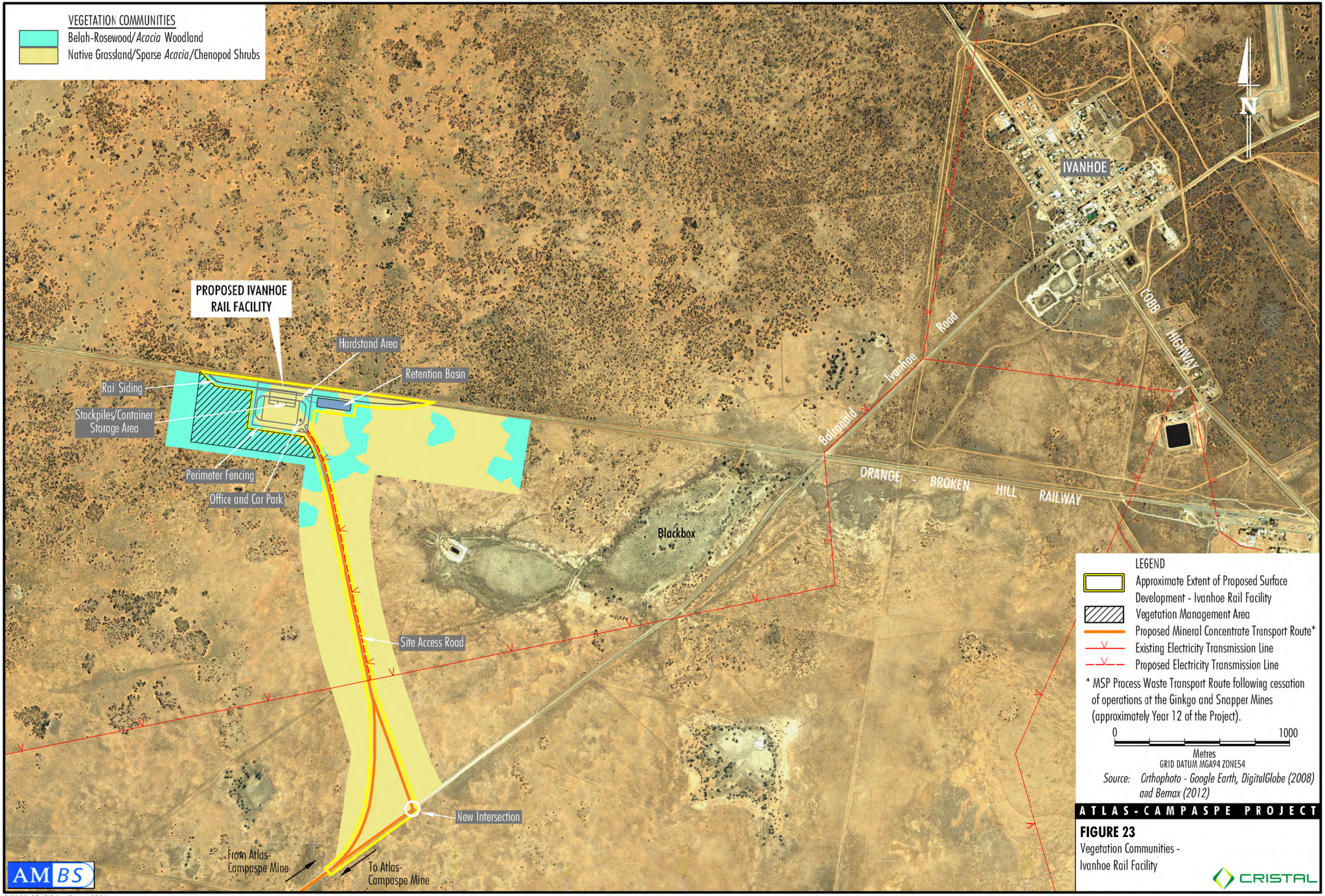


ATLAS-CAMPASPE PROJECT

FIGURE 23

Vegetation Communities - Ivanhoe Rail Facility

CRISTAL

BMX-11-25_EIS App Fauna_111H

Table 13: Fauna habitat types and corresponding vegetation.

Broad Fauna Habitat Stratification Types	AMBS (2013) Vegetation Communities	Vegetation Map Unit (Benson *et al.*, 2006)	Vegetation Types Database (Biobanking)	Description	Broad Keith (2006) Vegetation Type
Belah-Rosewood Woodland	Belah-Rosewood Woodland	ID-58 - Black-Oak Rosewood open woodland on deep sandy loams of the Murray-Darling Depression and Riverina Bioregions and 221 - Black Oak-Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones.	Black Oak - Western Rosewood open woodland on deep sandy loams of the Murray-Darling Depression and Riverina Bioregions (Benson 58). Black Oak - Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones (Benson 221).	Woodland on sandplains dominated by *Casuarina pauper* (Belah) and *Alectryon oleifolius* (Rosewood).	Semi-arid Sand plain Woodlands
Belah-Rosewood Woodland (Ivanhoe Rail Facility and surrounds)	Belah-Rosewood/ Acacia Woodland (vegetation community for Ivanhoe Rail Facility and surrounds)	As above	As above	As above	As above
Black Box Woodland	Black Box Woodland	ID-15 - Black Box open woodland with chenopod understorey mainly on the outer floodplains in south-western NSW.	Black Box open woodland with chenopod understorey mainly on the outer floodplains of the Riverina and Murray-Darling Depression Bioregions (Benson 15).	Woodland on clays in low-lying areas dominated by *Eucalyptus largiflorens, Lachnagrostis filiformis*, *Teucrium racemosum* (Forest Germander) and *Stemodia florulenta* (Blue Rod).	Inland Floodplain Woodland
Ephemeral Wetland	Black Box Woodland	N/A	N/A	As above	As above
Black Box Woodland (Ivanhoe Rail Facility and surrounds)	N/A	ID-17 Lignum shrubland of the semi-arid (warm) plains - mainly in the Riverina and Murray-Darling Depression Bioregions	Lignum shrubland of the semi-arid (warm) plains - mainly in the Riverina and Murray-Darling Depression Bioregions.	Woodland on clays in low-lying depressions dominated by *Eucalyptus largiflorens* and a understory dominated by *Duma florulenta* (previously known as *Muehlenbeckia florulenta*), *Chenopodium nitrariaceum* and *Eragrostis australasica.*	Inland Floodplain Shrublands
Ephemeral Wetland (Ivanhoe Rail Facility and surrounds)	N/A	As above	As above	As above	As above

Broad Fauna Habitat Stratification Types	AMBS (2013) Vegetation Communities	Vegetation Map Unit (Benson *et al.*, 2006)	Vegetation Types Database (Biobanking)	Description	Broad Keith (2006) Vegetation Type
Linear Dune Mallee	Linear Dune Mallee	ID-171 - Spinifex Linear Dune Mallee mainly of the Murray-Darling Depression Bioregion; and Deep Sand Mallee of irregular dunefields of the semi-arid (warm) zone.	Linear Dune Mallee mainly of the Murray-Darling Basin Bioregion (Benson 171).	Woodland on sand dunes dominated by mallee Eucalyptus species, *Triodia scariosa* (Spinifex or Porcupine Grass), *Bossiaea* sp., *Acacia* sp. and *Eremophila* sp.	Dune Mallee Woodlands
Sandplain Mallee	Sandplain Mallee	ID-170- Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones.	Linear Dune Mallee mainly of the Murray-Darling Basin Bioregion (Benson 171).	Woodland on sandplains dominated by mallee Eucalyptus species and chenopod shrubs.	Sand Plain Mallee Woodlands
Sandhill Pine Woodland	Sandhill Pine Woodland	ID-28 White Cypress Pine open woodland of sandplains, prior streams and dunes mainly of the semi-arid (warm) climate zone.	White Cypress Pine (*Callitris glaucophylla*) open woodland of sandplains, prior streams and dunes mainly of the semi-arid (warm) climate zone (Benson 28).	Degraded Woodland on dunes and rises of red sand on alluvial plains with a canopy of *Callitris glaucophylla*.	Riverine Sandhill Woodland
Acacia Woodland/Shrubland	Mulga Woodland	ID-199- Hooked Needlewood-Needlewood-Mulga-Turpentine Bush open shrubland of the semi-arid and arid plains.	Hooked Needlewood - Needlewood-Mulga - Turpentine Bush open shrubland of the semi-arid and arid plains (Benson 199).	Woodland in disturbed areas with a remnant canopy of *Acacia aneura* (Mulga).	Sand Plain Mulga Shrubland
Acacia Woodland/Shrubland	Yarran Shrubland	ID-23- Yarran shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones.	Yarran shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones (Benson 23).	Shrubland in disturbed areas of non-palatable shrub species with occurrences of *Acacia melvillei* (Yarran).	Sand Plain Mulga Shrubland
Chenopod Shrubland	Saltbush Shrubland	ID-18- Slender Glasswort low shrubland in saline depressions in the semi-arid and arid climate.	Slender Glasswort low shrubland in saline depressions in the semi-arid and arid climate zones (Benson 18).	Damper more saline areas on chenopod shrubland plains dominated by species such as *Atriplex vesicaria* (Bladder Saltbush), *Disphyma crassifolium, Tecticornia tenuis*, *Malacocera tricornis* (Soft Horns), and *Sclerolaena divaricata* (Tangled Copperburr).	Aeolian Chenopod Shrubland

Broad Fauna Habitat Stratification Types	AMBS (2013) Vegetation Communities	Vegetation Map Unit (Benson *et al.*, 2006)	Vegetation Types Database (Biobanking)	Description	Broad Keith (2006) Vegetation Type
Chenopod Shrubland	Bluebush Shrubland	ID-153- Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones.	Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (Benson 153).	Shrubland of chenopod species on alluvial plains dominated by *Maireana pyramidata* (Black Bluebush), saltbush such as *Atriplex lindleyi* and *Minuria cunninghamii.*	Aeolian Chenopod Shrubland
Chenopod Shrublands	Scalded Chenopod Shrublands	N/A	N/A	Areas suffering from scaling as result of heavy grazing and erosion.	N/A
Chenopod Shrubland Depressions	Chenopod Shrubland Depressions	ID-24- Canegrass swamp of drainage depressions, lakes and pans of the inland plains.	Canegrass swamp of drainage depressions, playa lakes and pans of the inland plains (Benson 24).	Depressions in chenopod shrubland plains dominated by species such as *Marsilea drummondii* (Common Nardoo), *Eleocharis pallens* (Pale Spike-sedge), *Juncus aridicola, Eragrostis australasica* (Cane Grass) and *Chenopodium nitrariaceum* (Nitre Goosefoot).	Aeolian Chenopod Shrubland
Disturbed Shrubland	Disturbed Area Shrubland Complex (A)	ID-143- Narrow-leaved Hopbush-Scrub Turpentine-Senna shrubland of semi-arid and arid sandplains and dunes.	143- Narrow-leaved Hopbush-Scrub Turpentine-Senna shrubland of semi-arid and arid sandplains and dunes.	Shrubland in disturbed areas dominated by non-palatable shrub species such as *Dodonaea viscosa* ssp. *angustissima* (Narrow-leaved Hopbush), *Eremophila sturtii* (Narrow-leaf Emu-bush) and *Senna* sp. (Cassia).	Structurally similar to North-west Shrubland
Grass and Herbland Depressions	Grass/Herbland of Drainage Depressions	N/A	N/A	Small to large depressions in sandplains dominated by species such as *Marsilea drummondii*, *Teucrium racemosum*, *Centipeda thespidioides* (Desert Sneezeweed) and *Stemodia florulenta.*	N/A

Broad Fauna Habitat Stratification Types	AMBS (2013) Vegetation Communities	Vegetation Map Unit (Benson *et al.*, 2006)	Vegetation Types Database (Biobanking)	Description	Broad Keith (2006) Vegetation Type
Native Grassland	Native Grassland/Sparse Acacia/Chenopod Shrubs	ID 165- Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone.	Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone.	Native grassland areas are located on sandplains that have been cleared for grazing. They lack a continuous canopy but isolated individual Acacia species were present along with a sparse distribution of chenopod shrubs.	May be derived grassland from a cleared version of Semi-arid Sandplain Woodlands
Cleared Land	Cleared Land	N/A	N/A	Areas cleared and ploughed for cropping.	N/A

The vegetation communities mapped by AMBS (2013) are shown on Figures 21 to 22 for Atlas-Campaspe Mine, MCTR and surrounds, and Figure 23 for the Ivanhoe Rail Facility and surrounds. The distribution of each broad habitat type is displayed in Figures 24 to 25 for Atlas-Campaspe Mine, MCTR and surrounds, and Figure 26 for the Ivanhoe Rail Facility and surrounds. The condition and availability of resources within each broad habitat type are described in the following sections. Vegetation communities identified from surveys of the Ivanhoe Rail Facility and surrounds (AMBS, 2013) have been combined with existing habitat types for two of the communities (Black Box Woodland and Belah-Rosewood Woodland) given their structural and floristic similarities to the communities/habitat types described for the Atlas-Campaspe Mine and surrounding areas. One new habitat type has been described for the Ivanhoe Rail Facility and surrounds, Native Grasslands. This community is not comparable to any of the habitat types described in the Atlas-Campaspe Mine study area or MCTR.

The results of the habitat assessments for each habitat type have been averaged to give an overall estimate of typical availability of resources within a 50 m x 20 m plot and then multiplied by 10 to give a per hectare value for each resource and habitat type. These results are a sample of the potential resources that may be available, which are likely to vary depending on the land use or natural event history of that section of the habitat type. The results may also be slightly biased due to the placement of each assessment plot by differing observers and the variability in observer interpretation.

4.4.2 Belah-Rosewood Woodland

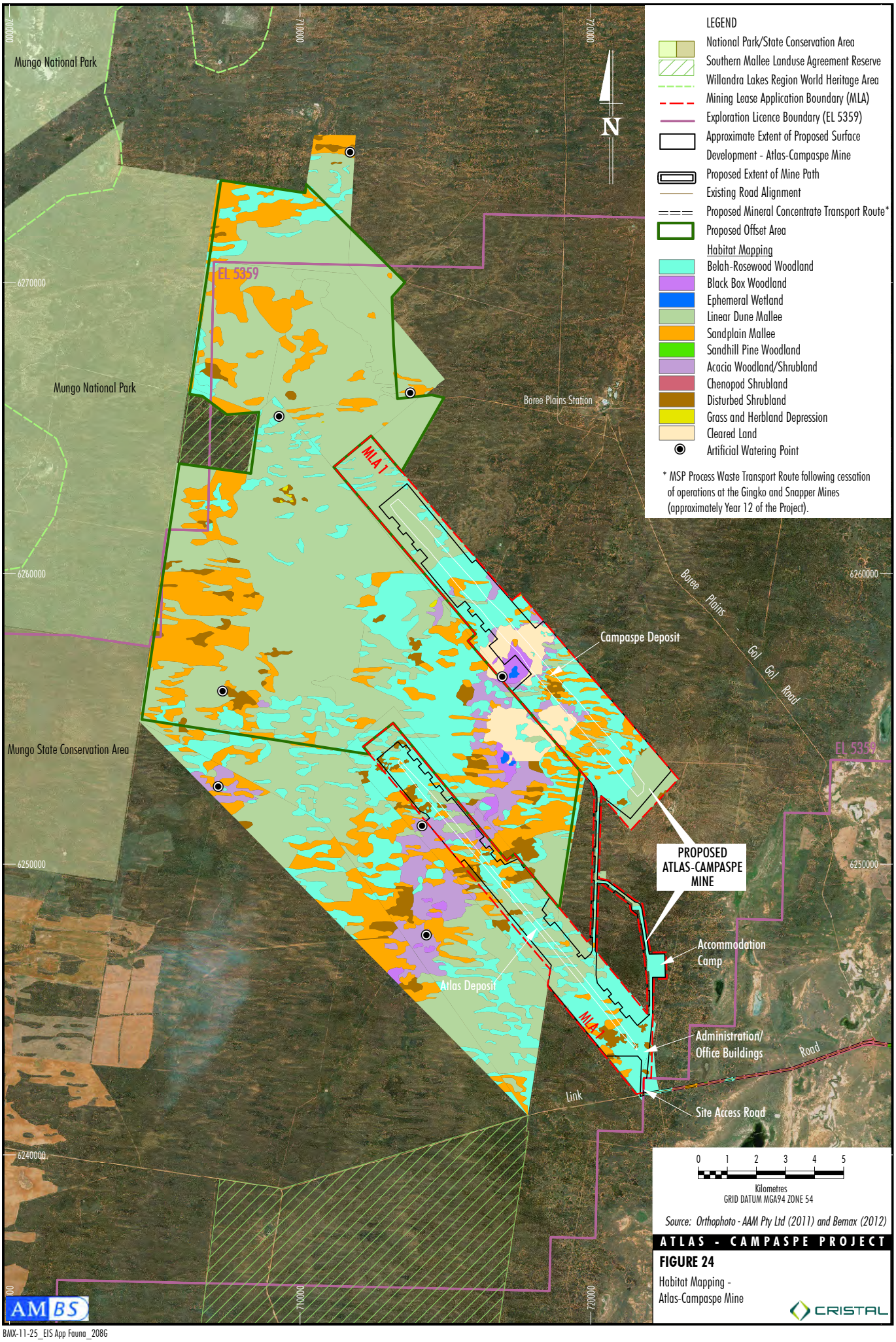
Atlas-Campaspe Mine and Surrounds
The majority of the Belah-Rosewood Woodland habitat type occurs as continuous tracts of vegetation in the south-east sections of the proposed offset area and across a large proportion of the Atlas-Campaspe Mine study area (Figure 24). The remainder of the type occurs as scattered isolated patches within large tracts of Linear Dune Mallee in the northern and southern sections of the proposed offset area (Figure 24).

Belah-Rosewood Woodland occurs predominantly on level to undulating sandplains on calcareous soils mainly of red-brown loam to loamy sands; solonised brown soils to sandy red earths; reddish brown sands and duplex soils (Porteners *et al.*, 1997).

The woodland canopy was generally dominated by *Casuarina pauper* (Belah) and *Alectryon oleifolius* (Western Rosewood), usually between 10-15 m high. Other small trees up to 5 m high occurred throughout in varying densities, including *Geijera parviflora* (Wilga), *Callitris glaucophylla* (White Cypress Pine) and a number of mallee eucalypt species. The groundcover was usually composed of grasses, herbs and low shrubs, with smaller areas of leaf litter and bare soil.

There was little evidence of previous fire and with the exception of a few locations; most areas had not been previously cleared. Evidence of goats was observed throughout most areas, noted by the presence of scats, and in some locations the habitat had been severely impacted by grazing. Key food sources for fauna such as *Acacia* spp. and *Eremophila* spp. were either rare or occasional throughout. Weeds were mostly rare.

This habitat type contains a number of trees with small hollows (>10 centimetres [cm]) at an average density of 100 hollows per hectare in the older woodland sections (Graph 3). Medium size hollows (10-30 cm) are also present on occasion with an average of 10 hollows per hectare (Graph 3). When compared to the other broad habitat types within the Project area and surrounds, Belah-Rosewood Woodland contains the second highest number of dead trees with hollows and has the second highest number of total hollows per hectare (112 hollows per hectare) (Graph 5).



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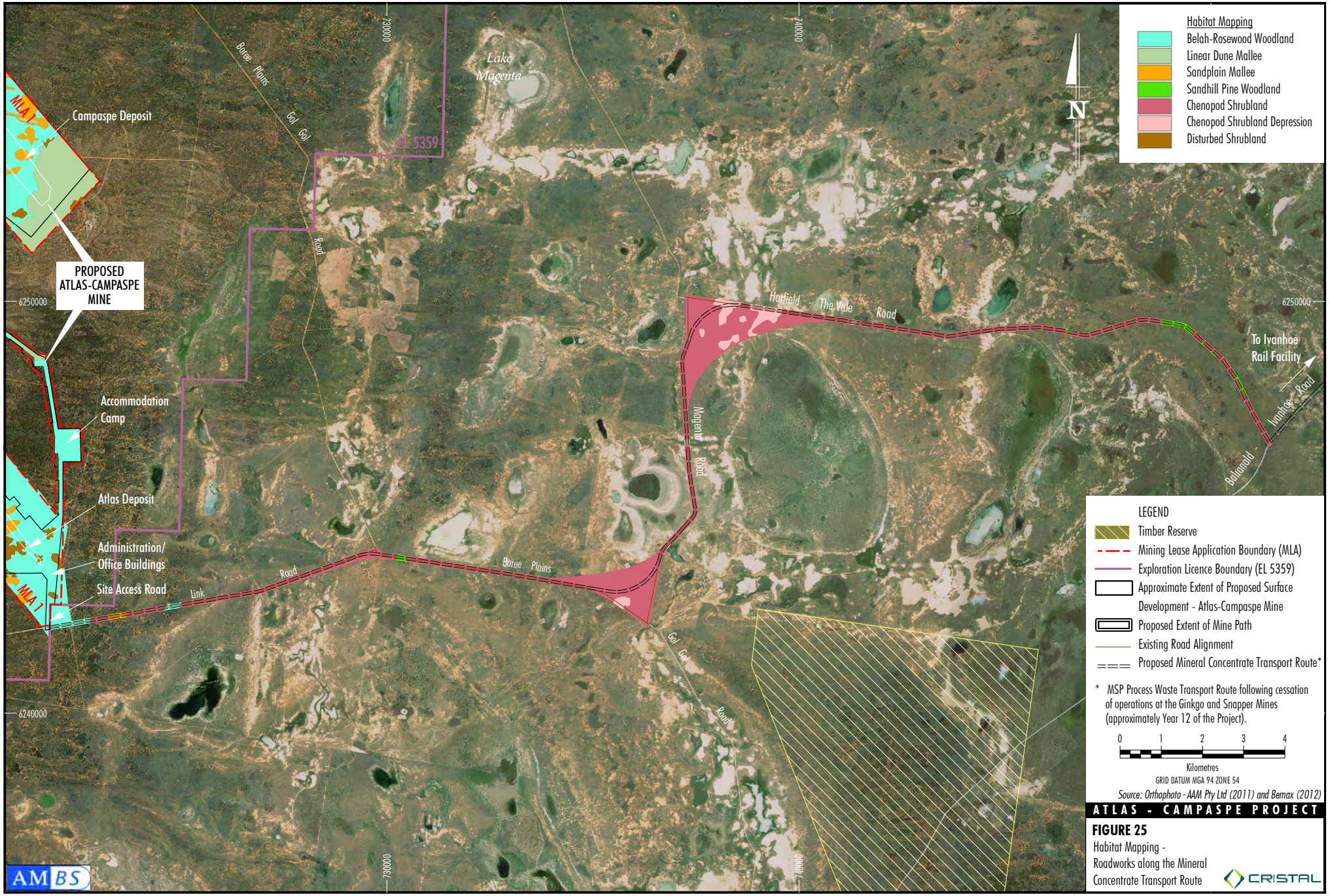

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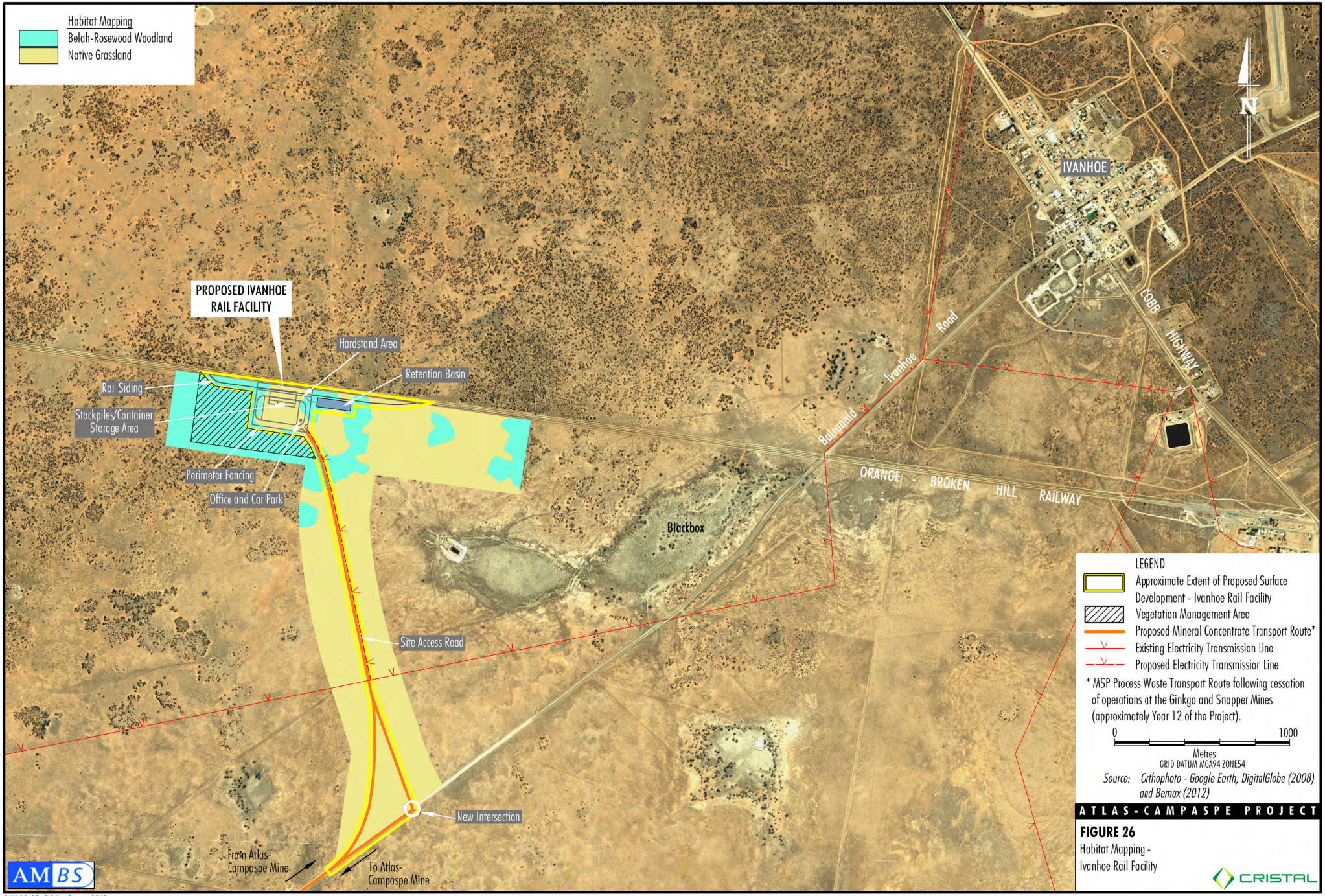

ATLAS-CAMPASPE PROJECT

FIGURE 26

Habitat Mapping - Ivanhoe Rail Facility

CRISTAL

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Fallen timber also provides a valuable den/shelter habitat resource within the Belah-Rosewood Woodland for common and threatened small mammals and reptiles. Fallen branches are very abundant, and this habitat type contains the highest load of large fallen logs (with a diameter greater than 15 cm) (Graph 8). On average 90 to 190 fallen branches were recorded per hectare of habitat and an average of 360 m of large logs per hectare (Graphs 8 and 10).

Overall the fauna habitat was in moderate to good condition in areas away from farm infrastructure such as tanks and feeding areas for cattle. In general, these latter areas had higher levels of disturbance to the ground layer (Plate 1). A number of threatened species were recorded within this habitat type during the AMBS surveys (2011-2012). Belah-Rosewood Woodland provides habitat resources for a number of threatened species (e.g. Little Pied Bat [*Chalinolobus picatus*]).

Plate 1: Typical Belah-Rosewood Woodland habitat.

Ivanhoe Rail Facility and Surrounds

Belah-Rosewood Woodland habitat type found in the Ivanhoe Rail Facility, in some regards is floristically different to the community observed in the mine and proposed offset area, given the greater abundance of Acacia species in the overstorey and shrub layer (this community is referred to as Belah-Rosewood/Acacia Woodland in Figure 23 and AMBS [2013]). However, for the purposes of fauna habitat type descriptions this community has been combined with the Belah Rosewood Woodland as they are structurally very similar and provide similar habitat resources for local fauna.

In this region Belah-Rosewood Woodland occurs on level to undulating sandplains on calcareous soils mainly of red-brown loam to loamy sands; solonised brown soils to sandy red earths; reddish brown sands and duplex soils (Porteners *et al.*, 1997). The vegetation contains a mosaic of overstorey dominance that changes from *Casuarina pauper* to *Acacia homalophylla* (Yarran).

In locations where the *Casuarina pauper* is the dominant canopy species (Plate 2) *Alectryon oleifolius* subsp. *canescens* (Western Rosewood) and *Geijera parviflora* also occur and the understory is dominated by chenopod shrubs the understorey. Alternatively where the *Acacia homalophylla* is the dominant canopy species (Plate 3) a denser layer of tussock grass species *Austrostipa nitida* occurs with a shrub layer dominated by *Maireana* species.

Overall, the Belah-Rosewood Woodland in the Ivanhoe study area ranges from good to moderate condition depending on the degree of disturbance from grazing or clearing. A number of weed species were recorded including *Medicago truncatula* (Barrel Medic), *Salvia verbenaca*, *Carrichtera annua* (Wards Weed), *Alyssum linifolium* (Flax-leaf Alyssum) and *Sonchus oleraceus.*

Within the Belah-Rosewood Woodland, large dead trees containing small and medium sized hollows occur, but there were no large hollows recorded (Graph 4). Large fallen logs were relatively common (with a length of approximately 140 m per hectare) (Graph 9) and fallen branches occur at a density of 20 to 50 per hectare (Graph 11). Decorticating bark was considered to be rare (Graph 13).

No threatened species were recorded in this habitat type in the Ivanhoe Rail Facility study area (AMBS survey 2012). Nevertheless, Belah-Rosewood Woodland in this area would provide habitat resources for a number of threatened species (e.g. Little Pied Bat, Grey-crowned Babbler [*Pomatostomus temporalis temporalis*], Major Mitchell Cockatoo [*Lophochroa aleadbeateri*] {foraging only} and Little Eagle [*Hievaaetus morphnoides*]). A raptor nest was observed in this habitat type, nearby but outside of the study area at Ivanhoe.

Plate 2: Belah-Rosewood/Acacia Woodland with a canopy dominated by *Casuarina pauper*.

Plate 3: Belah-Rosewood/Acacia Woodland with a canopy dominated by *Acacia homalophylla*.

Belah-Rosewood Woodland habitat is also present as continuous tracts of vegetation to the north, north-west, west (directly west of the rail facility only), and north-east of the study area. Interpretations of aerial imagery indicate that this habitat occurs as a denser woodland (greater canopy percent coverage) to the north and north-east (outside of the Ivanhoe Township), whilst portions of the habitat to the north-west and west are present as more sporadic patches (Figure 26). The latter section of the woodland is more representative of the habitat type and resource availability with the study area and footprint. All areas of this habitat type are currently connected to larger tracts of vegetation with only a few breaks attributed to road or railway corridors. The condition of the woodland habitat outside of the study area is comparable to conditions currently present within the designated study area, with similar availability of habitat resources such as hollows, fallen timber and decorticating bark. In some sections of the woodland outside of the study area, the shrublayer was more prevalent and occurs as denser clusters than those present in the study area. Weeds occur in similar densities to that in the study area, but with some areas presenting greater invasions of *Carrichtera annua*.

4.4.3 Black Box Woodland

Atlas-Campaspe Mine and Surrounds
The majority of the Black Box Woodland type occurs as scattered patches in the south-eastern sections of the proposed offset area and the central Campaspe footprint (Figure 24).

This habitat type has a limited distribution in the region and only occurs in low-lying areas were water accumulates after rain and where the soils are clay-based. Black Box Woodland occurs on silty or cracking grey and brown clays in floodplains.

The woodland canopy was dominated by *Eucalyptus largiflorens*, up to about 15 m high. The understorey was low, being composed of a variety of grasses, herbs and chenopod shrubs. Most areas were classified as early mature, but larger mature trees remained in some locations.

There was no evidence of previous fire but evidence of previous vegetation clearing was present. Evidence of land degradation was noted throughout, with contributing species including cattle, goats and rabbits. Potential food sources such as *Acacia* spp. and *Eremophila* spp. were rare or absent, however, some areas of the type contain a good cover of chenopod shrubs that would also provide food sources and shelter to species such as *Egernia* spp. Weeds were present in varying abundances.

This habitat type contains a number of trees with small hollows (<10 cm) at an average density of 320 hollows per hectare (with each tree containing around 6 hollows) in the older woodland sections (Graph 3). Medium size hollows (10-30 cm) are also present on occasion with an average of 10 hollows per hectare (Graph 3). When compared to the other broad habitat types within the Project area and surrounds, Black Box Woodland contains the highest number of dead trees with hollows and has the highest number of total hollows per hectare (340 hollows per hectare) (Graph 5). Large hollows were observed to be present within mature sections of this habitat. Large hollows are a limited resource within the locality and would provide essential nesting/breeding habitat for large hollow dependent species such as the Major Mitchell's Cockatoo. Two owl roosts were observed in this habitat type in the offset area during the surveys.

Fallen timber also provides a valuable den/shelter habitat resource within the Black Box Woodland for common and threatened small mammals and reptiles. Fallen branches were abundant, while large fallen logs (with a diameter greater than 15 cm) are less uncommon except in over mature sections of the habitat (Graphs 8 and 10). On average 90-190 fallen branches were recorded per hectare of habitat and an average length of 30 m of large logs per hectare (Graphs 8 and 10).

Decorticating bark was rare in this habitat type (Graph 12). Overall the fauna habitat was in poor to good condition. Much of the ground cover has been impacted by land clearing and ongoing disturbance (e.g. grazing). Old growth features such as large fallen logs and large hollows of the mature *Eucalyptus largiflorens* trees provide important habitat features for a variety of native fauna (Plate 4). These areas accumulate water after heavy rain, which also provides an important resource for native fauna.

Several threatened species were recorded within this habitat type during AMBS surveys (Appendix A). Black Box Woodland provides habitat resources for a number of threatened species. Some of the species that generally use this habitat type include, but are not restricted to the Grey Falcon (*Falco hypoleucos*) and Major Mitchell's Cockatoo.

A Black-shouldered Kite nest was recorded in this habitat type during the surveys.

Plate 4: Typical Black Box Woodland habitat.

Ivanhoe Rail Facility and Surrounds

The Black Box Woodland habitat type was recorded in the surrounds of the Ivanhoe Rail Facility study area. It is a floristically different community to the Black Box Woodland observed in the Atlas-Campaspe Mine study area, proposed offset area and surrounds, given the prevalence of understorey species such as *Duma florulenta* (Lignum [previously known as *Muehlenbeckia florulenta*]), *Chenopodium nitrariaceum* (Nitre Goosefoot) and *Eragrostis australasica*. However, the Black Box Woodlands have been considered to be the same fauna habitat type given they are structurally very similar and provide similar habitat resources for local fauna.

This habitat type also occurs on clays in low-lying depressions and is dominated by *Eucalyptus largiflorens*. It is in good condition with mature hollow-bearing trees, some regeneration in the overstorey, minimal weed invasion (except around edges of the wetland), and only minimal soil compaction from stock (Plate 5).

The Black Box Woodland contains numerous large dead trees and other trees with large, medium and small sized hollows (Graphs 4 and 6). Fallen branches (<15 cm diameter) occur at a density of greater than 190 branches per hectare (Graph 11). Incidental observations of large fallen logs were also noted. Decorticating bark was present in the Black Box Woodland but was considered to be rare (Graph 13).

Plate 5: Black Box Woodland (areas surrounding Ivanhoe Rail Facility).

Ephemeral Wetlands

Atlas-Campaspe Mine and Surrounds

Ephemeral Wetland is a sub-category of the Black Box Woodland and is located within two patches of this habitat type, in the south-eastern section of the proposed offset area and central area of the Campaspe Mine study area (nearby to the Campaspe footprint) (Figure 24). These wetlands are ephemeral and very similar in condition. During the surveys the ephemeral waterbodies contained water. The ephemeral wetlands are surrounded by both mature and semi-mature *Eucalyptus largiflorens* on all sides (Plates 6 and 7).

In areas closest to cleared croplands (Figure 24), the ground-layer and mid-layer are completely absent due to movement of cattle to and from the water. The ephemeral wetland in the proposed offset area has retained some ground vegetation on the western side of the wetland, closest to the Yarran Shrubland and Sandplain Mallee (Figure 24), some of the fringing ground-layer vegetation has been retained, consisting of sedge and grassy woodland species. Alternatively the ephemeral wetland close to the Campaspe footprint lacked a ground-layer and mid-layer closest to the water on all sides of the waterbody during the survey. This is presumably due to the movement of cattle as well. It is noted however that some shelter resources remained close to the water edge in the form of fallen logs and some grassy vegetation beyond the mudflats.

Due to the presence of water in the wetlands during the survey, several threatened species were recorded (Appendix A). When inundated, these wetlands provide potential foraging, breeding, nesting and shelter habitat for several migratory and wetland birds, such as Australian Painted Snipe, Freckled Duck (*Stictonetta naevosa*), Rainbow Bee-eater and Little Grebe (*Tachybaptus ruficollis*). A number of amphibians were observed utilising the wetland.

One old raptor nest, possibly from a kite or eagle, was observed in this habitat type in the offset area during the surveys.

Plate 6: Ephemeral Wetland habitat in the proposed offset area.

Plate 7: Ephemeral Wetland habitat in the Campaspe MLA.

Ivanhoe Rail Facility and Surrounds

The Ephemeral Wetland in the close surrounds to the Ivanhoe Rail Facility is a sub-category of the Black Box Woodland and is located within large patch of this habitat type, to west of the proposed Ivanhoe Rail Facility (Figure 26). The wetland is ephemeral and likely to be fed primarily by the surface runoff from the north. During the survey the ephemeral waterbody contained water. The wetland contains mature, semi-mature and regenerating *Eucalyptus largiflorens*, occurring mostly on the north and north-eastern section of the wetland. The remaining areas around the wetland are mostly treeless (Plate 8). Fringing ground-layer and shrub layer vegetation has been retained in most areas, consisting of *Duma florulenta*, *Chenopodium nitrariaceum* and *Eragrostis australasica*. Some evidence of stock tracks were present, however, no major soil compaction was observed and weed invasions were considered to be minor. A man-made dam is also present on the western side of the wetland (Figure 26).

Much of the Ephemeral Wetland contained no large dead trees, trees with hollows, fallen branches, or decorticating bark but some large fallen logs were present at a length of approximately 50 m per hectare (Graphs 4, 6, 9, 11 and 13). It is noted this data does not include the areas of the wetland where canopy trees were present. This data has been addressed in the Black Box Woodland section.

One threatened species was recorded in the wetland, the White-fronted Chat (*Epthianura albifrons*), which was likely due to the presence of water in the wetlands during the survey, (Appendix A). When inundated, these wetlands may provide potential foraging, breeding, nesting and shelter habitat for several migratory and wetland birds, such as Australian Painted Snipe, Freckled Duck, Blue-billed Duck (*Oxyura australis*), Australian Bittern (*Botauarus poiciloptilus*) and Rainbow Bee-eater. Two amphibians were also recorded within the wetland (Appendix A).

It is important to note that this habitat type is protected given it falls within the boundaries of the Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River, which is listed as an EEC under the FM Act. By definition all wetlands including ephemeral are considered part of the EEC (DPI, 2006).

Plate 8: Ephemeral Wetland habitat in the close surrounds to the Ivanhoe Rail Facility.

4.4.4 Mallee Woodland

A number of mallee eucalypt species occur in various abundances and assemblages. The more prevalent are *Eucalyptus socialis* (Red Mallee), *E. dumosa* (White Mallee), *E. gracilis* (Yorrell), *E. costata* subsp. *murrayana* (Ridge-fruited Mallee) and less commonly *E. leptophylla* (Narrow-leaved Red Mallee) and *E. oleosa* (Red Mallee).

Two forms of this vegetation type occur within the study area and have been mapped as two separate communities, namely, Linear Dune Mallee and Sandplain Mallee (Figures 21 and 24). These communities have been distinguished as separate broad fauna habitat types, as one of the communities (Linear Dune Mallee) provides an important habitat resource for some 'specialist' fauna species in the semi-arid zone. Several native (and threatened) species which are known to occur in the study area are limited in their geographic distribution by the presence or absence of *Triodia* sp. (this is discussed further below).

Linear Dune Mallee occurs on deeper dune sands with a ground layer dominated by *Triodia scariosa* subsp. *scariosa*, and Sandplain Mallee occurs on sandplains with a ground layer dominated by *Austrostipa nitida* and chenopod shrubs. Each community can occur as separate, distinguishable vegetation types or as transitional mixed patches of both. Sandplain Mallee was often observed as small areas between the dunes in large expanses of Linear Dune Mallee, and in areas predominantly covered by Sandplain Mallee patches of Linear Dune Mallee were often observed on small sandy rises. Spinifex hummocks are present within the transitional patches between both communities but in less abundance than is present within the Linear Dune Mallee.

Linear Dune Mallee

The majority of the Linear Dune Mallee occurs as large continuous tracts of vegetation in the western and north-western sections of the proposed offset area and northern tip of the Campaspe study area (Figure 24). The remainder of the habitat occurs as smaller, less connected patches in the central section of the Atlas Mine study area and southern section of the Campaspe Mine study area (Figure 24).

Linear Dune Mallee has a canopy dominated by *Eucalyptus socialis, E. gracilis,* with *E. leptophylla* and *E. costata* subsp. *murrayana* occurring less commonly.

The shrub and ground layer has a mix of species including *Dodonaea viscosa* ssp. *Angustissima*, *Triodia scariosa* subsp. *scariosa, Schoenus subaphyllus* (Desert Bog-rush), *Sclerolaena diacantha* (Grey Copperburr), *Sclerolaena parviflora, Chenopodium desertorum, Halgania cyanea* (Rough Halgania) and *Maireana decalvans* (Black Cotton Bush). Linear Dune Mallee has a number of species particularly associated with it including *Lomandra effusa* (Scented Mat-rush), *Lomandra leucocephala* (Woolly Mat-rush), *Lomandra collina* (Pale Mat-rush), *Eremophila glabra* subsp. *murrayana, Callitris verrucosa* (Mallee Pine), *Scaevola depauperata* (Skeleton Fan-flower), *Leptospermum coriaceum* (Green Tea-tree), *Bossiaea walkeri* (Cactus Pea), *Acacia wilhelmiana* (Wilhemi's Wattle), *Acacia rigens* (Needle Wattle), *Acacia brachybotrya* (Grey Mulga), *Schoenus subaphyllus*, *Dodonaea lobulata* and *Amphipogon caricinus* (Long Greybeard Grass).

Overall, the Linear Dune Mallee in the Project area and surrounds is in good condition (Plate 9). The type of vegetation, deep sand and distances from watering tanks reduce the visits to such areas by stock and goats. The *Triodia* spp. are considered to be less palatable to stock (Queensland Murray-Darling Committee, 2006) and with low nutritive value (Islam and Adams, 1999). Weed species were seldom recorded in this habitat type.

Plate 9: Typical Linear Dune Mallee habitat.

The Linear Dune Mallee habitat type contains a number of trees with small hollows (<10 cm) at an average density of 28 trees per hectare in the older woodland sections (Graph 3). These hollows occur as anything from small fissures, to hollow sections at the end of branches, to hollow trunks within a multi-stemmed mallee tree. Medium size hollows (10 to 30 cm) are rare within this habitat type with an average of 5 hollows per hectare and large hollows (>30 cm) are totally absent.

The presence of these hollows within this habitat type is dependent on the fire and disturbance history of each portion of the habitat. As a general observation, areas in the central and northern sections of the total study area (outside of the fire scar) are more mature and contained more hollows than some of the areas within the southern and eastern areas. This is based on the data collected from habitat assessments.

When compared to the Sand Plain Mallee within the Project area and surrounds, Linear Dune Mallee was recorded as having a slightly greater number of hollows per site than the Sandplain Mallee, but fewer trees with hollows. This is illustrated in Graph 3.

Another key habitat resource available in high abundance within this habitat type is well developed spinifex hummocks. A number of threatened and native species are known or predicted to occur within the Project area and surrounds are 'spinifex specialists' (e.g. Southern Ningaui [*Ningavi yvonneae*]). In general the spinifex hummocks were abundant and well-developed in this habitat type.

Fallen timber also provides a valuable den/shelter habitat resource within the Linear Dune Mallee for small mammals such as the Common Dunnart (*Sminthopsis murin*a). On average 90-190 fallen branches were recorded per hectare of Linear Dune Mallee habitat (Graph 10). Decorticating bark is in highest abundance within this habitat type than any of the other types (Graph 12). High loads of decorticating bark provide shelter resources for small mammals (e.g. Western Pygmy-possum [*Cercartetus concinnus*]) and microbats (e.g. South-eastern Long-eared Bat (also known as Corben's Long-eared Bat [*Nyctophilus corbeni*]).

A number of threatened species were recorded within this habitat type during AMBS surveys. In particular, large continuous Linear Dune Mallee with inter-spacing between spinifex hummocks provides breeding and foraging habitat for Malleefowl. Evidence of Malleefowl was found in several locations in Linear Dune Mallee within the Project area and surrounds. Other threatened species that generally use this habitat type include the Jewelled Gecko (*Strophurus elderi*), the Bardick (*Echiopsis curta*), the Spinifex Slender Blue-tongue (*Clyclodomorphus melanops elongatus*) and the Southern Ningaui.

Sandplain Mallee

The majority of the Sandplain Mallee occurs as continuous tracts of vegetation in the south-east sections of the proposed offset area and central and southern sections of the Atlas-Campaspe Mine study area (Figure 24). The remainder of the habitat occurs as smaller, less connected patches in the northern and south-western sections of the proposed offset area (Figure 24).

Sandplain Mallee has a canopy dominated by *Eucalyptus socialis, E. dumosa* and *E. gracilis*.

The shrub and ground layer has a mix of species including *Austrostipa nitida, Sclerolaena diacantha, Chenopodium desertorum, Olearia pimeleoides, Maireana georgei* (Slit-wing Bluebush), *Maireana triptera, Maireana radiata* (Grey Bluebush), *Enchylaena tomentosa* (Ruby Saltbush) and *Marsdenia australis* (Doubah). Sandplain Mallee shares many species with other vegetation communities in the offset study area.

Overall the Sandplain Mallee in the study area ranges from good to moderate condition depending on the degree of disturbance from grazing and clearing. Relatively few weed species were recorded in Sandplain Mallee (Plate 10).

Plate 10: Typical Sandplain Mallee habitat.

Small (<10 cm), medium (10 to 20 cm) and basal hollows are present sporadically throughout this habitat type, with an average of 8, 10 and 20 hollows per hectare of each size/position, respectively (Graph 3). No large hollows (>30 cm) were observed in this habitat type. These hollows occur as anything from small fissures, to hollow sections at the end of branches, to hollow trunks within a multi-stemmed mallee tree. In general, the Sandplain Mallee showed more signs of disturbance (particularly grazing) than the Linear Dune Mallee (Appendix F).

Despite this there is still a relatively high amount of hollows within this habitat that are likely to provide breeding/shelter/roosting habitat for a number of microbats, small marsupials and potentially some parrots known to use the area.

When compared to the other broad habitat types within the Project area and surrounds, the Sandplain Mallee contains more live trees with hollows than any of the other habitat types. This is illustrated in Graph 5.

Where saltbush understorey occurs in this type, it is also likely to provide food and shelter resources to several native and threatened species such as the Western Blue-tongue (*Tiliqua occipitalis*), the Chestnut-backed Quail-thrush (*Cinclosoma castanotum*), the Mallee Worm-lizard (*Aprasia inavrita*) and the Pied Honeyeater (*Certhionyx variegatus*). Several raptors are also known to hunt in Sandplain Mallee with a saltbush understorey (e.g. Spotted Harrier [*Circus assimilis*]). No raptor nests were observed in this habitat type during the surveys, although there is potential for raptors to nest in this habitat type.

Fallen timber also provides a valuable den/shelter habitat resource within the Sandplain Mallee for common and threatened small mammals, similar to those likely to be present in the Linear Dune Mallee. Some areas of this type were observed to have large loads of fallen timber, but large logs (>15 cm diameter) were absent from some areas (Appendix F). On average 50 to 90 fallen branches were recorded per hectare of Sandplain Mallee habitat (Graph 10). This habitat type also contains an abundance of decorticating bark, which is likely to provide shelter/roosting habitat for a number of microbats and small mammals. A number of threatened species were recorded within this habitat type during the AMBS surveys (2011-2012). Sandplain Mallee provides habitat resources for a number of threatened species. Some of the species that generally use this habitat type include, but are not restricted to, the Southern Ningaui, the Shy Heathwren (*Calamanthus cartus*) and the Southern Scrub-robin (*Drymodes brunneopygia*).

4.4.5 Sandhill Pine Woodland

This habitat type is located in a few scattered sections along Link Road and Boree Plains-Gol Gol Road (Figure 25). The vegetation community Sandhill Pine Woodland mapped by AMBS (2013) is listed as an EEC under the TSC Act.

Sandhill Pine Woodland is associated with raised sandy areas such as low linear dunes, sandhills and ridges (Porteners *et al*., 1997). Within the study area this assemblage of species is found on low red sand rises and dunes across the chenopod shrubland plains.

Typically Sandhill Pine Woodland is distinguished by a canopy of *Callitris glaucophylla* with *Alectryon oleifolius var. canescens* and *Geijera parviflora* occurring less often, and an understorey of species such as *Enchylaena tomentosa, Salsola kali, Chenopodium cristatum* (Crested Goosefoot), *Maireana pyramidata, Calandrinia eremaea* and *Calotis hispidula* (Bogan Flea) (Scott, 1992; Porteners *et al*., 1997; Westbrooke and Miller, 1995).

Within the study area, Sandhill Pine Woodland is very disturbed with only a few remnant *Callitris glaucophylla* trees present in the canopy layer (Plate 11). The shrub and ground layer includes species such as *Dissocarpus paradoxa, Enchylaena tomentosa, Sclerolaena diacantha, Salsola kali, Maireana pyramidata, Austrostipa nitida* and *Heliotropium europaeum*.

All remnants of Sandhill Pine Woodland in the study area are in very poor condition, being heavily grazed and possibly logged in the past. Weed invasion was high in this habitat type. Given the small size and disturbed nature of the remaining remnants no habitat assessments were undertaken in this habitat type. Visual observations were that resources such as fallen timber, logs, decorticating bark and hollows were relatively scarce in this habitat.

No threatened species were recorded within this habitat or nearby during AMBS surveys and no threatened species are likely to be reliant on this habitat type.

Plate 11: Sandhill Pine Woodland.

4.4.6 Acacia Woodland/Shrubland

The Acacia Woodland/Shrubland habitat type is a combination of the two vegetation types identified by AMBS (2013), namely, Mulga Woodland (Plate 12) and Yarran Shrubland (Plate 13). They have been combined for the purposes of this habitat type as they are structurally very similar and they provide similar habitat resources for local fauna. It is noted that Yarran Shrubland is listed as an EEC under the TSC Act. According to the NSW Scientific Committee final determination (2011) no threatened fauna is associated with this community.

Plate 12: Typical Mulga Woodland (sub-category of Acacia Woodland/ Shrubland).

Plate 13: Typical Yarran Shrubland (sub-category of Acacia Woodland/Shrubland).

Acacia Woodland/Shrubland habitat type occurs mostly as a continuous band of vegetation from south of the central section of the Atlas footprint and through to the south-eastern stretch of the proposed offset area (Figure 24). Small scattered patches of the habitat occur in the central sections of the Campaspe footprint (Figure 24). Mulga Woodland occurs less commonly than the Yarran Shrubland. Small stands of Mulga Woodland were located on red crusted loamy clay soils in the proposed offset area. The Yarran Shrubland occurs on level to undulating plains of brown-red calcareous loams and small depressions (gilgai) are typically found within this community.

The Acacia Woodland/Shrubland habitat type is dominated by a canopy of *Acacia aneura* or by *Acacia melvillei*, depending on which vegetation type is present. The understorey in both vegetation types is composed of a combination of chenopod shrubs, herbs and grasses with occasional occurrences of the shrubs *Acacia homalophylla*, *Dodonaea* sp. and *Eremophila* sp.

Remnants of the Yarran Shrubland in the study area are generally in moderate to poor condition, lacking structural integrity and having higher numbers of weed species than most other vegetation communities in the study area. Similarly, the Mulga Woodland is in poor condition given much of the canopy layer has disappeared and heavy grazing has depleted the shrub and ground layers. Weed invasions were also relatively high in this community.

This habitat type provides minimal shelter/breeding habitat given decorticating bark, hollows, fallen timber is either absent or very rare. Some shelter habitat is present within this habitat type, with low chenopod shrubs and taller sclerophyllous shrubs present as dense patches within the communities. These areas provide some shelter habitat for small mammals, reptiles and small passerine birds.

As a combined habitat type, these vegetation types provide some foraging and shelter resources for native and threatened species. Several threatened species were recorded within this habitat type or nearby during the AMBS surveys (2011-2012). The value of this habitat is limited to some extent by the previous clearing of strata. No threatened species are likely to be reliant on this habitat type, but may still utilise it.

One stick nest (possibly a corvid or raptor nest) was observed in a taller tree in this habitat type in the offset area during the surveys.

4.4.7 Chenopod Shrubland

The broad (fauna) habitat stratification type 'Chenopod Shrubland' is a combination of the two vegetation communities, Saltbush Shrubland and Bluebush Shrubland. They have been combined for the purposes of this habitat type as they can be structurally very similar and they provide similar habitat resources for local fauna.

This habitat type is located as a uniform type along Link Road, Boree Plains-Gol Gol Road, Magenta Road and Hatfield - The Vale Road (Figure 25).

Saltbush Shrubland occurs in saline situations on grey to brown clay soils of the alluvial plains in the study area (Plate 14). This assemblage occurs on chenopod shrubland plains in association with the map type Bluebush Shrubland. Bluebush Shrubland occurs on deep grey to brown clay soils of the alluvial plains in the Project area and surrounds (Plate 15). This assemblage occurs on Chenopod Shrubland plains in association with the map type Saltbush Shrubland.

A canopy layer is not present in Saltbush Shrubland. The shrub and ground layer has a mix of species generally dominated by *Atriplex vesicaria* and including *Disphyma crassifolium*, *Tecticornia tenuis* and other chenopod shrubs. Whereas the Bluebush also without a canopy layer is but dominated generally by *Maireana pyramidata, Maireana appressa, Austrostipa nitida* and other chenopod shrubs.

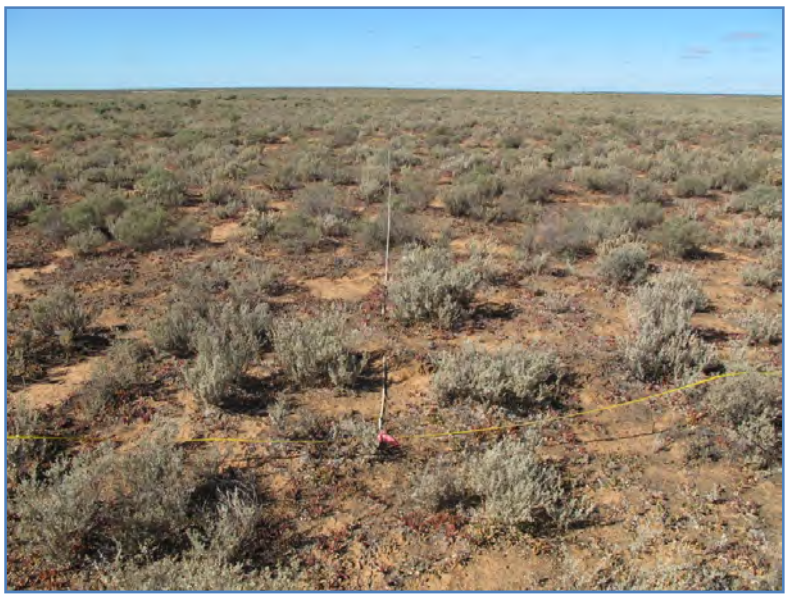


Plate 14: Chenopod Shrubland (Saltbush Shrubland).

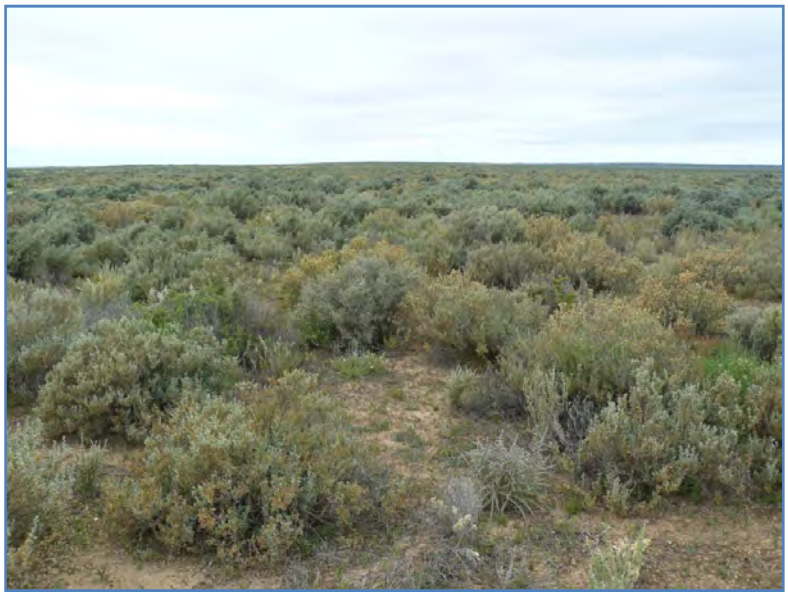


Plate 15: Chenopod Shrubland (Bluebush Shrubland).

Overall the Saltbush Shrubland in the study area is in moderate to poor condition depending on the intensity of grazing, damage from rabbits and soil erosion events. Few weeds were recorded in survey sites. Overall the Bluebush Shrubland in the study area is in moderate to poor condition depending on the intensity of grazing, damage from rabbits and soil erosion events. A number of weeds were recorded in survey sites.

Within the Chenopod Shrubland habitat type, a small section located at first corner of Link Road and Boree Plains-Gol Gol Road (Figure 25) is highly disturbed due to over grazing and soil erosion, and has resulted in the exposure of the subsoil. These areas, which are referred to as 'scalded', are devoid of almost all vegetation making determination of a specific type difficult (Plate 16).

Plate 16: Chenopod Shrubland (Scalded).

Scalding can occur in small or large patches and are often dotted with hummocks which may support vegetation in good seasons (Beadle, 1948). These small sections that are 'scalded' are in poor condition and are unlikely to provide any shelter, breeding or roosting habitat resources for common or threatened species within the locality. Some broad ranging generalist species such as Spotted Harrier and Little Eagle may hunt on the edges of the type on occasion.

The Chenopod Shrubland habitat type provides minimal shelter/breeding habitat given that decorticating bark, hollows and logs are generally absent (Graphs 5, 8 and 12). Dense chenopod shrubs that are present within this type provide shelter habitat for small mammals, reptiles and small passerine birds.

Several threatened species were recorded within this habitat type during the AMBS surveys (2011-2012). Chenopod Shrubland provides habitat resources for a number of threatened species. Some of the species that generally use this habitat type include, but are not restricted to the Redthroat (*Pyrrholoemus brunneus*), the White-fronted Chat and the Rufous Fieldwren (*Calamanthus campestris*).

4.4.8 Chenopod Shrubland Depressions

Chenopod Shrubland Depressions are located in the first two major corners of the MCTR study area (Figure 25). This habitat type varies in size and only the larger depressions have been mapped, however, unmapped smaller depressions also occur within the MCTR study area.

These depressions within the clay soils of the alluvial plains support an assemblage of species associated with locations where water accumulates and is retained after rain for longer periods than the surrounding environment. These depressions vary in size from 500 m across or more, to only a few metres across.

Chenopod Shrubland Depressions do not have a tree canopy layer, the shrub and ground layers are characterised by the following species *Marsilea drummondii, Eleocharis pallens, Senecio runcinifolius* (Tall Groundsel), *Juncus aridicola, Chenopodium nitrariaceum, Eragrostis australasica, Walwhalleya proluta, Sclerolaena muricata* (Black Rolypoly), *Nitraria billardierei* (Nitre Bush), *Haloragis glauca, Centipeda thespidioides, Stemodia florulenta* and *Lachnagrostis filiformis.*

Overall the Chenopod Shrubland Depression vegetation is in good condition as a result of the recent rainfall (Plate 17). It is likely that these depressions would have a much lower cover of vegetation during drought periods. The impact of sheep grazing appeared to be low in these locations even though they had a good cover of vegetation. Possibly the species present in these depressions are less palatable to stock than the surrounding chenopod shrubland species. A number of weed species were present in the depressions in low numbers.

This habitat type provides minimal shelter/breeding habitat given that decorticating bark, hollows and fallen timber are rare or absent (Graphs 5, 8 and 12). The dense pockets of tussock grass that are present within this type would provide shelter habitat for a number of chenopod specialists.

Several threatened species were recorded within this habitat type during the AMBS surveys (2011-2012) (Appendix A). Chenopod Shrubland Depressions provide habitat resources for a number of threatened species. Some of the species that maybe more reliant on the presence of this habitat type include, but are not restricted to, the Redthroat and the White-fronted Chat.

Plate 17: Chenopod Shrubland Depressions.

4.4.9 Disturbed Shrubland

The Disturbed Shrubland habitat type is found in drainage lines, swales between dunes and on sandplains within the Project area and surrounds. It is located as scattered, isolated patches throughout the central and southern sections of the proposed offset, as patches throughout the entire Atlas footprint and as a single patch in central section of the Campaspe footprint (Figure 24). Typically these shrublands occur on soils which have a hard crust or exposed subsoil surface as a result of erosion.

This habitat is the result of previous clearing and the continued pressures of grazing from introduced and native herbivores such as feral goats, European rabbits, macropods and stock. Such species prevent many palatable shrub and tree species from re-establishing and enable unpalatable species to become dominant over time (Beadle, 1948; Benson *et al.*, 2006). This habitat is typically dominated by the shrub species *Eremophila sturtii* and *Dodonaea viscosa* subsp. *angustissima* with *Nitraria billardierei* (Dillon Bush) and *Senna* sp. occurring less commonly. Other species associated with this type in the ground layer includes bluebush shrubs, daisy, herbs and grasses. Weed invasion within this habitat is highly variable with some areas containing very few weeds, while other areas in closer contact to farming infrastructure contain greater than 20% weeds in the understorey.

Disturbed shrubland is often found in association with disturbed remnants of the vegetation communities Yarran Shrubland, Belah-Rosewood Woodland, Black Box Woodland and Sandplain Mallee, and may represent vegetation of this type which is severely disturbed. These areas no longer have characteristics which allow for the determination of past vegetation types.

This habitat type provides minimal shelter/breeding habitat given that decorticating bark, hollows and fallen timber are rare or absent (Graphs 5, 8 and 12). Some shelter habitat is present within this habitat type including low chenopod shrubs and taller sclerophyllous shrubs as dense patches within the habitat. These areas provide some shelter habitat for small mammals, reptiles and small passerine birds.

Despite the disturbed nature of this habitat, some portions were regenerating and had limited signs of disturbances such as weeds (Plate 18). Sections of this habitat would provide food sources for mobile nectivorous species such as Pied Honeyeater and Purple-gaped Honeyeater where *Eremophila* sp. and *Dodonaea* sp. are dominant. Dense shrubby areas would also provide potential shelter for many species.

No threatened species were recorded within this habitat or nearby during the AMBS surveys (2011-2012). However, some threatened species may use this habitat to supplement their key habitat areas, in particular generalist hunters such as raptors or species that forage on the edge of cleared areas (e.g. the Hooded Robin [*Melanodryas cucullata cucullata*]). No raptor nests were observed in this habitat type during the surveys. No threatened species are likely to be reliant on this habitat type.

Plate 18: Typical Disturbed Shrubland habitat.

4.4.10 Grass and Herbland Depressions

Grass and Herbland Depressions are located as very small scattered, isolated patches throughout the central sections of the proposed offset only (Figure 24). Grass and Herbland depressions are scattered throughout the study area and most are small and consequently many have not been mapped.

Grass and Herbland Depressions are often associated with Black Box Woodland, Yarran Shrubland and Belah-Rosewood Woodland habitat types.

These depressions have a unique association of herb and grass species including *Marsilea drummondii, Centipeda cunninghamii, Centipeda thespidioides, Goodenia fascicularis, Stemodia florulenta, Teucrium racemosum, Teucrium albicaule, Eragrostis falcata, Wahlenbergia gracilenta* (Annual Bluebell), *Isolepis australiensis* and *Schenkia spicata* (Spike Centaury).

Grass and Herbland Depressions in the study area are in moderate to poor condition, being severely disturbed in some circumstances. Damage to this assemblage is high as they retain water for longer periods that surrounding areas and consequently are heavily visited by stock and goats. Weeds occur in moderate density within this habitat. These depressions are likely to have very little vegetation present during drought periods (Plate 19).

Habitat resources such as fallen timber, hollows and decorticating bark are generally absent in this habitat type (Graphs 5, 8 and 12). However, the presence of water in this habitat would provide a source for common mobile species after heavy rain events.

No threatened species were recorded within this habitat or nearby during the AMBS surveys (2011-2012). However, threatened species that are dependent on ephemeral wetlands may use this habitat after heavy rain events when they fill up with water (e.g. the White-fronted Chat). No threatened species are likely to be reliant on this habitat type.

Plate 19: Typical Grass and Herbland Depression.

4.4.11 Cleared Land

This habitat type is located in south-eastern section of the proposed offset area and central section of the Campaspe footprint (Figure 24).

A portion of the riverine plain located in the study area has been cleared and used as agricultural land. There are occasional occurrences of remnant native species within this area, sometimes occurring as small isolated clumps of trees. This broad stratification represents land that is considered too disturbed to be able to make reliable conclusions about the vegetation that occurred here in the past and has little to no habitat resources available, except when grasses are seeding or when crops are grown (Plate 20). It is most likely that this area was covered by stands of Yarran Shrubland, Black Box Woodland and Mixed Belah-Rosewood Woodland. Cleared Land is in poor condition.

This habitat type may provide some seasonal foraging resources for some local populations of parrots such as Major Mitchell's Cockatoo, Galah (*Eolophus roseicapilla*) and Mulga Parrot (*Psephotus varius*). Malleefowl have also been reported to forage in croplands after harvesting.

Cleared Land at the Ivanhoe Rail Facility study area occurs along the existing Balranald-Ivanhoe Road corridor, and along the existing rail corridor (Figure 26). These areas are heavily disturbed and mostly devoid of vegetation, providing few resources for native fauna. However, there is potential for a small availability of seeding grasses on road and railway edges to provide foraging habitat for some wildlife, and birds of prey could still hunt or scavenge on road kill over these areas (Plate 21).

Plate 20: Typical Cleared or Cropland habitat.

Plate 21: **Cleared habitat along road corridor/ railway easement at Ivanhoe Rail Facility.**

4.4.12 Native Grassland

Native Grassland was found in the Ivanhoe Rail Facility study area and is considered to be derived grassland, likely a result of clearing and grazing. It occurs on solonised brown and duplex soils. A continuous canopy layer does not occur in this assemblage (Plate 22); however, Acacia species occur as groups of one to a few individuals, and shrubs are sparsely distributed.

The dominant Acacia species is *Acacia homalophylla* with *A. oswaldii*. The sparse shrub layer is dominated by *Maireana pyramidata* and *Rhagodia spinescens.* The ground layer includes species such as *Austrostipa nitida*, *Sporobolus caroli*, and *Sclerolaena diacantha.*

Overall, the Native Grassland is in moderate to poor condition with the community retaining a cover of native species. A number of weed species occur including *Asphodelus fistulosus* (Onion Weed), *Carrichtera annua*, *Salvia verbenaca*, *Echium plantagineum* (Patterson's Curse) and *Medicago truncatula.* In some locations *Asphodelus fistulosus* and *Carrichtera annua* contributed significantly to the cover of vegetation in the ground layer.

Large dead trees and tree hollows were absent from the Native Grassland (Graphs 4 and 6) but large fallen logs and fallen branches were present (Graphs 9 and 11). Decorticating bark was absent from Native Grassland (Graph 13).

This habitat type may provide some seasonal foraging resources for some local populations of parrots such as Major Mitchell's Cockatoo, Galah and Mulga Parrot, when grasses are seeding. Several other threatened mammals may also use the grasslands such as Flock Bronzewing (*Phaps histrionica*), Kultarr (*Antechinamys laniger*) and the Australian Bustard (*Ardeotis australis*).

Plate 22: Typical view of native grassland areas Ivanhoe Rail Facility study area.

Native Grassland habitat is also present outside of the Ivanhoe Rail Facility study area to the east, west and south. Interpretations of aerial imagery indicate that the habitat type is interspersed with patches of Black Box Woodland, Belah-Rose Woodland and Acacia Shrublands in three directions (Figure 26). Given this habitat is considered to have been derived from cleared woodlands, these sporadic patches of woodland are to be expected and may represent remnant paddock trees and/or small woodland patches from the original community. Despite being cleared in the past, this habitat is currently in relatively good condition with only minor weed invasions and a moderate level of resources available. Resource availability in this habitat outside of the study area is comparable to those available within it.

4.4.13 Resources for threatened species

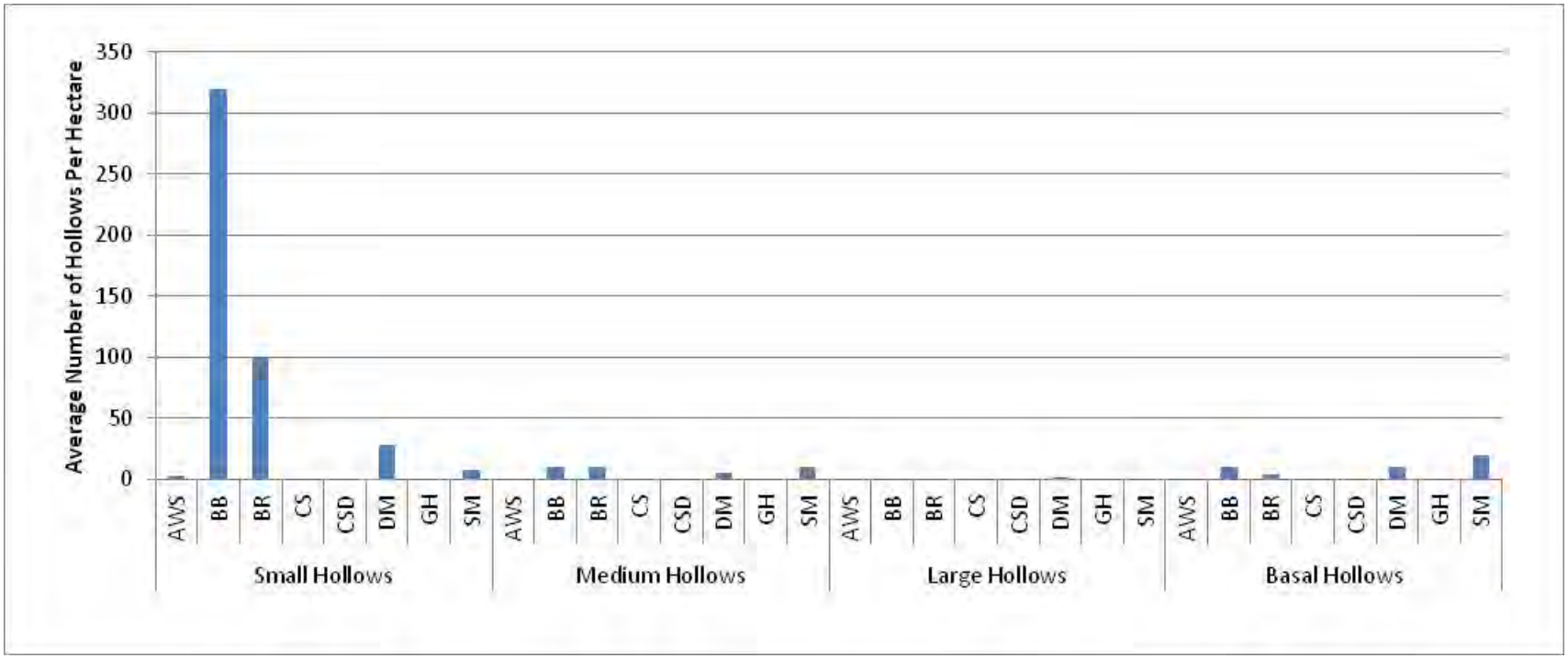
Hollows

Hollow bearing trees are present across the landscape. During the survey they were found to be variable in numbers and size and unevenly distributed across habitat types, dependent on the age of the vegetation, disturbance history and vegetation type. In general, the highest number of hollows per hectare was recorded in the remnant Black Box Woodland (Graph 5). A number of hollows and dead trees were also recorded in the Belah-Rosewood Woodland, Sandplain Mallee and Linear Dune Mallee (Graph 5).

The presence of hollows within these habitat types was highly dependent on the fire, grazing and disturbance history of each portion of the habitat. As a general observation, the Linear Dune Mallee, particularly in the central and northern sections of the study area (outside of the fire scar close the Boree Plains Homestead) contained a high number of hollows per hectare (62 hollows per hectare), as did Sandplain Mallee (55 hollows per hectare) and Belah-Rosewood Woodland (112 hollows per hectare) (Graph 5).

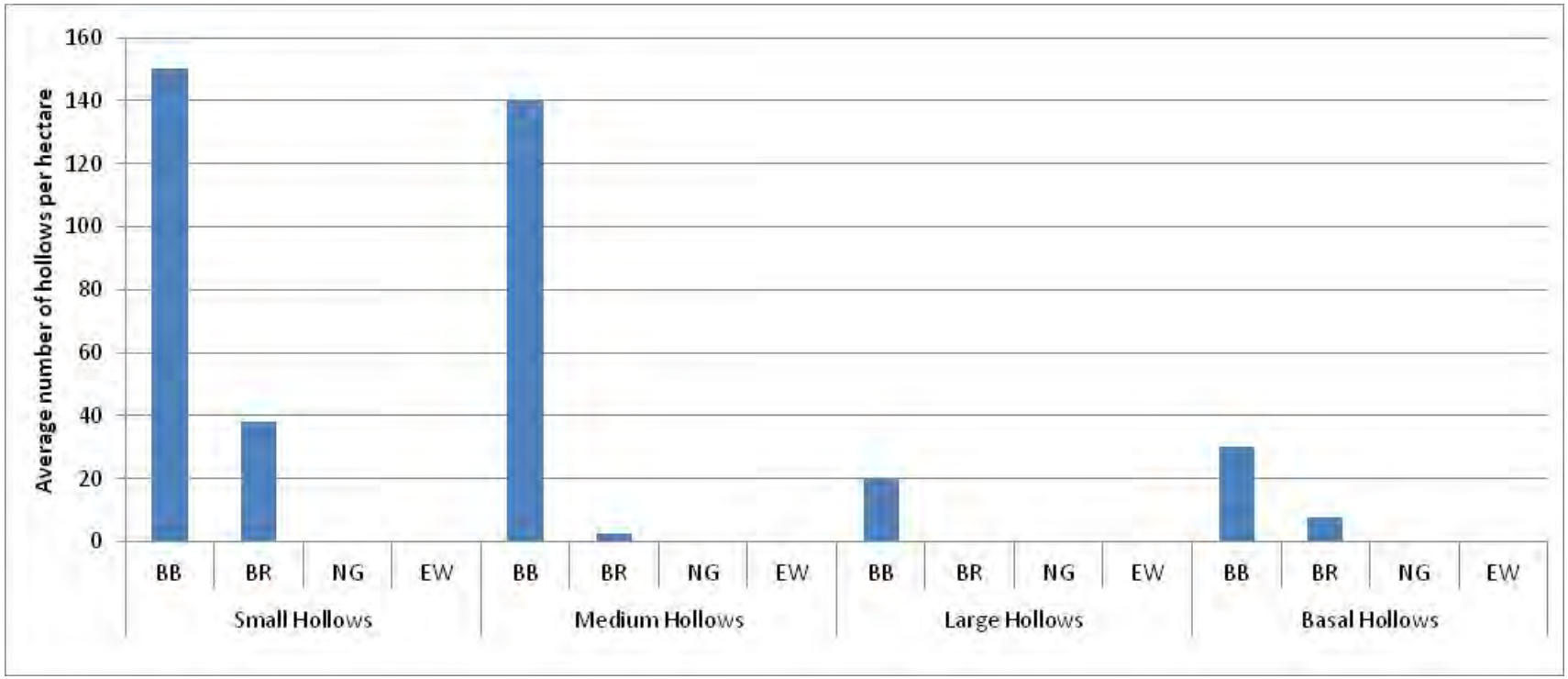
Hollows within the mallee woodlands and Belah-Rosewood Woodlands were generally (but not always) smaller than those observed in mature sections of Black Box Woodland. Medium to large hollows are a limited resource (Graph 3), and species dependent on larger hollows are likely to be restricted within the locality unless they are highly mobile. For instance large hollow-dependent mobile species such as the Major Mitchell's Cockatoo are likely to be present in the locality. Smaller hollow-dependent species such as microbats are likely to be present in high numbers given the large availability of small suitable hollows, fissures and decorticating bark in the Belah-Rosewood Woodland and mallee woodlands.

In the areas surveyed for the Ivanhoe Rail facility and surrounds, tree hollows were a relatively limited feature, with the majority of tree hollows across all sizes occurring in the Black Box Woodland (Graphs 4 and 5). Similarly, the abundance of large dead trees and number of trees with hollows, were greatest in the Black Box Woodland (Graph 5). There were also small hollows present within the Belah-Rosewood Woodland (Graph 4), which may provide potential habitat resources for small parrots, microbats and arboreal mammals.



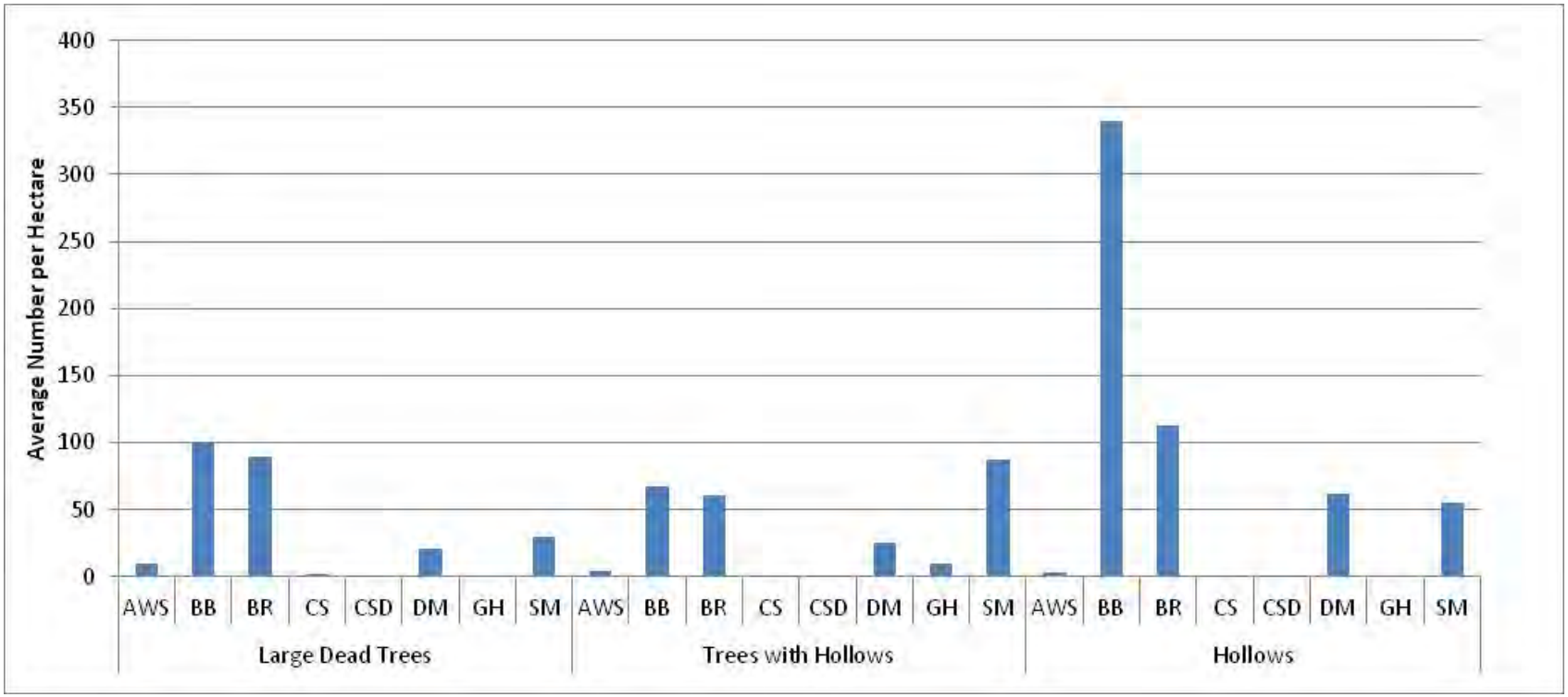
Graph 3: Average number of hollows, size and habitat type for Atlas-Campaspe Mine and surrounds.

Notes: AWS = Disturbed Shrubland; BB = Black Box Woodland; BR = Belah-Rosewood Woodland; CS = Chenopod Shrubland; CSD = Chenopod Shrubland Depressions; DM = Linear Dune Mallee; GH = Grass and Herbland Depression; SM = Sandplain Mallee.



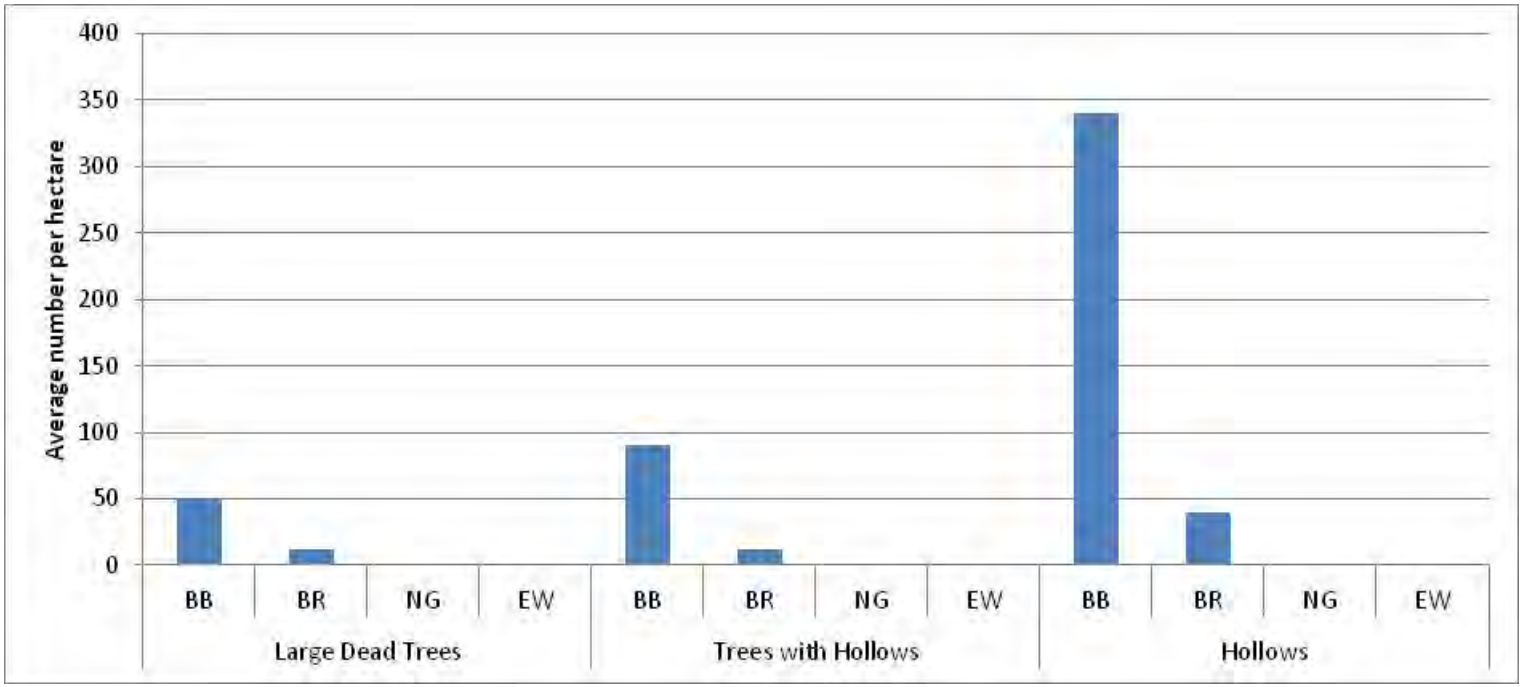
Graph 4: Average number of small, medium, large and basal hollows, and habitat type for the Ivanhoe Rail Facility and surrounds.

Notes: BB = Black Box Woodland; BR = Belah-Rosewood Woodland; NG = Native Grassland; EW = Ephemeral Wetland.



Graph 5: Average number of hollows, trees with hollows, large dead trees, and habitat type for the Atlas-Campaspe Mine and surrounds.

Notes: AWS = Disturbed Shrubland; BB = Black Box Woodland; BR = Belah-Rosewood Woodland; CS = Chenopod Shrubland; CSD = Chenopod Shrubland Depressions; DM = Linear Dune Mallee; GH = Grass and Herbland Depression; SM = Sandplain Mallee.



Graph 6: Average number of tree features per hectare for the Ivanhoe Rail Facility and surrounds.

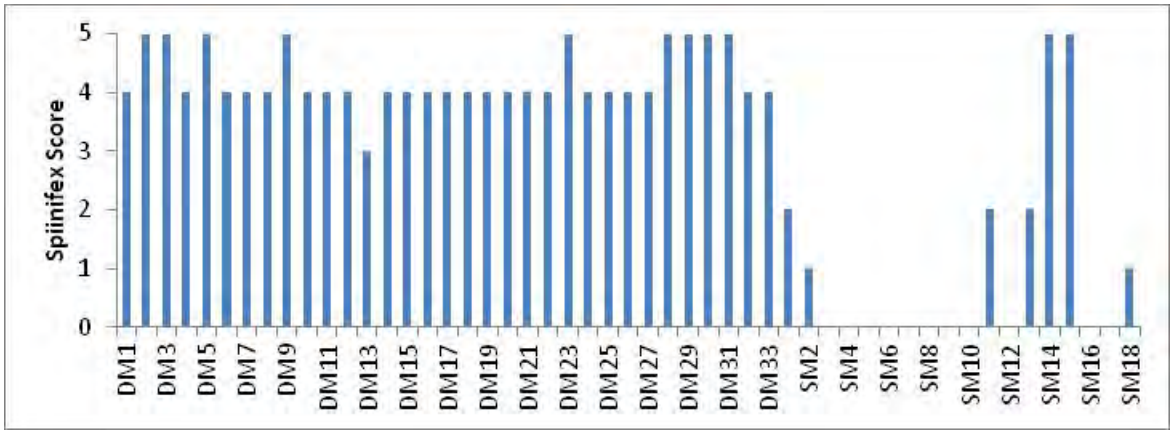
Notes: BB = Black Box Woodland; BR = Belah-Rosewood Woodland; NG = Native Grassland; EW = Ephemeral Wetland.

Spinifex

Another key habitat resource available in high abundance within the study area is well developed spinifex hummocks. A number of threatened species are known to occur within the study area and are spinifex specialists, namely, the Southern Ningaui, the Jewelled Gecko and the Spinifex Slender Blue-tongue.

These species and others are dependent upon well-developed spinifex hummocks as a shelter and/or foraging resource. In general, the Linear Dune Mallee areas that were surveyed during habitat assessments had retained well developed (good) spinifex hummocks in high abundance (Graph 7). The condition and abundance of spinifex hummocks in 50 m x 20 m plots was recorded during habitat assessments, given the importance of this resource within semi-arid regions. The condition and abundance categories were determined based on the 'frequency of occurrence' of hummocks within plots, size of hummocks and whether there were signs of disturbance in and around the hummocks (grazing, trampling, clearing, etc.). The basis for each spinifex score is displayed below.

Spinifex is present in highest abundance in the Linear Dune Mallee habitat type with an average score of 4.24, and to lesser but varying degree within Sandplain Mallee with an average score of 1 (Graph 7). Spinifex condition and abundance is highly variable in transitional zones between these two habitat types.



Graph 7: Spinifex score (condition/abundance) by habitat assessment site.

Notes: 0 = Absent; 1 = Disturbed/low abundance; 2 = Fair condition/occasional;
3 = Moderate condition/common; 4 = Good/high abundance; 5 = Dominant/highly abundant;
DM = Linear Dune Mallee; SM = Sandplain Mallee.

Water resources

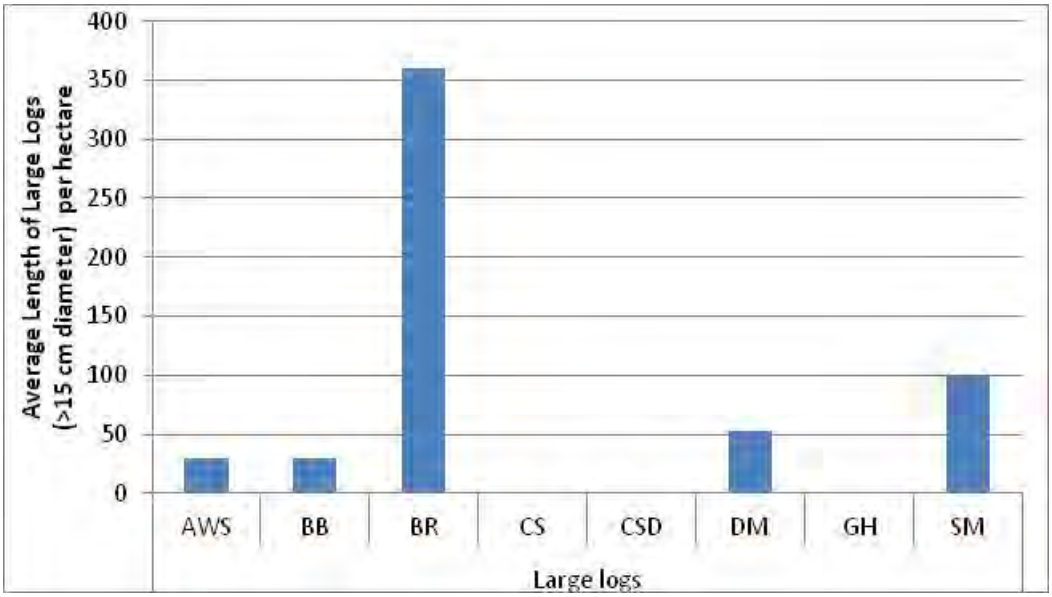
Water is a limited resource within the semi-arid zones and thus what standing water is present is an important habitat resource for species within the area, including some threatened microbats. Standing water occurs in two ways within the study area, as man-made tanks (dams) within the proposed offset area and two ephemeral or semi-permanent floodplain wetlands in Black Box Woodland (Figure 24), and to a lesser degree the Grass and Herbland Depressions (Figure 24). The greatest sources of natural water within the area are the Ephemeral Wetlands. These wetlands appear to hold water for long periods after rain and may provide wetland 'stepping stones' within the landscape for nomadic, semi-nomadic and migratory wetland birds, and seasonal habitat for resident or semi-nomadic species that breed in response to ideal conditions such as rain events.

The man-made tanks also provide water for feral species such as goats. Goats are identified as a key threatening process under the TSC Act. One technique to mitigate the presence of goat populations in the study area will be to close down the man-made tanks, thereby reducing available water resources for this species. This mitigation measure may also impact local populations of microbats and other fauna, e.g. Emus (*Dromaius novaehollandiae*) and macropods. This is discussed further in Sections 6.10 and 7.6.2.

Fallen timber

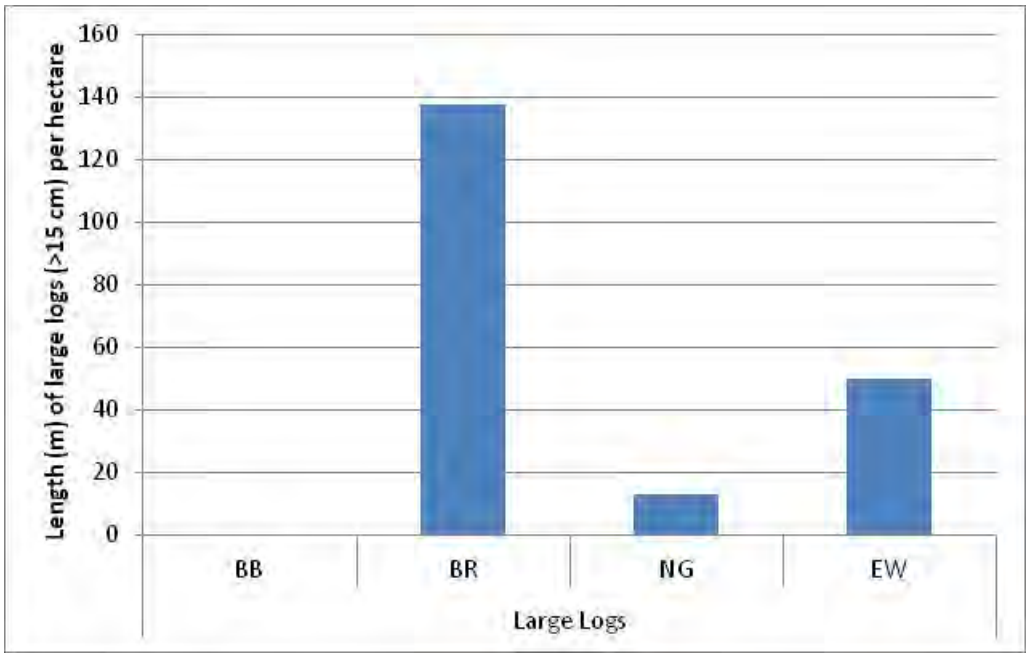
Fallen timber was present in varying densities and size throughout the study area. Some of the Sandplain Mallee, Linear Dune Mallee, Black Box Woodland and Belah-Rosewood Woodland areas contain large loads of fallen timber (Graphs 8 and 10), providing excellent habitat for species that shelter in or under logs. Of some note, is the amount of large logs (with a diameter greater than 15 cm) present in the Belah-Rosewood Woodland (Graph 8). In this habitat type, whole trees were often observed on the ground. Large logs suitable for larger species are limited in the study area, except for some over mature areas within the Black Box Woodland, where large hollow braches were present at the base of trees (Appendix F). Mallee woodlands also contained fallen timber in areas that have not been recently burnt (Graphs 8 and 10). The fallen timber in these habitat types is typically smaller in size but is still an important potential habitat resource for small mammals such as the Southern Ningaui and the Western Pygmy-possum.

Based on the quadrat data for the habitat assessments for the Ivanhoe Rail Facility study area and surrounds, the length of large logs was greatest within the Belah-Rosewood Woodland and sections of the Ephemeral Wetland (Graph 9). This occurred mostly where canopy trees were present. Smaller logs were observed in all communities with canopy trees and in small quantities within the native Grassland around *Acacia* individuals (Graph 11). There were also numerous incidental observations of large logs within the Black Box Woodland, and the low representation of this community in the data (Graph 9) is likely to be due to the placement of habitat assessment quadrats.



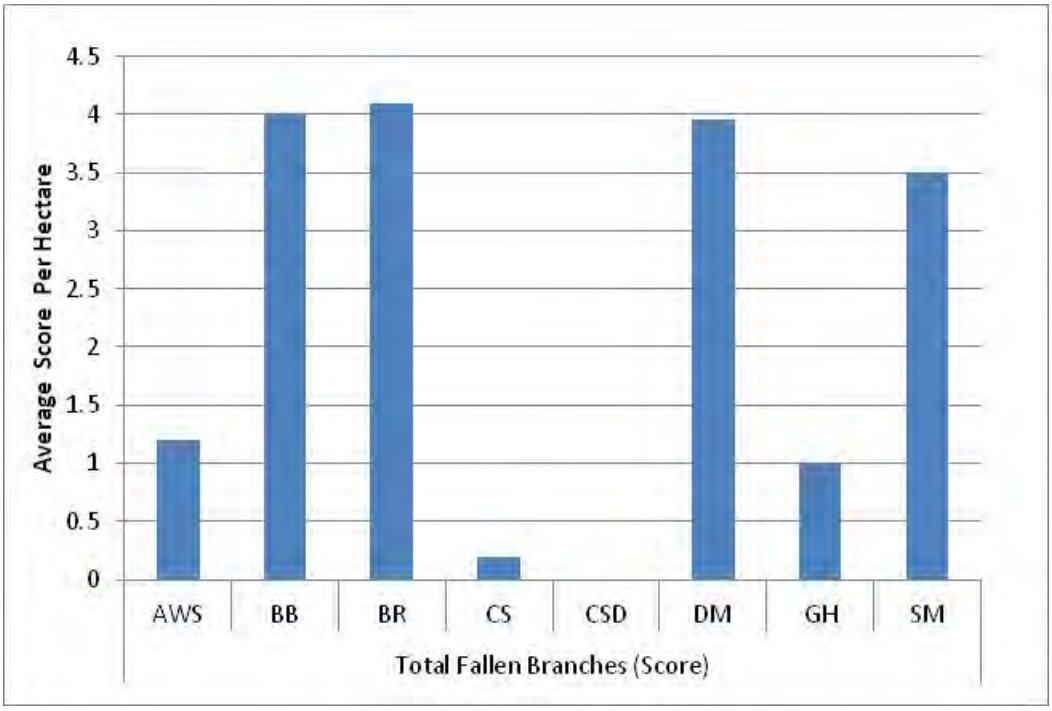
Graph 8: Average length of large logs per hectare for each habitat type for the Atlas Campaspe Mine and surrounds.

Notes: AWS = Disturbed Shrubland; BB = Black Box Woodland; BR = Belah-Rosewood Woodland; CS = Chenopod Shrubland; CSD = Chenopod Shrubland Depressions; DM = Linear Dune Mallee; GH = Grass and Herbland Depression; SM = Sandplain Mallee.



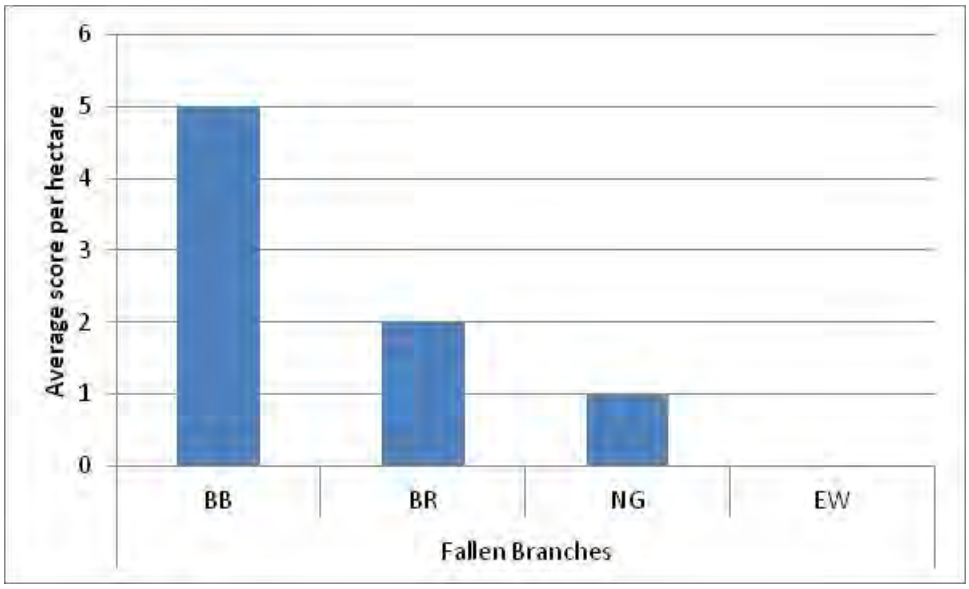
Graph 9: Average length of large logs per hectare for each habitat type for the Ivanhoe Rail Facility and surrounds.

Notes: BB = Black Box Woodland; BR = Belah-Rosewood Woodland; NG = Native Grassland; EW = Ephemeral Wetland.



Graph 10: Average fallen branches (score) per hectare for each habitat type for the Atlas Campaspe Mine and surrounds.

Notes: 0 = No fallen branches; 1 = 1 to 20 fallen branches per hectare; 2 = 20 to 50 fallen branches hectare; 3 = 50 to 90 fallen branches per hectare; 4 = 90 to 190 fallen branches per hectare; 5 = > 190 fallen branches per hectare; AWS = Disturbed Shrubland; BB = Black Box Woodland; BR = Belah-Rosewood Woodland; CS = Chenopod Shrubland; CSD = Chenopod Shrubland Depressions; DM = Linear Dune Mallee; GH = Grass and Herbland Depression; SM = Sandplain Mallee.



Graph 11: Average fallen branches (score) per hectare for each habitat type for the Ivanhoe Rail Facility and surrounds.

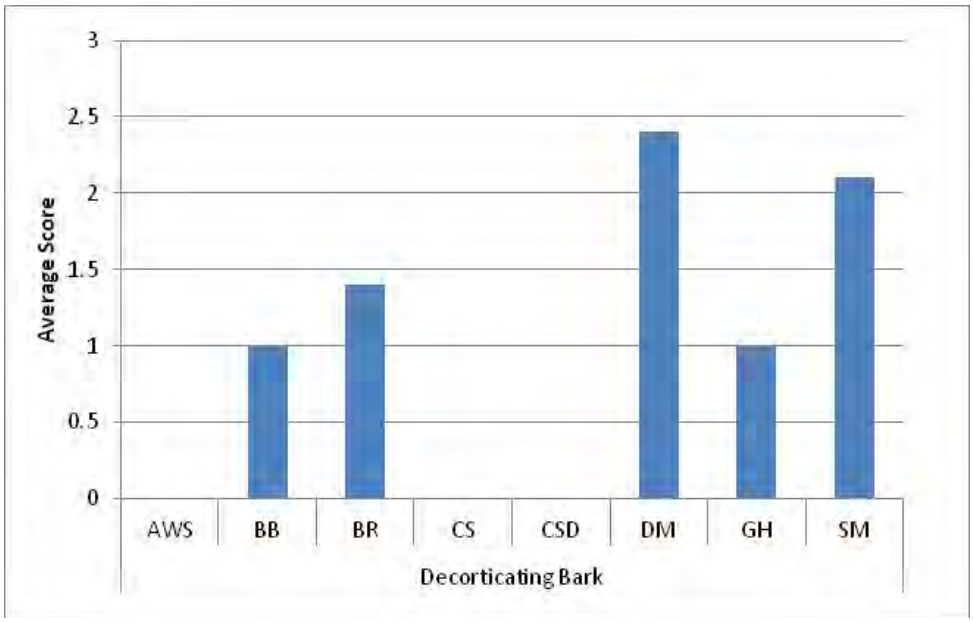
Notes: 0 = No fallen branches; 1 = 1 to 20 fallen branches per hectare; 2 = 20 to 50 fallen branches hectare; 3 = 50 to 90 fallen branches per hectare; 4 = 90 to 190 fallen branches per hectare; 5 = > 190 fallen branches per hectare; BB = Black Box Woodland; BR = Belah-Rosewood Woodland; NG = Native Grassland; EW = Ephemeral Wetland.

Other habitat resources

Shedding or decorticating bark also provides temporary shelter or roosting resources for fauna such as microbats, the Western Pygmy-possum and geckos. Based on the results from habitat assessments, it appears as though Linear Dune Mallee retains the highest loads of decorticating bark, followed by Sandplain Mallee (Graph 12). This is likely to be the case as both woodland types' possess Eucalyptus species that shed bark as long ribbons and the lack of fires in the past few decades.

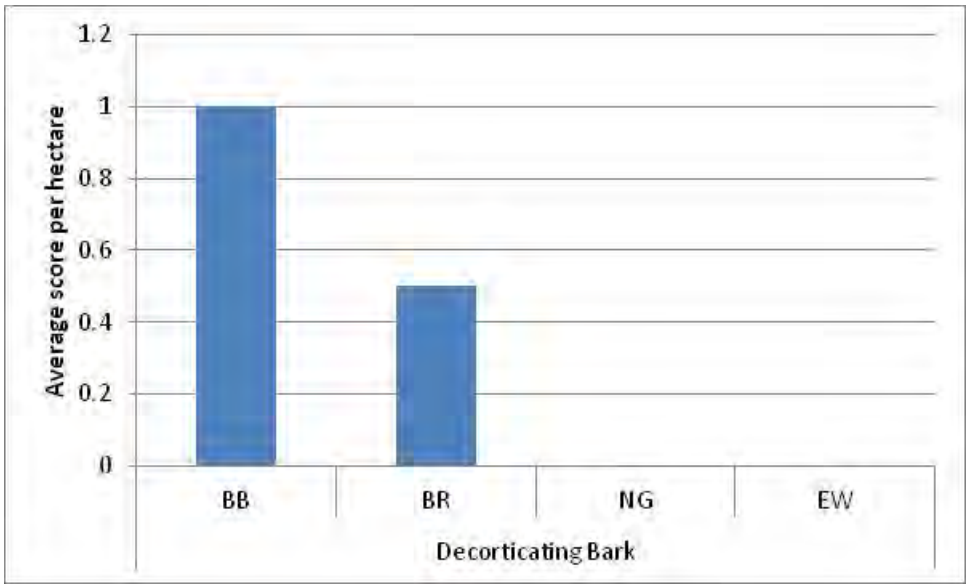
Decorticating bark was mostly absent or rare from the Ivanhoe Rail Facility study area and surrounds (Graph 13). This is mostly attributed to the absence of ribbon barked trees.

The study area did not contain rocky outcrops, cliffs or caves.



Graph 12: Average loads of decorticating bark for each habitat type for Atlas-Campaspe Mine and surrounds.

Notes: 0 = Absent; 1 = Rare; 2 = Common; 3 = Abundant; AWS = Disturbed Shrubland; BB = Black Box Woodland; BR = Belah-Rosewood Woodland; CS = Chenopod Shrubland; CSD = Chenopod Shrubland Depressions; DM = Linear Dune Mallee; GH = Grass and Herbland Depression; SM = Sandplain Mallee.



Graph 13: Average loads of decorticating bark for each habitat type for Ivanhoe Rail Facility and surrounds.

Notes: 0 = Absent; 1 = Rare; 2 = Common; 3 = Abundant; BB = Black Box Woodland; BR = Belah-Rosewood Woodland; NG = Native Grassland; EW = Ephemeral Wetland.

Food resources

A number of plant species are present through-out the Project area and surrounds that provide particular potential habitat resources for threatened fauna (Table 14).

Table 14: Plant species that provide particular habitat for threatened species.

Plant Species	Habitat Component	Example of Threatened Fauna Species
Flowering Eucalypts including *Eucalyptus dumosa, E. costata, E. socialis, E gracilis, E. largiflorens*	Food source	Major Mitchell's Cockatoo, Purple-crowned Lorikeet, Regent Parrot, Purple-gaped Honeyeater and Pied Honeyeater.
E. largiflorens.	Shelter/roosting	Major Mitchell's Cockatoo, Little Pied Bat and South-eastern Long-eared Bat (also known as Corben's Long-eared Bat).
Casuarina pauper.	Shelter/roosting	South-eastern Long-eared Bat (also known as Corben's Long-eared Bat), Western Pygmy-possum and Little Pied Bat.
Flowering or seeding Acacias including *Acacia aneura, A homalophylla*.	Food source	Malleefowl, Major Mitchell's Cockatoo, Pied Honeyeater and Purple-gaped Honeyeater.
Flowering shrubs such as *Dodonaea viscose* subsp. *angustissima, Eremophila mitchelli* (Budda), *E. sturtii, E. gabra.*	Food source, shelter	Pied Honeyeater and Bolam's Mouse.
Triodia sp.	Foraging and shelter source	Southern Ningaui, Jewelled Gecko, Spinifex Slender Blue-tongue, Western Blue-tongue, Marble-faced Delmar, Mallee Worm-lizard and Western Pygmy-possum.
Amyema sp. (*Mistletoe*).*	Food source	Painted Honeyeater, Pied Honeyeater.
Seeding *Austrostipa nitida.**	Food source/shelter	Major Mitchell's Cockatoo, Australian Bustard, Kultarr.

* Denotes habitat resource observed in Ivanhoe Rail Facility and surrounds survey area only.

4.5 Corridors

From a regional perspective, the habitats within the Atlas-Campaspe Mine study area are a small part of a larger area of extensive and largely contiguous north-south oriented vegetation (Figure 21). From a national perspective, the Atlas-Campaspe Mine study area does not form part of any national landscape corridors (SEWPaC, 2012c). No OEH wildlife corridors occur within the vicinity of the study area or surrounds (OEH, 2011a). No OEH or SEWPAC corridors are located in close vicinity to the Ivanhoe Rail Facility study area and surrounds (SEWPAC, 2012c; OEH, 2011a)

In the western portion of the proposed offset area and within the eastern portion of Mungo National Park, the habitats are dominated by Linear Dune Mallee and Sandplain Mallee, with smaller amounts of Belah-Rosewood Woodland in the depression areas. These habitat types continue further north and south. The Atlas-Campaspe Mine would intrude slightly on the fringes of these areas of mallee habitat.

Further east, in close proximity to the Atlas-Campaspe Mine study area, the mallee habitats become less dominant. A matrix of habitats associated with landscape depressions become more common, including Belah-Rosewood Woodland, Acacia Woodland/Shrubland, Black Box Woodland and Chenopod Shrublands. This area is a transition zone between the dunefields and sandplains to the west, and the Chenopod Shrubland dominated floodplain habitats which occur further east. The habitats within the transition zone also occur in a north-south oriented corridor, which would be interrupted by the Atlas-Campaspe Mine.

5 Potential Impacts

5.1 Description of likely direct impacts

5.1.1 Loss of habitat

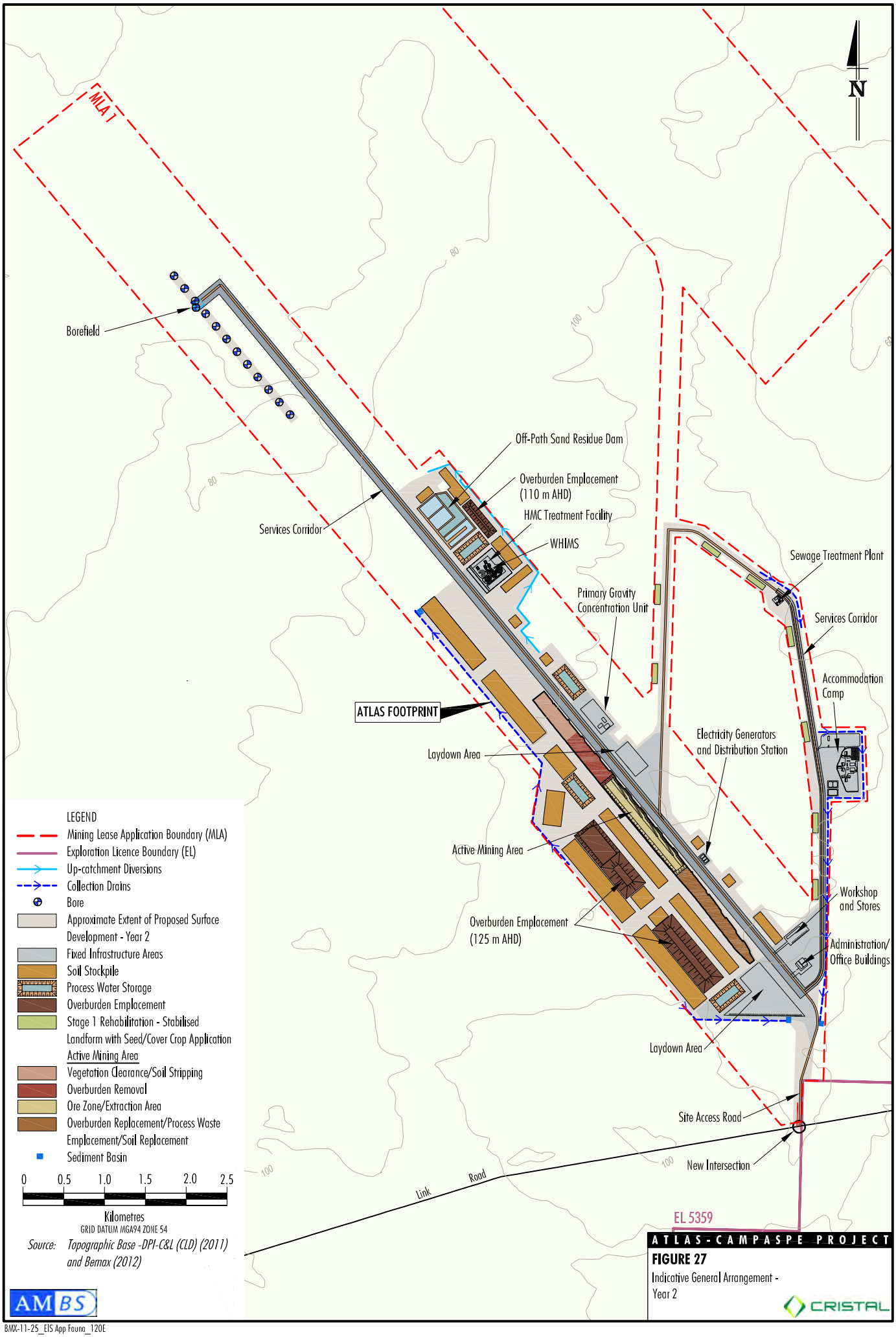
'Clearing of native vegetation' and *'Land clearance'* are similar key threatening processes listed under the TSC Act and EPBC Act, respectively. The impacts of clearing native vegetation include destruction of habitat causing a loss of biodiversity, isolation of populations, disturbed habitat which facilitates the establishment and spread of exotic or pioneering species and removing habitat for a wide variety of vertebrates and invertebrates (NSW Scientific Committee, 2001). The majority of the native vegetation within the Project area and the locality is currently uncleared, except for a portion which has been previously cleared for cropping, pasture paddocks and road/ railway easement (Figures 23 and 24, and Plates 20 and 21).

The Project would require the clearance of approximately 4,158 ha of mostly native vegetation. This clearance area includes native vegetation required to be removed for all of the various components of the Project (including within the Atlas-Campaspe Mine footprint, MCTR roadworks footprint and at the Ivanhoe Rail Facility footprint (Figures 21 to 23). The clearing associated with the Atlas-Campaspe Mine will occur progressively over approximately 20 years (Figures 27 to 29). The majority of the native vegetation to be cleared over the life of the Project is associated with the proposed infrastructure and stockpiles surrounding the proposed mine deposits. A smaller area of native vegetation would be cleared for the proposed mine deposits (Figure 21).

Approximately 98 ha of native vegetation would be cleared either side of existing roads or in uncleared areas in the MCTR roadworks footprint (Figure 22). This vegetation along the existing road comprises mostly disturbed vegetation on the existing road verge with less disturbed vegetation further from the existing road. A portion of undisturbed vegetation would be removed in those locations where corners of the existing road are to be rounded.

To the north of the Atlas-Campaspe Mine, approximately 45 ha of mostly native vegetation would be cleared for the construction of the Ivanhoe Rail Facility (Figure 23). The area of habitat that would be removed at the Ivanhoe Rail Facility is relatively small in comparison to the areas of available habitat in the surrounding area. Similar habitat types are widespread in the surrounding area, and are in better condition in comparison to the areas that would be impacted within the Project area.

The broad habitat types that would be cleared, the quantity and their location are described in Table 15 and shown in Figures 24 to 26. Of the broad habitat types in the Project area, the Belah-Rosewood Woodland habitat type would be subject to the most clearance (approximately 2,045 ha). The second highest level of clearance would occur in the mallee communities (Linear Dune Mallee and Sandplain Mallee), with a combined total clearance area of approximately 1,575 ha.



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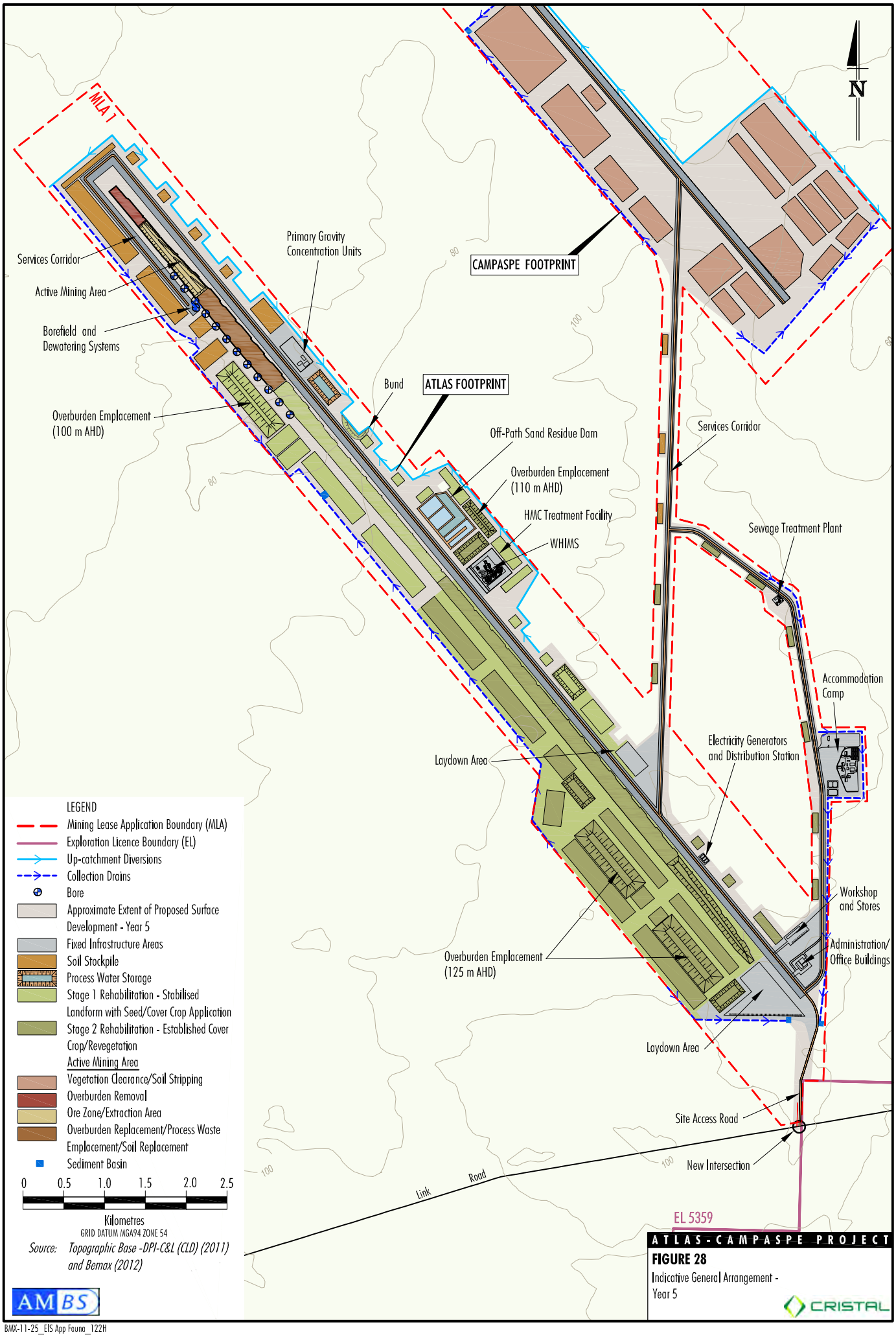
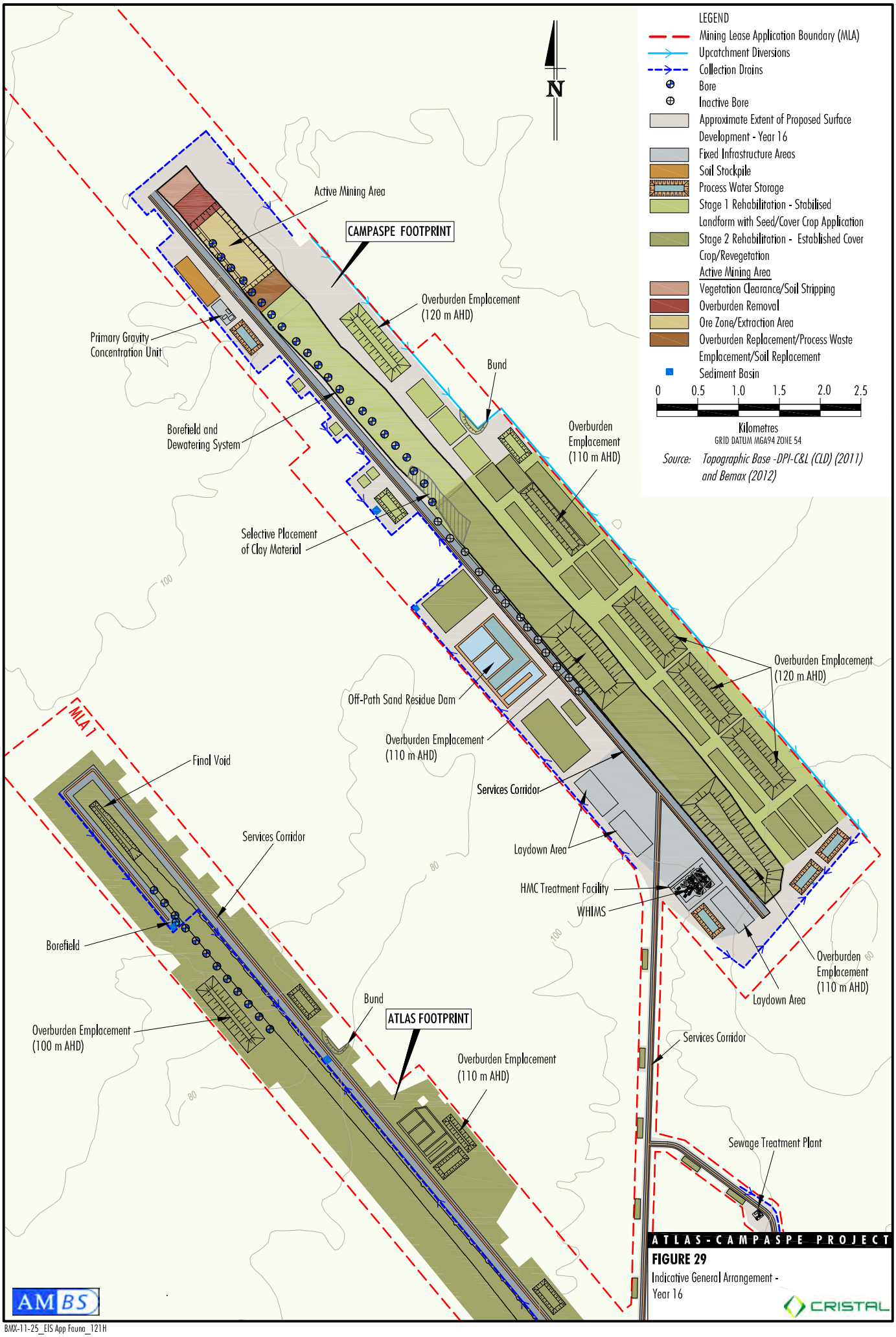

MLA 1
N
Services Corridor
Active Mining Area
Borefield and Dewatering Systems
Primary Gravity Concentration Units
CAMPASPE FOOTPRINT
Bund
ATLAS FOOTPRINT
Overburden Emplacement (100 m AHD)
Off-Path Sand Residue Dam
Overburden Emplacement (110 m AHD)
HMC Treatment Facility
WHIMS
Services Corridor
Sewage Treatment Plant
Accommodation Camp
Laydown Area
Electricity Generators and Distribution Station
Workshop and Stores
Administration/ Office Buildings
Overburden Emplacement (125 m AHD)
Laydown Area
Site Access Road
New Intersection
Link Road
EL 5359
80
100
LEGEND
Mining Lease Application Boundary (MLA)
Exploration Licence Boundary (EL)
Up-catchment Diversions
Collection Drains
Bore
Approximate Extent of Proposed Surface Development - Year 5
Fixed Infrastructure Areas
Soil Stockpile
Process Water Storage
Stage 1 Rehabilitation - Stabilised Landform with Seed/Cover Crop Application
Stage 2 Rehabilitation - Established Cover Crop/Revegetation
Active Mining Area
Vegetation Clearance/Soil Stripping
Overburden Removal
Ore Zone/Extraction Area
Overburden Replacement/Process Waste Emplacement/Soil Replacement
Sediment Basin
0 0.5 1.0 1.5 2.0 2.5
Kilometres
GRID DATUM MGA94 ZONE 54
Source: Topographic Base -DPI-C&L (CLD) (2011) and Bemax (2012)
AMBS
ATLAS-CAMPASPE PROJECT
FIGURE 28
Indicative General Arrangement - Year 5
CRISTAL



ATLAS-CAMPASPE PROJECT

FIGURE 29

Indicative General Arrangement - Year 16

AMBS

CRISTAL

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Table 15: Broad habitat types and approximate area to be cleared.

Broad Habitat Category	Approximate Area to be Cleared (ha)	Location
Atlas-Campaspe Mine and MCTR		
Acacia Woodland/Shrubland	200	Mostly through the low-lying areas of the Atlas-Campaspe Mine footprint.
Belah-Rosewood Woodland	2,035	In the Atlas-Campaspe Mine footprint and the MCTR road works footprint.
Black Box Woodland	50	Predominantly in the middle of the Campaspe footprint with smaller areas in the Atlas footprint.
Chenopod Shrubland	80	In the MCTR roadworks footprint.
Chenopod Shrubland Depressions	5	In the MCTR roadworks footprint.
Cleared Land	300	In the Atlas-Campaspe Mine footprint.
Sandhill Pine Woodland	3	In the MCTR roadworks footprint.
Disturbed Shrubland	170	In scattered occurrences through the Atlas-Campaspe Mine footprint.
Linear Dune Mallee	1,040	Predominantly in the middle of the Atlas footprint and in the northern end of the Campaspe footprint.
Sandplain Mallee	535	In scattered occurrences through the Atlas-Campaspe Mine footprint.
Subtotal	4,418	
Ivanhoe Rail Facility		
Belah-Rosewood Woodland	10	In the Ivanhoe Rail Facility footprint
Native Grassland	30	In the Ivanhoe Rail Facility footprint
Cleared Land	5	Road easement and other areas in the Ivanhoe Rail Facility footprint
Subtotal	45	
Total	**4,463**	

Some components of the Project would be fixed during the life of the mine (e.g. the MCTR, Ivanhoe Rail Facility and administration buildings and workshops). Others components of the Project would be temporary and/or change locations within the overall Project area (e.g. the active mine area, the location of the extraction area, internal roads and overburden emplacements). The progressive clearance of native vegetation ahead of the advancing extraction area and active mine area would be followed by progressive rehabilitation of the backfilled pit and overburden emplacements (Section 1.4). Most of the Project infrastructure would be decommissioned and revegetated at the end of the mine life, although the MCTR would be retained for public use.

Most of the broad habitat types recorded in the Project area are locally abundant, with a number protected within Mungo National Park or the Mungo State Conservation Area (e.g. Chenopod Shrublands, Belah-Rosewood Woodland and mallee communities). Acacia Woodland/Shrubland, Sandhill Pine Woodland and Black Box Woodland are less well represented in the landscape (Figure 24). Mallee, Belah-Rosewood and Black Box Woodland are represented by a greater quantity within the proposed offset area (Figure 24).

Two of the broad habitat types contain EEC's, namely, Sandhill Pine Woodland, which is the EEC Sandhill Pine Woodland, and parts of the Acacia Woodland/Shrubland are the EEC Yarran Shrubland.

Management approach

A number of impact mitigation and offset measures would be adopted to reduce the impacts of vegetation loss. The primary measures include:

- refining the mine design to avoid unnecessary land clearance (Section 2 in the Main Report of the EIS and Section 6.1);
- implementing land clearance procedures for controlled and progressive clearance (Section 6.6);
- undertaking progressive rehabilitation and vegetation of post-mine landforms (Section 6.2);
- retention and management of vegetation in the mining lease and Ivanhoe Rail Facility; and
- the offset strategy (described in Section 7) which includes conservation of existing vegetation and allowing Cleared Land to regenerate.

5.1.2 Loss of individual animals (including road mortality and entrapment)

The Project has the potential to cause the mortality of some animals as a result of direct encounters with construction works/vehicles or through removal of habitat during clearing. Nocturnal species, species with low mobility, territorial species and some ground-dwelling species (such as lizards and snakes) are particularly susceptible to injury or death during construction and clearing.

The Project may increase wildlife mortality on roads as a result of increased traffic, particularly vehicle movements around dusk and dawn. There is also a risk that a small number of animals may become trapped in the mine pits.

Management Approach

The following measures have been incorporated into the Project to help reduce the impact of loss of individual fauna:

- adopting vegetation clearance procedures (Sections 6.4 and 6.6);
- speed limits to minimise the impacts on native fauna (Section 6.13);
- inclusion of vehicle strike to fauna in inductions to increase awareness (Section 6.13); and
- installing road signs that increase awareness of fauna vehicle strike (Section 6.13).

5.1.3 Fauna interaction with the final void

At the cessation of mining, a final void would remain at the north-western extent of both the Atlas and Campaspe footprints. The final voids would be partially backfilled with overburden material pushed down from the void batters and adjacent overburden replacement areas within the mine path. The embankments would be sloped so as not to entrap fauna.

The depths of the final voids would remain above the groundwater table (i.e. a permanent water body would not be formed in the void), however incident rainfall and local surface water runoff following rainfall events would temporarily pond in the void prior to evaporating or infiltrating to the groundwater table.

The surface catchment of the final voids would be reduced to a practicable minimum by maximising backfilling to the natural surface and the use of upslope diversions and contour drains around their perimeter.

No significant impacts are expected from fauna interacting with the final void.

5.1.4 Loss of hollow-bearing trees

'Loss of hollow bearing trees' is listed as a key threatening process under Schedule 3 of the TSC Act. Hollow-bearing trees can be considered a restricted resource given the long time periods involved with the ontogeny of hollow development (Wormington and Lamb, 1999). Hollows are used by a range of vertebrate and invertebrate species for different life cycle stages and are considered to be a limiting factor for population growth for a number of threatened species. Many species that rely on hollows are highly selective and only use hollows of a particular diameter, aspect and shape (Goldingay *et. al.*, 2011).

The clearance of fauna habitat from the Project area (Section 5.1) would also include the loss of hollow bearing trees. A number of the broad habitat types within the Project area contain hollows (Section 4.4), including the mallee communities, the Belah-Rosewood Woodland and Black Box Woodland.

Fauna surveys included an assessment of tree hollow availability and size. It was found that the density of hollow-bearing trees, the number of hollows per hectare and the size of hollows within the Project area and surrounds varied according to habitat type. All of these factors were consistent across both the Project area and the proposed offset area. The proposed offset area, by virtue of its larger size, contains more hollows than would be lost from habitat clearance for the Project.

A number of threatened species are dependent on hollows and have been known or predicted to occur within the Project area or locality. The impacts on threatened fauna species are assessed in Section 5.7 and Appendices C and D.

Management approach
The following measures have been incorporated into the Project to help reduce the impact of removing hollow-bearing trees:

- land clearance procedures and timing would be adopted to minimise harm to arboreal animals;
- land clearing would be undertaken progressively, within the minimum amount of habitat removed that would allow Project works to continue;
- a selection of tree hollows removed would be retained and reintroduced in rehabilitation works;
- nest boxes of various sizes would be installed around the cleared areas in the short-term and in rehabilitation areas in the medium to long-term; and
- the proposed offset area includes conservation of existing habitat containing hollows.

These management approaches are discussed more in Section 6.

5.1.5 Removal of dead wood and dead trees

'Removal of dead wood and dead trees' is listed as a key threatening process under Schedule 3 of the TSC Act. Dead wood and trees provide essential habitat for a wide variety of native animals and are important in the functioning of many ecosystems. The removal of dead wood can have a range of environmental consequences, including the loss of habitat and disruption of ecosystem processes and soil erosion (DEC, 2003).

This threatening process is relevant because the Project would include the removal of dead standing trees and dead wood on the ground as a part of the clearing of habitat. The removal of these habitat components could result in impacts to a number of threatened fauna species (refer to Section 5.7).

These resources would be reduced over a 20 year period, with material salvaged and repositioned in the rehabilitated areas along the mine path. The proposed offset area also contains these resources in similar densities to the habitat within the Project area.

Management approach
The following measures have been incorporated into the Project to help reduce the impact of removing dead wood and dead trees:

- land clearing would be undertaken progressively, within the minimum amount of habitat removed that would allow Project works to continue;
- wood removed would be retained and reintroduced in rehabilitation works; and
- the proposed offset area includes conservation of existing habitat containing dead wood and dead trees.

These management approaches are discussed more in Section 6.

5.2 Description of potential indirect impacts

5.2.1 Habitat fragmentation/loss of connectivity

Land clearance for the Atlas-Campaspe Mine footprint would contribute to the fragmentation of fauna populations and habitat locality. The amount of contiguous bushland remaining, however, means that most of the surrounding native vegetation cover would remain physically connected. Some fauna populations and habitat would become more disconnected than they currently are, in particular the communities associated with drainage depressions running north-south (e.g. Black Box Woodland and Yarran Shrubland), such as the amphibians that are reliant on these habitats. Flora and fauna that occupy the mallee habitats would be less affected.

Flora and fauna that occupy the communities along the haul road corridor are already separated by the existing road. There may be some increase in loss of connectivity as a result of widening the road and increased traffic. Similarly, habitat fragmentation due to the Ivanhoe Rail Facility would be minor. The largest area of development at the site will occur adjacent to an existing rail corridor. The road corridor would result in a small increase in fragmentation of habitats in which it passes through.

5.2.2 Edge effects

Edge effects occur along ecological boundaries and can extend for some distance to either side of the boundary. The establishment of the mine pits, infrastructure and construction and widening of roads would create a number of new edges throughout the study area. Alterations to local habitat conditions and species composition (flora and fauna) are likely to occur in habitats adjacent to the new edges.

The new edges could facilitate the establishment and spread of exotic plant species without appropriate monitoring and control measures. An assessment of this potential impact is provided in the Atlas-Campaspe Flora Assessment, including measures to control weeds and pests (AMBS, 2013).

5.2.3 Alteration to hydrology

Alteration to the terrain and diversion of surface water during the life of the mine could impact on remaining vegetation if it is dependent on surface flow, subsurface flow and pooling. After substantial rain events, surface water in the locality generally flows towards depressions in the landscape. In these locations, water collects and persists before being utilised by plants, evaporating or seeping to the regional groundwater. Clay loam and sandy clay loam are the dominant topsoil textures in the run-on depressions in the Atlas-Campaspe Mine area (Ogyris, 2012).

These depressions in the landscape provide water habitat for a range of native species, some of which are likely to be dependent on them (such as amphibians). Other threatened and migratory species that may use these include (but are not limited to) the Australian Painted Snipe, Australasian Bittern, Freckled Duck, Blue-billed Duck, the Rainbow Bee-eater and some microchiropteran bats.

The proposed mining at Atlas and Campaspe is expected to have a limited, localised and temporary effects on areas where temporary surface ponding occurs at the Atlas Campaspe Mine site (i.e. through excavation) (GEO-ENG, 2013). Depressions located beside and 2.5 km to the south of the Campaspe footprint also have potential to be indirectly impacted by changes to hydrology. These depressions in the landscape provide habitat for Black Box Woodlands and Grass and Herbland Depressions (Figure 24) (AMBS, 2013). *Eucalyptus largiflorens* occurs within the woodland habitat type, providing potential foraging and shelter resources for the threatened species such as the Major Mitchell's Cockatoo and microbats.

The initial mine design was refined to avoid as much of the Black Box Woodland and the associated ephemeral wetland in these locations as practicable. However, mining of the Campaspe deposit (between Years 11 to 13) would remove an area of woodland and part of the clay associated with the water holding capacity in this depression. The total water holding capacity of the depression may be affected if the clay material to be removed was replaced with overburden and process waste after mining. To minimise this, Cristal Mining would selectively place clay material in low-lying portions of the re-profiled landform within the mine path to reinstate the water holding capacity of, and run-on to adjacent depressions. A range of mitigation measures would minimise these potential impacts (see management approach below).

Alterations to hydrology at the Ivanhoe Rail Facility are unlikely as the main inflow source to the wetland areas east of the impact area would remain unaffected. The Surface Water Assessment (Evans & Peck, 2012) did not identify any potential impacts to the ephemeral wetlands east of the Project area apart from sediment runoff, which would be mitigated by the retention basin and using standard control measures.

Management approach

The mine design has been refined to minimise clearance of Black Box Woodland. The mining of the Campaspe deposit (between Years 11 to 13) would affect the local catchment area associated with the Black Box Woodland 'downstream' of the Campaspe footprint. The proposed mine water management system includes a range of measures to minimise any potential impacts to these habitat types and catchment areas (Evans & Peck, 2012; GEO-ENG, 2013):

- Selective placement of clay material in low-lying portions of the re-profiled landform within the mine path to reinstate the water holding capacity of, and run-on to adjacent depressions.
- Construction of temporary diversions banks to divert any off-site runoff around the active mine path in order to maintain the opportunity for runoff to reach the relevant ephemeral water-bodies. Once mining is complete, the land levels along the main flow paths would be restored to levels that allow cross drainage to occur.
- Runoff from areas undisturbed by mining would be separated from water generated within active mining areas.
- Surface runoff from disturbed areas would be collected and preferentially re-used any for dust suppression or make-up of the water supply for on-site processing of the mineral sands. Sediment basins would be constructed and operated in accordance with the relevant requirements of Managing Urban Stormwater: Soils & Construction (Landcom, 2004).
- Potentially contaminated mine site water, principally associated with sand processing, would be retained within a 'closed' mine water management system. There would be no provision for surface water discharge from this system, with the exception of disposal of excess water to water disposal dams within the mine path (i.e. to the deep underlying saline groundwater system) (GEO-ENG, 2013).

See Section 6.10 for more detail on the water management actions.

5.2.4 Use of saline water for dust control

Dust would be suppressed on internal haul roads within the active mining area (i.e. areas of high dust generation potential) at the Atlas-Campaspe Mine by routinely spraying water sourced from the groundwater supply borefield (i.e. naturally saline) or from sumps which collect mine runoff water. In addition, as part of ongoing road maintenance works (i.e. for road conditioning and safety purposes) saline water would be applied as required to the internal access roads at the Atlas-Campaspe Mine and to the unsealed sections of the mineral concentrate transport route following completion of the roadworks (i.e. in the order of once a week).

During drought periods large areas of soil are exposed. Compared to the total exposed areas of soils, residual saline dust from trafficking along the haul roads, access roads and unsealed sections of the mineral concentrate transport route subject to watering with saline water and/or wind-blown dust from associated road verges would be negligible (Katestone Environmental, 2013). Therefore, based on the information provided by Katestone Environmental (2013) impacts on surrounding vegetation are expected to be negligible.

The use of saline water could potentially impact the vegetation nearby if residue salts dissolve in rainwater and wash from the roads after rain events. However, as referred below, the internal roads within the active mining area would be contained (i.e. would not wash to surrounding vegetation). Further, application of saline water to internal access roads and the unsealed sections of the mineral concentrate transport route (for road maintenance works) would be infrequent and any runoff water would be directed to road verges/drains.

Management Approach

- Watering of internal haul roads to control dust emissions.
- Runoff water from internal haul roads within the active mining area would be directed to the evaporation/sediment sumps for containment and re-use.
- Runoff water from the internal access roads and unsealed sections of the mineral concentrate transport route would be directed to road verges/drains.

5.2.5 Groundwater dependant vegetation

No evidence has been found to indicate that that vegetation associated with groundwater dependant ecosystems would be directly impacted by the Atlas-Campaspe Mine (AMBS, 2013; GEO-ENG, 2013).

5.2.6 Competition and land degradation by rabbits and goats

'Competition and grazing by the feral European Rabbit' and '*Competition and land degradation by unmanaged goats'* are listed as key threatening processes under Schedule 3 of the TSC Act and the EPBC Act. A Threat Abatement Plan has been prepared for goats and rabbits under the EPBC Act (NSW Scientific Committee, 2002a; NSW Scientific Committee, 2004).

Grazing and burrowing rabbits have potential to cause major erosion problems, reduce the recruitment and survival rate of native plants and alter entire landscapes. Grazing by feral rabbits appears also to have marked effects on the structure and composition of vegetation communities in many areas (Williams *et al*., 1995), including a number of EECs.

Feral goats are versatile generalist herbivores (Harrington, 1986). They would browse shrubs and trees, graze forbs and grass, and eat fallen fruit capsules, bark and other dead plant material (Dawson *et al*., 1975; Squires, 1980; Dawson and Ellis, 1996). When green foliage is abundant, feral goats obtain sufficient water from their food, but during summer and in drought they require drinking water (Dawson *et al*., 1975; Parkes *et al*., 1996).

Rabbits and goats are known to occur in the Project area and surrounds. Opening up of the vegetation canopy, areas of disturbed ground and open water sources would provide an environment that would allow rabbits and goats to increase in numbers. Rehabilitation areas would provide young plants that are palatable to rabbits and goats. Protection of the vegetation within the MLA during the life of the mine and rehabilitation areas would require the control of rabbits and removal of goats.

Management approach

- vegetation clearance procedures to minimise the land cleared ahead of mining (Sections 6.4 and 6.6);
- feral animal control program to control rabbits and remove goats (Section 6.8);
- introduce methods to prevent goats accessing water (Sections 6.10 and 7.6.2);
- protect rehabilitation areas from rabbits and goats (Section 6.8);
- decommission of all post-operative water storage facilities (Section 6.10); and
- decommission existing tanks in the proposed offset area (Sections 6.10 and 7.6.2).

5.2.7 Predation by foxes, cats or other animals

Feral cats and the European red fox already occur in the Project area and foxes are abundant. Without management, there is some potential for mining activities to increase the fragmentation of fauna habitats in the study area, which may provide increased foraging opportunities for these exotic predators.

Predation by Feral Cats

'Predation by the Feral Cat' is listed as a key threatening process under Schedule 3 of the TSC Act and is also listed by the EPBC Act. The feral cat is a common but elusive predator and occurs throughout Australia. Several threatened species that are predicted or known to occur within the Project area and surrounds are vulnerable to predation by feral cats.

Feral cats are known to have occurred in the Project area and surrounds. The woodland/lowland forest in the Project area and surrounds is highly fragmented and the Project is therefore unlikely to substantially increase the movement of feral cats. Activities associated with the Project may provide increased refuge and scavenging resources for feral cats, unless appropriately managed to discourage these exotic animals.

Management approach

- implementation of a feral animal control program for the mining lease and Ivanhoe Rail Facility (Section 6.8);
- implementation of a feral animal control program in the proposed offset area (Section 6.8);
- management of waste that could provide food for feral cats (Section 6.8); and
- no pet ownership on-site (Section 6.9).

Predation by the European red fox

'Predation by the European Red Fox' is listed as a key threatening process under Schedule 3 of the TSC Act and is also listed by the EPBC Act. Since their introduction into Australia, foxes have contributed to severe declines and extinctions of a suite of native fauna, particularly among medium size ground dwelling and arboreal mammals and birds (NSW Scientific Committee, 1998). There are a number of threatened animal species known or predicted to occur within the Project area and surrounds that are threatened by fox predation.

Foxes are abundant in the Project area and surrounds. Activities associated with the Project may provide increased refuge and scavenging resources for foxes, unless appropriately managed to discourage these exotic animals.

Management approach

- implementation of a feral animal control program for the mining lease (Section 6.8);
- implementation of a feral animal control program in the proposed offset area (Section 6.8); and
- management of waste that could provide food for foxes (Section 6.8).

Predation and hybridisation by Feral Dogs, Canis lupus familiaris.

Feral dogs (*Canis lupus familiaris*) were identified as being present in the study area, based on the identification of scats containing grooming hairs. However, the densities present must be considered low given the absence of sightings and no tracks being identified in sandy substrates such as when undertaking Malleefowl transects and scat searches. There is no evidence that dingoes occur in the study area. Feral dogs are likely to predate on a wide range of prey species present within the study area, including various threatened species. The Project is unlikely to substantially increase the number of dogs; however, without management, activities associated with the Project may provide increased refuge and scavenging resources.

Management approach

- implementation of a feral animal control program for the mining lease (Section 6.8);
- implementation of a feral animal control program in the proposed offset area (Section 6.8);
- management of waste that could provide food for feral dogs (Section 6.8); and
- no pet ownership on-site (Section 6.9).

It is important that such a program would not result in a resultant increase of other feral species (e.g. feral cat, European red fox and European rabbit) that may have an even greater significant impact on the region's fauna. The monitoring program described in Section 7.6.3 would address this issue.

Competition from feral honey bees (*Apis mellifera L*).

The introduced honeybee is abundant and widely but patchily distributed as a feral species across NSW. Feral honeybees occur in colonies, usually cantered on tree hollows. The Project would not contribute to the establishment or spread of feral honeybees in any way.

5.2.8 Introduction of pathogens

Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations

Psittacine Circoviral (beak and feather) Disease affects parrots and is often fatal. It is caused by a relatively simple virus that infects and kills the cells of the feather and beak, as well as cells of the immune system, leaving birds vulnerable to bacterial and other infections. It can remain present in the environment and viable in nest boxes and hollows for many years, and may result in the long-term contamination of nesting sites (NSW Scientific Committee, 2002b).

If nest boxes are used in the biodiversity enhancement programs in the proposed offset area then they would be new, unused boxes that could not have been infected previously. No nest boxes would be exported off the Project site for use elsewhere.

5.2.9 Alteration to fire regimes

There is the potential for the increased risk of fire from mine related activities to lead to bushfires. Historically, arid-zone bushfires tend to be associated with a proficient growth of native grasses following large rain events. The study area has had two good years of rainfall. A number of threatened species in the study area would be affected by a major bushfire (especially, for example, the Malleefowl and the South-eastern Long-eared Bat (also known as Corben's Long-eared Bat) and it would take decades for the habitat to recover.

'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is a key threatening process under Schedule 3 of the TSC Act. The long-term survival of plants and animals over repeated fires is dependent upon two key features: i) the ability of species to maintain life cycle processes; and, ii) the maintenance of vegetation structure over time as habitat for animal species. Where fires occur very close together in time (high frequency fire) both these key features can be disrupted (NSW Scientific Committee, 2000).

High frequency fire is defined as two or more successive fires close enough together in time to interfere with or limit the ability of plants or animals to recruit new individuals into a population, or for plants to build-up a seedbank of sufficient size to maintain the population through the next fire. Sustained high frequency fire would consequently lead to a loss of plant species, a reduction in vegetation structure and a corresponding loss of animal species (NSW Scientific Committee, 2000).

The specific frequency of fire that would be detrimental to a species or community varies depending upon the survival mechanisms that the species or community exhibit, and local conditions. The number of fires over any set time period that would constitute a detrimental high fire frequency is location and community specific (NSW Scientific Committee, 2000).

Historically, arid-zone bushfires tend to be associated with a proficient growth of native grasses following large rain events. During hot summer days following large rain events, dry swards of grasses pose a significant bushfire hazard when they are placed near a source of ignition. Vehicles driven through long grass often collect grass on the vehicle's crossmember and underbody protection plates. The hot exhaust could eventually ignite the dry grass.

Petrol vehicles with a fuel pump which pressurises the fuel on its way to the engine are at high risk if a fuel line ruptures from the heat of burning grass. If this was to occur, the fuel would ignite as it sprays out under the body and the consequent fire would be very difficult to control.

The risk of fire is greatest in mallee woodland, whereas the Belah-Rosewood Woodland is likely to be far less flammable (Bradstock and Cohn, 2002).

Management approach

- A fire management strategy would be adopted for the Atlas-Campaspe Mine, the Ivanhoe Rail Facility and the proposed offset area (Section 6.12).

5.2.10 Dust and pollution

Studies have shown that excessive dust generation can impact on the health and viability of surrounding vegetation. Dust can affect vegetation by inhibiting physiological processes such as photosynthesis, respiration and transpiration, and allow penetration of phytotoxic gaseous pollutants (Farmer, 1993; Eller, 1977). The activities that would generate dust include:

- dust created by construction activities in all locations;
- dust created by the on-site mining activities;
- dust created by trucks travelling along the MCTR; and
- dust created by the loading and unloading of mineral concentrate at Ivanhoe Rail Facility.

Spills of liquid pollutants (e.g. diesel fuel) and gross pollutants (e.g. general garbage) could also potentially occur. If not properly contained and managed, these pollutants can degrade natural areas and fauna habitats. If a spill was to occur it would be a localised impact and managed.

Management approach

- minimise dust generation where relevant by minimising the extent and time bare soil is exposed;
- develop pollutants and spill management plan to deal with potential spills from trucks, etc.; and
- mandatory requirements for vehicles to carry spill kits.

These management approaches are discussed more in Section 6.11.

5.2.11 Noise

Noise emissions from the mine may impact local fauna populations in a variety of ways depending on the species, the frequency and intensity of the noise (e.g. increased stress, behavioural changes and avoidance of the area).

Management approach

- The management approach is to minimise noise where possible.

5.2.12 Lights

The construction and operation of the mine would require the use of artificial lighting. Artificial lighting has the potential to affect the behavioural patterns of some fauna species. For example, some bird and bat species are attracted to insects that swarm around artificial lights and may become vulnerable to predation, while some species may completely avoid areas with excess lighting.

Management approach

- The management approach is to minimise artificial lighting and light spill into adjacent habitats (Section 6.14).

5.3 Cumulative impacts

Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of an activity on society, the economy and the environment (Franks *et al.*, 2010). They can arise from the compounding activities of a single operation given the interaction of that operation with past, current and future activities that may or may not be related to the existing development. Cumulative impacts may also arise through the interaction of one development with other types of activities and industries, such as grazing and broad scale agriculture.

In relation to the Project, the cumulative impacts are considered to be the total impact on the environment that would result from incremental impacts (including both direct and indirect impacts) from the development of the Project added to other existing impacts. The likely direct impacts of the Project may be obvious; however, the indirect impacts may be less identifiable. Clearing of vegetation during construction of the Project would result in a number of cumulative effects.

The regional setting of the Project and surrounding land use are described in Section 2. Currently there are two proposed sand mining projects for the Balranald area, the Atlas-Campaspe Mine (this Project) located approximately 80 km north of Balranald, and the Balranald Mineral Sands Project comprising two proposed mineral sand mines located approximately 12 km and 70 km north-west of Balranald (EMGA Mitchell McLennan, 2012). The Balranald Mineral Sands Project considered in conjunction with the Atlas-Campaspe Mine would result in cumulative impacts from vegetation clearing.

The Balranald Mineral Sands Project would involve the mining of two deposits (Ecotone Ecological Consultants Pty Ltd, 2012a; 2012b):

1. West Balranald: located approximately 12 km north-west of Balranald. This deposit is approximately 20 km long, 80 to 300 m wide and 50 to 80 m below the surface.
2. Nepean: located approximately 70 km north-west of Balranald, 30 km to the north-west of the West Balranald deposit. The deposit is approximately 12 km long, approximately 80 to 130 m wide and 40 to 60 m below the surface.

Transportation routes for the mineral extract from the Balranald Mineral Sands Project has not yet been finalised (EMGA Mitchell McLennan, 2012).

The Nepean deposit is located approximately 10 km south-west of the Atlas footprint of the Project in semi-arid woodland. The West Balranald deposit is located 45 km to the south of the Atlas-Campaspe Mine. The mining process would involve the clearing of vegetation, dewatering of aquifers overlying and surrounding the orebody to a sufficient depth to allow for dry mining, stockpiling and rehabilitation of the mine disturbance area. Transportation routes for the mineral extract from the Balranald Mineral Sands Project have not yet been finalised. Both deposits are partially located beneath land set aside under covenants as private conservation areas under Western Lands Lease agreements enacted by the Crown under the *Western Lands Act 1901* (Anon 1998; Iluka Resources, 2012). The Balranald Mineral Sands Project would result in the clearance of a significant area of native vegetation within these conservation areas.

The Balranald Mineral Sands Project considered in conjunction with this Project would result in cumulative impacts from vegetation clearing. The cumulative impact would include the removal of habitat for threatened species. Threatened fauna that were recorded in the vicinity of the Balranald Mineral Sands Project include a number of species that were also recorded in the vicinity of the Project area and would also be potentially impacted by the Project, including the Chestnut-backed Quail-thrush, Hooded Robin, Inland Forest Bat (*Vespadelus baverstocki*), Little Eagle, Little Pied Bat, Major Mitchell's Cockatoo, Malleefowl, Southern Ningaui, Spotted Harrier, Varied Sittella (*Daphoenositta chrysoptera*), White-fronted Chat and possibly the Yellow-bellied Sheathtail-bat (*Saccdolaimus flaviventeris*) and Pied Honeyeater.

Beyond these proposed developments, the main industries and land uses in the surrounding locality are cattle, sheep and goat grazing on native semi-arid pasture along with cropping.

The majority of the Project area still retains native vegetation although clearing for agriculture, timber harvesting and the impacts of grazing have altered the structure and composition of the vegetation.

This assessment has considered the following:

- fauna species present;
- habitat type and patterns of habitat type distribution; and
- presence of threatened fauna species or EECs.

The primary cumulative impacts of the Project are associated with the Project direct and indirect impacts described in Sections 5.1 and 5.2, respectively. The condition and composition of the habitat to be cleared for the Project area is described in Section 4.4. Impacts which are likely to be cumulative within the Project areas include the clearing of vegetation, loss of individuals, changes to hydrology and (potentially) increases in feral animal populations and weed invasion. It is likely that the accumulating impacts would increase linearly and proportionally with the area of disturbance. The cumulative impacts listed may not be fully expressed until well after completion of mining due to the characteristics of semi-arid woodland (dependent on sporadic rainfall for completion of reproductive processes, seedlings and young plants significantly prone to grazing by goats and rabbits) and the time-delay of flow-on effects on fauna.

The proposed impact avoidance and mitigation measures are likely to assist with mitigating these cumulative impacts in the Project areas. They would help to maintain fauna biodiversity in the short-term and to address the impact of vegetation clearance in the medium to long-term. The offset strategy described in Section 7 would maintain and improve regional biodiversity values in the medium to long-term once the area has been conserved in perpetuity and management plan protocols have been implemented.

5.4 State Environmental Planning Policy No. 44 - Koala Habitat Protection

The Koala (*Phascolarctos cinereus*) is not expected to occur in or near the Atlas-Campaspe Mine study area or the MCTR. However, there are records of the species from within a 20 km radius of the Ivanhoe Rail Facility Study Area. The Ivanhoe Rail Facility study area is located within the Central Darling LGA and therefore the provisions of *State Environmental Planning Policy No. 44 - Koala Habitat Protection* (SEPP No. 44) apply.

SEPP 44 requires that consent authorities making determinations under Part 4 of the EP&A Act consider whether ‘potential koala habitat’ and ‘core koala habitat’ will be affected. Potential koala habitat is defined as ‘an area of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component’. Core koala habitat, is defined as ‘an area of land with a resident breeding population of koalas, evidenced by attributes such as breeding females and recent sightings and historical records of a population’. Where core koala habitat is found to occur, SEPP 44 requires that a site-specific Koala Plan of Management be prepared.

Only a small area of woodland consisting of one type of secondary feed tree, *Eucalyptus largiflorens* was recorded, and the location was outside the Ivanhoe Rail Facility study area. Within the study area, koala feed trees do not constitute 15% of the total number of tree in the upper or lower strata of the tree component. No koala signs were observed, and there are only two historical records for the species (1976 and 1979) from the general area. Based on the definitions under SEPP 44, this habitat within the study area would not represent ‘core’, ‘primary’ or ‘potential’ habitat for the species.

5.5 Willandra Lakes Region World Heritage Area

One World Heritage Property, the Willandra Lakes Region World Heritage Area, occurs near the Project area (SEWPaC, 2012d). The Willandra Lakes Region World Heritage Area covers 240,000 ha of a semi-arid landscape mosaic comprising dried saline lake bed plains vegetated with saltbush communities, fringing sand dunes and woodlands with grassy understoreys in the Murray Basin area in far south-western NSW (SEWPaC, 2012d). The Region extends from between Spring Hill and Mulurulu (approximately 50 km north of Boree Plains), south-west to Mungo Station (33 km west of Boree Plains) and further south to Prungle (68 km south-west of Boree Plains) (SEWPaC, 2008). The Region includes Mungo National Park, which occurs to the west of the Project area.

The Willandra Lakes Region World Heritage Area is characterised by both cultural and natural value. It provides examples of major stages in the earth's evolutionary history, ongoing geological processes, and a cultural testimony to past civilisation (SEWPC, 2012d).

No direct impacts to the fauna of the Willandra Lakes Region World Heritage Area or other conservation reserves are likely as a result of the Project. At its closest point, the Willandra Lakes Region World Heritage Area is 10 km to the west of the Project area. Willandra Lakes Region World Heritage Area is separated from the Project area by a broad band of native vegetation. Some of the native fauna that occur in these conservation reserves would be part of a larger local or regional population that extends into the Project area and the proposed offset area. The direct impacts of the Project on these fauna would be mainly limited to individuals that occur in the Project area itself and it is not expected that the Project would affect the life cycle, abundance or area of occupancy of the fauna that occur in the conservation reserves.

Potential indirect impacts on the fauna of the conservation reserves would be changes to surface hydrology and/or groundwater, wildfire, dust, changes to the abundance of feral animal populations, and/or the introduction of weeds, feral animals or pathogens to the area.

Potential indirect impacts on the fauna of the conservation reserves could be changes to surface hydrology and/or groundwater, wildfire, dust, changes to the abundance of feral animal populations, and/or the introduction of weeds, feral animals or pathogens to the area. The Surface Water Assessment (Evans & Peck, 2012) concluded that the possibility of any runoff from the Atlas-Campaspe Mine site reaching, or having any impact on, the World Heritage Area could only occur under rainfall conditions that are unlikely to have been experienced in the region for thousands of years. The Hydrogeological and Water Supply Assessment (GEO-ENG, 2013) concluded:

- no impact on any surface ponding areas or shallow groundwater systems associated with the Willandra Lakes Region World Heritage Area or Mungo National Park; and
- no drawdown of the deep underlying saline groundwater aquifer below the Willandra Lakes Region World Heritage Area or the Mungo National Park.

No changes to surface water or groundwater in the Willandra Lakes Region World Heritage Area are expected as a result of the Project (GEO-ENG, 2013; Evans & Peck, 2012). Provided that other indirect impacts are effectively controlled, the Project is not likely to have an impact on the fauna of the Willandra Lakes Region World Heritage Area. Measures that would be undertaken to manage and control wildfire, dust, feral animals and other potential indirect impacts are discussed in Section 6.

The addition of the proposed offset area to the existing conservation reserves and the control of feral animals and wildfire in the proposed offset area has the potential to have a positive impact on the fauna of the conservation reserves adjacent to the proposed offset area, including the Willandra Lakes Region World Heritage Area.

5.6 Mungo National Park

Mungo National Park is located approximately 5 km to the west of the Atlas-Campaspe Mine. Mungo State Conservation Area adjoins Mungo National Park on the eastern border (Figure 1). Mungo National Park covers an area of 112,586 ha of which approximately 65% falls within the Willandra Lakes Region World Heritage Area (DEC, 2006).

No direct impacts to the fauna of Mungo National Park are likely as a result of the Atlas-Campaspe Mine. At its closest point, the Atlas-Campaspe Mine is located 5 km to the east of Mungo National Park. Both the Hydrogeological and Water Supply Assessment (GEO-ENG, 2013) and Surface Water Assessment (Evans & Peck, 2012) concluded that Mungo National Park would not be affected by any groundwater or surface water impacts associated with the Project, except under rainfall conditions that are unlikely to have been experienced in the region for thousands of years.

Potential indirect impacts on the fauna can relate to changes to surface hydrology and/or groundwater, wildfire, dust, changes to the abundance of feral animal populations, and/or the introduction of weeds, feral animals or pathogens to the area. No changes to surface water or groundwater in Mungo National Park are expected as a result of the Project (GEO-ENG, 2013; Evans & Peck, 2012). Provided that other indirect impacts are effectively controlled, the Atlas-Campaspe Mine is not likely to have an impact on the fauna of Mungo National Park or Mungo State Conservation Area. Measures that would be undertaken to manage and control fires, dust, feral animals and other potential indirect impacts are discussed in Section 6. The addition of the proposed offset area to the existing conservation reserve system has the potential to enhance biodiversity values resulting in a positive impact on the fauna of the areas adjacent to the proposed offset area, including Mungo National Park.

5.7 Significance of impacts on threatened fauna

5.7.1 TSC Act

A total of 40 species were considered to be potentially or likely affected by the Project at the Atlas-Campaspe Mine and MCTR study areas. This included six species of reptile, 25 species of bird and nine species of mammal. Fourteen species are likely to be impacted (one reptile, eight birds and five mammals), and 26 species are considered to possibly be impacted (five reptiles, 17 birds and four mammals) (Appendix B). Fifteen species are unlikely to be impacted (two reptiles, 11 birds and two mammals) but have been conservatively assessed within Appendix B.

A total of 24 species were considered to be potentially or likely affected by the Project at the Ivanhoe Rail Facility study area. This included one species of reptile, 18 species of bird and five species of mammal. Three species are likely to be impacted (all birds), 21 species are considered to possibly be impacted (one reptile, 15 birds and five mammals) and 24 species are unlikely to be impacted (one frog, one reptile, 19 birds and three mammals), but based on the habitats present conservatively assessed. The high number of species assessed in relation to the Ivanhoe Rail Facility is a result of the reduced targeted fauna survey effort. The impact on threatened species was mostly based on the habitat assessment data, thus the potential occurrence of threatened species was conservatively assessed (Appendix B).

Potential impacts on these threatened fauna species were assessed via an Assessment of Significance under section 5A of the EP&A Act (Table 16). The assessments are presented in Appendix C. Three species listed on the TSC Act were assessed as likely to be significantly affected by the Project, namely, the Malleefowl, South-eastern Long-eared Bat (also known as Corben's Long-eared Bat) and the Western Pygmy-possum. Impacts on all three species would be compensated in the medium to long-term by the provision of an appropriately managed offset associated with the Atlas-Campaspe Mine section of the Project (Section 7).

Table 16: Species for which assessments of significance were performed.

Scientific Name	Common Name	Status[1]	
		TSC Act	EPBC Act
Reptiles			
Strophurus elderi	Jewelled Gecko	V	-
Delma australis	Marbed-faced Delma	E	-
Aprasia inaurita	Mallee Worm-lizard	E	-
Cyclodomorphus melanops elongatus	Spinifex Slender Blue-tongue	E	-
Tiliqua occipitalis	Western Blue-tongue	V	-
Echiopsis curta	Bardick	E	-
Birds			
Leipoa ocellata	Malleefowl	E	V
Stictonetta naevosa	Freckled Duck	V	-
Oxyura australis	Blue-billed Duck	V	-
Botaurus poiciloptilus	Australasian Bittern	E	E
Falco hypoleucos	Grey Falcon	E	-
Lophoictinia isura	Square-tailed Kite	V	-
Hamirostra melanosternon	Black-breasted Buzzard	V	-
Circus assimilis	Spotted Harrier	V	-
Hieraaetus morphnoides	Little Eagle	V	-
Ardeotis australis	Australian Bustard	E	-
Burhinus grallarius	Bush Stone-curlew	E	-
Cinclosoma castanotum	Chestnut-backed Quail-thrush	V	-
Rostratula australis	Australian Painted Snipe	E	V
Phaps histrionica	Flock Bronzewing *	V	V
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	-
Polytelis anthopeplus monarchoides	Regent Parrot	E	V
Hylacola cautus	Shy Heathwren	V	-
Calamanthus campestris	Rufous Fieldwren	V	-
Pyrrholaemus brunneus	Redthroat	V	-
Drymodes brunneopygia	Painted Honeyeater *	V	-
Lichenostomus cratitius	Purple-gaped Honeyeater	V	-
Certhionyx variegatus	Pied Honeyeater	V	-
Epthianura albifrons	White-fronted Chat	V	-
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies) *	V	-
Daphoenositta chrysoptera	Varied Sittella	V	-
Pachycephala inornata	Gilbert's Whistler	V	-
Stagonopleura oculata	Diamond Firetail*	V	-

Scientific Name	Common Name	Status[1]	
		TSC Act	EPBC Act
Mammals			
Ningaui yvonneae	Southern Ningaui	V	-
Antechinomys laniger	Kultarr *	E	-
Sminthopsis macroura	Stripe-faced Dunnart	V	-
Cercartetus concinnus	Western Pygmy-possum	E	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-
Nyctophilus corbeni	South-eastern Long-eared Bat (also known as Corben's Long-eared Bat)	V	V
Chalinolobus picatus	Little Pied Bat	V	-
Vespadelus baverstocki	Inland Forest Bat	V	-
Pseudomys bolami	Bolam's Mouse	E	-
Rattus villosissimus	Long-haired Rat	V	-

[1] Threatened fauna species status under the TSC Act and/or EPBC Act (current at 9 August 2012).
V = Vulnerable; E = Endangered

* Threatened fauna species associated only within the general locality of the Ivanhoe Rail Facility study area.

5.7.2 FM Act

There are no aquatic threatened species listed under the FM Act that are relevant to this Project. However, the existing Balranald-Ivanhoe Road (part of the MCTR) crosses Willandra Creek, which is part of the Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River, which is listed as an EEC under the FM Act. The Ivanhoe Rail Facility study area is also within the distribution of the EEC. The Project does not include any works in the vicinity of Willandra Creek, and the Surface Water Assessment (Evans & Peck, 2012) did not identify any potential impacts to surface water at the Ivanhoe Rail Facility apart from sediment runoff, which would be mitigated using standard control measures.

5.7.3 EPBC Act

The Project was referred under the EPBC Act in June 2012 and on the 14 September 2012 a delegate of the Commonwealth Minister subsequently declared the Project to be a 'controlled action'. Matters of national environmental significance that are relevant to the fauna assessment (e.g. threatened fauna species) are assessed in this document. Five species listed under the EPBC Act were assessed using the 'Significance Criterion' in the EPBC Act Policy Statement *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DEWHA, 2009).

Two species listed on the EPBC Act were assessed as likely to be significantly affected by the Project, namely, the Malleefowl and the South-eastern Long-eared Bat (also known as Corben's Long-eared Bat).

Impacts on these two species would be compensated in the medium to long-term by the provision of an appropriately managed offset (Section 7).

5.7.4 Listed migratory species

Five migratory bird species listed under the EPBC Act have been recorded within a 20 km radius of the Project area, four of which (the Rainbow Bee-eater, Malleefowl, Great Egret and the Australian Painted Snipe) were recorded during the AMBS surveys (2011-2012). Searches of the EPBC Act Protected Matters database returned an additional five bird species that were predicted to have potential habitat (Appendix E).

Assessments for eight of the listed migratory species are shown in Appendix E. In summary, it was concluded that the Project is not likely to significantly impact on these listed migratory species, on the basis that:

- no 'important habitat' exists within the Project area for any listed migratory species;
- the Project would not result in an invasive species that is harmful to any migratory species becoming established in an area of important habitat; and
- the Project would not disrupt the life cycle of an ecologically significant proportion of any population of any migratory species.

Two listed migratory species, the Australian Painted Snipe and the Malleefowl, are also listed as threatened under the EPBC Act, and these species have been assessed using the 'significant impact criteria' for vulnerable species, consistent with the requirements of the EPBC Act Policy Statement *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DEWHA, 2009) (Appendix D).

6 Measures to Avoid and Mitigate Impacts on Fauna

6.1 Mine design and method

The following measures would be undertaken to avoid or mitigate the impacts relating to the mine design and method:

- Mining would be undertaken progressively over 20 years, commencing at the eastern end of the Atlas Mine and moving west, then commencing at the eastern end of the Campaspe Mine and moving west, thus the area to be disturbed at any one time would be limited.
- Area of disturbance for the Campaspe footprint has been designed to avoid some direct impacts on the Black Box Woodland (Figure 21).
- The MCTR mostly follows existing road alignments to reduce amount of vegetation clearance required.

6.2 Rehabilitation and revegetation

A Rehabilitation Management Plan (RMP) would be prepared to facilitate the progressive rehabilitation of the post-mine landforms. The progressive clearance of native vegetation ahead of the advancing extraction area and active mine area would be followed by progressive rehabilitation of the backfilled pit and overburden emplacements.

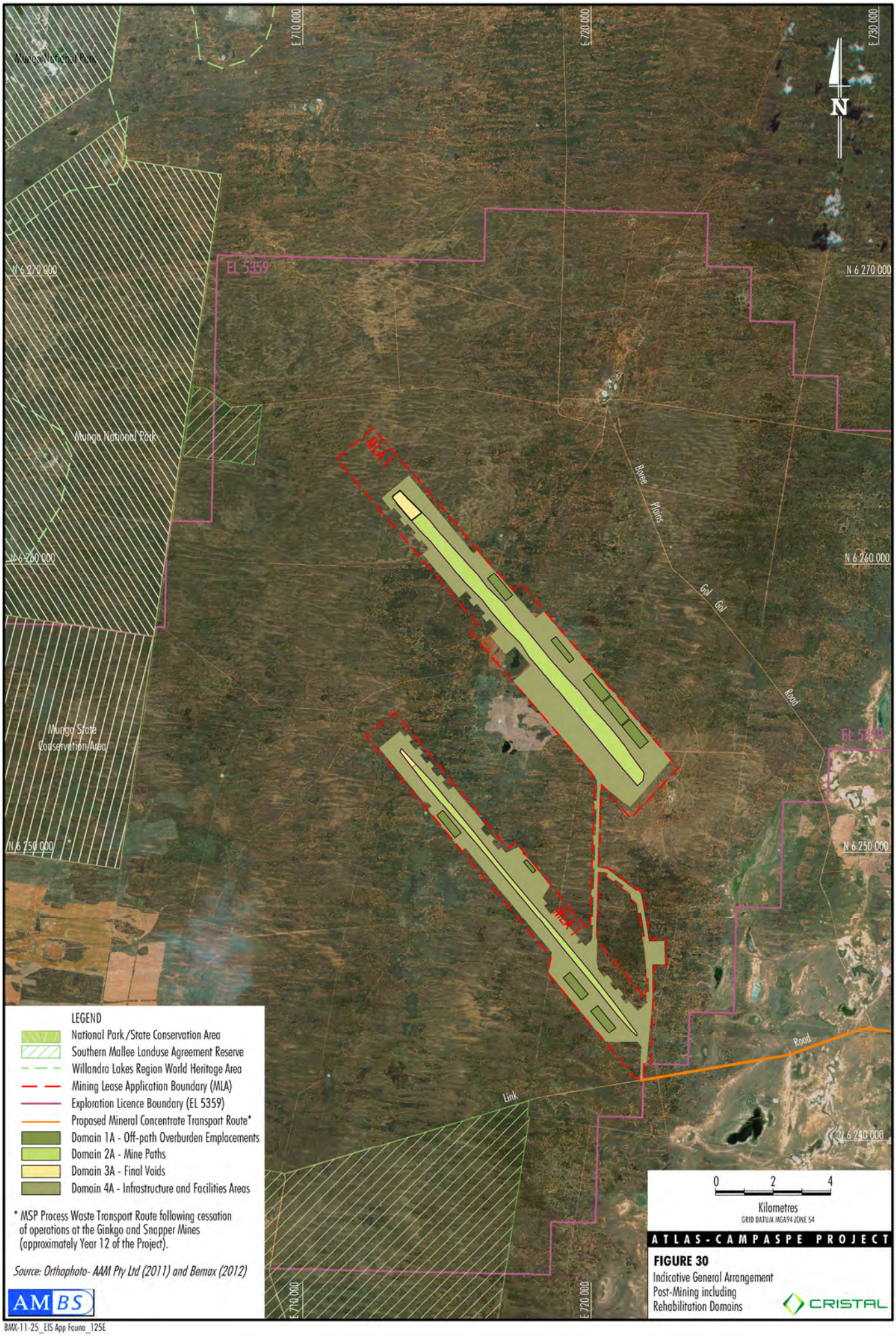
Conceptual rehabilitation domains have been developed by Cristal Mining in consideration of the NSW Department of Trade, Investment, Resources and Infrastructure Services (Division of Resources and Energy) (2011) *Interim Mining Operations Plan Guidelines - Guidance Note 1* to assist rehabilitation planning for the Project. The rehabilitation domains are relevant to the Project's post-mine landforms and the Project's final land use. The conceptual rehabilitation domains are shown on Figure 30 and include:

- Domain 1A - off-path overburden emplacements;
- Domain 2A - mine paths;
- Domain 3A - final voids; and
- Domain 4A - infrastructure and facilities areas.

Rehabilitation objectives for the domains have been developed by Cristal Mining based on the objectives for the Project's rehabilitation strategy and are as follows:

- the domain would be safe, stable and non-polluting;
- the domain would be revegetated with native vegetation species characteristic of vegetation communities cleared and include suitable Woodland and Shrubland species; and
- the domain would include self-sustaining ecosystems suitable for a final use to be determined in conservation with the relevant authorities.

Cristal Mining have experience with revegetation (mallee and shrubland) on post-mine landforms at the Ginkgo Mineral Sands Mine, Snapper Mineral Sands Mine and the former Wemen Mineral Sands Mine. Results from revegetation campaigns undertaken at these mines would be used to inform the Project's revegetation programme.



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Rehabilitation and revegetation would be progressive and would aim to re-establish vegetation across the disturbance area in order to reduce the impact on habitat connectivity. Propagules for regeneration and revegetation would be supplied by immediate reuse of removed topsoil and seed stocks collected prior to clearing or from local provenance sources. Yarran would be included in the seed mix. A mix of species associated with the *Acacia melvillei* Shrubland EEC including Yarran would be used to revegetate suitable areas in the rehabilitation areas. Habitat supplementation measures relevant to rehabitation are discussed in Section 6.5.

A rehabilitation monitoring programme based on sound scientific principles would be developed to assess the performance of the rehabilitated areas, in particular the progression of rehabilitated land and the effectiveness of rehabilitation techniques used. Results from the monitoring program would be regularly reviewed to allow for adaption of rehabilitation strategies as required to improve outcomes.

A key rehabilitation objective for the Project would be to selectively place clay materials in low-lying portions of the re-profiled landform within the mine path to reinstate the water holding capacity of, and run-on to adjacent depressions. This would provide for the potential for species representative of Black Box Woodlands (e.g. *Eucalyptus largiflorens*) to establish. This may provide potential habitat for the range of fauna that use this type of woodland, potentially including threatened species such as the South-eastern Long-eared Bat in the long term (with the re-establishment of hollow-bearing trees, installation of artificial hollows and addition of suitable habitat features).

The rehabilitated post mine landforms would include the establishment of species representative of Linear Dune Mallee and Sandplain Mallee such as *Eucalyptus socialis, E. dumosa,* Spinifex and *Callitris* sp in suitable locations. This may provide potential habitat for a range of species that utilise mallee habitats.

A detailed description of the Project's revegetation programme and rehabilitation monitoring programme would be included in the RMP.

6.3 Biodiversity Management Plan

A Biodiversity Management Plan would be prepared to manage biodiversity in the Project area. The plan would address the following impact avoidance and mitigation issues in relation to fauna and fauna habitat within these areas:

- impact avoidance measures;
- vegetation clearance procedures;
- threatened species management measures;
- weed management;
- management of rabbits and goats;
- management of feral predators;
- management of vehicles; and
- fire prevention, control and management.

6.4 Pre-clearance surveys

Vegetation clearing would be undertaken progressively over the life of the Project to retain vegetation until mining operations require its removal. Vegetation would be cleared in staged 'campaigns', where the area cleared in each campaign would be no greater than that required to accommodate the mine's needs for the following 12 months, where practicable.

A Threatened Species Management Protocol would be prepared and implemented to facilitate the management and minimisation of potential impacts on threatened fauna species. Key components of the Threatened Species Management Protocol would include pre-clearance surveys and the relocation of fauna and selected fauna habitat features to adjacent habitat. This would include surveying for active Malleefowl mounds in the area to be cleared prior to clearance. If active mounds are found, the eggs would be allowed to hatch and the chicks move away from the nest prior to habitat clearance (where practicable). This would require pre-clearance surveys and land clearance well in advance of the active mining.

6.5 Habitat supplementation

Select habitat features (e.g. tree hollows, trunks, logs, branches, small stumps and roots) would be salvaged during vegetation clearance activities and stockpiled for relocation to the rehabilitation areas. These are likely to provide habitat resources for a range of ground dwelling fauna, such as invertebrates, reptiles and small mammals, and relocated tree hollows may provide roosts for other species such as the South-eastern Long-eared Bat.

A nest box program would also be implemented progressively in rehabilitated areas. Nest boxes would provide potential habitat for hollow-dependant species by supplementing tree hollows in revegetating areas. Different styles and sizes would be used to suit the requirements of different species. Nest boxes would be placed on poles if required, to provide refuge areas in advance of vegetation re-establishment.

6.6 Timing of land clearance

Where practicable, vegetation clearing would occur during late summer or early autumn. This would minimise impacts to a large range of fauna breeding during spring and summer, and fauna which would hibernate during winter (e.g. microbats). It would also avoid the main breeding period of threatened fauna, such as the Malleefowl.

6.7 Stock management

Livestock would be excluded from the MLA area during the period the mine would be in operation.

6.8 Management of exotic animals

An integrated pest management strategy would be implemented to control feral animals, including goats, foxes, feral dogs, cats and rabbits; and would be integrated with a program in the proposed offset area. Control programs would need to be co-ordinated to avoid overabundance of predator or prey species.

The management of goats would include water management, to assist with reducing local populations. Goat-proof fencing and a one-way gate or ramps that permit goats to enter, but not to exit, the enclosure, would be installed around select watering points to trap goats. Closure of water-storage facilities after the closure of the mine would also assist with reducing feral goat populations.

In addition the storage of waste materials (in particular food waste) would be managed to ensure it does not attract feral animals.

6.9 Companion animals

No pet ownership would be allowed on-site.

6.10 Water management

The mine design has been refined to minimise clearance of Black Box Woodland. To mitigate the impact of the Project on the Ephemeral Wetland and Black Box Woodland the following would be undertaken (as described in Section 6.2):

- maintain the opportunity for runoff to the Black Box ephemeral depressions during the life of the mine as required;
- selective placement of clay material in low-lying portions of the re-profiled landform within the mine path to reinstate the water holding capacity of, and run-on to adjacent depressions; and
- once mining is complete, restoring land levels along the main flow paths to allow cross drainage to occur toward the Black Box Woodland.

Other water management measures would also assist with controlling populations of feral species such as goats within the Project and proposed offset area. These include:

- decommission of all post-operative water storage facilities; and
- decommission existing tanks in the proposed offset area.

6.11 Dust and spill control

- Minimise dust generation where relevant by minimising the extent and time bare soil is exposed, including the following:
  - water spraying of internal unsealed haul roads in the active mining area;
  - cleared areas are sprayed regularly with water during any construction activities, where appropriate;
  - progressive rehabilitation of disturbance areas including topsoil and subsoil stockpiles;
  - soil stripping is avoided during periods of high wind and/or low soil moisture as to minimise dust; and
  - a section of MCTR to be sealed (Figure 3).
- Develop procedures to deal with potential spills from vehicles and plant machinery and release of other pollutants during construction and operation activities associated with the mines.
- Mandatory requirements for vehicles to carry spill kits.

6.12 Fire management

A fire management strategy would be developed for the Project area in consultation with the local Rural Fire Service which integrates:

- fire prevention;
- fire control; and
- fire regimes for biodiversity.

Fire would be controlled and outbreaks managed in consultation with the local Rural Fire Service (Wentworth/Balranald Bush Fire Management Committee). The following fire prevention and control measures would be implemented to minimise the potential for fire ignition:

- Clearing restrictions:
  - Clearing would be minimised during periods of extreme fire danger (as defined by the BoM) to mitigate risk of fire ignition from machinery, where practicable.
- On-site precautions:
  - Provision and maintenance of fire fighting equipment on-site.
  - Training of mine personnel and contractors in fire awareness and response procedures.
  - Establishment and maintenance of fire breaks to contain fires within the mining tenements.
  - Prohibition of smoking in fire prone areas.
  - Appropriate management of dangerous goods.

6.13 Vehicles

Vehicles to remain on existing roads and tracks. Speed limits, the inclusion of the risk of vehicle strike to fauna in inductions and installing road signs to increase awareness would be implemented in order to reduce impacts. Staff and contractor inductions would include in particular the hazards of driving at dusk and dawn, when road strike of nocturnally active fauna is most likely.

6.14 Lights

Artifical lighting would be directed into the mine site and camp areas so as to minimise the impact on surrounding habitat.

6.15 Monitoring and reporting

Monitoring of fauna management measures would be undertaken and would aim to assess the effect of a range of control measures, including rehabilitation, use of nest boxes and relocated habitat features, stock removal, goat removal and feral animal control.

6.16 Land management

Cristal Mining will enter into agreements with the leaseholders for the lease of the land in the vicinity of the Atlas-Campaspe Mine for the Project. Cristal Mining would manage Boree Plains Station and Wampo Station in accordance with the requirements of the Western Lands Lease (e.g. control of noxious weeds and management of grazing). The management of the land would be consistent with the *Guidelines for Developments Adjoining Department of Environment and Climate Change Land* (NSW Department of Environment and Climate Change [DECC], 2008).

6.17 Ivanhoe Rail Facility

The Ivanhoe Rail Facility would include retention and management of 15 ha of existing vegetation comprising 14.8 ha of Belah-Rosewood Woodland and 0.2 ha of Native Grassland. The perimeter of the area would be fenced with a goat proof fence to facilitate regeneration of the native vegetation. Cristal Mining would undertake control of noxious weeds within this area.

Three fauna species listed under the TSC Act were recorded in the Ivanhoe Rail Facility study area (Figure 20). These species and others considered likely to occur within the study area or the Vegetation Management Area (VMA) are listed in Table 17. The list of species was based on a combination of the habitats present within the study area, and the presence or absence of recent reliable database records.

Table 17: Threatened fauna recorded or considered likely to occur in the Vegetation Management Area associated with the Ivanhoe Rail Facility.

Scientific Name	Common Name	Conservation Status		Area of Habitat in the Vegetation Management Area (ha)
		TSC Act	EPBC Act	
Reptiles				
Tiliqua occipitalis	Western Blue-tongue	V	-	14.8
Leipoa ocellata	Malleefowl	E	V	15
Falco hypoleucos	Grey Falcon	E	-	15
Lophoictinia isura	Square-tailed Kite	V	-	15
Hamirostra melanosternon	Black-breasted Buzzard	V	-	15
Circus assimilis	Spotted Harrier	V	-	15
Hieraaetus morphnoides	Little Eagle*	V	-	15
Ardeotis australis	Australian Bustard	E	-	15
Burhinus grallarius	Bush Stone-curlew	E	-	15
Phaps histrionica	Flock Bronzewing	V	-	15
Lophochroa leadbeateri	Major Mitchell's Cockatoo*	V	-	15

Scientific Name	Common Name	Conservation Status		Area of Habitat in the Vegetation Management Area (ha)
		TSC Act	EPBC Act	
Drymodes brunneopygia	Painted honeyeater	V	-	14.8
Certhionyx variegatus	Pied Honeyeater	V	-	14.8
Epthianura albifrons	White-fronted Chat*	V		0.2
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	15
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	14.8
Daphoenositta chrysoptera	Varied Sittella	V	-	14.8
Pachycephala inornata	Gilbert's Whistler	V	-	14.8
Stagonopleura guttata	Diamond Firetail	V	-	15
Antechinomys laniger	Kultarr	E	-	15
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	15
Nyctophilus timoriensis/corbeni	South-eastern Long-eared Bat (also known as Corben's Long-eared Bat)	V	V	14.8
Chalinolobus picatus	Little Pied Bat	V	-	14.8
Vespadelus baverstocki	Inland Forest Bat	V	-	14.8

* Recorded in the Ivanhoe Rail Facility adjacent to VMA.

7 Offset Strategy

This section describes the offset strategy, which aims to address residual impacts that cannot be mitigated. The objective of the offset strategy is to maintain or improve biodiversity values (including fauna habitat) in the region in the medium to long-term, through the conservation, management and improvement of habitat near the Atlas-Campaspe Mine in perpetuity. The land within the proposed offset area would be subject to ongoing management, monitoring and independent audits, allowing for ongoing adaptive management.

Specific information relating to the fauna species and their habitats were obtained from baseline fauna surveys undertaken in the proposed offset area. A copy of the full survey report is provided as a separate document in Appendix G.

The proposed offset area is shown on Figure 31 and its size, location and proposed management regime were selected on the basis of a range of factors:

- The location of the proposed offset area relative to the proposed disturbance area.
- How the proposed offset could complement the existing reserve system (e.g. Mungo National Park, Mungo State Conservation Area and Southern Mallee Land Use Agreement Reserves).
- The land tenure available on which to locate a proposed offset area (i.e. Cristal Mining controlled land).
- The location of existing fencelines and tracks (to minimise the need to create new ones).
- The size of the proposed offset area relative to the proposed disturbance area.
- The shape of the proposed offset area in relation to the spatial arrangement of existing vegetation in the landscape.
- The regional conservation priorities and habitats most in need of conservation (e.g. Yarran Shrubland).
- The vegetation/fauna habitat composition of the proposed disturbance area relative to the proposed offset area.
- The fauna species present (including threatened species) and the habitat needed to maintain local populations of the species.
- The ecosystem resilience and condition of the proposed offset area.
- A range of flora considerations (refer to AMBS, 2013).

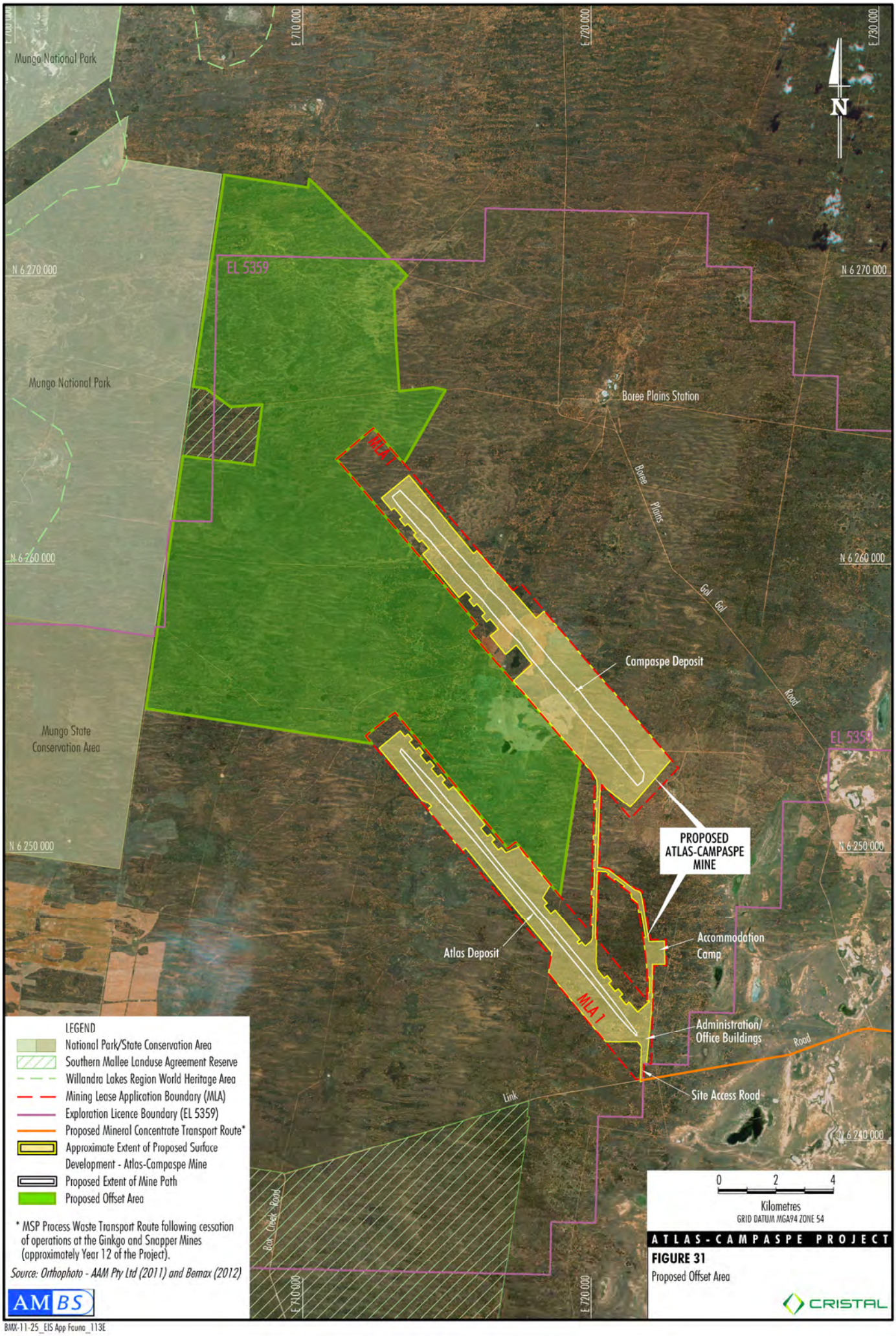
These factors are further discussed below in relation to the proposed offset area.

7.1 Location

The proposed offset area is located within the same CMA region as the Atlas-Campaspe Mine (i.e. the Lower Murray-Darling CMA Region), and therefore has the capacity to benefit biodiversity values in the same region as the Project.

Fauna habitats can change over distances due to differences in environmental factors. The proposed offset area is suitably located because it is adjacent to the area proposed to be disturbed and therefore has a greater chance of maintaining and improving biodiversity values which are similar to those to be impacted by the Project (Figure 24).

The proposed offset area adjoins Mungo National Park and a small Southern Mallee Land Use Agreement Reserve and as such would be an important addition to the conservation network (Figure 31).



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7.2 Tenure of the proposed offset area

The proposed offset area is located on leasehold land. Cristal Mining will enter into agreements with the leaseholders for the lease of the land in the vicinity of the Atlas-Campaspe Mine for the Project. The land tenure underlying the proposed offset area would be secured in perpetuity.

7.3 Characteristics of the proposed offset area

7.3.1 Size

The Project area covers 4,463 ha of land, comprising approximately 4,158 ha of native vegetation communities and 305 ha of Cleared Land/road and railway easement. The proposed offset area for the Project covers approximately 16,540 ha of land, comprising approximately 16,270 ha of native vegetation communities and 270 ha of Cleared Land which would be rehabilitated. The Cleared Land would be allowed to regenerate and trials of assisted regeneration of the EEC Yarran Shrubland would be undertaken, if natural regeneration fails.

The proposed offset area represents approximately 12% of the land already dedicated for conservation in the adjoin Mungo National Park (122,436 ha), Mungo State Conservation Area (5,794 ha) and the small Southern Mallee Land Use Agreement Reserve on Boree Plains Station (529 ha). The Southern Mallee Land Use Agreement Reserve south of the proposed offset area comprises 18,117 ha.

7.3.2 Shape

The shape of the proposed offset area is defined by an attempt to complement the existing reserve system including the Mungo National Park, encompass a representative example of the vegetation communities and fauna habitat to be impacted by the Atlas-Campaspe Mine.

7.3.3 Proximity to existing reserve system

The proposed offset area is located adjacent to Mungo National Park and a Southern Mallee Land Use Agreement Reserve associated with past vegetation clearing on Boree Plains Station. The proposed offset area would also enhance connectivity between these existing reserves and, to a limited extent, a Southern Mallee Land Use Agreement Reserve to the south-west. The proposed offset area would contribute a considerable area to conservation.

7.3.4 Existing infrastructure

The following infrastructure occurs in the proposed offset area:

- Water tanks (open dams and closed containers).
- Water pipelines to transport water from Boree Plains Station to some tanks in the proposed offset area.
- Fencing.
- Tracks associated with fencing, cropping areas and tanks.

Artificial watering points within the proposed offset area would be closed to prevent access by livestock and feral animals. Water pipelines and unnecessary fencing inside the proposed offset area would be removed. Tracks would be retained for management purposes.

7.3.5 Mining exploration

The proposed offset area is located within Exploration Licence 5359 held by Cristal Mining. No mining exploration would occur within the proposed offset area.

7.4 Fauna of the proposed offset area

7.4.1 Threatened species

Nineteen species listed under the TSC Act and/or EPBC Act were recorded in the proposed offset area (Figures 13 to 18). These species and species considered likely to occur within the proposed offset area (on the basis of habitat being present and recent reliable records) are listed in Table 18, along with the area of their habitat that would be impacted by the Project in relation to the Atlas-Campaspe Mine and the area of their habitat that would be conserved in the proposed offset area.

Two additional species were also included that may occur occasionally in the proposed offset area, the Bush Stone-curlew (one record of this species was made during the AMBS 2011-2012 surveys, but could be a vagrant) and the Long-haired Rat in good conditions (previously recorded from Mungo National Park and a "possible" record was obtained during the AMBS 2011-2012 surveys).

Table 18: Threatened fauna recorded or considered likely to occur in the proposed offset area.

Scientific Name	Common Name	Conservation Status		Habitat Area (ha)	
		TSC Act	EPBC Act	Project Area	Proposed offset area
Reptiles					
Strophurus elderi	Jewelled Gecko[*#]	V	-	1,040	9,640
Delma australis	Marble-faced Delma[#]	E	-	1,040	9,640
Aprasia inaurita	Mallee Worm-lizard[*]	E	-	1,575	12,765
Cyclodomorphus melanops	Spinifex Slender Blue-tongue[*#]	E	-	1,040	9,640
Tiliqua occipitalis	Western Blue-tongue Lizard	V	-	3,980	16,170
Echiopsis curta	Bardick[*#]	E	-	1,040	9,640
Birds					
Leipoa ocellata	Malleefowl[*]	E	V	4,280	16,440
Stictonetta naevosa	Freckled Duck	V	-	0	11
Oxyura australis	Blue-billed Duck	V	-	0	11
Botaurus poiciloptilus	Australasian Bittern	E	E	5	21
Falco hypoleucos	Grey Falcon	E	-	4,418	16,540
Lophoictinia isura	Square-tailed Kite	V	-	4,418	16,540
Hamirostra melanosternon	Black-breasted Buzzard	V	-	4,418	16,540
Circus assimilis	Spotted Harrier[*]	V	-	4,418	16,540
Hieraaetus morphnoides	Little Eagle[*]	V	-	4,418	16,540
Ardeotis australis	Australian Bustard	E	-	3,375	6,900
Burhinus grallarius	Bush Stone-curlew	E	-	2,755	3,765
Rostratula australis	Australian Painted Snipe	E	V	5	21
Lophochroa leadbeateri	Major Mitchell's Cockatoo[*]	V	-	4,418	16,540
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	-	3,860	15,830
Polytelis anthopeplus monarchoides	Regent Parrot	E	V	1,575	12,765
Calmanthus cautus	Shy Heathwren	V	-	1,575	12,765
Lichenostomus cratitius	Purple-gaped Honeyeater	V	-	1,575	12,765
Certhionyx variegatus	Pied Honeyeater[*]	V	-	1,910	13,270
Epthianura albifrons	White-fronted Chat[*]	V	-	435	370
Melanodryas cucullata	Hooded Robin[*]	V	-	2,030	13,725
Cinclosoma castanotus	Chestnut-backed Quail-thrush[*]	V	-	1,580	12,790
Daphoenositta chrysoptera	Varied Sittella[*]	V	-	3,860	15,830

Scientific Name	Common Name	Conservation Status		Habitat Area (ha)	
		TSC Act	EPBC Act	Project Area	Proposed offset area
Pachycephala inornata	Gilbert's Whistler*	V	-	3,610	15,325
Mammals					
Ningaui yvonneae	Southern Ningaui*#	V	-	1,040	9,640
Cercaretus concinnus	Western Pygmy-possum^	E	-	3,610	15,325
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat*	V	-	4,418	16,540
Nyctophilus corbeni	South-eastern Long-eared Bat (also known as Corben's Long-eared Bat)*	V	V	3,863	15,830
Chalinolobus picatus	Little Pied Bat*	V	-	4,118	16,270
Vespadelus baverstocki	Inland Forest Bat**	V	-	4,033	16,260
Pseudomys bolami	Bolam's Mouse#	E	-	4,117	16,270
Rattus villosissimus	Long-haired Rat	V	-	4,418	16,540

* Recorded in the proposed offset area.

^ Probable record.

\# Species may use small sections of Sandplain Mallee where well developed Spinifex clumps occur. However the full hectare value of this habitat is not included in the total area as this would be an over-estimation of the value.

The proposed offset area would benefit the conservation of these species by setting aside areas of known and potential habitat for conservation in perpetuity. In addition, management of the proposed offset area has the potential to improve the condition of the habitat and reduce some existing threats. For example, the proposed management of the proposed offset area includes control of feral animals such as foxes and cats, which are introduced predators of the Malleefowl, Southern Ningaui and other species; control of rabbits and goats, which would reduce grazing pressure on the vegetation and allow the regeneration of *Acacia melvillei* and shrubs that provide a potential food resource; and introduction of an appropriately managed fire regime that would reduce the threat of major wildfire to species such as the South-eastern Long-eared Bat (also known as Corben's Long-eared Bat). The proposed offset area would potentially benefit the Bush Stone-curlew, an individual of which was heard calling in or near the south-western end of the Atlas Mine study area, and the Western Pygmy-possum, for the same reasons.

Neither the Atlas-Campaspe Mine study area nor the proposed offset area contains habitat for the Redthroat; this species was only recorded along the MCTR in Chenopod Shrubland. The amount of potential habitat for this species that would be affected by the Project is limited to small areas along the existing road.

The proposed offset area includes potential breeding and foraging habitat for the White-fronted Chat. The reason why the overall area of potential habitat for this species that would be conserved in the proposed offset area is less than that in the Project area is that the habitat for this species within the Project area includes Chenopod Shrubland and potentially foraging areas in the Cleared Land. The proposed offset area does not include Chenopod Shrubland (the amount of this habitat type that would be affected by the Project is limited to small areas along the existing road) and there is 30 ha less Cleared Land in the proposed offset area than in the Project area.

However, the proposed offset area does contain the key habitat types for this species that were observed within the Atlas-Campaspe Mine study area, in particular, it contains an area of Ephemeral Wetland and more Black Box Woodland than would cleared by the Project.

7.4.2 Fauna habitats

The major fauna habitat types in the proposed offset area include Linear Dune Mallee, Sandplain Mallee and Belah-Rosewood Woodland (Figure 24). Table 19 compares the area of fauna habitats within the proposed offset area with those within the approximate extent of proposed surface disturbance for the Project.

Table 19: Quantification of the broad fauna habitat types in the Atlas-Campaspe Mine footprint, MCTR roadworks footprint, and proposed offset area.

Fauna Habitat Type	Atlas-Campaspe Mine and MCTR Roadworks (ha)	Proposed offset area (ha)
Belah-Rosewood Woodland	2,035	2,560
Black Box Woodland	50	79
Ephemeral Wetland	0	11
Linear Dune Mallee	1,040	9,640
Sandplain Mallee	535	3,125
Sandhill Pine Woodland	3	0
Acacia Woodland/Shrubland	200	415
Disturbed Shrubland	170	430
Chenopod Shrubland	80	0
Chenopod Shrubland Depressions	5	0
Grass and Herbland Depression	Not mapped	10
Native Grassland	0	0
Cleared Land	300	270
TOTAL	4,418	16,540

Habitat resources within the proposed offset area are generally comparable or better than those available in the Project area, given the greater level of disturbances (clearing for agriculture and grazing) that already exist in the Project area and the greater area of habitat type that would be conserved. The following habitat resources are available in the proposed offset area:

- Small to medium size hollows in Belah-Rosewood Woodland, Black Box Woodland, Sandplain Mallee and Linear Dune Mallee.
- Medium to large hollows in Black Box Woodland and Belah-Rosewood Woodland.
- Well-developed Spinifex hummocks in Linear Dune Mallee and some sections of Sandplain Mallee.
- Water resources in the Ephemeral Wetland, Grass and Herbland Depressions.
- Large fallen logs (with and without hollows) in appropriate loads in Belah-Rosewood Woodland, Black Box Woodland, Sandplain Mallee and Linear Dune Mallee.
- Fallen timber in high quantities in Belah-Rosewood, Black Box Woodland, Linear Dune Mallee and Sandplain Mallee.
- Decorticating bark in high loads in Linear Dune Mallee, Sandplain Mallee, Belah-Rosewood Woodland and Black Box Woodland.
- Important feed trees, shrubs and grasses in all habitat types.
- Dense ground cover shrubs in some sections of Sandplain Mallee, Linear Dune Mallee and Belah-Rosewood Woodland.
- Dense cover of mid-strata shrubs in Linear Dune Mallee, Shrubland and Acacia Woodland/Shrubland.

These habitat resources would provide habitat for a similar suite of threatened species to those found in the Project area. Habitats affected by the MCTR are limited in extent and distributed in a thin strip through extensive areas of similar habitat. They are not represented in the proposed offset.

7.4.3 Vegetation resilience and condition

The condition of the vegetation in the proposed offset area is strongly related to the vegetation type. For example mallee vegetation is generally in good condition while Black Box Woodland or Yarran Shrubland is in moderate to poor condition. Vegetation in the proposed offset area is in similar condition to the vegetation in the Project areas. The vegetation in the proposed offset area is expected to improve in condition with the removal of livestock and control of feral animals.

Cleared Land is represented in both the offset and Project areas. In the proposed offset area there is potential for native vegetation to regenerate in the Cleared Land as some native shrubs and herbs still occur. The removal of grazing and cropping activities would likely allow these native species to recolonise the Cleared Land, creating additional areas of potential fauna habitat.

7.5 Mungo National Park

As previously mentioned, the proposed offset area adjoins directly to the eastern edge of Mungo National Park and a private conservation reserve (a Southern Mallee Land Use Agreement). It would increase the available area of each vegetation community and habitat type within the bioregion. The availability and condition of habitat resources within the bioregion is also likely to be enhanced in the long-term with the introduction of the proposed offset area, due to the implementation of management measures such as removal of stock and goats, feral animal control and fire management.

A number of the threatened species that have been recorded in the proposed offset area have not previously been recorded in Mungo National Park. Some of these are:

- Bardick;
- Mallee Worm-lizard;
- Spotted Harrier; and
- Yellow-bellied Sheathtail-bat.

7.6 Proposed offset area management, security, monitoring and auditing

The sub-sections below provide detail on the proposed method of conserving the proposed offset area in perpetuity, and the proposed management, monitoring, independent audits and completion criteria. These sub-sections have been cross-referenced with the offset sections of the AMBS (2013) flora report to maintain consistency with the offset management procedures.

7.6.1 Conservation in perpetuity

An arrangement would be made for the enduring protection and management of the biodiversity offset area within 12 months of grant of Development Consent. A voluntary conservation agreement pursuant to section 69B of the *National Parks and Wildlife Act 1974*, Change of Lease Purpose or similar arrangement is proposed, which may include an agreement with the NSW Government so that the proposed offset area can be permanently added to the adjoining Mungo National Park.

7.6.2 Management

A management plan would be prepared by a suitably qualified person(s) within 12 months of Project approval. A management plan would provide a framework for the management of the proposed offset area and would incorporate adaptive management strategies to monitor management activities so that management priorities can be updated and adapted to reflect the observations of the monitoring programs, environmental changes and availability of resources.

The management plan would provide guidelines to undertake the following core activities.

Removal of livestock
Grazing by stock across the entire offset investigation area has had significant impacts on native vegetation, and consequently habitat for threatened fauna. Noticeable impacts include few seedlings, stunted shrub growth, disturbance of the biological soil crust by trampling, removal of ground layer habitat near watering points and along an extensive network of animal tracks, and moderate to severe erosion of bare areas. The removal of stock is likely to facilitate a significant improvement to fauna habitat in the proposed offset area.

Removal of stock would be achieved by:

- Fencing of the proposed offset area to prevent stock from entering.
- Removal and exclusion of all stock from the proposed offset area.

Any fences to be erected need to be constructed with no barbwire on the top strand to minimise entanglement by species such as the Yellow-bellied Sheathtail-bat and potentially the Malleefowl as well as more common species, such as the Spotted Nightjar (*Eurostopodus argus*).

Closure of artificial watering points
Artificial watering points within the proposed offset area would be closed to prevent access by livestock and feral animals, except in areas where traps will be established around tanks for the management of feral goats (Section 6.10). It is clear from the information accumulated during the survey of the proposed offset area that proximity to watering points is equated to higher levels of disturbance.

Animal pest management
Feral animals such as rabbits, goats, cats and foxes would be controlled and monitored by appropriately qualified persons using standard methods. Control of feral predators would have significant benefits to a range of threatened fauna known to occur in the area, including (but not necessarily limited to) the Malleefowl, the Southern Ningaui and threatened reptiles which are vulnerable to predation by foxes and cats.

Control of goats and rabbits (combined with stock removal) is expected to improve the quality of fauna habitats in the proposed offset area. Traps are goat-proof fences surrounding a watering point with a variety of one-way gates or ramps that permit goats to enter, but not to exit, the enclosure (Parkes *et al.*, 1996). Trapping, or self-mustering, can be used to reduce the stress on the animals and is a successful control method in dry times, when feral goats congregate around watering points (Thompson *et. al.*, 1999). It is less efficient and often impractical during periods of wet weather when water is plentiful.

In addition single goats can be radio-collared, referred to as ‘Judas’ goats, which can be used to locate groups of feral goats that are difficult to find by other methods (Parkes *et al.*, 1996). The collared goats are used to track down and ‘mob up’ with other goats, thereby allowing small or hard to find goats to be found and destroyed.

Goat numbers would be monitored to confirm that control mechanisms are effective and the number of goats in the proposed offset area is maintained at a significantly lower level than at present.

Weed control
Weed cover within the proposed offset area is comparatively low with the greatest diversity of weed species occurring in areas where grazing is more intense and hence disturbance is greatest. The removal of grazing may result in an increase in the density of weed species in these areas. Weeds in the proposed offset area would be monitored and controlled by an appropriately qualified persons using standard methods.

Regeneration
Approximately 270 ha of the proposed offset area has been cleared for cropping. Native vegetation would be allowed to naturally regenerate in these areas through the cessation of cropping and the reduction of grazing by stock, goats and rabbits. Should the native vegetation not regenerate naturally due to the extent of prior disturbance to the seed bank and/or the dominance of introduced flora species, revegetation would be assisted through:

- removal of weed species; and
- revegetation with appropriate plantings of seedlings of species represented in the surrounding native vegetation communities.

Fire
Bushfire prevention and control measures appropriate for threatened fauna potentially occurring in the proposed offset area would be undertaken. Fire breaks would be constructed and maintained around the perimeter of the proposed offset area. A fire break would potentially allow managers of the proposed offset area to control fire at the boundary, preventing it from entering or leaving the proposed offset area. This would also assist in ensuring good relationships with surrounding leaseholders through the ability to safely manipulate fire within the proposed offset area.

The management plan would outline fire management strategies for biodiversity, including controlled fire regimes where considered appropriate. The plan would include specific strategies for the Malleefowl, Western Pygmy Possum, and South-eastern Long-eared Bat (also known as Corben's Long-eared Bat), consistent with the recommendations and principles of each respective state or national recovery plan. The effect of fire on these three species is known to be severe. Fire management strategies are likely to include stringently controlled mosaic burns.

7.6.3 Monitoring

A monitoring program would be implemented to assess and report on the effectiveness of the measures and the performance of the offsets in conserving and improving native vegetation and habitat for native fauna. This would include, as a minimum, standardised fauna surveys performed every three years, throughout the proposed offset area targeting all vertebrate fauna groups. Surveys would be best undertaken during spring/early summer. Observation would be made of criteria that allows for assessment overtime via an independent audit.

Summary reporting would be carried out annually and comprehensive reporting would be carried out following the independent environmental audit (see below). The monitoring would be performed by suitably qualified persons.

7.6.4 Independent audits

The proposed offset area would be independently audited at intervals agreed to with relevant authorities. The audits would be performed by a suitably qualified person(s) to:

- assess compliance with the management plan;
- assess the performance of the proposed offset area;
- review the adequacy of the management measures and monitoring program; and

- recommend actions or measures to improve the performance of the offset, management plan, or monitoring program.

7.7 Reconciliation of the offset strategy against OEH and EPBC offset principles

A set of principles have been provided as a framework for considering environmental impacts and developing offset strategies (OEH, 2011b). A reconciliation of the proposed offset strategy against these principles is provided in Table 20.

The EPBC Act Environmental Assessment Requirements (EPBC 2012/6447) contain a number of requirements for environmental offsets. Table 21 highlights the elements of the Project offset that address the EPBC Act offset principles from 2012.

Table 20: Reconciliation of the proposed offset strategy against OEH offset principles.

OEH Offset Principles (OEH, 2011b)	Description of How the Proposed Offset Addresses the OEH Offset Principles
Impacts must be avoided first by using prevention and mitigation measures.	Section 6 describes measures to avoid and mitigate the Project impacts on fauna. The offset strategy is proposed to address residual impacts.
All regulatory requirements must be met.	Cristal Mining is required to meet all statutory requirements. The proposed offset strategy is not proposed to substitute other licence/approval requirements.
Offsets must never reward ongoing poor performance.	The proposed offset strategy is proposed to address residual impacts associated with the Project only.
Offsets would complement other government programs.	An arrangement would be made for the enduring protection and management of the biodiversity offset area within 12 months of grant of Development Consent. A voluntary conservation agreement pursuant to section 69B of the *National Parks and Wildlife Act 1974,* Change of Lease Purpose or similar arrangement is proposed, which may include an agreement with the NSW Government so that the proposed offset area can be permanently added to the adjoining Mungo National Park.
Offsets must be underpinned by sound ecological principles.	The offset is underpinned by sound ecological principles such as: • consideration of structure, function and compositional elements of biodiversity; • enhancement of biodiversity at a range of scales through a number of proposed management measures; and • measures to protect the long-term viability and functionality of biodiversity (e.g. enhancing the existing habitat as well as securing and managing the land for conservation purposes).
Offsets should aim to result in a net improvement in biodiversity over time.	A net improvement in biodiversity is likely because: • Management of the offset would include a series of measures likely to improve fauna habitat and reduce pressure on native fauna species, including removal of stock, ecological fire management and feral animal control. • The proposed offset area (16,540 ha) would be conserved in perpetuity. • The proposed offset area contains a similar suite of flora species and vegetation communities to those in the Project area. • Approximately 270 ha of Cleared Land would be regenerated. • Measures to monitor and independently audit the proposed offset area are provided.
Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.	The land tenure underlying the proposed offset area would be secured in perpetuity for flora and fauna conservation.
Offsets should be agreed prior to the impact occurring.	The offset strategy is proposed as part of the Project. The implementation of the offset is likely to be a condition of Project Approval.
Offsets must be quantifiable. The impacts and benefits must be reliably estimated.	The fauna habitats in the proposed offset area have been surveyed by AMBS. This report provides an assessment of: • area of the offset and area of impact; • fauna species known or with potential to occur, and their conservation status;

OEH Offset Principles (OEH, 2011b)	Description of How the Proposed Offset Addresses the OEH Offset Principles
	• connectivity and condition of habitat; and • management actions and security for the proposed offset area.
Offsets must be targeted.	The proposed offset area has been targeted to offset impacts of the Project. The proposed offset area contains a similar suite of fauna species and fauna habitats to those in the Project area.
Offsets must be located appropriately.	The proposed offset area is located adjacent to the disturbance area in a similar topographic, climatic and geographic environment. It is also located adjacent to Mungo National Park and would add 16,540 ha to the conservation network in south-western NSW.
Offsets must be supplementary.	The implementation of the offset strategy is beyond existing requirements, in that it is not part of any private conservation reserve system.
Offsets and their actions must be enforceable through Development Consent conditions, licence conditions, conservation agreements or a contract.	Measures to monitor and independently audit the proposed offset area are provided. The implementation of the offset is likely to be a condition of Project approval.

Table 21: EPBC Act Environmental Offset Requirements 2012.

Offset Requirements	Elements of the Project Offset that address these Requirements
Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action.	A conservation outcome that improves of maintains the viability environmental matters that are protect by national environmental law and affected by the Project is likely because: • management of the offset would include a series of measures likely to improve fauna habitat and reduce pressure on native fauna species, including removal of stock, ecological fire management and feral animal control; • habitat for any nationally threatened fauna species which could be impacted by the Project also occurs within part of the proposed offset area, including the Malleefowl, the Australian Painted Snipe and the South-eastern Long-eared Bat (also known as Corben's Long-eared Bat); • 270 ha of Cleared Land would be rehabilitated or revegetated; • with the exception of Chenopod Shrublands, each fauna habitat type to be impacted is represented in the proposed offset area; • the proposed offset area (totalling 16,540 ha) would be conserved in perpetuity; and • measures to monitor and independently audit the proposed offset area are provided.
Be built around direct offsets but may include other compensatory measures.	The proposed offset area contains habitat with a high conservation status, as demonstrated by the presence of numerous nationally threatened fauna species in the proposed offset area, including species which would be impacted by the Project.
Be in proportion to the level of statutory protection that applies to protected matter.	Nationally threatened species which are considered to have potential to be impacted by the Project are all likely to benefit in the medium to long-term from the offset strategy. All species that have been recorded in the study area that are listed as vulnerable under the EPBC Act would have known or potential habitat greater than the area which would be impacted, conserved and improved in the proposed offset area.
Be of a size and scale proportionate to the impacts on the protected matter.	The Project would disturb approximately 4,158 ha of native vegetation and 305 ha of Cleared Land. The proposed offset area would conserve and improve in perpetuity approximately 16,270 ha of native vegetation (composed of equivalent and/or additional fauna habitat types, with the exception of Chenopod Shrubland) and approximately 270 ha of Cleared Land, some of which would be revegetated.
Effectively account for and manage the risks of the offset not succeeding.	Measures to monitor and independently audit the proposed offset area are provided, which would provide for ongoing adaptive management in the unlikely event that the offset is not succeeding. The implementation of the proposed offset area is likely to be a condition of Project Approval.
Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or	The implementation of the offset strategy is beyond existing requirements, in that it is not part of any private conservation reserve system. The proposed offset is new and additional under duty of care or any environmental planning laws.

Offset Requirements	Elements of the Project Offset that address these Requirements
Be efficient, effective, transparent, proportionate, scientifically robust and reasonable.	The fauna in both the proposed disturbance area and the proposed offset area has been extensively surveyed by AMBS. This report provides an assessment of this information including: • area of the offset and area of impact; • nationally threatened fauna species present and their conservation status; • connectivity and condition of habitat; and • management actions and security for the proposed offset area.
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	An arrangement would be made for the enduring protection and management of the biodiversity offset area within 12 months of grant of Development Consent. A voluntary conservation agreement pursuant to section 69B of the *National Parks and Wildlife Act 1974,* Change of Lease Purpose or similar arrangement is proposed, which may include an agreement with the NSW Government so that the proposed offset area can be permanently added to the adjoining Mungo National Park.

7.8 Ecological gains from the proposed offset

It is considered the Project meets the standards in the DGRs that fauna biodiversity values in the region would be maintained and improved in the long-term. The proposed offset area contains equivalent fauna habitat types in a similar condition to those in the Project area. The proposed offset area has a number of features that meet the 'maintain or improve' test. These include:

- The proposed offset area is bordered to the west by Mungo National Park. Consequently, the offset is not isolated in the landscape and its high connectivity helps its long-term viability. The addition of the offset as a new protected area enhances nature conservation over the region.
- The offset protects habitat suitable for a number of threatened fauna species which have been located within the Project area (18). In addition, the Long-haired Rat and the Bush Stone-curlew were also possibly recorded in the Project area and potential habitat exists within the offset. A number of these are known to occur within the proposed offset area (16).
- The proposed offset area contains a similar suite of fauna species and fauna habitat types to those in the Project area (with the exception of Chenopod Shrubland).
- The vegetation in the proposed offset area is in similar condition to that of the study area, so that when it is removed from agricultural production (i.e. grazing and some cropping), the biodiversity values of the vegetation can be expected to improve.
- There is capacity for the ecological function of the vegetation in the proposed offset area to significantly improve with the removal of grazing, control of feral animals such as rabbits, goats, foxes and cats, and closure of artificial watering points.
- Land that has been previously cleared occurs in the proposed offset area. Removal of agricultural production from these areas would result in some regeneration.
- The offset protects large areas of known habitat for the Malleefowl and the South-eastern Long-eared Bat (also known as Corben's Long-eared Bat), both of which are listed as threatened under the EPBC Act.

8 Conclusion

The Project would involve the development of a mine and associated infrastructure in an area currently covered with native vegetation. As such, it would inevitably impact on fauna and fauna habitat within the local area. The aims of this study were to identify terrestrial fauna that are known or likely to occur in the Project area, on the basis of desktop reviews and field surveys, to assess the impacts of the Project on those fauna, to describe mitigation measures for those fauna and to consider the proposed offset area.

The fauna surveys recorded 228 animal species in the Atlas-Campaspe Mine study area and MCTR roadworks footprint and surrounds and 67 animal species in the Ivanhoe Rail Facility study area and surrounds. Literature and database searches indicate that there are 55 animal species that are listed as threatened under the TSC Act and/or the EPBC Act that have been reported or predicted to occur within a 20 km radius or the subregion of the Atlas-Campaspe Mine study area and MCTR roadworks footprint and 48 animal species that are listed as threatened within a 20 km radius or the subregion of the Ivanhoe Rail Facility study area. A total of 28 species of fauna listed under the TSC Act and/or EPBC Act were recorded within the Atlas-Campaspe Mine study area and MCTR roadworks footprint and/or surrounds, along with “probable” records of the Western Pygmy-possum (based on hairs identified to genus and a probable nest) and a “possible” record of the Long-haired Rat (the latter based only on hairs identified to genus). The Bush Stone-curlew may also have been recorded near the boundary of the Atlas-Campaspe Mine study area. Three species of fauna listed under the TSC Act and/or EPBC Act were recorded within the Ivanhoe Rail Facility study area and/or surrounds. Nine exotic species have also been recorded in the Project area, including feral goats, rabbits and foxes, all of which were relatively widespread and common in the Atlas-Campaspe Mine study area.

An assessment of fauna habitat within the Project area and surrounds identified 12 broad habitat types, with the majority comprising Linear Dune Mallee, Sandplain Mallee, Belah-Rosewood Woodland, Black Box Woodland, Acacia Shrubland and Chenopod Shrubland. Two Ephemeral Wetlands were identified, one within the Campaspe Mine study area and one within the proposed offset area. A number of smaller depressions and gilgai are scattered throughout. The habitat condition throughout the study area was variable, ranging from poor to good. In general, areas in poor condition were those around waterbodies and areas where native vegetation had been cleared for cropping or other purposes. Habitat types that occurred in the dune areas (particularly Linear Dune Mallee) were typically in better condition.

The Project area and surrounds contain a range of habitat features that provide resources for fauna, including tree hollows, spinifex, decorticating bark, fallen timber and food plants. Large tree hollows were generally confined to mature stands of Black Box Woodland.

Potential impacts from the Project would include loss and fragmentation of fauna habitat (including foraging, roosting and breeding habitat), removal of hollow-bearing trees, removal of dead wood and trees, alteration to hydrology, edge effects and loss of individuals. There would be some potential fragmentation of habitat for species reliant on waterbodies and depressions. A number of proposed impact avoidance and mitigation measures were assessed and details are provided regarding the value and management of the proposed offset area, which would be managed for conservation purposes and conserved in perpetuity.

Twenty-eight fauna species were recorded in the Atlas-Campaspe Mine Study Area, MCTR and surrounds, however it was considered that up to 40 species of threatened fauna listed under the TSC Act (including five species under the EPBC Act) could be impacted to some extent by the Project. These potential impacts range in type and severity, from loss of areas of potential foraging habitat for some species with no nearby records to the direct loss of known breeding habitat for others which are known to be present. Assessments of significance were performed for all species considered potentially and likely to be affected by the Project. The conclusion of these assessments was that, while the Project is likely to affect a range of threatened species, the impacts are not likely to be significant for most of those species. The species considered to have the greatest level of impact as a result of the Project were the Malleefowl, the South-eastern Long-eared Bat (also known as Corben's Long-eared Bat) and the Western Pygmy-possum. Impacts on these species were considered to be significant according to the assessment criteria set out in the legislation. In the long-term, the establishment and appropriate management of the proposed offset area has the potential to conserve and improve extensive areas of known or potential habitat for these species in the locality.

Potential impacts associated with the Project have been or would be minimised through a variety of impact avoidance and mitigation measures. These measures include refinement of the mine design to avoid an area of Ephemeral Wetland, two locations of Cobar Greenhood Orchids and two Malleefowl nesting mounds[5]; timing and staging of land clearing; post-mine rehabilitation; salvage and relocation of soil, seed and habitat features for use in the rehabilitation; installation of next boxes; weed control and management of risks at the mine site (e.g. bushfire). Once mining is complete, the land levels along the main flow paths would be restored to levels that allow cross drainage to occur.

An arrangement would be made within 12 months of the Project being approved so that the proposed offset area is conserved and managed in perpetuity. The proposed offset area occurs in close proximity to the Project area and is located adjacent to Mungo National Park. The proposed offset area contains most of the broad habitat types that would be lost as a result of the Project. The area of habitat in the offsets is greater than that which would be cleared, and a number of management measures would be implemented to enhance flora and fauna values of the proposed offset area. These measures would involve management of the proposed offset area to exclude stock and feral animals, implementation of a fire management strategy, removal of artificial water sources and weed control to encourage natural regeneration of native vegetation.

It is considered that the Project meets the standards in the DGRs for the Project because fauna biodiversity in the region would be maintained and improved in the medium to long-term. The proposed offset area contains numerous threatened species and have a number of features so they meet the 'maintain or improve' test. The offset would represent new protected areas in the region and they would conserve in perpetuity habitat for threatened species. The offset would have high connectivity with existing fauna habitat and conservation reserves, which would help to maintain their long-term viability. In particular, appropriate management of the proposed offset area could improve the existing habitat.

5 The mine plan has been refined to avoid a Malleefowl nesting mound and two Cobar Greenhood Orchid locations recorded during surveys. Given this commitment was made immediately prior to the finalisation of this report, and resulted in a change to the proposed surface development area, figures within the main body of this report (such as Figure 15) were amended to reflect this change. It should be noted however, that the figures in Appendix C of this report (Seven Part Tests) have not been updated, on the basis that at the scale presented, the relevant changes would have been immaterial. For clarity, the figures in the main body of this report provide the accurate representation of the proposed mine plan.

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Appendix A: Fauna species recorded during surveys

Note: Abundance scores are not comparable across survey areas due to differences in survey effort and timing of surveys. Sampling effort in the Project area was in general greater per unit of area than in the offset area or Mungo National Park.

Class	Family	Common Name	Scientific Name	Conservation Status[1]		Abundance Score by Survey Area[2]. (N.B. Abundance scores are not comparable across survey areas due to differences in survey effort and timing of surveys)				Ivanhoe Rail Facility Study Area	Ivanhoe Surrounds
				TSC Act	EPBC Act	Atlas-Campaspe Mine Study Area and MCTR Study Area	Proposed Offset Area	Mungo National Park	Other Areas+		
Amphibia	Myobatrachidae	Long-thumbed Frog	*Limnodynastes fletcheri*	-	-	1	-	-	-	-	-
		Sudell's Frog	*Neobatrachus sudelli*	-	-	A	-	-	-	-	-
		Spotted Grass Frog	*Limnodynastes tasmaniensis*	-	-	A	A	-	-	-	✓
		Peron's Tree Frog	*Litoria peronii*	-	-	-	-	-	-	-	✓
Reptilia	Gekkonidae	Box-patterned Gecko	*Lucasium steindachneri*	-	-	MC	1	-	-	-	-
		Wood Gecko	*Diplodactylus vittatus*	-	-	A	MC	-	U	-	-
		Tree Dtella	*Gehyra variegata*	-	-	A	A	U	MC	-	-
		Bynoe's Gecko	*Heteronotia binoei*	-	-	A	MC	U	U	-	-
		Beaded Gecko	*Lucasium damaeum*	-	-	A	MC	MC	1	-	-
		Three-lined Knob-tail	*Nephrurus levis*	-	-	-	1	-	-	-	-
		Beaked Gecko	*Rhynchoedura ornata*	-	-	A	MC	-	1	-	-
		Spiny-tailed Gecko	*Strophurus ciliaris*	-	-	-	U	-	-	-	-
		Jewelled Gecko	*Strophurus elderi*	V	-	1	MC	1	1	-	-
		Southern Spiny-tailed Gecko	*Strophurus intermedius*	-	-	A	MC	1	MC	-	-
		Thick-tailed Gecko	*Underwoodisaurus milii*	-	-	MC	MC	U	U	-	-
	Pygopodidae	Mallee Worm-lizard	*Aprasia inaurita*	E	-	-	U	-	-	-	-
		Unbanded Delma	*Delma butleri*	-	-	U	U	-	-	-	-
		Unidentified Delma	*Delma* sp.	-	-	-	1	-	-	-	-
		Burton's Snake-lizard	*Lialis burtonis*	-	-	U	MC	1	-	-	-
	Scincidae	Spiny-palmed Shinning-skink	*Cryptoblepharus carnabyi*	-	-	A	A	U	MC	-	-
		Southern Mallee Ctenotus	*Ctenotus atlas*	-	-	MC	MC	-	-	-	-

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				TSC Act	EPBC Act	Atlas-Campaspe Mine Study Area and MCTR Study Area	Proposed Offset Area	Mungo National Park	Other Areas+		
		Short-clawed Ctenotus	*Ctenotus brachyonyx*	-	-	MC	1	-	-	-	-
			Ctenotus orientalis	-	-	-	1	-	-	-	-
		Pale-rumped Ctenotus	*Ctenotus regius*	-	-	A	MC	-	1	-	-
		Barred Wedgesnout Ctenotus	*Ctenotus schomburgkii*	-	-	U	U	1	1	-	-
			Ctenotus sp.	-	-	-	1	-	-	-	-
		Eastern Barred Wedgesnout Ctenotus	*Ctenotus strauchii*	-	-	U	-	-	-	-	-
		Spinifex Slender Blue-tongue	*Cyclodomorphus melanops elongates*	E	-	-	1	-	-	-	-
		Desert Skink	*Liopholis inornata*	-	-	1	MC	U	-	-	-
		Tree Skink	*Egernia striolata*	-	-	A	MC	-	MC	-	-
		Broad-banded Sand-swimmer	*Eremiascincus richardsonii*	-	-	MC	-	-	-	-	-
		Wood Mulch-slider	*Lerista muelleri*	-	-	A	C	MC	MC	-	-
		Eastern Robust Slider	*Lerista punctatovittata*	-	-	MC	U	-	1	-	-
		Unidentified Lerista	*Lerista* sp.	-	-	-	1	-	1	-	-
		Common Dwarf Skink	*Menetia greyii*	-	-	MC	MC	U	U	-	-
		South-eastern Morethia Skink	*Morethia boulengeri*	-	-	A	A	MC	MC	-	-
		Shrubland Morethia Skink	*Morethia obscura*	-	-	1	1	-	-	-	-
		Unidentified Morethia	*Morethia* sp.	-	-	-	-	1	1	-	-
		Shingle-back	*Tiliqua rugosa*	-	-	U	1	1	-	-	-
	Agamidae	Nobbi	*Amphibolurus nobbi*	-	-	MC	U	-	U	-	-
		Mallee Military Dragon	*Ctenophorus fordi*	-	-	C	A	-	-	-	-
		Painted Dragon	*Ctenophorus pictus*	-	-	MC	U	-	1	-	-
		Central Bearded Dragon	*Pogona vitticeps*	-	-	MC	MC	MC	-	-	✓

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	Varanidae	Gould's Goanna	*Varanus gouldii*	-	-	MC	MC	U	-	-	-
	Elapidae	Coral Snake	*Brachyurophis australis*	-	-	MC	-	-	-	-	-
		Yellow-faced Whipsnake	*Demansia psammophis*	-	-	-	U	-	-	-	-
		Bardick	*Echiopsis curta*	E	-	1	1	-	-	-	-
		Dwyer's Snake	*Parasuta dwyeri*	-	-	-	U	-	-	-	-
		Mitchell's Short-tailed Snake	*Parasuta nigriceps*	-	-	U	1	-	-	-	-
		King Brown Snake	*Pseudechis australis*	-	-	1	-	-	-	-	-
		Western Brown Snake	*Pseudonaja nuchalis*	-	-	-	1	-	-	-	-
Aves	Dromaiidae	Emu	*Dromaius novaehollandiae*	-	-	A	A	MC	U	✓	-
	Megapodiidae	Malleefowl	*Leipoa ocellata*	E	V, M	U	C	1	1	-	-
	Phasianidae	Stubble Quail	*Coturnix pectoralis*	-	-	U	-	-	-	-	-
		Brown Quail	*Coturnix ypsilophora*	-	-	1	-	-	-	-	-
	Anatidae	Black Swan	*Cygnus atratus*	-	-	-	-	-	-	-	✓
		Freckled Duck	*Stictonetta naevosa*	V	-	A	-	-	-	-	-
		Pink-eared Duck	*Malacorhynchus membranaceus*	-	-	MC	-	-	-	-	-
		Australian Wood Duck	*Chenonetta jubata*	-	-	A	MC	U	C	-	-
		Pacific Black Duck	*Anas superciliosa*	-	-	MC	-	-	-	-	-
		Grey Teal	*Anas gracilis*	-	-	A	A	-	-	-	✓
		Chestnut Teal	*Anas castanea*	-	-	A	-	-	-	-	-
		Hardhead	*Aythya australis*	-	-	A	-	-	-	-	✓
	Podicipedidae	Australasian Grebe	*Tachybaptus novaehollandiae*	-	-	A	MC	-	-	-	✓
		Hoary-headed Grebe	*Poliocephalus poliocephalus*	-	-	A	U	U	-	-	✓
		Little Grebe	*Tachybaptus ruficollis*	-	-	-	-	1	-	-	-
	Threskiornithidae	Yellow-billed Spoonbill	*Olatalea flavipes*	-	-	-	-	-	-	-	✓
		Straw-necked Ibis	*Threskiornis spinicollis*	-	-	U	-	-	-	-	✓
	Ardeidae	Nankeen Night Heron	*Nycticorax caledonicus*	-	-	U	1	-	-	-	-

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		Great Egret	*Ardea alba*	-	M	-	-	-	-	-	✓
		White-necked Heron	*Ardea pacifica*	-	-	1	1	-	-	-	✓
		Intermediate Egret	*Ardea intermedia*	-	-	U	-	-	-	-	-
		White-faced Heron	*Egretta novaehollandiae*	-	-	U	-	-	-	✓	✓
	Phalacrocoracidae	Little Black Cormorant	*Phalacrocorax sulcirostris*	-	-	MC	-	-	-	-	-
		Pied Cormorant	*Phalacrocorax varius*	-	-	-	-	-	-	-	✓
	Falconidae	Australian Kestrel	*Falco cenchroides*	-	-	U	-	U	-	✓	✓
		Australian Hobby	*Falco longipennis*	-	-	U	-	-	-	-	-
		Brown Falcon	*Falco berigora*	-	-	U	MC	-	-	-	-
	Accipitridae	Black-shouldered Kite	*Elanus axillaris*	-	-	U	-	1	-	✓	-
		Black Kite	*Milvus migrans*	-	-	-	1	-	-	-	-
		Whistling Kite	*Haliastur sphenurus*	-	-	1	-	-	1	-	-
		Spotted Harrier	*Circus assimilis*	V	-	U	1	-	1	-	-
		Brown Goshawk	*Accipiter fasciatus*	-	-	U	-	-	-	-	-
		Collared Sparrowhawk	*Accipiter cirrocephalus*	-	-	-	U	-	-	-	-
		Wedge-tailed Eagle	*Aquila audax*	-	-	U	U	1	-	-	✓
		Little Eagle	*Hieraaetus morphnoides*	V	-	1	U	-	-	-	✓
	Rallidae	Dusky Moorhen	*Gallinula tenebrosa*	-	-	U	-	-	-	-	-
		Black-tailed Native-hen	*Gallinula ventralis*	-	-	A	1	-	-	-	✓
		Eurasian Coot	*Fulica atra*	-	-	A	MC	-	-	-	✓
	Turnicidae	Unidentified Button-quail	*Turnix* sp.	-	-	1	-	-	-	-	-
		Painted Button-quail	*Turnix varius*	-	-	1	-	1	-	-	-
		Little Button-quail	*Turnix velox*	-	-	U	U	-	-	-	✓
	Burhinidae	Bush Stone-curlew	*Burhinus grallarius*	E	-	1	-	-	-	-	-
	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	-	-	-	U	-	-	-	✓
	Charadriidae	Red-kneed Dotterel	*Erythrogonys cinctus*	-	-	MC	1	-	-	-	✓
		Banded Lapwing	*Vanellus tricolor*	-	-	-	U	-	-	-	-
		Masked Lapwing	*Vanellus miles*	-	-	-	U	-	-	-	-

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		Black-fronted Dotterel	*Elseyornis melanops*	-	-	MC	MC	-	-	-	-
	Rostratulidae	Australian Painted Snipe	*Rostratula australis*	E	V, M	MC	-	-	-	-	-
	Columbidae	Common Bronzewing	*Phaps chalcoptera*	-	-	MC	U	1	U	-	✓
		Crested Pigeon	*Ocyphaps lophotes*	-	-	U	MC	C	1	✓	✓
	Psittacidae	Galah	*Eolophus roseicapillus*	-	-	A	A	A	MC	✓	-
		Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	V	-	A	A	A	C	-	✓
		Cockatiel	*Nymphicus hollandicus*	-	-	A	-	-	-	✓	✓
		Australian Ringneck	*Barnardius zonarius*	-	-	A	A	MC	MC	-	-
		Blue Bonnet	*Northiella haematogaster*	-	-	MC	MC	U	-	✓	✓
		Mulga Parrot	*Psephotus varius*	-	-	A	C	MC	U	-	✓
		Blue-winged Parrot	*Neophema chrysostoma*	-	-	-	-	-	1	-	-
		Budgerigar	*Melopsittacus undulatus*	-	-	-	-	-	-	✓	✓
		Regent Parrot (eastern)	*Polytelis anthopeplus monarchoides*	E	V	-	-	-	U	-	-
	Cuculidae	Pallid Cuckoo	*Cacomantis pallidus*	-	-	U	-	-	U	-	-
		Fan-tailed Cuckoo	*Cacomantis flabelliformis*	-	-	-	-	-	U	-	-
		Black-eared Cuckoo	*Chalcites osculans*	-	-	-	U	-	-	-	-
		Horsfield's Bronze-Cuckoo	*Chalcites basalis*	-	-	U	U	1	1	-	✓
	Tytonidae	Barn Owl	*Tyto alba*	-	-	A	U	-	-	-	-
	Strigidae	Southern Boobook	*Ninox novaeseelandiae*	-	-	MC	MC	-	MC	-	-
	Podargidae	Tawny Frogmouth	*Podargus strigoides*	-	-	MC	U	-	1	✓	-
	Caprimulgidae	Spotted Nightjar	*Eurostopodus argus*	-	-	MC	U	1	1	-	-
	Aegothelidae	Australian Owlet-nightjar	*Aegotheles cristatus*	-	-	A	A	MC	MC	-	-
	Alcedinidae	Sacred Kingfisher	*Todiramphus sanctus*	-	-	U	-	-	-	-	-
	Meropidae	Rainbow Bee-eater	*Merops ornatus*	-	M	C	1	-	-	-	-

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	Climacteridae	White-browed Treecreeper	*Climacteris affinis*	-	-	MC	MC	-	U	-	-
		Brown Treecreeper	*Climacteris picumnus*	-	-	A	C	U	1	-	-
	Maluridae	Variegated Fairy-wren	*Malurus lamberti*	-	-	MC	MC	MC	MC	-	✓
		Splendid Fairy-wren	*Malurus splendens*	-	-	MC	-	MC	-	-	-
		White-winged Fairy-wren	*Malurus leucopterus*	-	-	A	-	MC	U	✓	✓
	Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*	-	-	MC	A	MC	U	-	-
		Red-browed Pardalote	*Pardalotus rubricatus*	-	-	-	1	-	-	-	-
		Striated Pardalote	*Pardalotus striatus*	-	-	A	A	A	MC	-	-
	Acanthizidae	Rufous Fieldwren	*Calamanthus campestris*	V	-	-	-	-	U	-	-
		Redthroat	*Pyrrholaemus brunneus*	V	-	MC	-	-	MC	-	-
		Weebill	*Smicrornis brevirostris*	-	-	A	A	A	MC	-	-
		Western Gerygone	*Gerygone fusca*	-	-	U	U	-	-	-	-
		Inland Thornbill	*Acanthiza apicalis*	-	-	A	MC	MC	U	-	-
		Buff-rumped Thornbill	*Acanthiza reguloides*	-	-	MC	-	-	-	-	-
		Chestnut-rumped Thornbill	*Acanthiza uropygialis*	-	-	A	A	MC	MC	-	-
		Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	-	-	C	MC	U	MC	-	-
		Yellow Thornbill	*Acanthiza nana*	-	-	U	MC	-	-	-	-
		Southern Whiteface	*Aphelocephala leucopsis*	-	-	MC	MC	MC	-	-	-
	Meliphagidae	Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	-	-	A	A	A	MC	✓	-
		Pied Honeyeater	*Certhionyx variegatus*	V	-	U	1	-	-	-	-
		White-fronted Chat	*Epthianura albifrons*	V	-	MC	U	U	A	-	✓
		Yellow-faced Honeyeater	*Lichenostomus chrysops*	-	-	-	MC	-	-	-	-
		Singing Honeyeater	*Lichenostomus virescens*	-	-	A	C	U	MC	-	✓
		White-eared Honeyeater	*Lichenostomus leucotis*	-	-	MC	A	MC	MC	-	-

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		Yellow-plumed Honeyeater	*Lichenostomus ornatus*	-	-	A	A	A	MC	-	-
		Fuscous Honeyeater	*Lichenostomus fuscus*	-	-	-	U	1	-	-	-
		White-fronted Honeyeater	*Purnella albifrons*	-	-	A	A	A	U	-	-
		White-plumed Honeyeater	*Lichenostomus penicillatus*	-	-	-	MC	-	-	-	-
		Noisy Miner	*Manorina melanocephala*	-	-	-	1	-	-	-	-
		Red Wattlebird	*Anthochaera carunculata*	-	-	MC	A	C	U	-	-
		Yellow-throated Miner	*Manorina flavigula*	-	-	A	A	C	U	✓	✓
		White-naped Honeyeater	*Melithreptus lunatus*	-	-	-	-	MC	-	-	-
		Brown-headed Honeyeater	*Melithreptus brevirostris*	-	-	A	A	MC	U	-	-
		Little Friarbird	*Philemon citreogularis*	-	-	-	U	-	-	-	-
		Striped Honeyeater	*Plectorhyncha lanceolata*	-	-	A	A	MC	MC	-	-
	Petroicidae	Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	MC	MC	-	U	-	-
		Jacky Winter	*Microeca fascinans*	-	-	MC	MC	U	MC	-	-
		Red-capped Robin	*Petroica goodenovii*	-	-	A	C	MC	U	-	-
	Pomatostomidae	Chestnut-crowned Babbler	*Pomatostomus temporalis*	-	-	U	U	-	U	-	-
		White-browed Babbler	*Pomatostomus superciliosus*	-	-	MC	MC	MC	-	-	-
	Eupetidae	Chestnut-backed Quail-thrush	*Cinclosoma castanotum*	V	-	MC	A	MC	MC	-	-
	Neosittidae	Varied Sittella	*Daphoenositta chrysoptera*	V	-	C	MC	MC	MC	-	-
	Pachycephalidae	Grey Shrike-thrush	*Colluricincla harmonica*	-	-	A	C	MC	U	-	-
		Crested Bellbird	*Oreoica gutturalis*	-	-	A	C	MC	U	✓	✓
		Gilbert's Whistler	*Pachycephala inornata*	V	-	-	U	-	-	-	-
		Golden Whistler	*Pachycephala pectoralis*	-	-	U	1	-	1	-	-

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		Rufous Whistler	*Pachycephala rufiventris*	-	-	A	A	U	MC	-	✓
	Dicruridae	Grey Fantail	*Rhipidura albiscapa*	-	-	MC	MC	U	U	-	✓
		Willie Wagtail	*Rhipidura leucophrys*	-	-	A	C	U	U	✓	✓
		Magpie-lark	*Grallina cyanoleuca*	-	-	MC	MC	MC	-	✓	✓
		Restless Flycatcher	*Myiagra inquieta*	-	-	MC	MC	1	-	-	-
	Artamidae	Grey Butcherbird	*Cracticus torquatus*	-	-	A	A	C	C	✓	-
		Pied Butcherbird	*Cracticus nigrogularis*	-	-	U	MC	U	1	✓	-
		Australian Magpie	*Cracticus tibicen*	-	-	A	A	MC	MC	✓	✓
		Grey Currawong	*Strepera versicolor*	-	-	C	A	MC	U	-	-
		White-breasted Woodswallow	*Artamus leucorynchus*	-	-	U	1	-	-	-	-
		Masked Woodswallow	*Artamus personatus*	-	-	MC	C	-	-	✓	-
		White-browed Woodswallow	*Artamus superciliosus*	-	-	A	A	-	MC	-	-
		Black-faced Woodswallow	*Artamus cinerus*	-	-	MC	-	-	-	-	-
		Dusky Woodswallow	*Artamus cyanopterus*	-	-	-	U	-	-	-	-
	Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	-	-	A	A	MC	MC	-	✓
		Ground Cuckoo-shrike	*Coracina maxima*	-	-	-	U	-	U	-	-
		White-winged Triller	*Lalage sueurii*	-	-	MC	-	-	-	-	-
	Corvidae	Little Crow	*Corvus bennetti*	-	-	A	MC	MC	U	✓	-
		Little Raven	*Corvus mellori*	-	-	A	MC	MC	-	-	✓
		Australian Raven	*Corvus coronoides*	-	-	A	A	U	U	✓	-
			Corvus sp.	-	-	-	-	-	-	✓	✓
	Corcoracidae	White-winged Chough	*Corcorax melanorhamphos*	-	-	A	MC	-	-	-	✓
		Apostlebird	*Struthidea cinerea*	-	-	C	MC	MC	MC	-	✓
	Ptilonorhynchideae	Spotted Bowerbird	*Chlamydera maculata*	-	-	-	-	-	-	-	✓
	Hirundinidae	White-backed Swallow	*Cheramoeca leucosterna*	-	-	-	U	1	-	-	-

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		Welcome Swallow	*Hirundo neoxena*	-	-	C	U	U	-	✓	✓
		Fairy Martin	*Petrochelidon ariel*	-	-	-	1	-	-	✓	✓
		Tree Martin	*Petrochelidon nigricans*	-	-	MC	MC	-	-	-	-
			Petrochelidon sp.	-	-	MC	-	-	-	-	-
	Zosteropidae	Silvereye	*Zosterops lateralis*	-	-	-	MC	MC	U	-	-
	Sylviidae	Australian Reed-Warbler	*Acrocephalus australis*	-	-	1	-	-	-	-	-
		Little Grassbird	*Megalurus gramineus*	-	-	1	-	-	-	-	✓
		Brown Songlark	*Cincloramphus cruralis*	-	-	-	-	-	-	✓	✓
		Rufous Songlark	*Cincloramphus mathewsi*	-	-	MC	-	1	-	-	-
	Alaudidae	Horsfield's Bushlark	*Mirafra javanica*	-	-	1	-	-	-	-	-
	Dicaeidae	Mistletoebird	*Dicaeum hirundinaceum*	-	-	MC	MC	U	U	-	✓
	Motacillidae	Australian Pipit	*Anthus novaeseelandiae*	-	-	U	-	1	-	✓	-
	Estrildidae	Zebra Finch	*Taeniopygia guttata*	-	-	MC	U	MC	-	-	-
Mammalia	Tachyglossidae	Short-beaked Echidna	*Tachyglossus aculeatus*	-	-	MC	U	-	1	-	-
	Dasyuridae	Giles' Planigale	*Planigale gilesi*	-	-	-	-	1	-	-	-
		Southern Ningaui	*Ningaui yvonneae*	V	-	MC	U	1	-	-	-
		Stripe-faced Dunnart	*Sminthopsis macroura*	V	-	-	-	1	-	-	-
		Common Dunnart	*Sminthopsis murina*	-	-	C	-	-	-	-	-
		Unidentified Dunnart	*Sminthopsis* sp.	-	-	1	1	-	1	-	-
	Burramyidae	Western Pygmy-possum (probable)	*Cercartetus concinnus*	E	-	MC	-	-	-	-	-
	Phalangeridae	Common Brushtail Possum	*Trichosurus* sp.	-	-	U	-	-	-	-	-
	Macropodidae	unidentified macropod	*Macropod* sp.	-	-	U	1	MC	1	-	-
		Western Grey Kangaroo	*Macropus fuliginosus*	-	-	MC	MC	U	U	-	✓
		Eastern Grey Kangaroo	*Macropus giganteus*	-	-	MC	-	-	-	-	-
		Red Kangaroo	*Macropus rufus*	-	-	U	1	MC	1	-	✓

Class	Family	Common Name	Scientific Name	Conservation Status[1]		Abundance Score by Survey Area[2]. (N.B. Abundance scores are not comparable across survey areas due to differences in survey effort and timing of surveys)				Ivanhoe Rail Facility Study Area	Ivanhoe Surrounds
				TSC Act	EPBC Act	Atlas-Campaspe Mine Study Area and MCTR Study Area	Proposed Offset Area	Mungo National Park	Other Areas+		
	Emballonuridae	Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	MC	U	-	-	-	-
	Molossidae		*Mormopterus* "Species 4"	-	-	A	A	MC	MC	-	-
			Mormopterus "Species 3"	-	-	A	A	-	-	-	-
		White-striped Freetail-bat	*Tadarida australis*	-	-	A	A	C	MC	-	-
	Vespertilionidae	Chocolate Wattled Bat	*Chalinolobus morio*	-	-	MC	MC	U	U	-	-
		Gould's Wattled Bat	*Chalinolobus gouldii*	-	-	A	A	MC	MC	-	-
		Little Pied Bat	*Chalinolobus picatus*	V	-	A	A	MC	MC	-	-
		South-eastern Long-eared Bat (also known as Corben's Long-eared Bat)	*Nyctophilus corbeni*	V	V	A	A	-	U	-	-
		Lesser Long-eared Bat	*Nyctophilus geoffroyi*	-	-	A	A	-	MC	-	-
		Long-eared bat	*Nyctophilus* sp.	-	-	A	A	MC	MC	-	-
		Inland Broad-nosed Bat	*Scotorepens balstoni*	-	-	A	MC	1	U	-	-
		Little Broad-nosed Bat	*Scotorepens greyii*	-	-	A	MC	U	U	-	-
		Unidentified Scotorepens	*Scotorepens* sp.	-	-	-	1	-	-	-	-
		Inland Forest Bat	*Vespadelus baverstocki*	V	-	A	A	-	U	-	-
		Large Forest Bat	*Vespadelus darlingtoni*	-	-	MC	-	-	-	-	-
		Southern Forest Bat	*Vespadelus regulus*	-	-	MC	MC	-	U	-	-
			Vespadelus sp.	-	-	U	U	-	-	-	-
		Little Forest Bat	*Vespadelus vulturnus*	-	-	C	1	-	-	-	-
	Muridae	Bolam's Mouse	*Pseudomys bolami*	E	-	-	-	1	-	-	-
		House Mouse*	*Mus musculus*	-	-	A	A	A	A	-	-
		Long-haired Rat (possible)	*Rattus* sp.	-	-	1	-	-	-	-	-
	Canidae	Dog/Dingo *	*Canis lupus familiaris/ dingo*	-	-	1	1	-	1	-	-
		Red Fox*	*Vulpes vulpes*	-	-	A	MC	MC	U	-	✓

Class	Family	Common Name	Scientific Name	Conservation Status[1]		Abundance Score by Survey Area[2]. (N.B. Abundance scores are not comparable across survey areas due to differences in survey effort and timing of surveys)				Ivanhoe Rail Facility Study Area	Ivanhoe Surrounds
				TSC Act	EPBC Act	Atlas-Campaspe Mine Study Area and MCTR Study Area	Proposed Offset Area	Mungo National Park	Other Areas+		
	Felidae	Cat*	*Felis catus*	-	-	C	MC	U	1	-	-
	Leporidae	Brown Hare*	*Lepus capensis*	-	-	U	-	-	-	-	-
		European Rabbit*	*Oryctolagus cuniculus*	-	-	A	MC	MC	U	-	-
	Suidae	Pig*	*Sus scrofa*	-	-	-	-	-	-	✓	-
	Bovidae	European Cattle*	*Bos Taurus*	-	-	U	-	-	-	-	-
		Goat*	*Capra hircus*	-	-	A	A	U	MC	-	✓
		Sheep (feral)*	*Ovis aries*	-	-	U	-	-	-	-	-

[1] Threatened/migratory fauna species status under the New South Wales *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current at 9 August 2012).
V = vulnerable, E = endangered, M = migratory.

[2] The abundance of each species recorded was estimated as follows:
1 = One sighting of the species, or at least one trace found.
U = Uncommon, 2-5 observations of the species, as well as an assessment of how widespread and persistent the species was.
MC = Moderately Common, 6-25 observations of the species, as well as an assessment of how widespread and persistent the species was.
C = Common, 26-35 observations of the species, as well as an assessment of how widespread and persistent the species was.
A = Abundant, more than 35 observations of the species, as well as an assessment of how widespread and persistent the species was.

* Introduced species.

✓ Indicates presence. Abundance scores are not used for Ivanhoe surveys due to reduced survey effort in that area.

\+ Indicates other areas surveyed either opportunistically or during designated surveys which are located within the original study area but occur outside of the proposed offset and Project areas and/or along roads travelled between accommodation and site.

Appendix B: Database search results

Appendix Table B-1: Threatened fauna previously recorded or predicted to occur within 20 km of the Atlas-Campaspe Mine study area and MCTR and/or are listed by OEH (2012a) for the CMA subregion (South Olary plain, Murray Basin Sands [Part B])

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
Frogs	*Neobactrachus pictus*	Painted Frog	E	-					✓	Not recorded. One record from broader region, near Scotia sanctuary.	Potential breeding and foraging habitat after rain.	Unlikely, apart from some loss of potential habitat. Species not recorded in the Project area or surrounds and no records within a 20 kilometre (km) radius.
	Litoria raniformis	Southern Bell Frog	E	V					✓	Not recorded. Known to occur closer to the Murrumbidgee.	Potential breeding and foraging habitat in dams, depressions, roadside drains and other waterbodies.	Unlikely, apart from some loss of potential habitat. Species not recorded in the Project area or surrounds and no records within a 20 km radius.
Reptiles	*Strophurus elderi*	Jewelled Gecko	V	-	✓				✓	Recorded in the Campaspe footprint, proposed offset area, Mungo National Park and other locations in the vicinity (Figure 13).	Known to occur. Known and potential habitat in habitat types containing spinifex, particularly Linear Dune Mallee.	Likely. Recorded in several locations in the Project area and surrounds. An assessment of significance was carried out for this species.
	Delma australis	Marble-faced Delma	E	-					✓	Not recorded.	Potential habitat in habitat types containing spinifex, particularly Linear Dune Mallee.	Possible. Although species not recorded in the Project area or surrounds it is difficult to detect and potential habitat is present. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Aprasia inaurita	Mallee Worm-lizard	E	-	✓				✓	Recorded in the proposed offset area and west and south of the Atlas footprint (Figure 13).	Known to occur. Known and potential habitat in habitat types containing spinifex, particularly Linear Dune Mallee.	Possible. Recorded close to the Project area and potential habitat is present in the Project area. An assessment of significance was carried out for this species.
	Cyclodomorphus melanops elongatus	Spinifex Slender Blue-tongue	E	-	✓				✓	Recorded in the proposed offset area (Figure 13).	Potential habitat in habitat types containing spinifex, particularly Linear Dune Mallee.	Possible. Recorded close to the Project area and potential habitat is present in the Project area. An assessment of significance was carried out for this species.
	Tiliqua occipitalis	Western Blue-tongue	V	-					✓	Not recorded.	Potential habitat in mallee, belah and acacia communities and some disturbed areas with vegetation.	Possible. Although species not recorded in the Project area or surrounds it is difficult to detect and potential habitat is present. An assessment of significance was carried out for this species.
	Echiopsis curta	Bardick	E	-					✓	Recorded in the proposed offset area and western end of the Mining Lease Application (MLA 1) (Figure 13).	Potential habitat in habitat types containing spinifex, particularly Linear Dune Mallee.	Possible. Recorded close to the Project area and potential habitat is present in the Project area. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
Birds	*Leipoa ocellata*	Malleefowl	E	V	✓	✓		✓	✓	Recorded in the Atlas-Campaspe Mine footprint, proposed offset area and surrounds (Figure 14).	Potential breeding habitat in mallee communities and may occur occasionally in other vegetation associations in the Atlas-Campaspe Mine study area and surrounds.	Likely. Recorded in several locations in the Project area and surrounds. An assessment of significance was carried out for this species.
	Anseranas semipalmata	Magpie Goose	V	-					✓	Not recorded. No records within a 20 km radius of the Project area. Likely to occur in areas closer to major rivers and wetlands. Does not breed in southern NSW.	Limited potential habitat present in Ephemeral Wetland.	Unlikely.
	Stictonetta naevosa	Freckled Duck	V	-					✓	Recorded within MLA 1 (Figure 14).	Potential breeding and foraging habitat in Ephemeral Wetland, dams, depressions.	Possible. Recorded adjacent to Project area. An assessment of significance was carried out for this species.
	Oxyura australis	Blue-billed Duck	V	-					✓	Not recorded. No records within a 20 km radius of the Project area.	Potential foraging habitat in Ephemeral Wetland, dams, depressions.	Possible. Although not recorded in the Project area or surrounds, potential habitat is present and it could occur on occasion. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Botaurus poiciloptilus	Australasian Bittern	E	E		✓			✓	Not recorded. No records within a 20 km radius of the Project area.	Potential foraging habitat in Ephemeral Wetland, depressions.	Possible. Although not recorded in the Project area or surrounds, potential habitat is present and it could occur on occasion. An assessment of significance was carried out for this species.
	Falco hypoleucos	Grey Falcon	E	-					✓	Not recorded. No records within a 20 km radius of the Project area.	Potential breeding and foraging habitat in Black Box. Potential foraging habitat in all other habitat types both cleared and treed.	Possible. Although not recorded in the Project area or surrounds, it is a rare, wide-ranging species and it could occur on occasion. An assessment of significance was carried out for this species.
	Lophoictinia isura	Square-tailed Kite	V	-					✓	Not recorded. No records within a 20 km radius of the Project area.	Potential foraging habitat present all other habitat types both cleared and treed.	Possible. Although not recorded in the Project area or surrounds, it is a rare, wide-ranging species and it could occur on occasion. An assessment of significance was carried out for this species.
	Hamirostra melanosternon	Black-breasted Buzzard	V	-					✓	Not recorded. No records within a 20 km radius of the Project area.	Potential breeding and foraging in treed habitats and foraging only habitat in all other community types associated with the Atlas-Campaspe Mine study area and surrounds.	Possible. Although not recorded in the Project area or surrounds, it is a rare, wide-ranging species and it could occur on occasion. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Circus assimilis	Spotted Harrier	V	-	✓				✓	Recorded within MLA 1, proposed offset area and surrounds (Figure 14).	Potential breeding and foraging in treed habitats and foraging only habitat in all other community types associated with the Atlas-Campaspe Mine study area and surrounds.	Possible. Recorded in the Project area and surrounds and potential habitat is present in the Project area. An assessment of significance was carried out for this species.
	Hieraaetus morphnoides	Little Eagle	V	-	✓			✓	✓	Recorded in the Atlas footprint, proposed offset area, Mungo National Park and surrounds (Figure 14).	Potential breeding and foraging in treed habitats and foraging only habitat in all other community types associated with the Atlas-Campaspe Mine study area and surrounds.	Possible. Recorded in the Project area and surrounds and potential habitat is present in the Project area. An assessment of significance was carried out for this species.
	Ardeotis australis	Australian Bustard	E	-	✓				✓	Recorded in locality (20 km).	Potential habitat present in all open community types associated with the Atlas-Campaspe Mine study area and surrounds (i.e. all except Liner Dune Mallee).	Possible. Although not recorded in the Project area or surrounds, potential habitat is present and it could occur on occasion. Has been recorded in Mungo National Park. An assessment of significance was carried out for this species.
	Grus rubicunda	Brolga	V	-					✓	Not recorded.	Marginal foraging habitat around Ephemeral Wetlands and surrounding Cleared Land and shrubland.	Unlikely.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Burhinus grallarius	Bush Stone-curlew	E	-					✓	Recorded during call playback from a location probably near the boundary of the Atlas-Campaspe Mine study area (Figure 14).	Some potential breeding and foraging habitat present in the Black Box, belah and acacia communities and foraging only habitat in Cleared Land and disturbed shrubland.	Possible. Recorded nearby and potential habitat is present in Project area. An assessment of significance was carried out for this species.
	Rostratula australis	Australian Painted Snipe	E	V		✓			✓	Recorded in the MLA area (Figure 14).	Potential breeding and foraging habitat in Ephemeral Wetland, and depressions.	Possible. Recorded adjacent to Project area. An assessment of significance was carried out for this species.
	Limosa limosa	Black-tailed Godwit	V	-					✓	Not recorded.	Marginal foraging habitat around Ephemeral Wetlands. Breeds on offshore islands, mostly found around major rivers in Murray-Darling Basin.	Unlikely.
	Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland species)	V	-					✓	Not recorded.	Minimal habitat.	Unlikely.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	✓		✓	✓	✓	Recorded in the Atlas-Campaspe Mine footprint, proposed offset area, Mungo National Park and surrounds (Figure 14).	Potential breeding and foraging habitat in Black Box and mallee communities (where medium hollows exist for breeding). Foraging habitat throughout.	Likely. Recorded in numerous locations throughout the Project area and surrounds. An assessment of significance was carried out for this species.
	Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	-	✓			✓	✓	Recorded in locality (< 5 km) to the north of the Campaspe footprint (Figure 14).	Potential breeding and foraging habitat in Black Box, mallee communities, and acacia and belah communities.	Possible. Not recorded in the Project area or immediate surrounds, but has been recorded within a 5 km radius. Some loss of potential habitat. An assessment of significance was carried out for this species.
	Polytelis anthopeplus monarchoides	Regent Parrot	E	V	✓			✓	✓	One record west of the Atlas footprint (Figure 14).	Marginal foraging habitat in Sandplain and Mallee, Linear Dune Mallee and perhaps cropland with seeds. Distribution is generally restricted to within 30 km of the Murray River. Only rare vagrants are found beyond this area.	Possible. May occur in the Project area on occasion. However, the species is generally expected to be found closer to major rivers. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Ninox connivens	Barking Owl	V	-	✓			✓	✓	Three records to the north of the Atlas-Campaspe Mine footprint (Figure 14).	Marginal breeding habitat in Black Box and potential foraging habitat elsewhere. Species distribution is generally limited to the major rivers such as the Darling and Murray River in the semi-arid zones and they are only sparsely recorded in areas beyond them.	Unlikely. Not detected in the Project area or surrounds despite repeated surveys.
	Amytornis textilis modestus	Thick-billed Grass-wren	CE	V		✓				Not recorded. No records from within a 20 km radius of the Project area.	Species regarded as extinct in NSW until recently recorded well to the north of the Project area.	Unlikely. Not recorded in the Project area and no records of the species within a 20 km radius. Species regarded as extinct in NSW until recently recorded well to the north of the Project area.
	Hylacola cautus	Shy Heathwren	V	-					✓	Not recorded. No records from within a 20 km radius of the Project area.	Potential breeding and foraging habitat Linear Dune Mallee and Sandplain Mallee.	Possible. Not recorded in the Project area or surrounds and no records within a 20 km radius, but the species is known from mallee areas between Balranald and Mallee Cliffs National Park and further north (OEH, 2012b). Some loss of potential habitat. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Calamanthus campestris	Rufous Fieldwren	V	-						Recorded approximately 40 km to the south of the MCTR.	Potential breeding and foraging habitat along MCTR.	Possible. Potential habitat present along in the MCTR. An assessment of significance was carried out for this species.
	Pyrrholaemus brunneus	Redthroat	V	-	✓			✓	✓	Recorded in MCTR roadworks footprint (Figures 14 and 19) and south of the Atlas-Campaspe Mine footprint.	Potential breeding and foraging habitat along MCTR.	Possible. Recorded along the MCTR and known habitat is present. An assessment of significance was carried out for this species.
	Lichenostomus cratitius	Purple-gaped Honeyeater	V	-	✓				✓	Recorded in locality to the south of the Atlas footprint (Figure 16).	Potential/seasonal foraging habitat in Sandplain Mallee and Linear Dune Mallee.	Possible. Not recorded in the Project area or surrounds and but has been recorded within a 5 km radius. Some loss of seasonal habitat. An assessment of significance was carried out for this species.
	Manorina melanotis	Black-eared Miner	CE	E					✓	One record in Mungo National Park. Record suspected to be misidentification (Baker-Gabb, D [2003]).	Potential foraging habitat in Linear Dune Mallee and Sandplain Mallee. Needs 12,000 hectares of mallee woodland to be viable.	Unlikely. Considered unlikely to occur in the Project area. Species only recorded once within the Mungo National Park area and it is thought to be a misidentification (Recovery Plan). Only known records are from the Scotia Sanctuary.
	Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-					✓	Not recorded.	No habitat generally associated with Box-Ironbark Woodland or River Red Gum Woodland.	Unlikely.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Certhionyx variegatus	Pied Honeyeater	V	-	✓			✓	✓	Recorded in the Atlas footprint, proposed offset area, Mungo National Park and surrounds (Figure 16).	Potential breeding and foraging habitat present in mallee, Black Box and acacia communities. Foraging habitat in Chenopod Shrubland communities.	Likely. Recorded in numerous locations throughout the Project area and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Epthianura albifrons	White-fronted Chat	V	-	✓			✓	✓	Recorded in the MCTR roadworks footprint, proposed offset area, Mungo National Park and surrounds (Figures 16 and 19).	Potential habitat in Ephemeral Wetlands, Black Box Woodland and Chenopod Shrublands. Some foraging habitat in Cleared Land.	Likely. Recorded in numerous locations throughout the Project area, and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	✓			✓	✓	Recorded in the Atlas-Campaspe Mine footprint, proposed offset area, Mungo National Park and surrounds (Figure 16).	Breeding and foraging habitat in Black Box Woodland, Disturbed Shrubland, Linear Dune Mallee and Sandplain Mallee. Potential foraging habitat in shrubland and Cleared Land close to more structured vegetation.	Likely. Recorded in numerous locations throughout the Project area, and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Petroica phoenicea	Flame Robin	V	-				✓	✓	Single record from Mungo National Park (Birdlife Australia 2012) (Figure 16).	Minimal habitat available.	Unlikely. Considered unlikely to occur in Project area, except perhaps as rare vagrant.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Drymodes brunneopygia	Southern Scrub-robin	V	-					✓	Not recorded. No records within a 20 km radius.	Potential habitat present in mallee communities.	Unlikely. Records of this species are a considerable distance from the Project area.
	Cinclosoma castanotum	Chestnut-backed Quail-thrush	V	-	✓			✓	✓	Recorded in Campaspe footprint, proposed offset area, Mungo National Park and surrounds (Figure 16).	Potential habitat present in mallee and acacia communities.	Likely. Recorded in numerous locations throughout the Project area, and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Daphoenositta chrysoptera	Varied Sittella	V	-	✓		✓	✓	✓	Recorded in Campaspe footprint, proposed offset area, Mungo National Park and surrounds (Figure 16).	Potential breeding and foraging habitat present in mallee, black box, belah and acacia communities.	Likely. Recorded in numerous locations throughout the Project area, and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Pachycephala inornata	Gilbert's Whistler	V	-	✓			✓	✓	Recorded in the proposed offset area and surrounds (Figure 16).	Potential habitat present in mallee and belah communities.	Likely. Recorded nearby, may occur in Project area, and potential habitat is present in Project area. An assessment of significance was carried out for this species.
	Stagonopleura guttata	Diamond Firetail	V	-				✓	✓	Single record from road near Turlee Station.	Minimal habitat available.	Unlikely. Considered unlikely to occur in Project area, except perhaps as rare vagrant.
Mammals	*Ningaui yvonneae*	Southern Ningaui	V	-	✓		✓		✓	Recorded in the Atlas-Campaspe Mine footprint, proposed offset area and surrounds (Figure 17).	Potential habitat present in mallee communities with spinifex, particularly Linear Dune Mallee.	Likely. Recorded in the Project area and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Antechinomys laniger	Kultarr	E	-					✓	Not recorded within 20km of Projects. Nearest records are close to Euston.	Potential breeding and foraging habitat present in mallee, acacia, chenopod shrubland and belah communities.	Unlikely. Records of this species are a considerable distance from the Project area.
	Smithopsis macroura	Stripe-faced Dunnart	V	-						Recorded once in Mungo National Park (id from predator scat) (Figure 17).	Potential breeding and foraging habitat present in mallee, belah and acacia communities.	Possible. Recorded in Mungo National Park and surrounds and potential habitat is present in Project area. An assessment of significance was carried out for this species.
	Cercartetus concinnus	Western Pygmy-possum	E	-	✓		✓		✓	Recorded from scats collected in the Atlas footprint (probable records) and also known from surrounds (Figure 17).	Potential breeding and foraging habitat present in mallee and belah communities.	Possible. Recorded from surrounding area and from scats collected in the Project area. An assessment of significance was carried out for this species.
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-					✓	Recorded in the Atlas-Campaspe Mine footprint, proposed offset area and surrounds (Figure 18).	Potential breeding/roosting habitat in all treed communities. Foraging habitat in all other communities associated with the Atlas-Campaspe Mine study area and surrounds.	Likely. Recorded in numerous locations throughout the Project area and surrounds and known habitat is present in the Project area. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Nyctophilus corbeni	Corben's Long-eared Bat (also known as South-eastern Long-eared Bat)	V	V	✓				✓	Recorded within MLA 1 in the Campaspe footprint, within the Atlas footprint, proposed offset area, Mungo National Park and surrounds (Figure 18).	Potential breeding/roosting habitat in all wooded communities except Sandhill pine Woodland due its isolation in the landscape.	Likely. Recorded in numerous locations throughout the Project area, and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Chalinolobus picatus	Little Pied Bat	V	-	✓				✓	Recorded in the Atlas-Campaspe Mine footprint, proposed offset area, Mungo National Park and surrounds (Figure 18).	Potential habitat in all wooded and chenopod shrubland communities. No habitat in Cleared Lands.	Likely. Recorded in numerous locations throughout the Project area and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Vespadelus baverstocki	Inland Forest Bat	V	-	✓				✓	Recorded in the Atlas-Campaspe Mine footprint, proposed offset area, Mungo National Park and surrounds (Figure 18).	Potential breeding/roosting and foraging habitat in all wooded communities. Foraging only habitat present in acacia and disturbed shrublands.	Likely. Recorded in numerous locations throughout the Project area, and surrounds and known habitat is present in Project area. An assessment of significance was carried out for this species.
	Pseudomys bolami	Bolam's Mouse	E	-	✓		✓		✓	Recorded in Mungo National Park (Figure 17). Previously recorded within 20 km of the south of the study area.	Potential habitat present in all communities except Cleared Land.	Possible. Recorded in Mungo National Park and surrounds and potential habitat is present in Project area. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA Sub-region[6]			
	Pseudomys desertor	Desert Mouse	CE	-					✓	Not recorded within 20km of Projects. Nearest records are close to Buronga.	Potential habitat in Linear Dune Mallee.	Unlikely. Records of this species are a considerable distance from the Project area
	Rattus villosissimus	Long-haired Rat	V	-	✓		✓			Previous record from Mungo National Park. Not definitely recorded during AMBS surveys, a "possible" record was made on the basis of hair from the genus *Rattus* found in a scat in the Atlas footprint (Figure 17).	Potential breeding and foraging habitat in all communities during extended wet periods.	Possible. Recorded in Mungo National Park, may occur in Project area when conditions are suitable.

1 Threatened fauna species status listed under the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999 (current at 9 August 2012). E = Endangered; CE = Critically Endangered: V = Vulnerable.

2 Office of Environment and Heritage (2012) *Atlas of NSW Wildlife (July 2012). Database Search, 20km radius of study area*.

3 Department of Sustainability, Environment, Water, Population and Communities (2012a) *SEWPaC Protect Matters (July 2012). Database Search, 10km radius of study area*.

4 Australian Museum (2012) *Database Search, (July 2012) 20km radius of study area.*

5 Birdlife Australia (2012). *Database Search of study area (July 2012).*

6 Office of Environment and Heritage (2012) *CMA sub-region (Lower Murray-Darling- South Olary Plain, Murray Basin Sands (Part B)) Threatened Species list.*

Appendix Table B-2: Threatened fauna previously recorded or predicted to occur within 20 km of the Ivanhoe Rail Facility study area and/or are listed by OEH (2012b) for the CMA subregion (Lachlan CMA, Darling Depression [Part B]).

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
Frogs	*Crinia sloanei*	Sloane's Froglet	V	-					✓	It is typically associated with periodically inundated areas in grassland, woodland and disturbed habitats.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species may breed and forage in the Black Box Woodland to the east of the Ivanhoe Rail Facility study area during periods of inundation.	Unlikely. Changes to water flows into nearby wetland are not expected.
Reptiles	*Delma australis*	Marble-faced Delma	E	-					✓	Potential habitat in habitat types containing spinifex, particularly Linear Dune Mallee.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	No habitat.	Unlikely.
	Tiliqua occipitalis	Western Blue-tongue	V	-					✓	Potential habitat in mallee, belah and acacia communities and some disturbed areas with vegetation.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species may breed and forage in Belah-Rosewood Woodland.	Possible. Species has not been recorded within 20km of the Ivanhoe Rail Facility study area, but suitable habitat may be present. An assessment of significance was carried out for this species.
Birds	*Leipoa ocellata*	Malleefowl	E	V		✓			✓	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other in other woodlands such dominated by Mulga or native cypress pine	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Primary Malleefowl habitat (mallee communities) is not present in the Ivanhoe rail Facility study area or close surrounds. Secondary or supplementary habitat maybe present in the Belah-Rosewood Woodland and Native Grassland.	Possible. Small amount of supplementary feeding habitat would be lost. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
										species.			
	Stictonetta naevosa	Freckled Duck	V	-					✓	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species may breed and forage in the Black Box Woodland and the associated Ephemeral wetland to the east of the Ivanhoe Rail Facility study area. during periods of inundation.	Unlikely. Changes to water flows into nearby wetland are not expected.
	Oxyura australis	Blue-billed Duck	V						✓	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species may breed and forage in the Black Box Woodland wetlands to the east of the Ivanhoe Rail Facility study area during periods of inundation.	Unlikely. Changes to water flows into nearby wetland are not expected.
	Botaurus poiciloptilus	Australasian Bittern	E	E					✓	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.).	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species may breed and forage in the Black Box Woodland wetlands to the east of the Ivanhoe Rail Facility study area during periods of inundation.	Unlikely. Changes to water flows into nearby wetland are not expected.
	Falco hypoleucos	Grey Falcon	E	-					✓	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species is wide ranging but shows preference for wooded water courses and wetlands in semi-arid regions and as such may be present across the Ivanhoe Rail Facility study area for hunting and may breed/nest around the Black Box Wetlands to the east of the study area.	Possible. Small loss of potential foraging habitat only. Species has not been recorded within 20km of Ivanhoe Rail Facility study area, however, it is a rare, wide-ranging species and it could occur on occasion. Suitable habitat present in Ivanhoe Rail Facility study area and surrounds.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
													An assessment of significance was carried out for this species.
	Lophoictinia isura	Square-tailed Kite	V	-					✓	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species is wide ranging but shows preference for wooded water courses and wetlands in semi-arid regions. Potential foraging habitat may occur in Belah-Rosewood Woodland.	Possible. Small loss of potential foraging habitat only. Species has not been recorded within 20km of Ivanhoe Rail Facility study area, however, it is a rare, wide-ranging species and it could occur on occasion. Suitable habitat present in Ivanhoe Rail Facility study area and surrounds. An assessment of significance was carried out for this species.
	Hamirostra melanosternon	Black-breasted Buzzard	V	-					✓	Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species is wide ranging and may breed and forage in habitats in the Ivanhoe Rail Facility study area and may breed/nest around the Black Box Wetlands to the east of the study area.	Possible. Small loss of potential breeding and foraging habitat. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area, however, it is a rare, wide-ranging species and it could occur on occasion. Suitable habitat present in Ivanhoe Rail Facility study area and surrounds. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
	Circus assimilis	Spotted Harrier	V	-					✓	Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in Native Grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species is wide ranging and may breed and forage in habitats in the Ivanhoe Rail Facility study area and may breed/nest around the Black Box Wetlands to the east of the study area.	Possible. Small loss of potential breeding and foraging habitat. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area, but is known from CMA region and potential habitat is present. An assessment of significance was carried out for this species.
	Hieraaetus morphnoides	Little Eagle	V	-					✓	Occupies open eucalypt forest, woodland or open woodland. She-oak or Acacia Woodlands and riparian woodlands of interior NSW are also used.	Recorded close to the Ivanhoe Rail Facility study area.	This species is wide ranging and may breed and forage in habitats in the Ivanhoe Rail Facility study area and may breed/nest around the Black Box Wetlands to the east of the study area.	Possible. Small loss of potential breeding and foraging habitat only. Species was recorded during previous surveys of areas close to the Ivanhoe Rail Facility study area. Potential habitat is present.
	Ardeotis australis	Australian Bustard	E	-					✓	Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species may breed and forage in all habitat types in the Ivanhoe Rail Facility study area, however; the species is rarely seen in Western NSW.	Possible. Small loss of potential breeding and foraging habitat. Species has not been recorded within 20km of Ivanhoe Rail Facility study area and would be a rare visitor to the area if present.
	Grus rubicunda	Brolga	V	-					✓	Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	This species may breed and forage in Black Box Woodland and ephemeral wetland to the east of the Ivanhoe Rail Facility study area, however; the species is rarely seen in Western NSW.	Unlikely. Changes to water flows into nearby wetland are not expected. Species has not been recorded within 20km of the Ivanhoe Rail Facility study area and would be a rare visitor to the area if present.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
	Burhinus grallarius	Bush Stone-curlew	E	-					✓	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Species may breed and forage in Belah-Rosewood Woodland and Black Box Woodland and forage in the Native Grassland in Ivanhoe Rail Facility study area and surrounds.	Possible. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area, but is known from CMA region and potential habitat is present. An assessment of significance was carried out for this species.
	Rostratula australis	Australian Painted Snipe	E	V		✓	✓		✓	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Recorded in locality (20 km).	This species may breed and forage in the Black Box Woodland and associated Ephemeral wetland to the east of the Ivanhoe Rail Facility study area during periods of inundation.	Unlikely. Changes to water flows into nearby wetland are not expected.
	Phaps histrionica	Flock Bronzewing	V	V	✓					Observed in a variety of vegetation types, including grassy plains, saltbush, spinifex and open mulga. Its preferred habitat is tussock grassland, particularly Mitchell grassland. They need to drink daily and may be seen adjacent to water, e.g. at stock tanks, bore drains and pools in water courses.	Recorded in locality (20 km).	The species may breed and forage in the Native Grassland in the Ivanhoe Rail Facility study area and the Black Box Woodland and associated Ephemeral wetland to the east of the Ivanhoe Rail Facility study area during periods of inundation. Not likely to be a common visitor to the area.	Possible. Species was recorded within 20 km of the Ivanhoe Rail Facility study area. Suitable habitat is also present. An assessment of significance was carried out for this species.
	Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	✓		✓	✓	✓	Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water.	Recorded close to Ivanhoe Rail Facility study area.	Potential foraging habitat throughout Ivanhoe Rail Facility study area, potential breeding and foraging habitat in Black Box Woodland to the east of study area.	Likely. Recorded in several locations near the Ivanhoe Rail Facility study area (within 20 km).

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
													Potential foraging habitat present. An assessment of significance was carried out for this species.
	Glossopsitta pusilla	Little Lorikeet	V	-					✓	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Marginal habitat present in Belah-Rosewood Woodland within Ivanhoe Rail Facility study area.	Unlikely. Species has not been recorded within 20 km of the Ivanhoe Rail Facility study area and would be an extremely rare vagrant to the area if present. Occurrence would be well outside known distribution.
	Neophema pulchella	Turquoise Parrot	V	-					✓	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Marginal foraging habitat present in Belah-Rosewood Woodland in the study area and Black Box Woodland to the east of Ivanhoe Rail Facility study area.	Unlikely. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area and would be a rare vagrant to the area if present.
	Polytelis swainsonii	Superb Parrot	V	V					✓	Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Marginal foraging habitat in Belah-Rosewood Woodland in study area and Black Box Woodland to east of study area.	Unlikely. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area and would be a rare vagrant to the area if present.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
	Ninox connivens	Barking Owl	V	-					✓	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend into closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Potential foraging in all habitats in Ivanhoe Rail Facility study area. Marginal breeding habitat in Black Box near study area. Species distribution is generally limited to the major rivers such as the Darling and Murray River in the semi-arid zones and they are only sparsely recorded in areas beyond them.	Unlikely. Species has not been recorded within 20 km of Project area.
	Amytornis striatus	Striated Grasswren	V	-					✓	Confined to areas with mature spinifex (*Triodia irritans*), usually in association with mallee eucalypts and sandy soils.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	No habitat	Unlikely.
	Amytornis textilis modestus	Thick-billed Grass-wren	CE	V		✓				Usually inhabiting dense, low saltbush, cottonbush, bluebush and nitre-bush areas on sandy plains or depressions in gibber; also occurs along watercourses in clumps of Canegrass.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Species regarded as extinct in NSW until recently recorded well to the north of the Project area.	Unlikely. Not recorded in the Ivanhoe Rail Facility study area and no records of the species within a 20 km radius. Known recent record more than 300 km from study area. Species regarded as extinct in NSW until recently.
	Hylacola cautus	Shy Heathwren	V	-					✓	Inhabits mallee woodlands with a relatively dense understorey of shrubs and heath plants. The central NSW population (for example in Cocoparra National Park) also occurs at low densities in rocky hilltop vegetation with a thick shrub layer such as	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	No habitat.	Unlikely.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
										Broombush or Tea-tree.			
	Chthonicola sagittata	Speckled Warbler	V	-					✓	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Marginal potential foraging habitat in Belah-Rosewood Woodland in study area and in Black Box Woodland to the east of the study area.	Unlikely. Not recorded in the Ivanhoe Rail Facility study area and no records of the species within a 20 km radius and would be a rare vagrant to the area if present. Nearest record is more than 100 km away.
	Pyrrholaemus brunneus	Redthroat	V	-			✓			In NSW the species has been recorded mainly in chenopod shrublands including Old Man Saltbush, Black Bluebush and Dillon Bush shrublands.	Recorded in locality (20 km).	No habitat present.	Unlikely. No habitat present in Ivanhoe Rail Facility study area.
	Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-					✓	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*).	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Minimal habitat in Black Box Woodland near Project area.	Unlikely. No habitat present in Ivanhoe Rail Facility study area. Indirect impact on potential Black Box Woodland habitat unlikely.
	Drymodes brunneopygia	Painted honeyeater	V	-					✓	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Potential habitat in Belah-Rosewood Woodland in study area and in Black Box Woodland to the east of the study area.	Possible. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area, but is known from CMA sub- region and potential habitat is present.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
										genus *Amyema*.			An assessment of significance was carried out for this species.
	Certhionyx variegatus	Pied Honeyeater	V	-					✓	Inhabits wattle shrub (primarily Mulga, Acacia aneura), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes (*Eremophila* spp.); also from mistletoes and various other shrubs (e.g. *Grevillea* spp.); also eats saltbush fruit, berries, seed, flowers and insects.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Some potential breeding and foraging habitat in Belah-Rosewood Woodland in study area and in Black Box Woodland to the east of the study area.	Possible. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area, but is known from CMA sub- region and potential habitat is present. An assessment of significance was carried out for this species.
	Epthianura albifrons	White-fronted Chat	V	-					✓	Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground	Recorded close to Ivanhoe Rail Facility study area.	Potential breeding and foraging habitat in Black Box Woodland and the associated Ephemeral Wetland and may forage in the Native Grasslands and on the edge of cleared areas to the east of Ivanhoe Rail Facility study area.	Likely. Recorded during surveys of the Ivanhoe Rail Facility study area and there are several known records (within 20 km). Potential loss of foraging habitat. An assessment of significance was carried out for this species.
	Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-			✓		✓	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	Recorded in locality (20 km).	Potential breeding and foraging habitat in all wooded habitats in Ivanhoe Rail Facility study area and surrounding Black Box Woodland. Foraging only habitat in the Native Grassland and the edges of cleared areas within the study area.	Likely. Recorded within Ivanhoe Rail Facility study area and surrounds and potential habitat present. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
	Petroica phoenicea	Flame Robin	V	-					✓	Mainly occurs closer to the coast. In winter migrates to drier more open habitats further inland; occurs then in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. Outside known range, not likely to occur.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility.	Unlikely to occur. Marginal foraging habitat present in Ivanhoe Rail Facility study area.	Unlikely. Considered unlikely to occur in Ivanhoe Rail Facility study area, except perhaps as a very rare vagrant.
	Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-					✓	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area. But single record just outside the 20 km radius.	Potential breeding and foraging habitat in well-connected Belah-Rosewood Woodland and species may forage on the edges of Native Grassland as well as in Black Box Woodland to east of study area.	Possible. Species recorded in surrounds of Ivanhoe Rail Facility study area and potential habitat present in Ivanhoe Rail Facility area and Black Box area to the east. An assessment of significance was carried out for this species.
	Drymodes brunneopygia	Southern Scrub-robin	V	-					✓	Inhabits mallee and acacia scrub, particularly with dense sub-shrubs in the understorey, including Broombush and other dry shrubs.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility.	No habitat.	Unlikely. Considered unlikely to occur in Ivanhoe Rail Facility study area.
	Cinclosoma castanotum	Chestnut-backed Quail-thrush	V	-					✓	In NSW it seems to occur almost exclusively in mallee habitats, with understorey dominated by spinifex, chenopods or other shrubs including Acacia species. Only rarely, such as in Cocoparra National Park, is it recorded in other types of woodland, and in these areas a dense understorey may be a prerequisite.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	No habitat, given there is no mallee habitat within the study area and it is outside the species distribution.	Unlikely. Considered unlikely to occur in Ivanhoe Rail Facility study area.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
	Daphoenositta chrysoptera	Varied Sittella	V	-			✓		✓	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia Woodland.	Recorded in locality (20 km).	Potential breeding and foraging habitat in Belah-Rosewood Woodland in the study area and Black Box Woodland to the east of the study area.	Possible. Recorded in surrounds of Ivanhoe Rail Facility study area and potential habitat is present. An assessment of significance was carried out for this species.
	Pachycephala rufogularis	Red-lored Whistler	CE	V					✓	Found in mallee woodland with a shrub layer, usually of Broombush and native pine such as Mallee Pine (*Callitris verrucosa*), with occasional patches of spinifex and emergent mallee, forming a relatively dispersed canopy.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	No Habitat.	Unlikely.
	Pachycephala inornata	Gilbert's Whistler	V	-			✓		✓	The Gilbert's Whistler occurs in a range of habitats within NSW, though the shared feature appears to be a dense shrub layer. It is widely recorded in mallee shrublands, but also occurs in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests, though at this stage it is only known to use this habitat along the Murray, Edwards and Wakool Rivers. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including wattles, hakeas, sennas and hop-bushes.	Recorded in locality (20 km).	Potential breeding and foraging habitat in Belah-Rosewood Woodland in the Ivanhoe Rail Facility study area and foraging habitat in the Black Box Woodland to the east of the study area.	Possible. Recorded in surrounds and potential habitat present in Ivanhoe Rail Facility study area. An assessment of significance was carried out for this species.

Group	Scientific Name	Common Name	Conservation Status[1]		Previously Recorded in Locality (database)					Suitable Habitat	Survey Records from Project Area or Surrounds	Potential Habitat in the Project Area	Likely to be Impacted by the Project?
			TSC Act	EPBC Act	OEH Atlas[2]	EPBC Report[3]	Australian Museum[4]	Birdlife Australia[5]	OEH CMA sub-region[6]				
										In woodland habitats, the understorey comprises dense patches of shrubs, particularly thickets of regrowth Callitris pine. Parasitic 'cherries' (*Exocarpus* species) appear to be an important habitat component in Belah and Red Gum communities, though in the latter case other dense shrubs, such as Lignum and wattles, are also utilised.			
	Stagonopleura guttata	Diamond Firetail	V	-					✓	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands, also in open forest, lightly wooded farmland and derived grasslands.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Potential breeding and foraging habitat in Belah-Rosewood Woodland in the Ivanhoe Rail Facility study area and foraging habitat in Native Grassland. Potential breeding and foraging habitat also present in the Black Box Woodland to the east of the study area.	Possible. Species has not been recorded within 20 km of Ivanhoe Rail Facility study area, but is known from CMA region and potential habitat is present. An assessment of significance was carried out for this species.
Mammals	*Ningaui yvonneae*	Southern Ningaui	V	-					✓	Closely associated with habitats containing spinifex. Shelters in spinifex clumps, beneath logs, and in dense vegetation, but may also dig its own burrows.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	No habitat.	Unlikely.

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	Antechinomys laniger	Kultarr	E	-					✓	A terrestrial insectivore that inhabits open country, especially claypans among Acacia Woodlands.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Potential breeding and foraging habitat in Belah-Rosewood Woodland and Native Grassland in Ivanhoe Rail Facility study area and Black Box Woodland to east of study area (particularly during drought conditions when cracking clays are exposed).	Possible. Species not recorded from Ivanhoe Rail Facility study area or surrounds but known from CMA region and potential habitat present. An assessment of significance was carried out for this species.
	Phascolarctos cinereus	Koala	V	V	✓					Inhabit eucalypt woodlands and forests.	Recorded in locality (20 km).	No habitat in Ivanhoe Rail Facility study area. Limited potential foraging habitat in Black Box Woodland to east of study area.	Unlikely. Changes to water flows into nearby wetland and associated Black Box Woodland are not expected.
	Petrogale penicillata	Brush-tailed Rock-wallaby	E	V					✓	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	No rocky outcrops, no habitat.	Unlikely.
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-					✓	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility study area.	Potential breeding and foraging habitat in Belah-Rosewood Woodland in Ivanhoe Rail Facility study area and Black Box Woodland to east of study area. Potential foraging habitat also present in the Native Grassland and cleared areas around the study area.	Possible. Species not recorded in Ivanhoe Rail Facility study area or surrounds but potential habitat present. An assessment of significance was carried out for this species.

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	Nyctophilus timoriensis/corbeni	Corben's Long-eared Bat (also known as South-eastern Long-eared Bat)	V	V	✓				✓	Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	Recorded in locality (20 km).	Potential breeding and foraging habitat in Belah-Rosewood Woodland in Ivanhoe Rail Facility study area and Black Box Woodland to east of study area.	Possible. Species recorded in surrounds. Potential habitat present. An assessment of significance was carried out for this species.
	Chalinolobus picatus	Little Pied Bat	V	-					✓	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility.	Potential breeding and foraging habitat in Belah-Rosewood Woodland in Ivanhoe Rail Facility study area and Black Box Woodland to east of study area.	Possible. Not recorded in Ivanhoe Rail Facility study area or surrounds but known from CMA sub-region and potential habitat present. An assessment of significance was carried out for this species.
	Vespadelus baverstocki	Inland Forest Bat	V	-					✓	Roosts in tree hollows and abandoned buildings. Known to roost in very small hollows in stunted trees only a few metres high.	Not recorded. No records within a 20 km radius of the Ivanhoe Rail Facility.	Potential breeding and foraging habitat in Belah-Rosewood Woodland in Ivanhoe Rail Facility study area and Black Box Woodland to east of study area.	Possible. Not recorded in Ivanhoe Rail Facility study area or surrounds but known from CMA sub region and potential habitat present. An assessment of significance was carried out for this species.

1 Threatened fauna species status listed under the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999 (current at 9 August 2012).

2 Office of Environment and Heritage (2012) *Atlas of NSW Wildlife (July 2012). Database Search, 20km radius of study area*.

3 Department of Sustainability, Environment, Water, Population and Communities (2012a) *SEWPaC Protect Matters (July 2012). Database Search, 10km radius of study area*.

4 Australian Museum (2012) *Database Search, (July 2012) 20km radius of study area.*

5 Birdlife Australia (2012). *Database Search of study area (July 2012).*

6 Office of Environment and Heritage (July 2012) *CMA sub-region (Lachlan CMA, Darling Depression (Part B)) Threatened Species list.*