



# CHAPTER 11

## NATIVE FAUNA & PEST SPECIES



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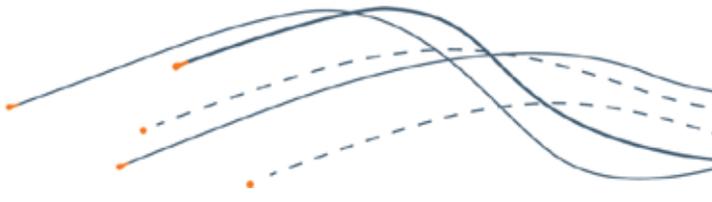
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## 11 Native Fauna and Pest Species

The predominantly agricultural environment of the proposed CEIP supports fragmented, degraded and isolated patches of remnant vegetation, providing restricted habitat opportunities for native fauna. The ecological integrity of the region is further degraded as a result of historic grazing and the presence of rabbits and other feral and pest animal species.

The area covered by the proposed mining lease (the mine site) is surrounded by agricultural land; however, the Hambidge Wilderness Protection Area (WPA) lies approximately 3.6 km to the southeast of the mine site boundary and a series of dry playa 'salt lakes' (or saline depressions) known as Lake Warrambo are located approximately 1.2 km to the north of the mine site. As groundwater modelling undertaken for the project indicates the potential for groundwater drawdown to occur in the vicinity of the Lake Warrambo complex, the ecological values and potential impacts to native fauna at Lake Warrambo were investigated. Potential impacts to the Hambidge WPA were also investigated as part of the groundwater impact assessment (and vegetation impact assessment), but no impacts are anticipated as a result of the mine development (construction, operation or closure). Other potential impacts to Hambidge WPA are considered as part of Iron Road's Environmental Impact Statement for the proposed CEIP Infrastructure and are not dealt with in this document.

This chapter describes the effects the mine will have on native fauna communities and associated habitats within the mine site and in adjacent areas where potential impacts exist. This chapter also describes the likely effects on pest animal species which have the potential to further degrade ecological values. It discusses specific design modifications and management measures to be implemented to minimise impacts on native fauna, including minimising the design footprint of the project, vegetation management (fauna habitat) and measures to reduce direct impacts to fauna. This chapter also assesses the effectiveness of these measures and the residual impacts upon and risks to, native fauna species, with a focus on conservation-significant species listed under Commonwealth and State legislation. Information relating to vegetation clearance and associated environmental offsets is provided in Chapter 12.

### 11.1 Applicable Legislation and Standards

Threatened and conservation-listed fauna species and some vegetation communities which represent habitat to fauna within South Australia are protected both at Commonwealth and State level via the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) (Commonwealth). This Act prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas. Under the environmental provisions of the EPBC Act, actions that are likely to have 'significant impact' on a matter of National Environmental Significance require assessment and approval by the Commonwealth Environment Minister. There are nine matters of national environmental significance identified under the EPBC Act.

Aspects of this Act that are relevant to fauna include conservation listings for threatened fauna species (Critically Endangered, Endangered and Vulnerable) and migratory species (marine, terrestrial and wetland).

A referral of the proposed mining lease pursuant to Section 68 of the EPBC Act was made on 30 September 2014. The proposed mining lease was declared to be 'not a controlled action' and therefore approval under the EPBC Act is not required.

The *National Parks and Wildlife Act, 1972* (Schedules 7, 8 and 9 of the Act) (NPW Act) (SA) provides for the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters) and provides for the use of wildlife through a system of permits allowing certain actions, i.e. keeping, selling, trading, farming, hunting and the destruction of native species. This Act also assigns species to state conservation categories; Endangered (Schedule 7), Vulnerable (Schedule 8) and Rare (Schedule 9).

The *Natural Resource Management Act, 2004* (NRM Act) (SA) is to assist in the achievement of ecologically sustainable development in the State by establishing an integrated scheme to promote the use and management of natural resources that recognises and protects the intrinsic value of natural resources. The Act combines critical elements of the now repealed *Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986*, the *Soil Conservation and Land Care Act 1989* and the *Water Resources Act 1997*.

The *Native Vegetation Act, 1991* (NV Act) and *Native Vegetation Regulations, 2003* (SA) controls the clearance of native vegetation (fauna habitat) and provides incentives and assistance to landowners and proponents in relation to the preservation and enhancement of native vegetation.

The Department of State Development (DSD) currently has delegation for the administration of the *Native Vegetation Act, 1991* for clearance undertaken as part of mine developments. Further details regarding this Act are provided in Chapter 12.

For more detail about the application of these Acts refer to Chapter 4 of the Mining Lease Proposal.

## 11.2 Assessment Method

An assessment of the study area, including vegetation composition as it relates to habitat condition and likelihood of occurrence of conservation-significant fauna species was conducted for the mine site in Spring of 2011 and updated in 2014 to reflect a revised mine site boundary (Appendix J, Jacobs 2014a – Mine Terrestrial Ecology Report). The assessment involved desktop analysis and a detailed in-field fauna (and flora) survey.

### 11.2.1 Desktop Review

Desktop investigations were undertaken to identify the possible occurrence of threatened species or species of particular conservation significance within the mine site through a search of the EPBC Act Protected Matters Database and the historical species records in the Biological Database of South Australia (BDBSA, December 2013 extraction). The EPBC Protected Matters Search was conducted using a 5 km buffer zone around the mine site and compared to BDBSA records. A wider BDBSA search area around the Exploration Licence (EL4849) area was used where there was a paucity of records for species, specific habitats are known to occur in the area, or to support or reject suggestions from the EPBC Protected Matters Search Tool.

### 11.2.2 Field Surveys

Field studies targeted remnant vegetation patches within the mine site area which represent the most intact habitat to maximise the potential of identifying native fauna at the site. The survey established a baseline of the site's ecology by assessing 15 sites across the mine site, comprising five targeted fauna trapping sites (where vegetation and habitat condition were also assessed) and 10 sites where just habitat condition was assessed. A range of standard South Australian Biological Survey methodologies were employed at each trapping site, including Elliot, pitfall and cage trapping, active bird surveys, active reptile searches, opportunistic sightings, ANABAT recording for bat vocalisations, spotlighting for nocturnal species and call play back for nocturnal birds (see Appendix J for further detail). The surveyed sites were representative of the habitat types present across the mine site and provided an indication of actual species or communities of conservation significance which would potentially be impacted by the development. The location of the five fauna survey sites is shown on Figure 11-1 below. An additional 10 sites (A to J), primarily flora and habitat value survey sites, are described in detail in Chapter 12 (Vegetation and Weeds).

Habitat condition of remnant native vegetation patches was assessed following the methodology outlined by DLWBC (2005). A key component of this assessment was the determination of vegetation condition and the assignment of a "significant environmental benefit" (SEB) ratio to calculate the overall requirement for an environmental offset (as per the *Native Vegetation Act, 1991*) to compensate for the clearance of native vegetation habitat as a result of the project. Further details of the proposed SEB for the project are provided in Chapter 12 (Vegetation and Weeds).

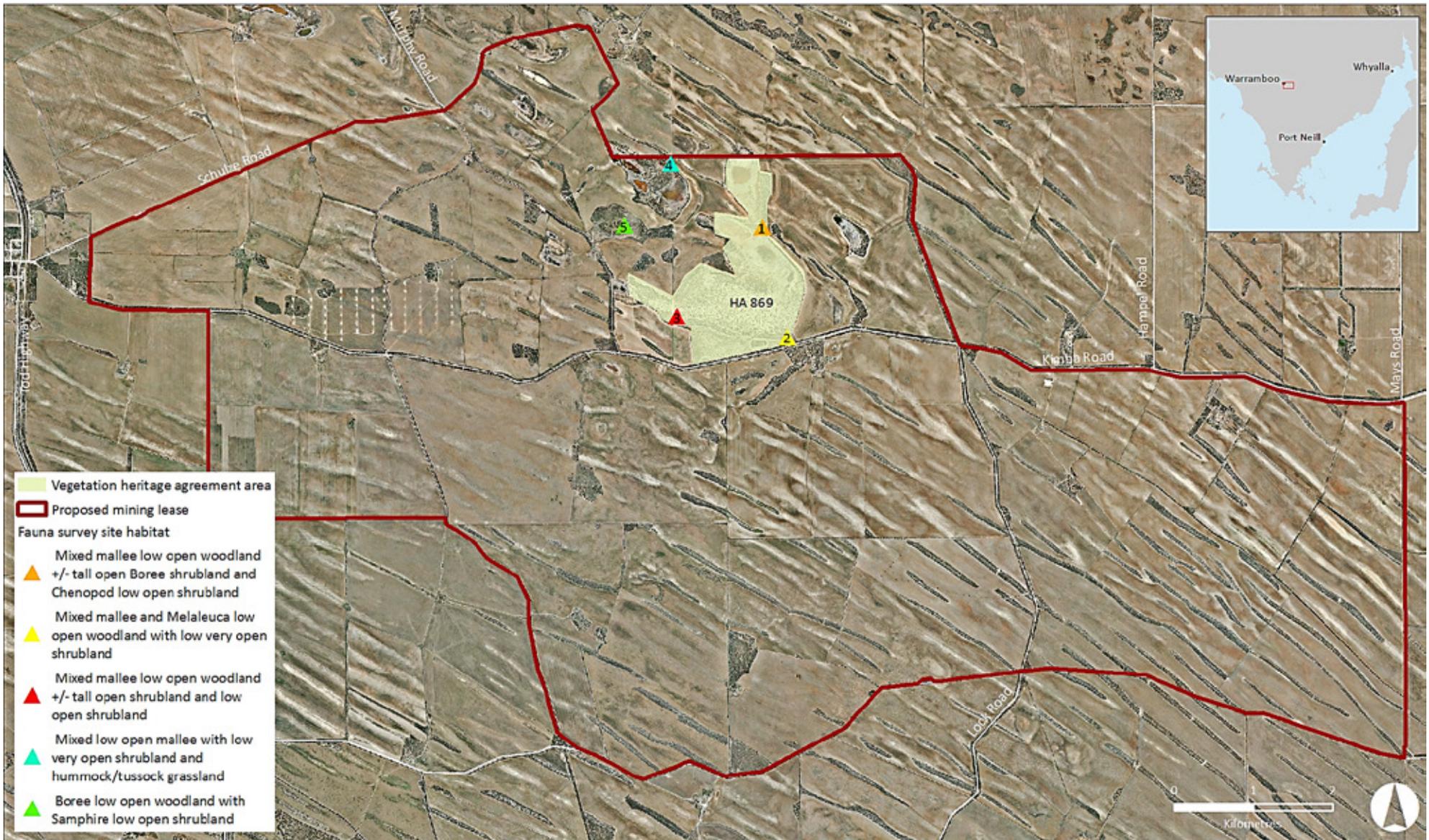


Figure 11-1 Location of Survey Sites within the Proposed Mining Lease Area

## 11.3 Existing Environment

This section provides an overview of the existing environment within and surrounding the mine site in relation to native fauna and pest species. Fauna habitat and species of particular conservation significance are discussed.

### 11.3.1 Regional Context

The mine site is located within the Eyre Mallee subregion of the Eyre Yorke Block (EYB) bioregion as described by the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995). The landscape of the wider EYB bioregion is unique and varied, comprising limestone rolling plains, granite inselbergs, coastal and inland wetlands, salt lakes, ephemeral lakes, stands of mangroves and offshore islands. This bioregion contains the transition from semi-arid to arid ecological communities, where habitat fragmentation and degradation are key threatening processes for native fauna as a result of the significant clearance of native vegetation for agriculture and grazing. Feral animals are relatively common (including rabbits, foxes, cats, goats and horses as well as introduced stock) and present substantial threats to native habitat and animal species through grazing, competition and predation. Further threats to habitat values in the bioregion include competition from aggressive exotic weed species (e.g. Bridal Creeper, exotic grasses) (DEH 2002, Brandle 2010).

The Eyre Mallee subregion has the highest biodiversity within the EYB bioregion with 1,212 recorded plant species, 177 bird species, 82 reptile species and 23 species of mammals (DEH 2002). The vegetation of this subregion is described further in Chapter 12. Little native vegetation occurs within the subregion and habitat for fauna primarily occurs within small, isolated remnant blocks within farmland, often restricted to dune crests. Pinkawillinie Conservation Park and Hambidge WPA, to the northeast and southeast of the study area respectively, provide key areas of fauna habitat within the subregion, particularly for threatened species.

### 11.3.2 Habitat Condition and Diversity

Remnant vegetation which provides habitat for native fauna within the mine site is restricted to scattered and isolated patches of varying size across farmland or as roadside vegetation. Only 13% of the mine site is mapped as native vegetation (DEWNR 2011). The remainder of the site is cleared agricultural land dominated by exotic species. Larger areas of native vegetation representing habitat for native fauna are found on the northern portion of the mine site, including a group of larger (though degraded) scrub blocks which comprise Heritage Agreement 869 (HA 869) (Figure 11-1) above. Heritage Agreements are private conservation areas, where an agreement has been made between the landowner and the Minister for Sustainability, Environment and Conservation.

The significant historical vegetation clearance and adjacent ongoing agricultural practices influence the condition of each patch of native vegetation across the mine site. In addition, there are also a number of areas within the mine site (including within HA 869) which support saline groundwater-affected vegetation or where vegetation is absent as a result of salt scarring. These depressions may hold water for up to several weeks after heavy winter rains. The habitat condition across the mine site therefore varies with the size of the remnant patch and with local hydrogeological conditions. Where present, the majority of degradation occurs within the understorey layers. Plate 11-1 to Plate 11-5 demonstrate some of the variation in habitat condition across the mine site. In addition, the average condition of roadside vegetation patches within or surrounding the mine site is relatively poor (see Chapter 12 for further detail).

As mentioned above, fauna surveys were undertaken at five sites across the mine site providing a representative snapshot of the habitat types across the site. Sites were selected as representative of the best habitat condition within the mine site rather than typical habitat across the site to maximise survey return for effort and to highlight the presence of ecological values.

Four habitat types were identified during the survey of the study area, namely:

- Red Mallee (*Eucalyptus oleosa*) / Yorrell (*E. gracilis*) / Narrow-leaved Mallee (*E. leptophylla*) low open woodland on calcareous sandy plains and low dune flanks.
- Ridge-fruited Mallee (*E. incrassata*) / Beaked Red Mallee (*E. socialis*) / Gilga (*E. brachycalyx*) low open woodland on the deeper sands of dune crests.
- Southern Cypress Pine (*Callitris gracilis*) open woodland on sandy calcareous plains.
- Boree (*Melaleuca pauperiflora* ssp. *mutica*) low open woodland with Brown-head Samphire (*Tecticornia indica* ssp. *leiostachya*) and Grey Samphire (*T. halocnemoides* ssp. *halocnemoides*) open low shrubland on saline depressions.

A brief summary of the broad habitat types that occur across the fauna survey sites and their condition is provided below. Further detail is provided in Appendix J.

## Fauna Site 1

Site 1 is located within HA 869, the largest remnant 'scrub block' on the mine site (see Figure 11-1). This block is approximately 260 ha in total and although the area represents the best habitat within the mine site, it also includes large areas that are devoid of vegetation as a result of salt and/or grazing impacts. The site is located on a red sand plain fringing a salty shallow depression or small lake. The sand plain is dominated by low open woodland of Ridge-fruited Mallee / Yorrell / Gilga with patches of tall shrubland (see Plate 11-1). This community grades into Boree scrub over a Samphire low open shrubland understorey fringing the bare saline clay flats. There are large areas that either support salt-affected vegetation, or are devoid of vegetation, where the saline groundwater table is elevated. More detailed vegetation descriptions are provided in Chapter 12, Vegetation and Weeds and species lists are provided in Appendix J.

While currently free of significant patches of weeds, the elevated salt water table and reduced habitat quality in portions of this area has the potential to create opportunities for future weed infestations. It is estimated that the site has not been burnt for more than 10 years and there is no evidence of a recent fire scar. Existing grazing levels are low, including light browsing of palatable shrubs by kangaroos. Although the site has a medium to high diversity of native plants, there is limited litter cover, the understorey is sparse and there are few large trees with hollows. Given the diversity of floral resources, number of hollows, low litter levels, high edge effects (which include the presence of salt-affected vegetation), this site is considered to provide low to moderate habitat value for native fauna.



Plate 11-1 Habitat of Mixed Mallee Low Open Woodland

## Fauna Site 2

Site 2 is also located within HA 869, near the south-eastern corner, which is located on a low gypsiferous rise just off Kimba Road (see Figure 11-1). The pale sandy soils support low open woodland, with a sparse understory (see Plate 11-2). Spinifex hummock grassland dominates the areas of deeper sand along with Speargrass species. More detailed vegetation descriptions are provided in Chapter 12, Vegetation and Weeds and species lists are provided in Appendix J.

It is estimated that the site has not been burnt for more than 10 years, there is no evidence of recent fire activity and low levels of vegetative litter are present. The site itself is surrounded by cleared land used for cereal cropping. This site is free from weed infestations and supports a medium diversity of native species, though the understorey is sparse in parts and small hollows are present. The presence of edge effects from cereal cropping is high, litter levels are low and hollows are small, hence the site is considered to provide an overall low to medium habitat value for native fauna.



Plate 11-2 Habitat of Mixed Mallee and Boree Open Woodland with Low Very Open Shrubland

### Fauna Site 3

Site 3 is located on a low pale sand dune in the southwest of HA 869 and is characterised by Red Mallee / Yorrell / Narrow-leaved Mallee low open woodland with Ridge-fruited Mallee on the dune crest (see Figure 11-1, Plate 11-3). The site supports a diverse range of shrubs (e.g. Broombush, Honeysuckle Grevillea and Bottlebrush Hakea) on the deeper sandy soils of the dune crests and Dryland Tea-tree and Sheep Bush on the shallower dune flanks. More detailed vegetation descriptions are provided in Chapter 12, Vegetation and Weeds and species lists are provided in Appendix J.

Recent grazing levels are low, including light kangaroo browsing of palatable shrubs. It is estimated that the site has not been burnt for more than 10 years, there is no evidence of recent fire activity and there are clumps of vegetative litter. This site is free from significant weed infestations and supports a medium-high diversity of native flora species, with some small hollows present in the Mallee species. Similar to site 2, this site is surrounded by cleared land used for cereal cropping, the presence of edge effects are high, but there is some litter cover and small hollows are present, therefore the site is considered to provide a moderate habitat value for native fauna.



Plate 11-3 Habitat of Mixed Mallee with Patches of Tall and Low Open Shrubland

#### Fauna Site 4

Site 4 is located in a 48 ha remnant scrub block northwest of HA 869 near the northern boundary of the mine site (see Figure 11-1). The site occurs on a low pale sand plain adjacent to a shallow saline depression and is dominated by Mallee over a diverse range of shrubs. Spinifex hummock grassland and Speargrass tussock grassland dominate the ground cover (Plate 11-4). This community grades into Boree over a low open shrubland understorey fringing the bare saline clay flats of the lake bed. More detailed vegetation descriptions are provided in Chapter 12, Vegetation and Weeds and species lists are provided in Appendix J.

This site was relatively free of weed infestations apart from scattered small patches of non-declared weeds (e.g. Wild Turnip, Pimpernel and Small Ice Plant) on the saline clay flats fringing the lake. No Declared weeds were recorded on the site, apart from an infestation of False Caper in cleared land immediately east of the scrub block. Recent grazing levels were low, including light kangaroo browsing of palatable shrubs. No evidence of recent fire was recorded and it is estimated that the site has not been burnt for more than 10 years. The presence of significant weed infestations at this site, a medium-high diversity of native flora species, presence of edge effects, small hollows and fissures in older mallee and patchy litter cover therefore provides a low to medium habitat value for native fauna.



Plate 11-4 Habitat of Mixed Mallee Low Open Woodland, Open Shrubland and Spinifex Hummock Grassland

## Fauna Site 5

Site 5 is located in a 31 ha remnant patch of vegetation west of HA 869 near the northern boundary of the mine site (see Figure 11-1). The site is positioned within a shallow saline depression and is dominated by low open shrubland. The saline depression is fringed with a tall Boree shrubland with a Samphire understorey which grades into Red Mallee low open woodland on the adjoining sandplain and low sandy rise north and south of the site. More detailed vegetation descriptions are provided in Chapter 12, Vegetation and Weeds and species lists are provided in Appendix J.

Edge effects are high at this site. Cleared cropping land (north and south of the site), two old, abandoned, shafts (unrelated to Iron Road's exploratory activities in the area) and existing two-wheel tracks (adjacent to the site) have all played a major role in the historical degradation of habitat value of this site. The saline soils support dense patches of the exotic Ice Plant with moderate infestations of several Declared weeds (e.g. False Caper and Horehound).

Total grazing pressure at the site is low, with no evidence of recent rabbit grazing. There is evidence of extensive die off in the Boree tall shrubland in the saline depressions, due to an apparent rise in the saline water table (see Plate 11-5). The dead Boree in the lake bed do however provide small hollows, which may serve as suitable nesting for several bird and bat species. This site contains multiple significant weed infestations, including two Declared weeds and there is a low diversity of native flora species. The presence of edge effects, weeds, low litter levels, high levels of disturbance, negatively impacting saline depressions and small hollows in dead Boree is therefore considered to provide a low to moderate habitat value for native fauna.



Plate 11-5 Habitat of Boree Low Open Woodland with Samphire Low Open Shrubland

## Flora Only Sites

Sites A-J were assessed for flora and habitat condition only. These sites were primarily smaller blocks of vegetation (1.5 – 29 ha) or roadside strips. The habitat condition of the majority of these patches was poor to moderate, with low species diversity and weeds prevalent, therefore providing lower habitat value to fauna. Brief descriptions of these sites are summarised in Table 12-1 of Chapter 12, Vegetation and Weeds and further detail is provided in Appendix J.

### 11.3.3 Native Fauna Diversity

The mine site and surrounds in general provide low habitat value for native fauna due to the very high rates of vegetation clearance and subsequent small size, isolated occurrence and degraded nature of remnant vegetation patches. While open fields can favour some species, the widespread lack of suitable habitat excludes a number of native fauna and therefore limits biodiversity. A total of 77 vertebrate species (70 native, 7 introduced) were recorded during the baseline survey of the mine site, 41 of which represent new records for the area for the Biological Database of South Australia. However all species identified were relatively common throughout the greater Eyre Peninsula region. The fauna species diversity of the site is considered low which is commensurate with the degraded condition and isolated nature of the habitat fragments encountered during the survey. The vertebrate species identified in the study area are summarised below:

- Birds – 59 (including three introduced species)
- Reptiles – 8
- Amphibians – 0
- Mammals – 10 (including two bats and four introduced species)

Table 11-1 summarises fauna diversity across the survey sites. A complete list of all recorded fauna is provided in Appendix J.

**Table 11-1 Fauna Species Diversity by Habitat Type across Proposed Mine site**

Site	Broad habitat type within proposed mine site	Birds <sup>1</sup>	Reptiles	Mammals <sup>1</sup>	Total <sup>1</sup>
1	Mixed Mallee low open woodland with patches of tall open shrubland and low open shrubland	17	4	1	22 (0)
2	Mixed Mallee and Boree ( <i>M. pauperiflora</i> ssp. <i>mutica</i> ) low open woodland with low very open shrubland	22	2	3 (1)	27 (1)
3	Mixed Mallee low open woodland with patches of tall open shrubland and low open shrubland	25	3	2 (1)	30 (1)
4	Mixed Mallee low open woodland with open shrubland and Spinifex hummock grassland	22 (1)	4	3 (2)	29 (3)
5	Boree ( <i>M. pauperiflora</i> ) low open woodland with Samphire low open shrubland	13 (2)	0	(2)	13 (4)

<sup>1</sup>Pest species numbers in brackets

#### Birds and Mammals

The diversity of the mammal and bird species at the mine site area is consistent with what is expected for an agriculturally dominated landscape interspersed with small fragments of native regrowth and a few remnant stands (Doherty 1998, Menkhorst and Bennett 1990). The survey of the mine site found that most bird groups were represented, although some, such as the raptors (three species) and robins (one species), were poorly represented (Appendix J). Similarly, richness of the bat species was relatively low for what would usually be expected for Mallee or grassy woodland habitat in good condition, with the notable absence of three common groups (*Nyctophilus*, *Mormopterus* and *Tadarida*). Dunnarts were also a notable mammal absence and would usually be anticipated if the habitat was in good condition, particularly with areas of Spinifex and sandy dune crests found in the region. However the findings are consistent with the isolated and fragmented nature of such habitat within the mine site.

## Reptiles

The diversity of reptiles is usually high for mallee habitat types particularly where there is considerable leaf and bark litter build-up and a reasonable shrub storey or ground cover (DEH 2002, Moseby and Read 2001). However the survey of the mine site indicated much lower reptile species richness compared to what would be expected for this habitat type when intact, with notable absences of smaller reptiles such as Sliders (*Lerista*), *Menetia greyii* and *Hemiergis* spp. and also larger species such as the Sand Goanna (*Varanus gouldii*). Similarly, Williams and colleagues (2011) noted two important factors that influence the diversity of reptile species in mallee fragments within an agricultural landscape on the Eyre Peninsula; namely distance from conservation parks and quality of habitat. Whilst the southern boundary of the mine site is 3.6 km from Hambidge WPA, the fauna survey sites are primarily in the north of the mine site and are more than 5 km from the nearest conservation park (i.e. Hambidge WPA). The habitat of the surveyed patches was in poor to moderate condition, therefore likely to impact reptile species richness. Williams and colleagues (2011) also noted that corridor connections (e.g. roadside remnants) by themselves may not be sufficient to provide a dispersal corridor for all reptiles and that some reptile species may remain isolated in patches even with corridor connectivity.



Plate 11-6 Stellate Knob-tailed Gecko Located at Four out of Five Sites

### 11.3.4 Conservation Significant Fauna

A total of 16 fauna species of national or state conservation significance were identified by the desktop review as potentially occurring in the mine site boundary (with a 5 km buffer). The actual likelihood of occurrence for all these species was assessed and a justification provided in Table 11-2. Likelihood is based on identification through the EPBC Act Protected Matters Search Tool ("species or habitat may occur or likely to occur"), BDBSA historic records, survey results and regional information (e.g. DEH 2002, Ward et al 2008, Brandle 2010). Historical BDBSA records for the broader region are shown in Figure 11-2 below. Of the 16 fauna species identified by the desktop study as potentially present, one Migratory EPBC listed bird (Rainbow Bee-eater, Plate 11-7) and four NPW listed birds (Gilbert's Whistler, Restless Flycatcher, Slender-billed Thornbill and White-winged Chough) are confirmed as present within the study area. Five birds (three EPBC and two NPW) and two mammals (EPBC) are considered unlikely to occur at the site and four EPBC listed birds are considered to possibly occur at the site (see Appendix J for further details). It should be noted that the Slender-billed Thornbill has recently been delisted from the EPBC Act.

No reptiles or mammals of conservation significance were recorded in field surveys and none are considered to occur within the mine site (see Table 11-2 and Figure 11-2).



Plate 11-7 EPBC Listed Migratory Bird Identified in Project Area; Rainbow Bee-eater (source: Darryl Bray)

Table 11-2 Likelihood of Occurrence Assessment: EPBC and NPW Fauna Species

Common Name	Species Name	EPBC Act <sup>1</sup>	NPW Act <sup>2</sup>	Occurrence	Justification for Likelihood of Occurrence <sup>3</sup>
Rainbow Bee-eater	<i>Merops ornatus</i>	MT, LM	-	Present	Widely distributed, highly mobile migratory species known to use a range of habitat types, including woodlands, shrublands and various cleared and semi-cleared habitats. Occurs throughout Australia, eastern Indonesia and Papua New Guinea. No previous records for this species within 5 km of mine site. Observed at site 2 of the mine site survey (remnant vegetation within HA). Given wide distribution, not expected to be solely reliant on the habitat within the mine site.
Gilbert's Whistler	<i>Pachycephala inornata</i>	-	R	Present	Occupies diverse habitats, including chenopod shrublands, Mallee and open shrublands which are common to central EP and the mine site. Subspecies ' <i>gilberti</i> ' known from upper EP, with a distribution that extends far west over the Nullarbor into WA. No records within 5 km of mine site, seven regional records since 2001. Species observed commonly at sites 2 and 3 during mine site survey and during other surveys for the CEIP.
Restless Flycatcher	<i>Myiagra inquieta</i>	-	R	Present	Woodland bird that uses cleared land, open forest, woodland and inland scrub habitats across semi-arid and temperate zones of SA. Although species has declined extensively and is less common regionally, it is an extremely mobile and active bird that is more often seen in farmland and usually in the same habitats as the similarly sized common Willie Wagtail. Only recorded at site 3 (low open Mallee woodland with tall and low open shrubland) during the mine site survey.
Slender-billed Thornbill	<i>Acanthiza iredalei iredalei</i>	-	R	Present	A relatively sedentary bird, with core habitat of chenopod shrubland dominated by Samphire, Bluebush or Saltbush, but it also ranges into Mallee grassy woodlands and dense heathy shrublands. A transient population was recorded within the mine site (sites 2 and 3 below a Mallee canopy, but not recorded at site 5 (dominated by Samphire)). Southern margin of known distribution is northeast of the EP region, with a strong hold in coastal areas around the top Spencer Gulf. Species has recently been delisted from the EPBC Act; previously rated as Vulnerable.
White-winged Chough	<i>Corcorax melanorhamphos</i>	-	R	Present	Distribution ranges across temperate and semi-arid regions in SA. Occupies diverse open woody habitat types including Mallee, ranging into open shrubland. On the Eyre Peninsula, occurs at the western limit of distribution and is widespread in tall mallee woodlands. Records within 5 km of mine site (2001). Observed within mine site (site 5) and opportunistically in roadside Mallee.
Cattle Egret	<i>Ardea ibis</i>	MW, LM	R	Possible	Occupies pasture habitats, as well as floodwaters, wetlands and intertidal mudflats. Degraded (weed invasion and livestock impacts) pasture habitats are present within the mine site and surrounding districts. No records for this species within 5 km of mine site. Highly mobile species. May occur as a rare visitor to the region and may utilise low lying 'salt pans' within the mine site whilst holding water, but not expected to be reliant upon such habitat features.

Common Name	Species Name	EPBC Act <sup>1</sup>	NPW Act <sup>2</sup>	Occurrence	Justification for Likelihood of Occurrence <sup>3</sup>
Fork-tailed Swift	<i>Apus pacificus</i>	MM, LM	-	Possible	Uses many habitat types, including coastal, arid and urban areas. Suitable habitat exists within mine site. No records within 5 km of mine site. Highly mobile and transient in nature, with distribution over vast areas of Australia and overseas. Not expected to be solely reliant upon habitat found within the mine site.
Oriental Plover	<i>Charadrius veredus</i>	MW, LM	-	Possible	Small shorebird, known to occupy dry plains and semi-arid regions. Highly mobile species, migrating annually between Mongolia, China and Australia. Vast amount of suitable habitat occurs across Australia, therefore unlikely to rely directly upon habitat features within the mine site.
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	MT, LM	E	Possible	Uses many habitat types, particularly coastal regions, but also flies over terrestrial habitats in semi-arid zones. Significant populations occur on the Eyre Peninsula (e.g. off-shore islands, coastal regions of the upper-western Eyre Peninsula and the southern Eyre Peninsula, Venus Bay and Cowell). Observed flying over Cape Hardy coastal field site. No records within 5 km of mine site. May be present as an occasional visitor, likely to occur in habitat closer to the coastline, but not expected to be reliant on habitat within the mine site.
Great Egret / White Egret	<i>Ardea modesta</i>	MM, MW, LM	-	Unlikely	Uses a wide range of wetland habitats; inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial. Suitable habitat occurs north of the mine site (e.g. Lake Warrambo complex), but not within the mine site. No records within 5 km of the mine site. May be transient visitor, but not expected to be reliant upon the very small salt pans and salt depressions within and north of the mine site.
Greater Long-eared Bat (SE form – now 'South-eastern Long-eared Bat')	<i>Nyctophilus timoriensis</i> (now <i>N. corbeni</i> )	V	-	Unlikely	Species has had taxonomic review, <i>Nyctophilus timoriensis</i> is now known as <i>N. corbeni</i> (has EPBC rating) or <i>Nyctophilus</i> sp 2, with distribution centralised around the Murray-Darling Basin (distant from the mine site). Form not specified within fauna records. Last record within EL (14 km from mine site, 1984), is unlikely to be the listed form.
Grey Currawong (north western subspecies)	<i>Strepera versicolor plumbea</i>	-	E	Unlikely	Occupies range of habitat types, including mallee, heath and semi-desert habitats. NW ssp. ranges from WA (Geraldton) to extreme NT (Petermann Ranges) to SA (Musgrave and Everard Ranges and Great Victoria Desert). Mine site is beyond known limit of extent. No records within 5 km, regional records 10 km and 32 km from mine site (2001 and 2006). Subspecies not specified within fauna records. Records likely to be <i>Strepera versicolor intermedia</i> (subspecies with no formal legislative protection).
Jacky Winter (south eastern subspecies)	<i>Microeca fascinans ssp. fascinans</i>	-	R	Unlikely	The non-protected 'assimillis' ssp. is dominant in this region and was observed within the mine site. The south eastern ssp. is more common to VIC / NSW. No records within 5 km of the mine site. Records do not specify which ssp. is represented, but unlikely to be protected ssp. as beyond known limit of extent.

Common Name	Species Name	EPBC Act <sup>1</sup>	NPW Act <sup>2</sup>	Occurrence	Justification for Likelihood of Occurrence <sup>3</sup>
Malleefowl	<i>Leipoa ocellata</i>	V, MT	VU	Unlikely	Inhabits sandy dune / mallee habitats throughout the Eyre Peninsula. Requires deep organic matter to build mounds for egg incubation (best provided by long unburnt remnants with good canopy cover). Will utilise habitat adjacent to cropping areas and feed on grain. Not located during targeted searches within mine site. Last record within 1-5 km of mine site (1900), most recent records 12 km from mine site (2006), multiple records in HA 370 (12-15km away 2003, 2005, 2006). Remaining vegetation of the mine site is primarily on dune crests, rather than swales where litter accumulates, therefore not preferable habitat. If present, only as rare visitor.
Osprey	<i>Pandion cristatus</i> / <i>P. haliaetus</i> <sup>6</sup>	LM	E	Unlikely	Uses coastal habitats, including elevated coastal cliffs exposed sites and sea stacks. Previously population occurred at Spencer Gulf. Known to have a sparse distribution within SA including an estimated 52 breeding pairs, primarily located on the west coast of the Eyre Peninsula. No suitable nesting habitat observed during field assessments. No records within 5 km of mine site. Record, for <i>Pandion cristatus</i> 11 km (Eastern EP 2009). Taxonomy of species is controversial.
Sandhill Dunnart	<i>Sminthopsis psammophila</i>	EN	V	Unlikely	Elusive species, known primarily from nine populations, in SA and WA. Key SA populations are near Ooldea (Yellabinna Regional Reserve) and near Whyalla on the Eyre Peninsula (SPRAT 2015). Occupies low parallel dunes with open woodland and diverse shrubbery over large mature hummocks of <i>Triodia</i> . Populations are known from the Shirrocoe Pastoral Lease (west of Middleback Ranges near Whyalla, Ward et al 2008) in the Pinkawillinnie to Cowell region and Hinks CP (Ward et al 2008). Suitable habitat occurs in Hambidge WPA (there are records from SE corner, 30 km away from mine site, 2011). Remnant vegetation patches in the mine site are too isolated and do not contain the preferred age class of <i>Triodia</i> , therefore it is highly unlikely they would occur.

<sup>1</sup> *Environment Protection and Biodiversity Conservation Act, 1999* Status: Endangered (EN), Vulnerable (VU), Migratory Marine (MM), Migratory Terrestrial (MT), Migratory Wetland (MW), Listed Marine (LM); EPBC (Protected Matters Search Tool), 5 km buffer from mine site, habitat or species "may or likely to occur in the area".

<sup>2</sup> *South Australian National Parks and Wildlife Act, 1972* (NPWA) Status: Endangered (E); Vulnerable (V); Rare (R).

<sup>3</sup> For references and further detail see Appendix J.

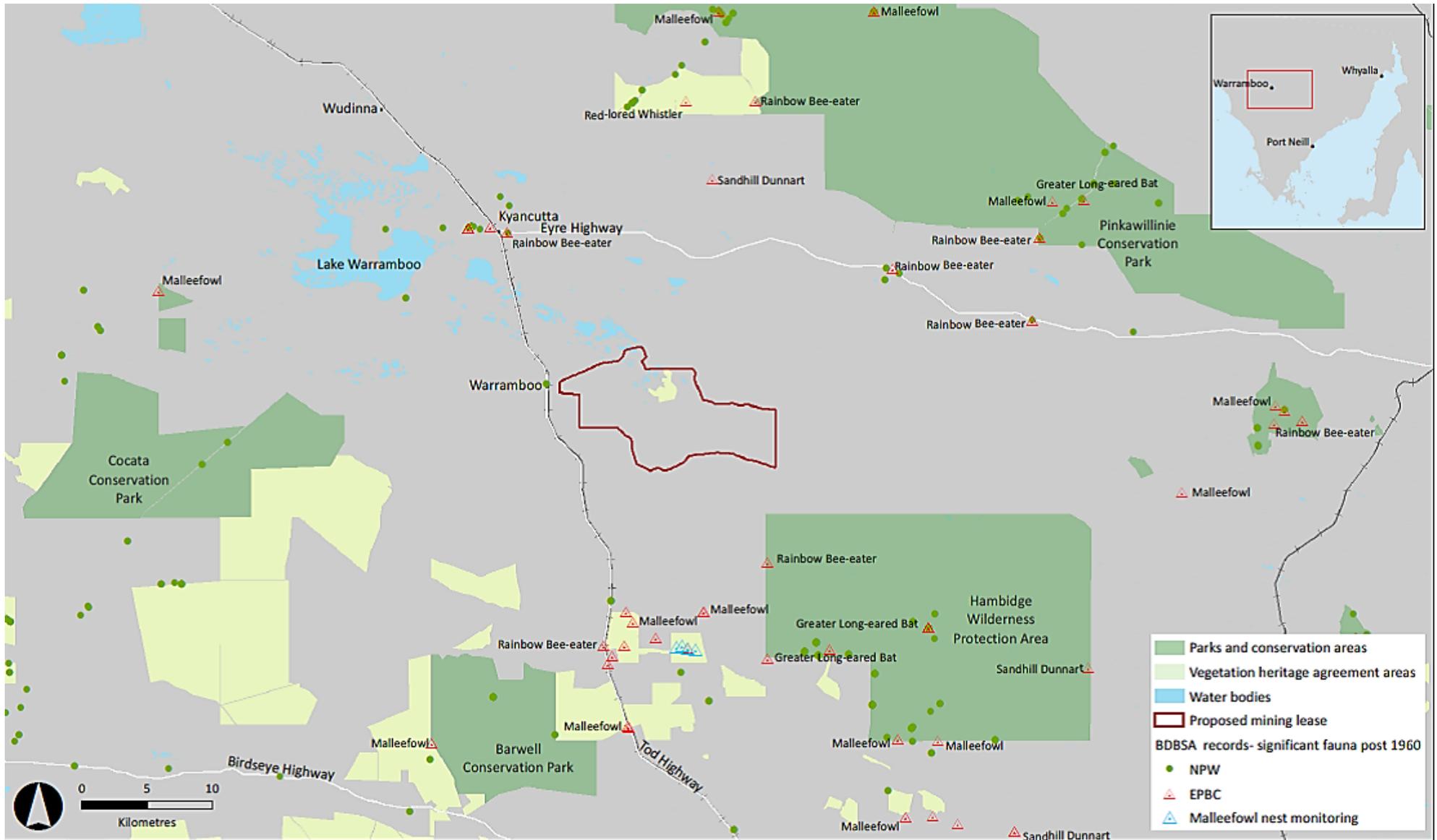


Figure 11-2 Historical Threatened and Migratory Fauna Records of Proposed Mining Lease Area and Surrounds (labels only provided for EPBC listed fauna)

### 11.3.5 Lake Warrambo Complex

The Lake Warrambo complex is located approximately 1.2 km to the northwest of the mine site boundary (see Figure 11-2). This area was included in the study area for the mine site to determine whether there were any groundwater impacts as a result of the proposed mine. The Lake Warrambo complex is comprised of numerous low-lying saline depressions that vary in size, the smaller depressions ranging from 2.3 ha to 56 ha. There are also three larger depressions of 380 ha, 240 ha and 124 ha that rarely hold any water. The lower-lying depressions are typically seasonally inundated for short periods in winter and spring following local rainfall and are characterised by saline localised clayey and silty soils. Numerous low sandy accumulations are scattered throughout the basins and shallow lunettes are present on the south eastern margins of the larger depressions. In addition, smaller depressions between dunal crests are also inundated by winter rains and these ephemeral waterholes retain water for several months before evaporating in spring and summer.

The Lake Warrambo complex is surrounded by cleared cropping land and most areas have been historically grazed by livestock resulting in the proliferation of exotic species throughout the ground storey. In addition, the widespread clearance of the predominantly mallee vegetation communities for agriculture has led to reduced evapotranspiration, increased recharge from rainfall and the subsequent rise of saline groundwater. This has resulted in the die-off of deeper rooted and less salt tolerant tree and shrub species such as Boree and mallee that once fringed the depressions.

Three main habitats are present in the Lake Warrambo complex, namely:

- Saline basins with Brown-head Samphire (*Tecticornia indica* ssp. *leiostachya*) and Grey Samphire (*T. halocnemoides* ssp. *halocnemoides*) open low shrubland with scattered low shrubs including Leafy Sea Heath (*Frankenia foliata*), opposite leaf bluebush (*Maireana oppositifolia*).
- Shallow sandy rises and lunettes support Bladder Saltbush (*Atriplex vesicaria*) / Brown-head Samphire low open shrubland often with a sparse cover of the tall shrub Boree (*Melaleuca pauperifolia* ssp. *mutica*) +/- White Mallee (*Eucalyptus gracilis*) and an understorey dominated by exotic grass and herb species.
- Shallow interdune basins with temporary saline depressions fringed by sparse Summer Red Mallee (*Eucalyptus socialis*), Boree and Dryland Tea Tree (*Melaleuca lanceolata*) on the adjoining sand dunes and scattered patches of Brown-head Samphire lining the margins of the saline depressions. Local landowners advise that these depressions typically fill following significant rainfall events, hold for short periods and are usually dry during summer months.

Further detail about the vegetation of this area is provided in Chapter 12, Vegetation and Weeds.

The saline depressions associated within the Lake Warrambo Complex form a small proportion of a similar habitat found scattered throughout northern Eyre Peninsula. Lake Warrambo may provide limited foraging habitat for short periods following rain, though it is apparent that the environment is highly saline as a result of historic clearance and consequential elevated groundwater and it is not considered likely to support significant macroinvertebrate or crustacean populations as a reliable food source for waders. Surface water appears to be the current and historical cause of inundation.

The Slender-billed Thornbill (NPW rating) is potentially present within the Lake Warrambo Complex in the better quality samphire and chenopod habitat fringing the lakes. However, the majority of the samphire and chenopod habitat is in poor to moderate condition, subject to edge effects from surrounding agricultural land and subject to impacts of sheep grazing. It is unlikely that this complex forms core habitat for this species.

### 11.3.6 Introduced Fauna and Pest Species

A total of 10 introduced fauna species (five mammals and five birds) potentially occur within or adjacent to the mine site (see Table 11-3). There are Biological Database of SA records for most of these pest fauna within 5 km of the mine site. Although the potential presence of remaining fauna was not supported by corresponding BDBSA records, regional records occur and they are known to exist in the greater Eyre Peninsula region (DEH 2002, Brandle 2010).

It is likely that the BDBSA dataset underestimates the presence of other common introduced species, particularly birds, which are often overlooked by the average observer when submitting formal records (in comparison to sightings of threatened species). A total of seven of the introduced fauna listed in Table 11-3 are confirmed as present in the mine site area (Appendix J). This includes four mammals and three birds. All the identified pest fauna, mammals in particular, are considered to pose a significant threat to natural biodiversity in Australia.

In addition, exotic invertebrates can impact native flora and fauna. On the Eyre Peninsula known pest invertebrates include Honeybees (*Apis mellifera*), the Egyptian Beetle (*Blaps polycresta*), the European Wasp (*Vespa germanica*) and Australian Plague Locust (*Chortoicetes terminifera*) (DEH 2002). These insects impact native fauna through habitat destruction and / or competition. In addition, control of pest insect species through spraying of insecticide can potentially threaten a number of conservation significant vertebrate and invertebrate fauna (DEH 2002). The Common White Snail (*Cerutuella virgata*) also occurs in the region. This snail generally occurs on fence posts and cereal stems, but has been recorded feeding on native plants and is becoming a significant pest problem in South Australia (Biosecurity Fact Sheet 2013).

Table 11-3 Introduced Fauna Species within the Proposed Mine site

Common Name	Species Name	Occurrence	Justification for Occurrence <sup>1</sup>
Cat	<i>Felis catus</i>	Present	PMST - likely to occur, no records within 5 km, regional BDBSA records (2001, 10 km), recorded during field survey.
Common Blackbird	<i>Turdus merula</i>	Present	No records within 5 km, recorded during field survey.
Common Starling	<i>Sturnus vulgaris</i>	Present	PMST - likely to occur, BDBSA records within 5 km (2001), recorded during field survey.
European Goldfinch	<i>Carduelis Carduelis</i>	Likely	PMST - likely to occur, no BDBSA records within region.
European Red Fox	<i>Vulpes vulpes</i>	Present	PMST - likely to occur, no records within 5 km, regional BDBSA records (1969, 15km), recorded during field survey and opportunistic sightings in 2011 (infrastructure corridor survey).
Goat	<i>Capra hircus</i>	Likely	PMST - likely to occur, no records within 5 km, regional BDBSA records (2003, >32 km).
House Mouse	<i>Mus musculus</i>	Present	PMST - likely to occur, no records within 5 km (2001), recorded during field survey.
House Sparrow	<i>Passer domesticus</i>	Present	PMST - likely to occur, records within 5 km (2001), recorded during field survey.
Rabbit	<i>Oryctolagus cuniculus</i>	Present	PMST - likely to occur, no records within 5 km, regional BDBSA records (2001, 13 km), recorded during field survey.
Rock Pigeon	<i>Columbia livia</i>	Likely	PMST - likely to occur, no BDBSA records within region.

<sup>1</sup>PMST – EPBC Protected Matters Search Tool invasive species likelihood of occurrence recommendation; BDBSA = Biological Database South Australia.



Plate 11-8 Feral Fauna Presence on the Eyre Peninsula

### 11.3.7 Summary of Key Environment Values

The majority of the vegetation within the mine site is in moderate to poor condition and highly fragmented, as a result of historical clearing and agricultural practices. The largely isolated patches of vegetation are therefore likely to provide moderate habitat, at best and the mine site as a whole represents poor habitat for native fauna. Faunal diversity at the site includes common native fauna, a number of feral pest animals and a small number of conservation significant fauna, primarily State listed bird species. Likelihood assessments suggested there is potential for several EPBC fauna to utilise habitat within the mine site, but in general these species are likely to be occasional visitors to the area. Better quality habitat that would support fauna populations of greater viability and in greater numbers, occurs southeast of the mine site area in Hambidge WPA. Feral pests that occur within the mine site represent an ongoing threat to common fauna and particularly any conservation significant fauna that may occur within the area.

Habitat deterioration has also occurred as a result of the rising saline water table, evidenced by dead woodland trees, surficial salt scarring and salt tolerant plants communities. Water ponding may remain for several weeks in saline depressions after heavy rain, generally only in winter when rainfall exceeds evaporation. As surface water interacts with the salt pans and quickly becomes saline, these ponds can be expected to only support a low diversity of macro-invertebrates and provide limited feeding habitat for birds. Such ponding is common across the landscape following rain events.

The Lake Warrambo Complex is surrounded by cleared cropping land and provides degraded habitat that has historically been grazed. Whilst this area is periodically inundated via surface water providing ephemeral habitat for some fauna, salinity levels and weed invasion reduce the quality of the habitat. It is unlikely that the Lake Warrambo Complex provides critical habitat to common fauna or conservation significant fauna.

## 11.4 Context and Views of Affected Parties

Stakeholders relevant to native fauna and introduced species include:

- The Department of the Environment (Commonwealth)
- The Eyre Peninsula Natural Resources Management Board
- The Department of Environment Water and Natural Resources
- The Native Vegetation Council (for vegetation (habitat) clearance, though it is noted that authority for vegetation clearance is delegated to Department of State Development for the purposes of a Mining Lease Proposal)
- Wudinna DC
- Local naturalist groups
- Members of the community

The key environmental value identified by stakeholders is the importance of threatened fauna species that have the potential to occur within the mine site and surrounding areas. Long-term management and mitigation of impacts to threatened fauna are important to the key stakeholders.

Stakeholders are seeking the following outcomes in relation to native fauna and introduced species at the mine site and surrounds (with Impact Event ID referencing Appendix C):

- No impacts to Malleefowl which are known from the Eyre Peninsula region (IM\_11\_02, IM\_11\_04, IM\_11\_05)
- Effective management of existing and no introduction of new pest species to the area (e.g. Common White Snail, *Ceratomyxa virgata*) (IM\_11\_07, IM\_11\_08, IM\_11\_10)
- No impacts to fauna (birds) that may be utilising the complex of salt pans and depressions (Lake Warramboe) (PIM\_11\_14)
- No impacts upon species of national significance which are Protected Matters under the EPBC Act and State listed species protected under the NPW Act (IM\_11\_02, IM\_11\_04)

All issues raised by stakeholders across the entire project are presented in Chapter 5. Impacts and risks relevant to each of the existing environmental values associated with native fauna and potential issues identified by stakeholders are discussed below and summarised in Table 11-6. The Impact and Risk Register in Appendix C presents all impact events across the entire project.

## 11.5 Potentially Impacting Events

Considering the views and contexts of affected parties and the issues raised during technical studies, an assessment of Source Pathway Receptor (SPR) has been undertaken, as per the methodology outlined in Chapter 6, to determine which potential impact events are considered applicable to this project. Potential impact events associated with the construction, operation and closure of the mine site that have a confirmed SPR linkage which effects native fauna and pest species include:

- Removal of vegetation which represents habitat for fauna (IM\_11-01, 11-02)
- Direct mortality or indirect mortality of fauna (including conservation significant) as a result of vegetation clearance or other human induced activities (IM\_11-03, 11-04, 11-05, 11-06, 11-09, 11-13, 11-17)
- Increase in feral animals and pest species (IM\_11-07, 11-08, 11-10)
- Altered fauna behaviour as a result of light and noise (IM\_11-11, 11-12)
- Introduction and spread of weeds in fauna habitat (IM\_11-19)
- Activities that might lead to bushfire and injury or death to fauna and/or loss of habitat (IM\_11-18)

- Establishment of fauna habitat through rehabilitation, landscaping and landform creation (IM\_11-14, 11-15, 11-16)

For native fauna and pest species, a number of potential impact events (listed below) are not considered further as there is no confirmed linkage between source, pathway and receptor, as demonstrated in Appendix C. These include:

- Loss of habitat at the Lake Warrambo complex as a result of reduced groundwater elevation due to pit dewatering, as this is not expected to harm the limited environmental values (PIM\_11-14). This is discussed further below.
- Stress or mortality of native fauna as a result of poor water quality within eventual pit lake, as the water within the pit lake will not contain any contaminants of concern (PIM\_11-20, Chapter 19)

### 11.5.1 Altered Habitat at Adjacent Saltpans

Groundwater modelling undertaken as part of the environmental impact assessment for the proposed mine indicates that groundwater levels beneath the Lake Warrambo complex north of the mine site boundary may drop by 1 to 5 m as a result of pit dewatering required to access the mine pit (refer to Chapter 19 Groundwater for further details). This has the potential to impact the ephemeral lake complex including the existing hydrological regime and any groundwater dependent ecosystems that provide fauna habitat.

The lake complex is made up of a series of depressions and low lying saline pans. The deeper depressions remain ephemeral (pers. comm. with landholder), are hyper-saline and devoid of vegetation within the extent of inundation. Given the high salinity of surface water and the lack of submerged plant structure, these areas are considered unlikely to support a diverse range of macro-invertebrate species and therefore provide limited foraging habitat for wader species. Consequently, these habitats are not considered of critical importance to fauna.

The shallower depressions and saline pans support salt tolerant samphire communities with evidence of dead and senescing boree shrubs and mallee, common as a result of saline groundwater incursion into their root zones (Plate 13-9). Low shrubland is evident around elevated fringes (salt-bush) where boree and mallee persist. Significant agricultural weed incursion occurs throughout. The predicted reduction in the groundwater table level may result in minor changes to primarily degraded vegetation communities within the salt pans as the elevated saline groundwater level decreases. It is considered likely that the areas which are currently devoid of vegetation as a result of salt scarring may revert to seasonally inundated samphire low open shrubland communities, more representative of their natural state and that this may provide more productive foraging habitat for waders and terrestrial species. In addition, a change in water table is predicted to result in improved survival and recruitment of boree and mallee communities that fringe the depressions. These deep-rooted species have been severely impacted by rising saline groundwater as a result of historic regional vegetation clearance with populations observed to be senescing with no recruitment. A potential lowering of the groundwater table may arrest the decline of this community. Whilst the dead boree and mallee provide some hollows for fauna to utilise, living trees would provide more resources for a greater diversity and number of fauna (e.g. food from flowers, roosting opportunities, shade, refuge for invertebrates – a resource for reptiles, birds and mammals).



**Plate 11-9 Dead Boree and Samphire as a Result of Elevated Groundwater**

Where sub-soils in these areas are saturated by groundwater, surface water may pool quicker in depressions and remain longer, compared to areas where sub-soils are unsaturated. Consequently, a lowering of the groundwater table may result in saline depressions being inundated for shorter periods. If this occurs, however, the reduced groundwater contribution will also reduce salinity, making the inundated areas more suitable for macroinvertebrates. Consequently, this is not expected to result in an adverse impact on fauna.

For an SPR linkage to exist, the source and pathway must result in a negative impact (harm) to a receptor (an environmental value). The current elevated groundwater level at Lake Warrambo is causing harm to the ecological values that remain in this disturbed landscape. A reduction in groundwater level will not cause increased harm to the ecological values. Instead, it is plausible that a lowering of saline groundwater may enable the stressed and senescing shrub (boree) and mallee vegetation at the site to rejuvenate, reduced salinity levels in soils may enable viable seed stock to propagate and reduced soil salinity (and therefore surface water salinity) may result in a higher diversity of macroinvertebrates during periods of inundation. A reduction in groundwater levels is therefore not considered to be a viable pathway for adverse impact upon the Lake Warrambo complex. Consequently, this has not been assessed further as an impact event.

## 11.6 Control Measures to Protect Environmental Values

The following section identifies design measures and management or control strategies which will be implemented to mitigate the level of impact and risk associated with fauna, such that it is considered to be as low as reasonably possible (ALARP).

### 11.6.1 Design Measures

The following design control measures have been incorporated to minimise impacts and risks to native fauna as a result of activities involved with the construction, operation and closure of the proposed mine:

- The final proposed integrated waste landform design requires significantly less land (approximately 3,000 ha less) than the previous tailings storage and waste rock facility designs considered, resulting in a reduced requirement for habitat clearance.
- The integrated waste landform design proposed results in a significant reduction in water usage for processing (approximately 70 % / 31 GL), thereby reducing the risk of elevating saline groundwater and impacting surrounding habitat for fauna.
- Lighting design technologies to minimise unnecessary night lighting impacts to fauna (e.g. birds, bats). Light spill will be reduced wherever practicable by managing the spread and direction of lighting, using screens and directional lighting and avoiding high UV wavelength insect-attracting light globes.
- Waste to be contained and managed on-site or removed to an authorised regional waste management centre to avoid attracting pest animals.
- Establishment of designated haul routes and light vehicle roads on-site to restrict vegetation (habitat) impacts to designated areas.
- Establishment of bunded vehicle washdown areas with controlled surface water runoff to maintain weed hygiene practices and reduce weed impacts to native fauna habitat.
- Pit base (and subsequent lake) designed to be unattractive to fauna.
- Construction of bund around pit during closure.
- Dust design measures as per (Chapter 15) to minimise impacts to fauna habitat via dust impacts to vegetation.
- Noise design measures as per (Chapter 16) to minimise noise impacts to fauna.

### 11.6.2 Management Strategies and Commitments

In order to minimise and mitigate impacts to native fauna, or increases in pest species as a result of construction, operation and closure activities, control and management strategies will be incorporated into the PEPR and implemented for relevant project phases. Key control and management strategies are outlined in Table 11-4.

Table 11-4 Control and Management Strategies: Native Fauna and Pest Species

Control and Management Strategies	Project Phase
<b>Fauna habitat reduction (vegetation impacts)</b>	
<p>Develop and implement vegetation management programme to minimise degradation and loss of fauna habitat, including:</p> <ul style="list-style-type: none"> <li>• All vegetation clearance will be restricted to the approved footprint.</li> <li>• Disturbance footprints will be minimised by using existing tracks and designated tracks established for the project only.</li> <li>• Areas approved for vegetation clearance will be clearly marked with pegs and/or flagging tape.</li> <li>• Clearance contractors will be supervised to ensure no unauthorised vegetation clearance occurs.</li> <li>• Vegetation clearance will be staged and progressive rehabilitation will be undertaken where practicable, to minimise and stagger loss of habitat.</li> <li>• Improvements will be made to available fauna habitat in the local region as part of Native Vegetation SEB offsets (e.g. rehabilitation activities to improve poor to moderate vegetation, establishment and protection of new native vegetation blocks).</li> </ul> <p>Further details on Control and Management Strategies for vegetation are provided in Chapter 12.</p>	<p>Construction Operation Closure</p>
<p>Weed management plan will be incorporated into the PEPR with strategies to be developed in consultation with EP NRM Board and local landowners to reduce impacts to fauna habitat, as per Chapter 12.</p>	<p>Construction Operation Closure</p>
<p>Existing topsoils and sub-soils which contain native seed bank will be stockpiled and used to maximise success of site rehabilitation (e.g. the Integrated Waste Landform), as outlined in Chapter 12 and 13.</p>	<p>Construction Closure</p>
<p>Erosion and surface water runoff controls will be implemented, as outlined in Chapter 13 and 20.</p>	<p>Construction Operation Closure</p>
<p>Dust impacts to vegetation (fauna habitat) will be minimised through implementation of the PEPR air quality requirement as outlined in Chapter 15.</p>	<p>Construction Operation Closure</p>
<p>The Integrated Waste Landform will undergo progressive trials and rehabilitation to minimise loss of fauna habitat at the site via establishment of new habitat on the landform as quickly as is practicable.</p>	<p>Construction Closure</p>
<b>Fauna mortalities</b>	
<p>Measures to reduce direct or indirect fauna mortalities include:</p> <ul style="list-style-type: none"> <li>• Speed limits on site to reduce risk of vehicle strike.</li> <li>• Speed limits for vegetation excavators to maximise chance of fauna escape.</li> <li>• Temporary fencing of trenches and excavations which are left open for more than a week during construction.</li> <li>• Provision of ramps and refuges within all long-term open trenches during construction to minimise stress on any trapped fauna and to allow them to escape.</li> <li>• Regular monitoring of fencing and long-term trenches for trapped fauna in accordance with regular site safety checks during construction and operation.</li> <li>• Qualified fauna handling expert be present on site during construction to remove any trapped animals from trenches and to manage displaced fauna during vegetation clearance. Species details to be recorded (to enhance survey information). Humanely disposal of feral animals captured following Wildlife Ethics Committee protocols.</li> <li>• Education regarding conservation significant fauna (and associated habitat) and animal welfare issues for all staff and contractors via awareness training (e.g. during site inductions, notice board fact sheets).</li> </ul>	<p>Construction Operation Closure Post closure</p>

Control and Management Strategies	Project Phase
<ul style="list-style-type: none"> <li>Education regarding potential recreational impacts to regional fauna (and flora as habitat) as a result of increased population through awareness training of staff and families (e.g. during site inductions, notice board fact sheets).</li> <li>Construction of fence around pit post closure and arrangements developed for ongoing maintenance.</li> </ul>	
<b>Pest fauna</b>	
Develop and implement pest management actions as part of the PEPR to reduce impacts to native fauna from predation and resource competition. Strategies include: <ul style="list-style-type: none"> <li>Implement regular audits of waste storage facilities as per Chapter 14.</li> <li>Implement waste management strategies identified in Chapter 14 (Waste Management), in particular, implement an incident reporting process for regular pests (e.g. fox, cat, rabbit) and potential new pests (e.g. Common White Snail) as part of broader site environmental management. This will also enable high level monitoring of pest numbers across the site to track seasonal and operational changes.</li> <li>Implement adaptive management practices when required, including identification of the cause of any increase in pest animal numbers and development and implementation of control strategies where required, such as trapping, controlled baiting programmes or controlled culling in co-ordination with the Eyre Peninsula NRM Board.</li> </ul>	Construction Operation Closure
<b>Noise</b>	
Noise impacts to native fauna during construction and operation will be managed through implementation of the site wide noise management strategies outlined in Chapter 16, which are to be included in the PEPR.	Construction Operation
<b>Light</b>	
Strategies to manage lighting impacts to fauna will be outlined within the PEPR and will include: <ul style="list-style-type: none"> <li>Construction and operational lighting kept to a minimum to reduce light spill and potential impacts to fauna behaviour.</li> </ul>	Construction Operation

## 11.7 Impact and Risk Assessment

This section identifies and assesses impact and risk associated with existing fauna values as a result of the construction, operation and closure of the proposed mine. Impact events (confirmed by presence of a source, pathway and receptor) are those which are predicted to occur as a result of the development, whilst risk events would not be expected as part of the normal operation of the project, but could occur as a result of uncertainty in the impact assessment process. Although the risks may or may not eventuate, the purpose of the risk assessment process is to identify management and mitigation measures required to reduce the identified risks to a level that is ALARP. This assessment has been undertaken in accordance with the methodology outlined in Chapter 6.

Impact and risk events were identified through technical studies and stakeholder consultation. Impact events can include multiple sources, pathways or receptors and where practical have been grouped together to minimise duplication of information. Risks are events that would not be expected as part of the normal operation of the project, but could occur as a result of either uncertainties with the impact assessment, or as a result of faults, failures and unplanned events. A summary of impact and risk events relating to native fauna is presented in Table 11-6 at the end of this section (with Impact IDs). A complete register of impact and risk events by source, pathway and receptor is provided in Appendix C.

Impacts and risks are assessed following the application of the design measures outlined in Section 11.6. Where required, management measures are proposed to reduce the impact to a level that is ALARP. Through the adoption of design modification or specific mitigation measures, all identified impacts were categorised as low (or negligible) and all risks were considered low (with the exception of bushfire risks to fauna). All impacts and risks were considered ALARP. The key environmental risks would be monitored through the environmental management framework.

### 11.7.1 Reduction of Habitat Through Vegetation Clearance

Construction of the mine will require clearance of vegetation for the establishment and maintenance of associated mine infrastructure, ore extraction and development of the integrated waste landform, which will result in impacts to fauna as a result of loss of habitat (see Chapter 12 for impacts to native vegetation).

Vegetation type (and therefore broadly the habitat type) present across the mine site is common throughout the central Eyre Peninsula. This native vegetation, which provides habitat for fauna, is restricted to small and isolated patches within an agricultural landscape. In addition, within the mine site there are areas of remnant native vegetation where saline groundwater is close to the surface and there is evidence of stress to vegetation and a transition to salt-tolerant communities. There is little presence of conservation significant fauna at the site and common fauna communities (e.g. reptiles and mammals) were noted to be lacking in species diversity and abundance, which is commensurate with the degraded nature of the habitat present. Whilst the degraded nature of the habitat at the site does not lend itself for use as a core refuge for many fauna species, highly mobile fauna would likely move to vegetation patches within and surrounding the mine site during disturbance or clearance activities.

Given the control strategies outlined in Section 11.5 (minimisation of clearance, staged clearance, environmental offsets via an approved Significant Environmental Benefit), impacts to common fauna will primarily be associated with habitat reduction as a direct result of vegetation clearance. There may be short-term impacts to some small mammals and reptile species as well as less mobile nocturnal species. There are unlikely to be long-term impacts to regional (or even local) populations of common fauna. Impacts can be minimised by use of local flora species in revegetation and rehabilitation programmes as part of the wider CEIP to enhance available habitat and floral resources in the region. As such, reduction of habitat through vegetation clearance associated with the mine is considered to represent a **low** impact to common fauna populations (localised and short term).

Similarly, given that most conservation significant fauna are considered unlikely to be present within the mine site (with four State-listed species being considered present in small or transient numbers), impacts to individual conservation significant fauna species range from negligible to low (see Table 11-5). Overall there may be short-term impacts to conservation significant species (if present), but there are unlikely to be long-term impacts to populations of conservation significant fauna in the region (or even locally). Impacts can be minimised by use of local flora species in revegetation and rehabilitation programmes as part of the wider CEIP, to enhance available habitat and floral resources. As such, reduction of habitat through vegetation clearance associated with the mine is considered to represent a **low** impact to conservation significant fauna populations (short term and localised).

A risk remains that unauthorised clearance of native vegetation may occur if control measures fail, resulting in a greater area of clearance than anticipated. This would result in similar impacts to native fauna and conservation listed fauna as authorised clearance, such as habitat removal, fragmentation or disturbance. Given that all clearance of native vegetation will be subject to approval under the Native Vegetation Act (and a requirement for a commensurate Significant Environmental Benefit offset for any clearance), unauthorised clearance could only occur if there is a breakdown of clearance protocols and associated compensations or equipment failure. A further risk, more relevant to species of conservation significance, is that habitat values on the site may have been under-estimated, reflecting the uncertainties inherent in any fauna study.

The consequences to general fauna from additional habitat removal would be considered **minor** given the proposed mine is largely in a cleared area; localised short-term impacts that would be remediated in the future through the SEB offset programme. With strict clearance protocols in place based on the design and control measures outlined in Table 11-4 of Section 11.6 above (clear delineation of clearance areas prior to commencing clearance, supervision of clearance contractors and the fact that conservative clearance approvals will be sought), it is considered (conservatively) **possible** that unauthorised clearance will occur during the life of the project. In the event that unauthorised clearance of native vegetation did occur, the risks to the habitat of general fauna are therefore considered to be **low**.

Likelihood assessments considered that there is both limited habitat and limited presence of conservation significant fauna within the mine site. While it is possible that the presence of conservation significant fauna may be greater than expected, there is sufficient knowledge on the habitat requirements for these species and of the habitat quality on the proposed mining lease to rule out any potential for regional impacts. In a worst case and taking account of the limited potential for unauthorised clearance, the project could result in a local long-term decrease in abundance of conservation significant species without reduction in local population viability, i.e. a medium consequence. Given the strict clearance controls and the good understanding of habitat on site, this consequence is considered to be unlikely. The risk is therefore considered to be **medium**.

### 11.7.2 Direct or Indirect Mortality of Conservation Significant Fauna

During vegetation clearance activities, including earth disturbance, there is potential for direct mortality of conservation significant fauna. There may be impacts to individual small mammals and reptiles, nocturnal species and less mobile species, as vehicles and machinery move through vegetation, however these are considered unlikely to be conservation significant fauna. In addition, fauna mortality could occur through vehicle strike, accidental capture in trenches or fencing required during construction and operation.

The likelihood assessments determined that four migratory birds possibly occur at (or visit) the site and four conservation significant fauna (one EPBC, three NPW Act) are known to occur within the study area (see Table 11-5). In reality, most of these species are likely to occur as rare visitors at the site and are not expected to be solely reliant upon the fragmented habitat found within the study area. Therefore, it is not expected that construction and operation of the proposed mine would significantly impact these species. In general, impacts may occur to individuals (or small isolated sub-populations) as a result of vegetation clearance and other site activities, however most individuals are likely to move away from the area, with the exception of some less mobile smaller mammals that are unlikely to be conservation listed mammals. Small reptiles may be impacted, however the species that occur at the site, occur commonly throughout the region and none have conservation ratings. Impacts to a species as a whole and viable populations are unlikely to occur as a result of the project.

Impacts to conservation significant fauna as a result of the construction and operation of the proposed mine have been based on assessments of the existing vegetation and habitat condition at the site and the interpreted presence and abundance of conservation significant fauna at the mine site and surrounds. Justification comments for potential impacts to conservation species that may occur within the mine site are provided in Table 11-5. For conservation significant fauna species that do occur, impacts are likely to be negative short-term changes or changes that will not be detectable to the population as a whole, hence impacts to conservation significant fauna are considered to be **low** to **negligible** depending on the species (see Table 11-5).

Based on the above it is acknowledged that vegetation clearance, vehicle movement, erection of fencing and excavation of trenches would occur as part of normal operations and may result in impacts to conservation significant fauna. There is a risk however that such activities may result in greater impacts to conservation significant fauna than described above. This could occur if there is a breakdown in protocols or if numbers of conservation significant fauna that occur on the site are higher than predicted. Although likelihood assessments of conservation listed species (i.e. likelihood of presence at the site) are based on field results, historical data, current reference information and ecological knowledge, such fauna are often difficult to detect and occur in lower numbers than common fauna. In addition, species may move into an area, e.g. when seasonal conditions change, nearby habitat is removed or destroyed or a food resource becomes abundant.

Design and control measures outlined in Table 11-4 of Section 11.6 above, include conservative clearance approvals, inclusion of buffers in clearance areas for mobilisation of vehicles and equipment, speed limits, education of site-staff and monitoring of open trenches and fencing. Based on this, along with the existing fragmented and degraded nature of the habitat within the mine site and confidence in the predictions about the conservation significant fauna considered to occur at the site, the consequences to conservation listed fauna are considered to be **minor**; localised short-term impacts to individuals that would not affect local populations. It is considered **possible** that direct or indirect mortality to conservation significant fauna will occur during the life of the project. Therefore, the risks to a species of conservation significant fauna in excess of impacts described above are considered to be **low**.

Table 11-5 Summary of Impacts to Conservation Significant Fauna

Common Name	Species Name	EPBC Act <sup>1</sup>	NPW Act <sup>2</sup>	Occurrence	Justification for Impact Potential <sup>1</sup>	Impact
Gilbert's Whistler	<i>Pachycephala inornata</i>	-	R	Present	Occupies diverse habitats, including Chenopod shrublands, Mallee and open shrublands which are common to central Eyre Peninsula and the study area. Observed commonly at sites 2 and 3 during mine site survey. Known from other surveys of the Eyre Peninsula. Mobile species that will move away from the area during disturbance. Suitable habitat surrounding mine site for species to move to. Impacts to local populations are likely to be short-term or below notable changes.	Low
Rainbow Bee-eater	<i>Merops ornatus</i>	MT, LM	-	Present	Occurs throughout Australia, eastern Indonesia and Papua New Guinea, breeding primarily on Rottneest Island (WA) and islands southwest of Torres Strait. In SA key known populations occur in Dengali CP. Was observed at site 2 of the mine site located within remnant vegetation within HA 869. Highly mobile, widely ranging species, uses a broad range of habitat types. Not expected that habitat of the study area is critical to the species. Likely to move away from the area during construction and operation.	Negligible
Restless Flycatcher	<i>Myiagra inquieta</i>	-	R	Present	Woodland bird, uses cleared land and variety of open forest to inland scrub habitats across semi-arid and temperate zones of SA. Often seen in farmland and similar habitats to common Willie Wagtail. Only recorded at site 3 during mine site survey (low open Mallee woodland with tall and low open shrubland). Extremely mobile and active species that will move away from the area during disturbance. Suitable habitat surrounding mine site for species to move to. Impacts to local populations are likely to be short-term or below notable changes.	Low
Slender-billed Thornbill	<i>Acanthiza iredalei iredalei</i>	-	R	Present	Core habitat is Chenopod shrubland dominated by Samphire, Bluebush or Saltbush, but may range into Mallee grassy woodlands and dense heathy shrublands. Transient population recorded at sites 2 and 3 in the shrub layer below Mallee canopy, not recorded at site 5 (dominated by Samphire). Mobile species that will move away from the area during disturbance, but nests may be present. Suitable habitat surrounding mine site for species to move to. Impacts to local populations are likely to be short-term or below notable changes.	Low

Common Name	Species Name	EPBC Act <sup>1</sup>	NPW Act <sup>2</sup>	Occurrence	Justification for Impact Potential <sup>1</sup>	Impact
White-winged Chough	<i>Corcorax melanorhamphos</i>	-	R	Present	On the Eyre Peninsula, species occurs at the western limit of distribution and is widespread in tall mallee woodlands. Observed in the mine site at site 5 and opportunistically in roadside Mallee. Mobile species that will move away from the area during disturbance. Suitable habitat surrounding mine site area for species to move to. Possible that communal nest sites may be present within mine site. Impacts to local populations are likely to be short-term or below notable changes.	Low
Cattle Egret	<i>Ardea ibis</i>	MW, LM	R	Possible	Highly mobile species, may utilise the sites low lying 'salt pans' whilst holding water, or surrounding pasture habitats, but not expected to be reliant upon habitat features present within study area and only occurs as a rare visitor to the region.	Negligible
Fork-tailed Swift	<i>Apus pacificus</i>	MM, LM	-	Possible	Highly mobile and transient in nature, ranging across Australia and overseas. Not expected to be present at the site during clearance and not solely reliant upon habitat found within study area.	Negligible
Oriental Plover	<i>Charadrius veredus</i>	MW, LM	-	Possible	Highly mobile species, migrating annually between Mongolia, China and Australia. Breeding occurs in the northern hemisphere. Vast amount of suitable habitat found across Australia, not considered likely to be present at the site during clearance and not likely to be directly reliant upon habitat features contained within study area.	Negligible
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	MT, LM	E	Possible	May be present as an occasional visitor, but likely to occur in habitat closer to the coastline. Not expected to be reliant on habitat within the mine site.	Negligible
Great Egret / White Egret	<i>Ardea modesta</i>	MM, MW, LM	-	Unlikely	May be present as a transient through the site, but not expected to be reliant upon the habitat within the mine site, prefers wetland habitat and is highly mobile, therefore impacts are likely to be below notable changes.	Negligible
Greater Long-eared Bat	<i>Nyctophilus timoriensis</i>	V	-	Unlikely	SE form – now 'South-eastern Long-eared Bat' (now <i>N. corbeni</i> ). Listed form unlikely to occur in study area, occurs in the South East of SA. Limited suitable habitat available in study area. If individuals occurred, impacts would be below notable changes. Impacts to the species as a whole are highly unlikely.	Negligible
Grey Currawong (north western spp.)	<i>Strepera versicolor plumbea</i>	-	E	Unlikely	Site is outside known distribution of north western subspecies. Regional records likely for <i>Strepera versicolor intermedia</i> (subspecies with no formal legislative protection). Highly unlikely to occur, therefore impacts are likely to be below notable changes.	Negligible

Common Name	Species Name	EPBC Act <sup>1</sup>	NPW Act <sup>2</sup>	Occurrence	Justification for Impact Potential <sup>1</sup>	Impact
Jacky Winter (south eastern spp.)	<i>Microeca fascinans ssp. fascinans</i>	-	R	Unlikely	Site is outside of known distribution. The non-protected 'assimillis' subspecies is common in this region and was observed during the mine site survey. Regional records likely to be for subspecies with no formal legislative protection. Highly unlikely to occur, therefore impacts are likely to be below notable changes.	Negligible
Malleefowl	<i>Leipoa ocellata</i>	V, MT	VU	Unlikely	Not located during targeted searches in mine site survey sites. Remaining vegetation in study area is primarily on dune crests, rather than swales where deeper soils and litter accumulate, therefore habitat considered not preferable for Malleefowl. If present, only as rare visitor, therefore any impacts are likely to be below notable changes.	Negligible
Osprey	<i>Pandion cristatus / P. haliatus<sup>6</sup></i>	LM	E	Unlikely	No suitable nesting habitat observed during field assessments. Mobile species, if individuals did occur in the area, they are likely to move away during disturbance activities. Impacts to individuals are unlikely. Listed Marine level of significance not applicable to terrestrial environment.	Negligible
Sandhill Dunnart	<i>Sminthopsis psammophila</i>	EN	V	Unlikely	Elusive species, known primarily from nine populations, in SA and WA. No suitable habitat of <i>Triodia</i> with older hummocks in ring formation within the study area. Remnant vegetation patches in study area are too isolated and fragmented. Species unlikely to occur within study area, therefore any impacts to the species as a whole are likely to be below notable changes.	Negligible

<sup>1</sup>Environment Protection and Biodiversity Conservation Act 1999 Status: Endangered (EN), Vulnerable (VU), Migratory Marine (MM), Migratory Terrestrial (MT), Migratory Wetland (MW), Listed Marine (LM).

<sup>2</sup>SA National Parks and Wildlife Act 1972 (NPW) Status: Endangered (E), Vulnerable (V), Rare (R).

<sup>3</sup>For references and further detail see Appendix J.

### 11.7.3 Direct or Indirect Injury or Mortality of General Fauna

Vegetation clearance and other activities associated with mine construction and operation have the potential to result in direct or indirect injury or mortality of general fauna (no conservation rating). There may be impacts to individual small mammals and reptiles, nocturnal species and less mobile species (including birds) as vehicles and machinery move through vegetation and disturb the ground. Temporary trenches will also be required as part of the construction of the mine and associated infrastructure and as a result, native fauna may fall into, or move into, open excavations. Fauna may also become trapped in fencing. In addition, pest fauna (e.g. foxes and cats) can utilise such structures to prey on native fauna. Post closure, mortality could occur through fauna falling into the pit or drowning in the pit lake.

Given the degraded, isolated and fragmented nature of the vegetation within the mine site, it is unlikely that significant populations of common local fauna occur, or that the remaining habitat on site represents regional strongholds for any specific species. Based on this, along with the control and measures presented in Section 11.6 to reduce the risk of fauna capture, injury or death (e.g. speed limits for excavators and vehicles, temporary fencing around trenches, ramps and shelters within open trenches, fauna handlers on site during clearance and plans for fauna release if captured or struck), impacts are likely to be short-term and localised when considering local populations of species. Injury and mortality impacts to general fauna as a result of vegetation clearance, vehicle strike and capture in trenches are considered to be **low**.

In addition to the impacts of injury or mortality of native fauna described above, there is a risk that these impacts may be higher than predicted. This could occur if there is a failure of management strategies (e.g. waste management protocols), if fauna are injured or die as a result of accidental capture in temporary trenches and excavations, or vehicle strike, or if numbers of general fauna within the site are higher than predicted, or if the site represents a habitat stronghold for a particular species. However, given the regional understanding of common fauna on the Eyre Peninsula, the baseline survey work undertaken in remnant patches within the site and the historic databases reviewed as part of the technical study of fauna in the region, there is only a low level of uncertainty around common fauna at the site and surrounds. The consequences beyond the described impact level to general fauna species as a result indirect or direct injury or mortality are considered to be **insignificant**; resulting in short-term losses to the local population of general fauna only. It is considered **possible** that direct or indirect mortality impacts to general fauna (beyond those predicted as an impact) will occur during the life of the project. Therefore the overall risk of general fauna mortality beyond a low level of impact to populations from vegetation clearance activities, trenches or excavations and vehicle strike is considered to be **low**.

The pit lake post closure potentially represents a hazard to fauna. The pit lake will be hypersaline and conditions at the bottom of the pit are only likely to support minimal vegetation growth. Consequently, the pit is unlikely to provide significant habitat for fauna. Given the expected low usage of this area by fauna, while it is **possible** that a small number of animals may drown in the pit lake or suffer injury or death, the consequence of such events would be **insignificant**. This risk is also considered to be **low**. As discussed in Chapter 18, pit water quality would be hypersaline but it would not contain any contaminants that would represent a hazard to birds.

#### 11.7.4 Increase in Feral and Pest Species Abundance

Vertebrate and invertebrate pest animal species are known to occur in the mine site and surrounds (see 11.3.6). Overabundant pest and native animals can threaten agriculture, industry and the health and safety of people (EPNRB 2009). Vertebrate pest levels are one of the major threats to native fauna, particularly threatened fauna in the region (DEH 2002, Brandle 2010). Small mammals, reptiles and ground-nesting birds (e.g. Malleefowl) are particularly at risk from predator pests such as foxes and cats. Other vertebrate pests can impact both native fauna and flora (e.g. rabbits and goats) through resource competition, weed spread and habitat degradation. Increases in pest bird species, as well as atypical numbers of native species (e.g. Silver Gulls, Ravens and Cockatoo species) can also be detrimental to native fauna populations through resource competition. Invertebrate pests (e.g. Common White Snail) can also impact native fauna through direct disturbance or competition and indirectly via control mechanisms such as insecticide.

Activities that may result in an increase of native and introduced pest fauna or increase in abundance of native fauna, particularly scavenging species, include unmanaged waste collection areas and landfill sites (breakdown of waste management protocols), increases in road-kill, increased human activity in the region resulting in an increase in recreational activities (e.g. camping, off-road driving, sight-seeing and riding), accidental transport within machinery, equipment or supplies (e.g. mice or invertebrate pests) an increase in cats and dogs as pets (which can potentially escape).

The Eyre Peninsula NRM Board assists the community in coordinating integrated pest management (between all stakeholders), which provides more successful outcomes for all. The Board's particular focus is on foxes and rabbits (EP NRM B 2009). Impacts to native fauna can also be exacerbated if pest control programmes are not well managed, for example, if the ratio of pest predators (cats, foxes) to pest prey (e.g. rabbits, mice) is out of balance, pest predators may focus more on native reptiles and mammals or pest prey may increase in number.

Based on the above, it is considered that construction and operation of the proposed mine may result in an increase in the number of vertebrate pests in the region. Given the design and control measures outlined in Section 11.6 (including incident reporting and adaptive management practices where required), coupled with existing management practices that occurs in the region and the low numbers of native fauna that exist on the site, impacts to native fauna as a result of increases in pest fauna are likely to be short-term and able to be remediated, hence impacts are considered to be **low**.

There is however a risk that construction and operation of the proposed mine may result in an increase in the number of vertebrate pests in the region, beyond the anticipated impact. In addition, there is the risk of introduction of new pests. This could occur if there was a breakdown in protocols (e.g. waste management, pest monitoring), during extreme seasonal conditions or if numbers of pests in the region are greater than predicted. Given the design and control measures outlined in Section 11.6 (audits of and active management of waste storage facilities, incident reporting of pest species and adaptive management where required), coupled with existing management practices that occur in the region, if increases in vertebrate pests as a result of the mine are encountered, the consequences to native fauna will be **insignificant**; localised with no effect on broader populations and, at worse, able to be remediated in the long term. It is considered that the likelihood of an increase in pest animal numbers at the mine site is **likely**, in that it may occur at some point during the mine life. Therefore the risk associated with an increase in existing site vertebrate pest levels beyond the low level of impact described above is considered to be **low**.

### 11.7.5 Altered Fauna Behaviour as a Result of Light

Lighting from construction and operation of the proposed mine could impact upon behaviour of native fauna. Potential pathways and sources of impacts to fauna from an introduction of light into the environment are day and night construction activities and lights at the mine site to allow 24-hour a day operation.

Introduction of artificial lighting to an area has the potential to affect local fauna and impact the ecosystem (Schelling 2006). Foraging behaviour, predator / prey interactions, reproduction, migration and social interactions of fauna could all be affected. Indirect impacts to flora that rely upon nocturnal pollinators are also possible. These impacts can occur as a direct result of the intensity, brightness, colour, direction or elevation of artificial light or be indirectly related to the increase in insects attracted to the light (Rich and Longcore 2006). In addition, an increase in insects (attracted to light) can result in an increase in predators up the food chain such as insectivorous microbats, geckos and some spiders. Some nocturnal bird species (e.g. owls) may then be attracted to the geckos and the microbats. The aerial predators that are attracted to artificial lights (e.g. microbats and owls) also may become disoriented resulting in collision with lighting structures. Similarly other birds (e.g. migratory birds) may become disoriented when attracted to artificial lighting, particularly on tall structures, resulting in collision with structures or be subject to exhaustion and increased predation (Gautheraux and Belser 2006; Monevecchi 2006 cited in BHP EIS 2009).

Lighting impacts are expected to occur throughout the life of the mine. There are no regulatory limits for lighting impacts to fauna. Fauna diversity within and immediately surround the mine site is already low. If native fauna remain in the area, rather than move into surrounding habitat (as is expected), short-term negative changes to fauna behaviour may occur and these changes would be detectable changes (e.g. there would be an increase in fauna activity near lighting structures or fauna mortalities below light structures). It is therefore considered that lighting impacts to fauna during the life of the mine, including construction, will be **low** as a result of the insignificant but detectable effects on fauna.

There is a risk that lighting impacts to fauna could be higher than expected. This could occur if design measures were not adequate to minimise fauna impacts. If this occurs the consequences to general native fauna are considered to be **minor**; local long-term behavioural effects that do not unduly affect the ecology of the population. Given the uncertainty around lighting impacts to fauna in general, it is considered **possible** that this event could occur during the life of the mine. As such, the risk rating of this event is considered to be **low**.

### 11.7.6 Altered Fauna Behaviour as a Result of Noise

Noise from construction and operation of the proposed mine could impact upon behaviour of native fauna. Potential pathways and sources of impacts to fauna from an introduction of noise into the environment are:

- Day and night construction activities
- General construction and operation noise, drilling and blasting above 48 dB (levels where fauna may exhibit stress – see below)

Increases in noise from background levels can impact native fauna. Changes to existing noise levels can affect the behaviour of fauna, including breeding behaviour and social interactions. This can ultimately affect fecundity of local individuals and populations. Noise impacts vary depending on the noise levels, frequency and duration of levels and are likely to be species (or body size) specific. For example, some studies on traffic noise suggest birds are affected when noise levels are above 55 dB(A) (Dooling and Popper 2007).

Both mammals and birds can be affected by noise, however bird hearing at higher and lower frequencies is reduced compared with mammals due to structural differences of the middle ear (Dooling and Popper 2007). Bird species are most sensitive to noise that occurs at frequencies where absolute hearing threshold is lowest (Dooling et al. 2000). A review of noise-induced hearing in birds indicated that continuous noise levels between 93 and 110 dB(A) may cause temporary hearing loss in birds, with higher levels possibly resulting in permanent loss (e.g. single blasting noise above 140 dB(A) or multiple passes of 125 dB(A)) (Dooling and Popper 2007). General traffic noise adjacent to highways does not normally exceed exposure criteria for noise-induced hearing damage in birds, however construction activities during road projects can induce hearing impacts for birds (Phoenix Environmental Services 2011). Whilst birds do have the ability to mask noise and alter the frequencies they use for communication, this varies per species and depends on ambient noise levels. Where ambient noise levels range between 50 to 55 dB(A), difficulties in acoustic communication between birds is likely to occur between 55 to 60 dB(A) (Dooling and Popper 2007). Similarly a number of studies have been undertaken for a range of mammals and reptiles, where animals showed stress where noise levels were above 48 dB(A) (Brumm and Slabbekoorn 2005, Patricelli and Blickley 2006, Warren et al. 2006, Christensen et al. 2011, Aitkin 1995).

For the proposed mine, habitat within the mine site will be extremely limited and the site is surrounded by agricultural land, hence significant blocks of habitat are limited immediately adjacent to the site. Examples of typical noise levels are provided in Chapter 16 (Noise), ranging from 15 db(A) for a woodland to 65 db (A) within a standard office. Chapter 16 outlines human noise criteria for rural areas that the project will be required to meet (e.g. maximum of 57 dB(A) during the day and maximum of 50 dB(A) at night). Noise modelling predicts that noise levels during operation will be 30 to 35 db(A) at the southern mine site boundary and would dissipate to less than 20 dB(A) at approximately 5 km from the southern boundary (noting that Hambidge WPA represents the closest significant patch of habitat at ~3.6 km from the south-eastern boundary of the mine). In addition, the highest predicted noise levels for surrounding sensitive human receiver (e.g. sensitive receiver number 96) are 31 dB(A) during the Construction phase. As such it is likely that some local fauna may become accustomed to the noise of the mine and remain in local habitat patches, whilst others will move away from an area and may or may not return when the noise levels subside. Some conservation significant species that have potential to periodically occur in the vicinity of the mine site area are particularly affected by disturbance (e.g. White-bellied Sea-eagle, Malleefowl) (see Table 11-2, Table 11-5). However, given the distance of Hambidge WPA from the noise-producing activities within the mine site, it is unlikely that such fauna would be impacted by noise from the mine.

In summary, there are no legislative noise criteria for fauna, but mammals are known to exhibit stress above noise levels of 48 dB(A) and birds have difficulties in communication when noise levels are above 55 to 60 dB(A). Chapter 16 (Noise) outlines human noise criteria for rural areas that the project will be required to meet (e.g. maximum of 57 dB(A) during the day and maximum of 50 dB(A) at night). In addition, noise modelling predicts 30 to 35 dB(A) day and night at the southern boundary of the mine site and this will dissipate to imperceptible levels (e.g. less than 20 dB(A) around the northern boundary of Hambidge WPA. Based on this, it is considered that noise impacts to local fauna may occur during construction and operation of the mine, but they will be short term or occur below detectable changes, hence impacts would be **negligible** to **low** depending on distance from the mine and the individual tolerances of the animal species.

There is a risk that noise impacts to fauna could be higher than expected. This could occur if there was a breakdown in management strategies or if design measures were not adequate. If this occurs the consequences to general native fauna are considered to be **minor** given the low levels of native fauna that occur across the site; local long-term behavioural affects that do not unduly affect the ecology of the population. Based on the limited understanding of noise impacts on specific fauna of the Eyre Peninsula region, it is considered **possible** that this risk will eventuate during the life of the mine. Based on this the risk of this event is considered to be **low**.

### 11.7.7 Establishment of Microhabitats on Integrated Waste Landform

The conceptual Integrated Waste Landform (IWL) design (see Appendix S) includes a number of features that may provide habitat benefits for fauna, including diversity in landform shape, microhabitat features and native vegetation of diverse height. The IWL would include outer slopes, benches, areas with cover of rocky strew, banded and / or contoured areas and top soil and subsoil. The planned rehabilitation of the IWL includes revegetation of the slopes and benches with native vegetation, which would provide areas for a diversity of local groundcover plant species to establish and areas for small mammals and reptiles to utilise. The proposed depth of the topsoil (15 cm) and subsoil (0.5 to 1 m) would also allow small mammals, reptiles and insects to establish burrows. Vegetation of the IWL with local provenance trees and shrubs (e.g. Chenopods such as Salt Bush, Acacia species) plus native grasses would also provide habitat opportunities for fauna. Further detail regarding the IWL concept design is provided in Appendix S. It is considered this would represent a positive change, would be long term and localised, hence this would be considered a **low benefit**.

### 11.7.8 Establishment of Fauna Habitat Through Revegetation

General rehabilitation, landscaping and screening (where required) on and adjacent to the mine site would provide some benefit to local fauna in terms of habitat and food resources. In addition to the staged rehabilitation of the IWL for long-term slope stability mentioned above, landscaping around the mine site (e.g. near office buildings, along internal roads and screening to reduce visual amenity impacts will incorporate local provenance plants). Whilst the main function of these plants would be to stabilise soil (reducing dust and erosion) and screen operations, they would also benefit local fauna by providing habitat resources. Groundcovers would provide refuge for small mammals, reptiles and birds, as well as food resources, particularly Chenopods and native grasses which often have small berries and seed that are consumed by a range of fauna. Shrubs such as Acacias and Melaleuca have deeper roots and would provide shade and roosting sites as well as seed and floral food resources for a range of fauna. Where higher screening is required, taller trees would be used; a number of Mallee species that occur in the region as well as Native Pine and taller Acacia species. It is considered that these revegetation activities would provide short to long term positive changes to local fauna within the local study area, hence this would be considered to be a **low benefit**.

### 11.7.9 Establishment of Fauna Habitat Through SEB

As mentioned earlier, clearance of vegetation is required for the project. Chapter 12 discusses the impacts of vegetation clearance and the associated Significant Environment Benefits that are required (under the Native Vegetation Act) to offset the impacts of clearance.

Discussions are underway between Iron Road, the EP NRM Board and the Nature Foundation regarding environmental programmes that would provide suitable offsets for the impact from vegetation clearance within the mine site. Fauna will benefit from such programmes through the establishment of good quality fauna habitat, such that a series of low to moderate quality patches of vegetation would be replaced by areas of habitat that have regional importance and align with regional NRM objectives (such as connectivity, low to no threats, viable patch size).

Conceptual options being considered for the SEB offset that would benefit native fauna include:

- Purchase of properties with existing native vegetation intact to protect and improve environmental values into the future. This would require a suitable property being available in the region to ensure equivalent value to that being impacted is protected and enhanced.
- Protection and enhancement of existing moderate condition remnant patches in the region via fencing, stock exclusions and / or weed control. Ideally to strengthen and create habitat linkages for fauna.

- Improving degraded and poor habitats through weed control and supplementary revegetation of missing vegetation strata (site specific for sustainability and success). Ideally these degraded habitats would provide linkages for fauna to disperse throughout the region.
- Creating landscape linkages by prioritising areas to improve / rehabilitate based on condition and size of nearby remnant vegetation patches.
- Contributions to local weed and pest control programmes to reduce threats to native fauna and enhance the ecological values of the region.
- Using local flora species to revegetate areas of the proposed mine to provide additional habitat and food resources for local fauna (as mentioned above).

It is anticipated that these offsets will provide positive long-term changes to the Eyre Peninsula region, providing benefit to general fauna and potentially conservation significant fauna, as such the benefit would be **medium**.

#### 11.7.10 Weed Impacts to Fauna Habitat

Control and management strategies will be in place to prevent weed introduction or exacerbation. Therefore, impacts on fauna from weeds are expected to be **negligible**. Weeds have the potential to degrade or replace native vegetation which results in a loss of habitat for native fauna; including general fauna and conservation listed fauna. There are a range of weeds that already exist within the mine site and there is still a risk that construction and operation activities could result in the spread of weeds or the introduction of new weeds onto the mine site (see Chapter 12 (Vegetation and Weeds)). Given the design and control measures that will be followed during construction and operation, spread of weeds should only occur if there is a breakdown of protocols (e.g. weed, soil and waste management, see 14.6.1). The consequences of any such weed event to fauna habitat are considered to be **minor**; short-term disturbance of locally common habitat features and able to be remediated. It is considered **unlikely** that spread of existing weeds or introduction of a new weed species (as a result of the mine) will impact fauna habitat throughout the life of the mine since the site and surrounds are already degraded and support numerous agricultural weeds. As such, the risk associated with the introduction of new weeds or spread of existing weed issues to fauna habitat is considered to be **low**.

#### 11.7.11 Bushfire Impacts to Native Fauna

Control and management strategies will be in place to prevent fires on the mine site. Therefore, impacts to native fauna as a result of a bushfire caused by construction and operation of the mine are expected to be **negligible**. However, there is still a risk of bushfire occurrence that could be related to mining operations. A bushfire can impact native fauna via habitat loss and direct mortality. Construction and operation activities that could result in bushfire include: system failure, inadequate emergency response, contractor or site visitor use of petrol vehicles near pasture stubble, welding activities and other hot works and improper storage or use of flammable materials. In addition, recreational activities as a result of increased workers to the region could result in bushfire that could impact native fauna.

Even with the design and control measures in place (as per Section 11.6), the consequence to native fauna could be **major** in a worst case scenario, regional reduction or loss of population viability or a regional long-term decreases in abundance of listed species. Given the degraded habitat and low general fauna presence (and even lower presence of conservation significant fauna) at the mine site and immediate surrounds and the control and management strategies that will be in place, it is considered **rare** that construction and operation of the proposed mine would result in a 'worst case' consequence bushfire that impacts native fauna. As such, the risks to fauna associated with bushfire caused by mining activities are considered to be **medium**.

### 11.7.12 Summary of Impacts and Risks

With the implementation of design and management measures, all residual negative impacts have been categorised as low or negligible. Similarly, all risks have been reduced to a level of medium or lower. The impacts and risks were considered to be ALARP and not warrant further specific control measures other than the environmental management controls and measures outlined here. A summary of each of the identified impacts and risks associated with native fauna and pest species at the mine site are presented in Table 11-6.

Table 11-6 Impact and Risk Summary: Native Fauna and Pest Species

Impact ID	Impact Event	Level of Impact <sup>1,2</sup>	Level of Risk <sup>3</sup>
IM_11-01 IM_11-02	Reduction of habitat (conservation significant and common fauna) through authorised or unauthorised vegetation clearance.	Low	Low
IM_11-04 IM_11-05 IM_11-13 IM_11-17	Direct or indirect mortality of conservation significant fauna during vegetation clearance, vehicle strike or accidental capture.	Negligible to low	Medium
IM_11-03 IM_11-06 IM_11-09 IM_11-13 IM_11-17	Direct or indirect mortality of general fauna during vegetation clearance, vehicle strike or accidental capture.	Low	Low
IM_11-11	Altered fauna behaviour as a result of light.	Low	Low
IM_11-12	Altered fauna behaviour as a result of noise.	Negligible to Low	Low
IM_11-14	Establishment of microhabitats on IWL for native fauna.	Low Benefit	–
IM_11-15	Establishment of fauna habitat through rehabilitation and landscaping within and adjacent to mine site.	Low Benefit	–
IM_11-16	Establishment of fauna habitat through rehabilitation and revegetation requirements of the SEB offset (outside of mine site).	Medium Benefit	–
IM_11-19	Weed impacts to fauna habitat.	Negligible	Low
IM_11-07 IM_11-08 IM_11-10	Increase in feral animal and pest animal presence.	Low	Low
IM_11-18	Bushfire impacts to native fauna.	Negligible	Medium

<sup>1</sup> For some events the impact level has a range, this relates to species-specific impacts or differences for common fauna compared to conservation significant fauna.

<sup>2</sup> Impact events are expected to occur as part of the project. Level of impact is assessed post control strategies, as per the impact assessment methodology provided in Chapter 6.

<sup>3</sup> Level of risk reflects the risk that the assessment of impact is incorrect due to uncertainties in the assessment method, the control strategies, or in assumptions used. Risk is assessed post control strategies, as per the risk assessment methodology provided in Chapter 6.

### 11.7.13 Justification and Acceptance of Residual Impact and Risk

With the implementation of design and operational management measures, all impacts associated with native fauna are considered to be **low** (or **negligible**) with the establishment of habitat in the region from the SEB offset considered to represent a medium benefit. Similarly, all risks have been reduced to a level of **low**, with the exception of fire that represents a **medium** risk. The impacts and risks are considered ALARP.

## 11.8 Proposed Outcome(s) and Criteria

In accordance with the methodology presented in Chapter 6, outcomes have been developed for all impact events with a confirmed linkage between source, pathway and receptor. Each outcome is supported by measureable assessment criteria that will be used to assess compliance against the proposed outcomes during the relevant phases (construction, operation, closure) of the project. Whilst outcomes may be the same for multiple impact events, separate measurement criteria and leading indicators are proposed to demonstrate compliance. Proposed outcomes and measurement criteria have been developed for each of the impact events identified with a confirmed linkage and these are presented in Table 11-7. Outcomes for the entire project are presented along with all impact events in Appendix C.

**Table 11-7 Outcomes and Measurement Criteria: Native Fauna and Pest Species**

Proposed Outcome	Impact ID	Impact Event	Draft Outcome Measurement Criteria	Draft Leading Indicator Criteria															
No loss of abundance or diversity of native vegetation on or off the mine site during construction, operation and post mine completion through: <ul style="list-style-type: none"> <li>• Clearance</li> <li>• Dust/contaminant deposition</li> <li>• Fire</li> <li>• Reduction in water supply</li> <li>• Salinisation, or</li> <li>• Other damage</li> </ul> Unless prior approval under the relevant legislation is obtained.	IM_11-01	Reduction of habitat (conservation significant and common fauna) through authorised or unauthorised vegetation clearance.	Annual vegetation audit demonstrates the total area cleared or damaged does not exceed the approved clearance area in the SEB plan.  Compliance with SEB plan.	None proposed															
	IM_11-02				No native fauna injuries or deaths due to construction, operation and closure activities that could reasonably have been prevented.	IM_11-04	Direct or indirect mortality of conservation significant fauna during vegetation clearance, vehicle strike or accidental capture.	Investigations of all native fauna deaths or injuries recorded on the mine site demonstrate that the mine operator did not cause, or could not have reasonably prevented, the deaths or injuries occurring.	None proposed	IM_11-05	IM_11-13	IM_11-17	IM_11-03	Direct or indirect mortality of general fauna during vegetation clearance, vehicle strike or accidental capture.	IM_11-06	Altered fauna behaviour as a result of light.	IM_11-09	IM_11-13	Altered fauna behaviour as a result of noise.
No native fauna injuries or deaths due to construction, operation and closure activities that could reasonably have been prevented.	IM_11-04	Direct or indirect mortality of conservation significant fauna during vegetation clearance, vehicle strike or accidental capture.	Investigations of all native fauna deaths or injuries recorded on the mine site demonstrate that the mine operator did not cause, or could not have reasonably prevented, the deaths or injuries occurring.	None proposed															
	IM_11-05																		
	IM_11-13																		
	IM_11-17																		
	IM_11-03	Direct or indirect mortality of general fauna during vegetation clearance, vehicle strike or accidental capture.																	
	IM_11-06	Altered fauna behaviour as a result of light.																	
IM_11-09																			
IM_11-13	Altered fauna behaviour as a result of noise.																		
IM_11-11																			
IM_11-12	Bushfire Impacts to native fauna.																		
IM_11-18																			

Proposed Outcome	Impact ID	Impact Event	Draft Outcome Measurement Criteria	Draft Leading Indicator Criteria
No introduction of new species of weeds, plant pathogens or pests (including feral animals), or sustained increase in abundance of existing weed or pest species on the mine site.	IM_11-07 IM_11-08 IM_11-10	Increase in feral animal and pest animal presence.	Annual survey demonstrates: <ul style="list-style-type: none"> <li>• No new weeds or feral animals have become established on the mine site.</li> <li>• There has not been a statistically significant increase in abundance of existing weed or pest species in the mine site area, compared to baseline studies and accounting for seasonal variation (regional trends) and pit/IWL areas.</li> </ul>	None proposed
	IM_11-19	Weed impacts to fauna habitat.		
Post mine completion, the risks to fauna from access to the open pit are as low as reasonably practicable.	IM_11-17	Direct mortality of fauna as a result of falling into pit lake.	Independent audit of the physical stability of the pit and physical barrier at mine completion demonstrates risks to fauna are as low as reasonably practicable.	None proposed

## 11.9 Findings and Conclusion

Fauna impacts within the mine site are expected as part of the proposed development and relate to vegetation clearance (e.g. loss of habitat, direct injury or mortality), groundwater modifications (e.g. altered habitat near salt pans), vehicle strike, excavation activities and the effects of noise and light.

Risks to fauna will be alleviated wherever possible through implementation of control and management strategies. Risks that were considered to be **low** included weed impacts to fauna habitat, increases in feral animals and pests resulting in changes to ecological interactions with native fauna, unauthorised clearance of native vegetation resulting in greater than anticipated habitat loss and accidental injury or death of fauna captured in trenches or excavation material. A **medium** level risk is underestimation of the presence of listed fauna within the mine site, potentially leading to greater than expected impacts to conservation listed fauna. The risk of bushfire as a result of the proposed mine is also considered to represent a **medium** risk to native fauna in that it may result in a regional reduction or loss of population viability or a regional long-term decrease in abundance of listed species.

**Low** level benefits of the project include the predicted reduction in groundwater level at the nearby salt pans which form part of the Lake Warrambo complex, establishment of microhabitat features on the slopes and benches of the IWL and establishment of fauna habitat through site rehabilitation, landscaping and screening. A **medium** benefit of the project would be the establishment of the SEB offset which would have a regional positive affect ideally aligning with regional objectives for native fauna.

The outcomes proposed ensure that IRD Mining will manage aspects related to native fauna and their environment in a proactive and responsible manner.