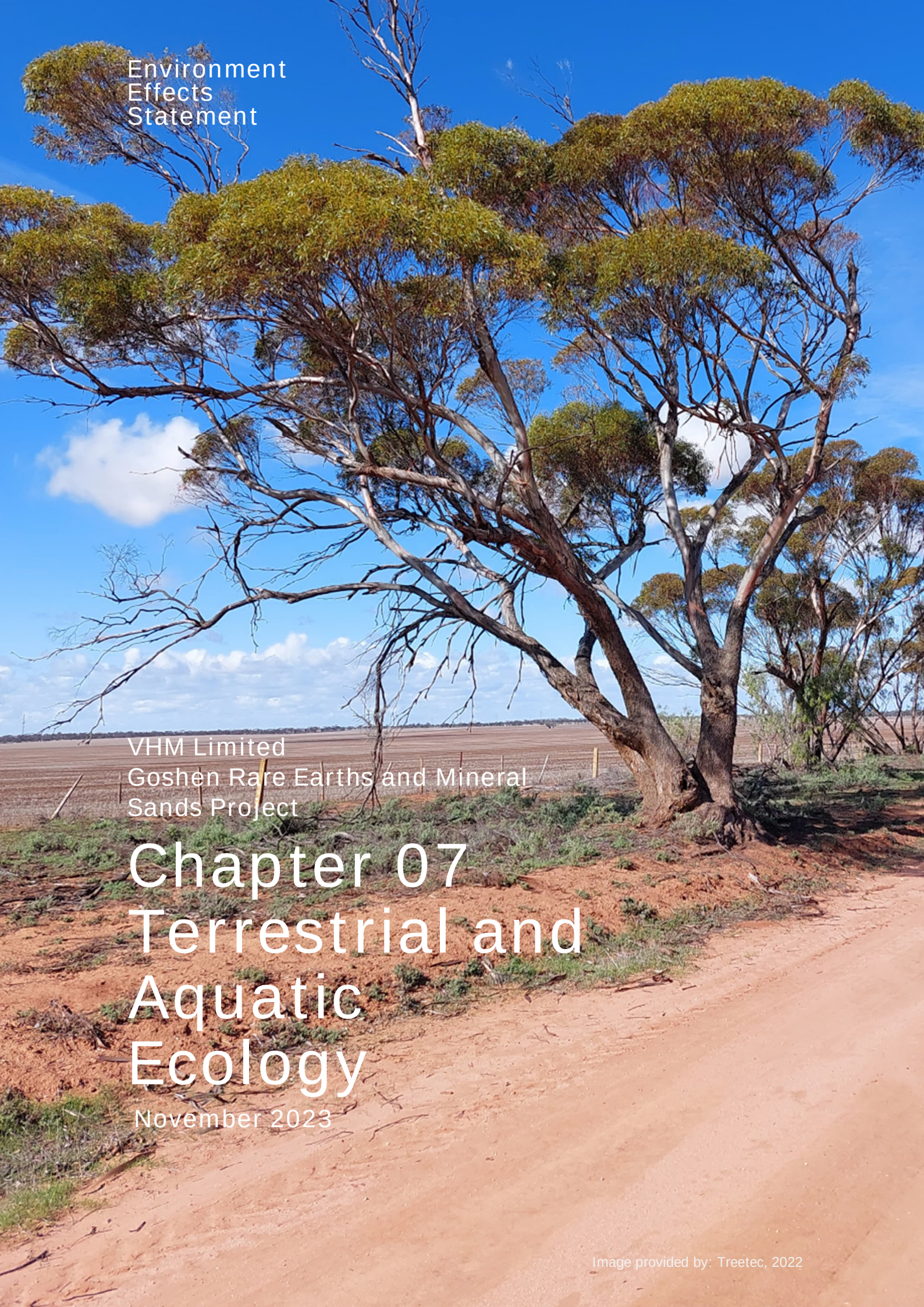
Environment
Effects
Statement

VHM Limited
Goshen Rare Earths and Mineral Sands Project

Chapter 07 Terrestrial and Aquatic Ecology

November 2023



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7. Terrestrial and aquatic ecology

This chapter provides an assessment of the terrestrial ecology impacts associated with the construction and operation of the Goshen Rare Earths and Mineral Sands Project (the Project), including flora, native vegetation and fauna impacts.

This chapter summarises the outcomes of Technical Report A: Native vegetation and flora impact assessment and Technical Report B: Fauna ecology impact assessment, prepared in support of the Environment Effects Statement (EES).

Overview

The Project would be located amongst extensively cleared agricultural land, generally used for broadacre farming and the production of wheat, barley, sheep and lambs. Vegetation in the Project area and its surrounds consists mostly of mallee trees and shrubs indicative of the Murray Mallee and Victorian Riverina Bioregions of north western Victoria. The four most common native trees identified during flora surveys were Dumosa Mallee, Oil Mallee, Red Mallee and Bull Mallee.

Construction activities for the Project would result in the loss of a total extent of 14.36 hectares of native vegetation, including 531 large trees in patches, 37 large scattered trees and 14 small scattered trees. This 'worst-case' scenario is based on the removal of all native vegetation within mine site Area 1 and Area 3 and it assumes the loss of all native understorey vegetation intersecting the six metre construction corridor along the length of the 38 kilometre underground pipeline, including 61 large trees in patches (as assessed by the arborist). Trees determined lost along the alignment of the underground water supply pipeline have been assumed lost considering a 10 percent encroachment of the tree protection zone. It is noted that trees along the pipeline alignment assumed lost would be left in-situ and there would be no habitat removal.

Six flora species listed as threatened under the state *Flora and Fauna Guarantee Act 1988* (FFG Act) were recorded within the development footprint of the Project during the native vegetation and flora impact assessment, and are considered likely to be impacted by the construction of the Project. These include Fragrant Saltbush (11 individuals), Umbrella Wattle (353 individuals), Yarran (17 individuals), Bush Minuria (18 individuals), Dwarf Myall (one individual) and Frosted Goosefoot (54 individuals). The Plains Mallee Box Woodlands, listed as a threatened ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), would also be impacted by the construction of the Project. Prior to the implementation of mitigation measures, approximately 11.347 hectares of Plains Mallee Box Woodlands would be removed.

There would not be any direct loss of conservation significant species from the construction of the Project, however conservation significant species such as Superb Parrot, Black Falcon, Diamond Firetail, Hooded Robin, Samphire Skink, Eastern Bearded Dragon and Eastern Great Egret may utilise fauna habitat in the study area, and the direct removal and fragmentation of native vegetation would result in losses of fauna habitat. Approximately 6.8 hectares of native vegetation would actually be removed as a result of construction activities within Project mining areas, plus an additional 0.27 hectares along transport routes. This would not cause a significant change to the network of remnant vegetation along road reserves that allow conservation significant species, in particular birds, to move across the landscape to larger conservation reserves. The removal of native vegetation during Project construction is not considered to impact habitat critical to the survival of Commonwealth and State listed fauna species.

The offset target for the proposed removal of native vegetation for this Project totals 4.819 general habitat units (GHU), plus 531 large trees in patches and 37 large scattered trees. Once offsets are secured, the impacts of the Project would be in line with the overarching objective of the Victorian native vegetation retention controls, namely, there would be 'no net loss' of biodiversity as a consequence of native vegetation removal for the Project. Offsets are not required for the Plains Mallee Box Woodlands threatened ecological community. The listing of this community occurred following the Project being determined as a 'Controlled Action' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The construction and operation of the Project would result in negligible impacts to Kangaroo Lake and associated aquatic fauna species. Construction of the pump station at Kangaroo Lake would have a relatively small footprint and impact upon low quality habitat. During operation, Project water demand would represent only an eight percent increase on the lake's current average daily demand.

Opportunities to avoid and minimise impacts to native vegetation have been undertaken at mine site Area 1 and Area 3. This has resulted in the retention of a total extent of 23.868 hectares of native vegetation, including 22.445 hectares in patches and 22 scattered trees at mine site Area 1 and a total extent of 41.375 hectares of native vegetation, including 40.497 hectares in patches and 17 scattered trees at mine site Area 3. Impacts to trees along the proposed underground water supply pipeline alignment were reduced to 61 trees from 1,844 trees following a preliminary arboricultural impact assessment.

Measures to minimise impacts to native vegetation would include engaging an arborist to assist with micro-siting the underground pipeline during construction and to identify additional measures to avoid adverse impacts to structural root zones and safeguard trees at the mine site and along the pipeline alignment.

During operation of the Project, there is not expected to be any direct impacts to fauna. Indirect impacts are considered the most likely threat to fauna and fauna habitat, however measures such as speed restrictions, buffers around the mine operations area, maintaining vehicle exhaust systems and utilising Commonwealth Light Pollution Guidelines (2020) for light installation would reduce the likelihood of indirect impacts.

EES evaluation objective

The scoping requirements provided by the Minister for Planning for the project set out the specific environmental matters to be investigated and documented in the Project's EES. The scoping requirements inform the extent and scope of the EES technical studies. The following EES evaluation objective is relevant to the terrestrial and aquatic biodiversity impact assessment:

To avoid or minimise potential adverse effects on biodiversity values within and near the site including native vegetation, listed threatened species and ecological communities, and habitat for these species, as well as address offset requirements for residual environmental effects consistent with state and commonwealth policies.

Technical Report A: Native vegetation and flora impact assessment and Technical Report B: Fauna ecology impact assessment were prepared in support of the Project EES. The technical reports provide more detailed information on the investigations and impact assessments conducted in response to the EES scoping requirements.

7.1 Methodology

The following approach was adopted for the native vegetation and flora impact assessment and fauna ecology impact assessment:

- Establishment of the study area.
- Characterisation of the existing environment.
- Review of the project description, comprising the key project components, proposed construction activities and proposed operation.
- Undertaking a desktop review of relevant databases, including:
  - Victorian biodiversity atlas (VBA).
  - EPBC Act Protected Matters Search Tool (PMST).
  - NatureKit.
  - FFG Act – Threatened list: Characteristics of threatened communities.
  - FFG Act – Threatened list.
  - FFG Act – Protected Flora list.
  - Native vegetation information management system (NVMIM).
- A review of previous assessments.
- A review of the preliminary arboricultural impact assessment and the desktop aquatic ecology assessment of Kangaroo Lake.
- Undertaking targeted field surveys to identify the potential and actual presence of fauna species, native vegetation, threatened species and threatened ecological communities consistent with Commonwealth and State guidelines. Flora and fauna survey locations included (but were not limited to) the Project mining areas, along the proposed pipeline alignment between Kangaroo Lake and the Project mine site, and at Kangaroo Lake.
- Assessment of impacts to native vegetation and flora and fauna ecology during construction and operation of the Project.
- Evaluation of the potential cumulative impacts (where relevant).
- Developing mitigation measures in response to identified impacts.
- Evaluating the residual environmental impacts once mitigation has been implemented.

In accordance with the Assessor's Handbook (DELWP 2018), the extent of native vegetation to be removed has been calculated by adding together the extent of any patches of native vegetation and the extent of any scattered trees.

- The extent of a patch is the area of the patch (including mapped wetland) being impacted (removed or destroyed) in hectares.
- The extent of a small scattered tree is the area of a circle with a 10 metre radius (with the trunk at the centre of the circle) in hectares.
- The extent of a large scattered tree (dead or alive) is the area of a circle with a 15 metre radius (with the trunk at the centre of the circle) in hectares.

Multi-stemmed trees, and trees with multi-stemmed coppice regrowth, are mapped and assessed as single trees. Their size is determined from the stem with the largest circumference at 1.3 metres above the ground.

Native vegetation occurring in the following locations was considered to be removed:

- Within the construction footprint of the Project mining areas (Area 1 and Area 3).
- Along the alignment for the underground water pipeline.
- At eight intersections along the transport route proposed to be widened.

In accordance with the Assessor's Handbook (DELWP 2018), unless an arborist report indicates otherwise, a tree is deemed lost when earthworks encroach on more than 10 percent of its Tree Protection Zone (TPZ). A TPZ is defined as an area around the trunk of the tree which has a radius of 12 times the diameter at breast (to a maximum of 15 metres but no less than two metres). Dead trees are treated in the same manner. This applies to canopy trees in native vegetation patches and scattered trees. This method was applied within the Project mining areas, the water supply pipeline alignment and at the eight road intersections.

For a long and linear development such as the water pipeline, where it is impractical for an arborist to individually assess every tree where more than 10 percent of the TPZ is impacted, an arborist can assess the proposal (rather than assessing each tree) (DELWP 2019). From this, an arborist can determine the likely impact of the Project on trees to decide whether they should be deemed lost based on impacts in the TPZ.

Supporting the native vegetation and flora impact assessment and the fauna ecology impact assessment, an arborist assessment was undertaken to assess route alternatives for the proposed underground water supply pipeline between Kangaroo Lake and the mine site, and a preliminary investigation of the aquatic biodiversity values of Kangaroo Lake was undertaken. The findings of each assessment have been included in this chapter. Further information is provided in EES Technical Report A: Native vegetation and flora impact assessment and EES Technical Report B: Fauna ecology impact assessment.

7.2 Study area

Native vegetation and flora

The study area for the native vegetation and flora impact assessment comprised the proposed mine site located approximately 30 kilometres south of Swan Hill, the proposed alignment of the 38 kilometre underground pipeline between Kangaroo Lake and the mine site and eight intersections surrounding the mine site proposed to be upgraded as a result of the Project (refer to Figure 7-1).

The study area included areas of targeted surveys, bounded by Kelly Road and Holmes Road to the north, Quambatook–Swan Hill Road to the east, Nalder Road and Lalbert–Kerang Road to the south and Donald–Swan Hill Road and Ultima Road to the west. The underground pipeline would run from Kangaroo Lake at the eastern extent of Mystic Park East Road, to the mine site. In addition, desktop analysis of existing records of threatened flora was undertaken within the 10 kilometre buffer zone around the Project area (refer to Figure 7-1).

The native vegetation and flora Impact assessment study area is presented in Figure 7-1.

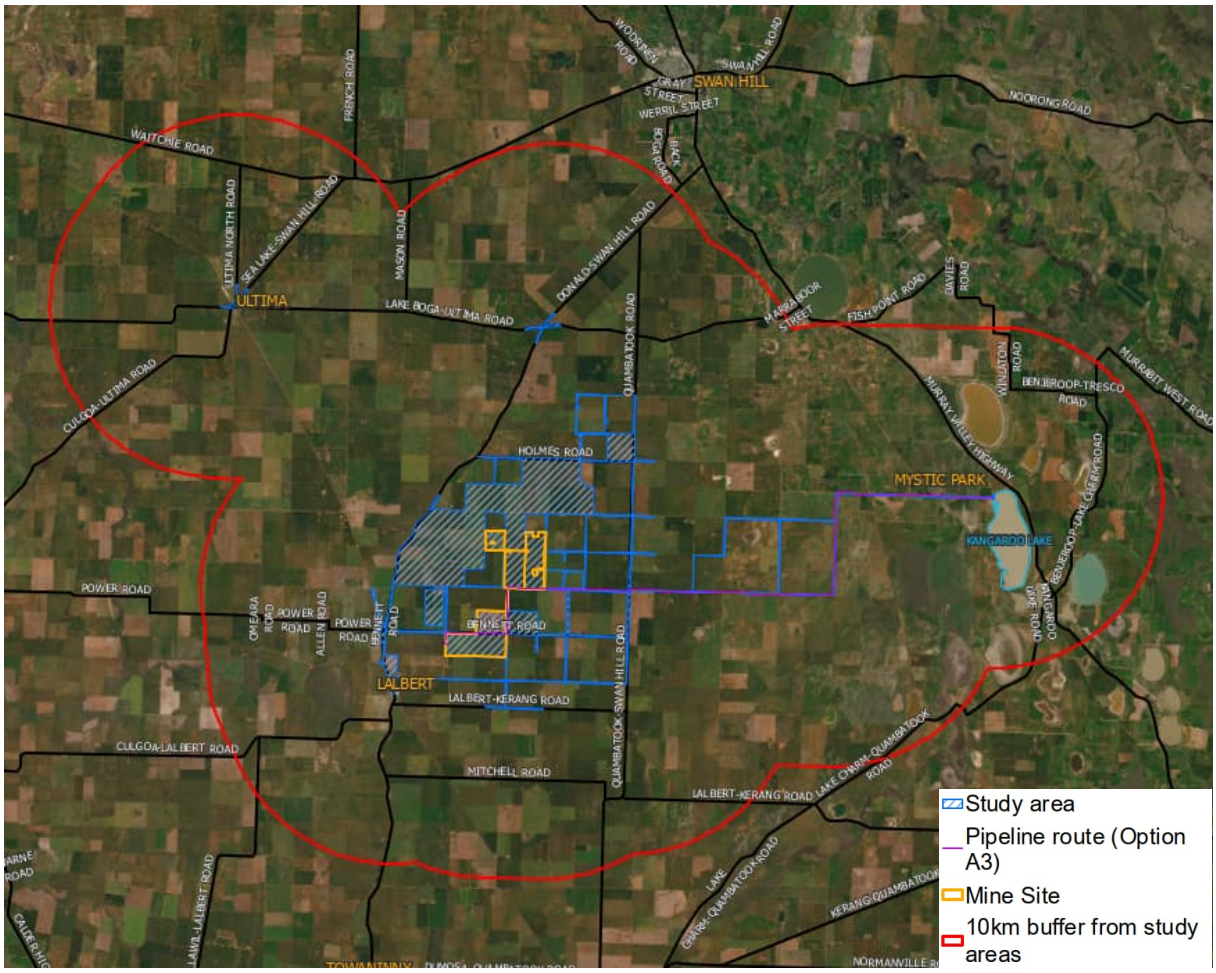

Figure 7-1 Native vegetation and flora impact assessment study area

Fauna ecology

The study area for the fauna ecology impact assessment included the mine site, the underground water supply pipeline and a 20 kilometre buffer surrounding the Project components.

7.3 Existing environment

A comprehensive assessment was undertaken to understand the existing environment of the study area to inform the native vegetation and flora impact assessment and fauna ecology impact assessment. These assessments included a review of relevant legislation, database searches, review of previous assessments and field-based assessments.

7.3.1 Native vegetation

The study area spans the Murray Mallee and Victorian Riverina Bioregions of north western Victoria. Bioregions are a landscape-scale approach to classifying the environment using a range of attributes, including vegetation, climate and geomorphology. Vegetation in the study area is largely characterised by mallee trees and shrubs. Mallee was found on red sands throughout the central and eastern parts of the study area. The western portion of the study area was on the edge of a floodplain and supported a healthy canopy of large Black Box trees.

The four most common canopy trees recorded during field assessments were Dumosa Mallee, Oil Mallee, Red Mallee and Bull Mallee. The understory often comprised a moderate layer of shrubs including Cattle Bush, Weeping Pittosporum, Sugarwood and Umbrella Wattle, as well as a diverse ground layer of saltbushes with Hedge Saltbush, Prickly Saltwort, Ruby Saltbush, Grey Copperburr and Black Cotton-bush. Native grasses and herbs were observed, but were generally sparse. Common herbs included Pale Twin-leaf and Variable Sida. During field assessments, 84 percent of the 119 recorded plant species were noted to be native species.

Figure 7-2 Woorinen Mallee (EVC 824) along a farm boundary

Under Victorian planning schemes, native vegetation is defined as plants that are indigenous to Victoria, including trees, shrubs, herbs, and grasses. Native vegetation in Victoria is classified into Ecological Vegetation Classes (EVC) based on floristic, structural, and ecological features. Each EVC has been assigned a 'benchmark' condition for each of Victoria's Bioregions. The EVC benchmark is used for comparison when assessing vegetation quality through a Vegetation Quality Assessment (VQA).

A total of 1220 habitat zones were recorded, mapped and assessed. Table 7-1 below presents the recorded EVCs and their Biodiversity Conservation Status (BCS) within the study area.

Table 7-1 Summary of native patch vegetation recorded in the study area

Ecological Vegetation Class	Bioregional conservation status	Number of habitat zones	Area (hectares)	Number of large trees in habitat zone
Woorinen Mallee (EVC 824) Murray Malley bioregion	Vulnerable	990	429.859	45,020
Ridged Plains Mallee (EVC 96) Murray Malley bioregion	Endangered	94	42.529	513
Semi-arid Woodland (EVC 97) Murray Mallee bioregion	Vulnerable	2	2.530	13
Plains Savannah (EVC 826) Murray Mallee and Victorian Riverina Bioregions	Endangered	38	9.709	89
Riverine Chenopod Woodland (EVC 103) Murray Malley Bioregion	Depleted	68	41.627	272

Ecological Vegetation Class	Bioregional conservation status	Number of habitat zones	Area (hectares)	Number of large trees in habitat zone
Riverine Chenopod Woodland (EVC 103) Victorian Riverina Bioregion	Vulnerable	26	15.252	4
Chenopod Grassland (EVC 829) Victorian Riverina Bioregion	Endangered	2	0.166	Not applicable
Total		1220	541.672	45,911

Woorinen Mallee (EVC 824) was considered to be the most dominant remnant vegetation type in the study area. This EVC was largely distinguished by the occurrence on red-brown sandy soils where chenopods were the dominant ground layer. Ridged Plains Mallee (EVC 96) occurred where the ground layer in the understorey supported a higher cover of graminoids. Both of these EVCs have a similar canopy, comprising of at least one of the four most common mallee eucalypts: Red Mallee, Dumosa Mallee, Oil Mallee and Bull Mallee.

Plains Savannah (EVC 826) was mapped in the study area when Buloke and/or Slender Cypress Pine formed a notable portion of the canopy. Riverine Chenopod Woodland (EVC 103) was distinguished by the presence of Black Box in the canopy. Semi-arid Woodland (EVC 97) was distinguished by a canopy dominance or co-dominance of Belah.

7.3.2 Threatened species

Matters of national environmental significance (MNES) are protected under national environment law (EPBC Act) and include (but are not limited to) threatened species and communities. The Victorian FFG Act identifies threatened species and communities that require management to minimise threats to those species and communities. The following section presents the flora and fauna species protected under the commonwealth EPBC Act and the state FFG Act that have the potential to be impacted by the Project.

Flora

Database searches indicated that there was potential suitable habitat for 13 threatened species listed under the Commonwealth EPBC Act and 81 threatened species listed under the Victorian FFG Act. Eight species were listed under both Acts.

Species considered 'likely to occur' are those that have a very high chance of being in the study area based on numerous records in the region and suitable habitat in the study area. Species considered to have the 'potential to occur' are those for which suitable habitat exists, but recent records are scarce.

Seven FFG Act listed threatened species were recorded during the field assessment and are considered likely to be impacted by the proposed development, from a total of 21 FFG Act listed threatened species that are considered likely or to have the potential to occur within the study area. These species are summarised in Table 7-2 below.

No EPBC Act listed threatened species were recorded in the study area during the field assessment and none are considered to have the potential to occur in the study area based on habitat suitability and a paucity of records. Refer to Technical Report A: Native vegetation and flora impact assessment for a complete list of threatened species listed under the EPBC Act and FFG Act.

Table 7-2 FFG Act listed threatened species considered likely to be impacted, or to have potential to occur within the study area based on database records

Name	Status (FFG Act)	Habitat	Number of records (VBA)	Date of last record	Likelihood of occurrence
Dwarf Myall	Endangered	Grows mostly on flats in sandy loam and loam over limestone, usually in mallee communities	14	30/06/2010	Recorded in a small number of instances in the study area

Name	Status (FFG Act)	Habitat	Number of records (VBA)	Date of last record	Likelihood of occurrence
Yarran	Critically Endangered	Scattered through north western Victoria, mostly along the Murray River and its flood plain, often in woodland	21	17/10/2018	Recorded in a small number of instances in the study area
Umbrella Wattle	Critically Endangered	Uncommon through north western Victoria, mainly found in calcareous sands or loam	35	17/10/2018	Recorded commonly in several patches of remnant mallee on roadsides within the study area
Buloke	Critically Endangered	Found in woodlands on non-calcareous soils, commonly grows with Grey Box	8	17/10/2018	Recorded as a canopy tree in a number of patches and occasionally as scattered paddock trees
Buloke Mistletoe	Critically Endangered	Previously widespread in western Victoria, but somewhat depleted due to small number of its host plant, Buloke	3	03/05/2004	The study area supports Buloke and records exist within close proximity to the study area. Likely to occur, but not recorded in targeted survey.
Spear-grass	Endangered	Known scattered sites in the west and north west, occurring in mallee and woodland formations	1	18/11/2003	One record within 10 kilometres of the study area. The study area supports suitable habitat. Potential to occur, but not recorded in targeted survey.
Frosted Goosefoot	Endangered	Occurs mainly on sand-ridges	1	13/10/2011	Recorded within study area
Frosted Goosefoot	Endangered	Mallee scrub and heavy soils	2	18/12/1995	Recorded within the study area
Veined Peppercress	Endangered	Often recorded in relatively bare sites with crusting red clay loam soils	2	07/11/2017	The study area supports at least some suitable habitat. Potential to occur, but not recorded in targeted survey.
Bush Minura	Vulnerable	Saline sand, clay or gypseous soils	5	07/11/2017	Recorded within the study area
Satin Daisy-bush	Endangered	Scattered on loamy soils with mallee in north west Victoria	1	05/09/1999	One record within 10 kilometres of the study area. The study area supports suitable habitat. Potential to occur, but not recorded in targeted survey.
Glandular Phebalium	Critically Endangered	Confined to mallee woodland in north west Victoria	13	10/12/2014	Numerous records exist within close proximity to the study area. The study area supports suitable habitat. Likely to occur, but not recorded in targeted survey
Fragrant Saltbush	Vulnerable	Steep rocky and broad ridges	1	29/05/2012	Recorded within study area during targeted survey.

Name	Status (FFG Act)	Habitat	Number of records (VBA)	Date of last record	Likelihood of occurrence
Spiny Goosefoot	Endangered	Occurring in red loamy soils, usually containing limestone in dune swales and on flat ground	6	19/11/2003	Records exist within close proximity to the study area. Likely to occur, but not recorded in targeted survey
Salt Copperburr	Endangered	Occurring on treeless, saline alluvial flats	1	10/07/2011	Other chenopod species occurred commonly in the understorey through much of the native vegetation recorded. Potential to occur in areas of Black Box woodland, but not recorded in targeted survey
Downy Swaisonpea	Endangered	Heavier clay soils in woodland	6	20/09/2019	Limited woodland habitat, though several records in the search region. Potential to occur in areas of Black Box woodland, but not recorded in targeted survey
Round Templetonia	Endangered	Favours deep sandy soils in mallee and woodland communities	6	10/07/2011	Records within close proximity to the study area. The study area supports suitable habitat. Likely to occur, but not recorded in targeted survey
Club-hair New Holland Daisy	Endangered	Grassland and grassy woodlands on better mallee soils and loams	1	24/10/1995	One record within 10 kilometres of the study area. The study area supports suitable habitat, but not recorded in targeted survey
Winged New Holland Daisy	Endangered	Confined to relatively clay-loam soils	7	29/05/2012	Two records within close proximity to the study area. The study area supports suitable habitat. Potential to occur, but not recorded in targeted survey
Three-nerved Wattle	Critically Endangered	Usually found in red earths or clays near water sources	None	-	No previous records within 10km. Recorded within study area.
Spreading Scurf-pea	Endangered	Known from very few collections in the far north-west of Victoria, growing in clay or sandy clay soils.	1	1/02/1982	Lack of recent records - single record from over 40 years ago, near (outside) of study area at Ultima, however study area contains suitable soil type. Potential to occur, but not recorded in targeted survey.

Of the FFG listed species recorded during field surveys, the following six species were recorded within the development footprint:

- Bush Minuria (18 individuals impacted)
- Dwarf Myall (one individual impacted)
- Fragrant Saltbush (11 individuals impacted)
- Frosted Goosefoot (54 individuals impacted)
- Umbrella Wattle (353 individuals impacted)
- Yarran (17 individuals impacted).

Terrestrial fauna

A database search indicated that three critically endangered, one endangered, seven vulnerable and two migratory fauna species listed under the EPBC Act were found within the study area. Twenty eight fauna species within the study area were listed as threatened under the FFG Act.

Of these listed species, fauna species with a medium or high likelihood of occurrence in the study area are presented in Table 7-3 below. A full table of listed fauna species within the study area is provided in EES Technical Report B: Fauna ecology impact assessment.

Table 7-3 EPBC Act and FFG Act listed threatened fauna species considered to be impacted

Name	Status (FFG Act)	Status (EPBC Act)	Habitat	Likelihood of occurrence
Birds				
Eastern Great Egret	Vulnerable	-	Prefers shallow water but may be seen on any watered area	One individual recorded from the study area during the June 2022 survey. High likelihood of occurrence
Freckled Duck	Endangered	-	Feeds in shallow water dabbling and/or filtering crustaceans aquatic seeds and grasses	Suitable habitat present, most recent record in 2020 at Lake Charm. High likelihood of occurrence
Curlew Sandpiper	Critical	Critical	Forages on exposed intertidal mudflats and occasionally on inland freshwater wetlands	Preferred habitat limited and very fragmented in region. Most recent database records are: 2020 Bael Bael; 2018 at Lake Kelly, Lake Tutchewop - northern end and Cullens Lake Wildlife Reserve. Medium likelihood of occurrence
Australasian Bittern	Critically Endangered	Endangered	Prefers vegetated shallow freshwater and brackish swamps	Suitable habitat present, recorded from the study area, some regional records. High likelihood of occurrence
Superb Parrot	Endangered	Vulnerable	Variety of habitats, typically forested areas and adjacent grasslands for foraging	One individual recorded from the study area during a 2018 survey. High likelihood of occurrence.
Regent Parrot	Vulnerable	Vulnerable	Riparian vegetation with River Red Gum and adjacent Black Box woodland. Also, farmland with remnant roadside woodland	Study area on eastern edge of species' dispersal range; dispersing individuals may pass through study area. No desktop records. Medium likelihood of occurrence
Painted Honeyeater	Vulnerable	Vulnerable	Dry open forest and woodland associated with mistletoe, rivers, plains and farmland	Some suitable habitat present and study area within distribution, no desktop records. Medium likelihood of occurrence.

Name	Status (FFG Act)	Status (EPBC Act)	Habitat	Likelihood of occurrence
Australian Bustard	Critically Endangered	-	Open grasslands and shrublands across Australia	Will utilise remnant mallee habitats and open agricultural areas on occasion, some regional records. Medium likelihood of occurrence
Grey-crowned Babbler	Vulnerable	-	Open forests and woodlands, little ground cover with plenty of fallen timber and leaf litter	Remnant mallee habitats are suitable and previous records adjacent to study area. Medium likelihood of occurrence
Bush Stone-curlew	Critically Endangered	-	Farmlands and grassy woodlands. Often shelters in dense vegetation	Remnant mallee habitats may provide suitable conditions. Previous records adjacent to study area. Medium likelihood of occurrence
Ground Cuckoo-shrike	Endangered	-	Variety of open woodlands and shrublands	Suitable habitat present, study area in species' distribution, some regional records. Medium likelihood of occurrence
Black Falcon	Critically Endangered	-	Tree-lined watercourses and isolated woodlands	Suitable habitat present, recorded from the study area, some regional records. High likelihood of occurrence
Diamond Firetail	Vulnerable	-	Grassy woodlands, heath and farmland with scattered trees	Suitable habitat present, study area in species' distribution, some regional records. High likelihood of occurrence
Hooded Robin	Vulnerable	-	Open forests, acacia shrubland and mallee, preferably diverse	Some suitable habitats present. Study area in species' distribution, some regional records. Medium likelihood of occurrence
Reptiles				
Samphire Skink	Endangered	-	Inhabits saline or gypseous areas on the margins of freshwater lakes in samphire and chenopod scrublands	Suitable habitat present, adjacent to pipeline alignment on Mystic Park-Beauchamp Road. Recent regional record in 2018. Medium likelihood of occurrence
Hooded Scaly-foot	Critically Endangered	-	Variety of habitats including stony plains, dry woodlands, mallee and mulga shrublands. Also, spinifex dominated desert grasslands	Suitable habitat present, adjacent to pipeline alignment. Recent regional record in 2018. Medium likelihood of occurrence
Carpet Python	Endangered	-	Riverine habitats and rocky areas in mallee shrubland, Callitris woodland and freshwater swamps. High density rabbit populations can attract the species	May occur when rabbit density is high, habitat is present and few regional records. High likelihood of occurrence
Eastern Bearded Dragon	Vulnerable	-	Dry woodlands, agricultural land and urban areas	Suitable habitat present, recorded from study area during multiple surveys, regional records. High likelihood of occurrence

A total of 191 mammal, bird, bat and reptile species were recorded during surveys between 2018 and 2022 at the Project mine sites, along proposed pipeline alignments and at Kangaroo Lake. Of these recorded species, only four were listed under the EPBC Act and/or FFG Act. They are:

- Eastern Bearded Dragon, recorded in 2018 and 2022.
- Eastern Great Egret, recorded in 2022.
- Superb Parrot, recorded in 2018.
- Black Falcon, recorded in 2018.

Suitable habitat is considered to be present within the study area for both Eastern Bearded Dragon and Black Falcon, and Eastern Great Egret at Kangaroo Lake and other waterbodies. Suitable habitat for the Superb Parrot is not considered present in the Project study area. It is considered that the presence of an individual Superb Parrot within the Project study area in 2018 does not indicate a continuum of the population east of the known distribution of the species. The individual was likely to be a vagrant or aviary escapee moving through, before utilising more suitable foraging habitat outside the Project study area.

Aquatic fauna

A desktop review was undertaken for aquatic fauna species either occurring, potentially occurring or potentially having habitat within 10 kilometres of Kangaroo Lake. The desktop review returned 41 aquatic fauna species, including 26 fish, eight amphibians, two aquatic reptiles, one aquatic mammal and one common aquatic invertebrate. Nine aquatic fauna species were listed under the FFG Act. Six aquatic fauna species were listed under the EPBC Act as follows:

- Flatheaded Galaxias (*Galaxias rostratus*) – EPBC Act Critically Endangered and FFG Act Vulnerable, two VBA records as recent as 1963 and associated with Lake Cullen and Third Reedy Lake.
- Freshwater Catfish (*Tandanus tandanus*) – FFG Act Endangered, five VBA records as recent as 1980/81 in Kangaroo Lake, Third Reedy Lake and Lake Charm.
- Murray Cod – EPBC Act Vulnerable and FFG Act Endangered, 16 VBA records as recent as 1981, however Victorian Fisheries Authority (VFA) stock tens of thousands each year into Kangaroo Lake.
- Murray Hardyhead (*Craterocephalus fluviatillis*) – EPBC Act Endangered and FFG Act Critically Endangered, 6 VBA records as recent as 1971, however there is a 2013 record from Middle Reedy Lake and a 2019 record from Third Reedy Lake.
- Silver Perch (*Bidyanus bidyanus*) – EPBC Act Critically Endangered and FFG Act Endangered, 21 VBA records as recent as 2021 in Third Reedy Lake, the connecting channel between Middle and Third Reedy Lake in 2013 and Lake Tutchewop, Lake Charm, Racecourse Lake and Middle Lake in 2007. In 1983, there was a record in Kangaroo Lake.
- Southern Purple Spotted Gudgeon – FFG Act Critically Endangered, six VBA records as recent as 2021 all associated with Third Reedy Lake. Three individuals were recorded in Kangaroo Lake in 2019, as well as Racecourse Lake.
- Trout Cod (*Macullochella macquariensis*) – EPBC Act and FFG Act Endangered, no existing records, species returned on PMST search as “species or species habitat may occur.
- Growling Grass Frog (*Litoria raniformis*) – EPBC Act and FFG Act Vulnerable, a single 2021 records of a dead individual being found near Winlaton approximately eight kilometres north north east of Kangaroo Lake. Nearest recent/valid records approximately 17 kilometres east at Chapels Crossing.
- Murray River Turtle (*Emydura macquarii*) – FFG Act Critically Endangered, four VBA records from as recent as 2021 in Third Reedy Lake and 1988 in Kangaroo Lake.

Murray Cod and Southern Purple Spotted Gudgeon are known to be present in Kangaroo Lake. Up to 50,000 Murray Cod are stocked annually into Kangaroo Lake by VFA as part of VFA’s ’10 million fish’ recreation fishing stocking program. Three individual Southern Purple Spotted Gudgeon were recorded in Kangaroo Lake during surveys.

Silver Perch is considered likely to be present in Kangaroo Lake. There was a 1983 record of Silver Perch in Kangaroo Lake and more recently in 2007 in Lake Tutchewop, Lake Charm, Racecourse Lake and Middle Lake. Given the direct connectedness of Racecourse Lake, it is highly likely that if still present, they would also be in Kangaroo Lake.

Murray Hardyhead and Growling Grass Frog are considered possibly present at Kangaroo Lake. There were records in 2019 of Murray Hardyhead in Third Reedy Lake and historical records from early 1970 of records in Lakes Cullen and Tutchewop. In 2021, there was a record of a dead Growling Grass Frog eight kilometres north north east of Kangaroo Lake, but suitable habitat is still present and only few surveys have been undertaken in the region.

The likelihood of occurrence assessment determined that the remaining EPBC and FFG-listed aquatic fauna species were unlikely or very unlikely to occur at Kangaroo Lake due to lack of habitat, or recent or nearby records.

7.3.3 Threatened ecological communities

Flora

Six ecological communities listed under the EPBC Act had the potential to occur in the study area. Two of these communities were identified within the study area.

Plains Mallee Box Woodland

Patches of native vegetation occurring within the proposed project footprint were assessed. Where information on patch quality was not available, a precautionary approach was taken and patches were considered to be of sufficient quality for listing where Black Mallee Box, Bull Mallee, Red Mallee or Dumosa Mallee were the dominant species of Eucalyptus, and the minimum patch size requirement of 0.5 hectare in conjunction with other nearby patches was met. This precautionary approach was also applied to all parts of the study area occurring outside the proposed Project footprint.

This community was found to occur extensively throughout the study area, comprising mostly of Woorinen Mallee (EVC 824) and Ridged Plains Mallee (EVC 96).

The listing of the Plains Mallee Box Woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions occurred post the Project being deemed a Controlled Action under the EPBC Act and cannot be assessed for that referral. Nonetheless, impacts to this community have been considered as part of the impact assessment, through the Project's approach to avoidance and minimisation and in the development of mitigation measures. Impacts to this community are discussed in Section 7.4.1 and Section 7.4.3 and mitigation measures are presented in Section 7.7. Further information is provided in EES Technical Report A: Flora impact assessment.

Buloke Woodlands

This community was classified as present where Buloke was noted to be the dominant or co-dominant canopy tree species in the patch, and the patch was at least 0.1 hectare in area. On this basis, seven habitat zones were classified as the listed community.

One ecological community listed under the FFG Act was considered to occur in the study area.

Semi-arid Shrubby Pine-Buloke Woodland Community

This community was distinguished by a canopy of Slender Cypress-pine and Buloke, over a characteristic shrub layer of Weeping Pittosporum, Cattlebush and various chenopods and herbs. This community is associated with the EPBC Act-listed *Buloke Woodlands.*

Fauna

The EPBC listed Mallee Bird Community of the Murray Darling Depression Bioregion was modelled to potentially occur in the study area. The Mallee Bird Community consists of an assemblage of 20 birds that are reliant on mallee habitat to persist. Six birds associated with the community were recorded over the duration of all surveys, none of which were listed as threatened at Commonwealth or State level. Conservation Advice provides the thresholds required to meet the criteria of the Mallee Bird Community of the Murray Darling Depression Bioregion. The presence of six mallee dependant species did not meet the threshold of three categories. The categories are presented in EES Technical Report B: Fauna impact assessment.

Additionally, the listing of the Mallee Bird Community of the Murray Darling Depression Bioregion occurred post the Project being deemed a Controlled Action under the EPBC Act and cannot be assessed for that referral. Nonetheless, impacts to birds within this community have been considered as part of the impact assessment through the avoid and minimise approach in relation to fauna habitat and by the implications of mitigation strategies.

Further information is provided in EES Technical Report B: Fauna impact assessment.

7.3.4 Kangaroo Lake

Kangaroo Lake, located approximately 30 kilometres east of the mine site, is one of 23 named lakes, marshes and swamps that form the Kerang Wetlands Ramsar site. Ramsar wetlands are recognised as a MNES under the EPBC Act and any action that has, will have, or is likely to have a significant impact on the ecological character of a Ramsar Wetland must be referred to the Commonwealth Minister and be subject to an environmental assessment and approval process. Under the Ramsar Convention, Kangaroo Lake is classified as a "permanent freshwater lake" and its primary contribution to the Ramsar site is its "special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna."

With a surface area of approximately 984 hectares and maximum depth of 8.4 metres, Kangaroo Lake is one of the largest and deepest permanent freshwater lakes in the Murray-Loddon region of the Murray-Darling Drainage Division. It is located within the Torrumbarry Irrigation System (TIS) area of the Loddon-Campaspe irrigation region.

Kangaroo Lake has a capacity of 39.7 GL and is generally maintained at greater than 36 GL. It is a major irrigation supply storage basin and high operational water levels in the lake are required to optimise water supply for regional irrigators with downstream water user demands.

Water would be sourced from Goulburn Murray Water at Kangaroo Lake via the open water market with no constraints put on existing or future agricultural availability. The water would be delivered via a new pumpstation adjacent to Kangaroo Lake accompanied by a 38 kilometre underground pipeline to be constructed beneath existing local road easements.

7.3.5 Declared pest plants, animals and pathogens

A total of 34 introduced flora species were recorded in the study area during the field assessment. The highest proportion of weed cover was from annual grasses, most of which had died off by the time of the February and April 2019 surveying. The most common broadleaf weed recorded was Common Heliotrope, a common farm weed that was present throughout most of the study area.

Two woody weeds were recorded in the study area, namely African Box-thorn and Prickly Pear. Introduced trees included Pepper Tree and Sugar Gum.

Eight weed species listed under the *Catchment and Land Protection Act 1994* (CaLP Act) were recorded in the study area including five species listed as regionally controlled. These are African Box-thorn, Field Dodder, Horehound, Paterson's Curse and Sticky Ground-cherry. Three species have been listed as restricted, namely Bridal Creeper, Onion Weed and Soursob. Of these eight CaLP Act-listed species, most were recorded in low numbers and never formed a dense infestation.

7.4 Construction impact assessment

Construction activities have the potential to impact terrestrial ecology, including native vegetation, threatened flora species, threatened ecological communities and fauna ecology. Key construction activities include the construction of a 38 kilometre underground pipeline from Kangaroo Lake to the mine site, the construction of a pump station at Kangaroo Lake, intersection widening at eight key locations and the development of approximately 1,479 hectares for the mine site, comprising Area 1 and Area 3.

7.4.1 Native vegetation

To facilitate the construction of the mine and underground pipeline, it has been calculated that the Project would result in the loss of a total extent of 14.36 hectares of native vegetation including 531 large trees in patches, 37 large scattered trees and 14 small scattered trees, prior to the implementation of mitigation measures (refer to Table 7-4).

Table 7-4 Native vegetation removal extent (note that this summary excludes area of removal associated with scattered trees – 2.59 hectares)

Project area	Native vegetation in patches (ha)	Number of patches	Trees in patches	Large scattered trees	Small scattered trees
Mining Area 1	4.095	13	253	6	5
Mining Area 3	2.699	17	187	31	9
Underground pipeline	4.695	49	61	0	0
Intersections	0.274	28	30	0	0

This 'worst-case' scenario total extent is based on the removal of all native understorey vegetation within mine site Area 1 and Area 3, at upgraded transport intersections and it assumes the loss of all native vegetation intersecting the six metre construction corridor along the length of the underground pipeline.

The 4.289 hectares of native vegetation considered impacted along the underground pipeline alignment is due to 61 trees in patches that may require pruning for machinery access or have impacts to their Tree Protection Zone (TPZ). Impacts to the TPZ are defined as "*12 x the diameter at breast height at 1.4 metres above the ground and a tree or trees will be deemed lost if the encroachment into the Tree Protection Zone/Structural Root Zone is s greater than 10 percent*". Despite this, it is anticipated all trees will be retained in-situ, and the deemed "loss" of these trees is a conservative approach.

The remaining 0.406 hectares of removal along the pipeline is due to impacts associated with the pump station at Kangaroo Lake and small incursions into the road reserve where the width of the existing road does not accommodate the six metre wide pipeline construction footprint.

The underground water supply pipeline alignment is proposed to be constructed in the existing road reserve and has been sited to avoid impacts to native vegetation. An initial pipeline route was assessed as impacting 1,844 trees along its alignment. Subsequently, two alternate pipeline routes were investigated to avoid areas of dense native vegetation along the roadsides between Kangaroo Lake and the mine site. Assessment of these two alternative routes was undertaken by a botanist using the Habitat Hectares approach and by an arborist as part of a preliminary arboricultural impact assessment.

The arboricultural impact assessment considered the likely impact from the proposed construction of the underground water supply pipeline (a one metre trench in the centre of the road) and the current state of the of the surrounding areas, for example the road width and surface compaction. The arboricultural assessment also considered the species of trees and likely impacts of trench construction on the root zone.

The preferred pipeline route was chosen, as recommended by the arboricultural impact assessment, due to having significantly less impact to native vegetation and trees. As a result of this avoidance and minimisation approach, the number of trees impacted along the pipeline was reduced to 61 large trees in patches. The arborist determined that the 61 trees deemed 'lost' is conservatively assessed, with the number likely to be lower.

A similar avoidance and minimisation approach was undertaken within mine site Area 1 and Area 3. Opportunities to avoid and minimise impacts to native vegetation within mine site Area 1 have been adopted where possible and have resulted in the retention of a total extent of 23.868 hectares of native vegetation, including 22.445 hectares in patches and 22 scattered trees (19 large scattered trees and three small scattered trees). At mine site Area 3, a similar approach has resulted in the retention of a total extent of 41.375 hectares of native vegetation, including 40.497 hectares in patches and 17 scattered trees (nine large scattered trees and eight small scattered trees).

It is anticipated that the extent of native vegetation removed during construction activities would be reduced further by the implementation of mitigation measures. These would include engaging an arborist to assist with micro-siting the underground water supply pipeline and to identify additional measures to avoid adverse impacts to structural root zones and safeguard trees at the mine site and along the pipeline alignment (refer to mitigation measure MM-BD01). In addition, provision of vegetation protection zones may enable protection of some understorey vegetation along the pipeline alignment, particularly in areas where native vegetation occurs only on one side of the road reserve (refer to mitigation measure MM-BD02). This would reduce the total loss of native vegetation and the number of trees removed. Mitigation measures are presented in Section 7.7.

7.4.2 Threatened flora species

No EPBC Act-listed threatened flora species were recorded in the study area as part of the native vegetation and flora impact assessment, and none are considered to have the potential to occur based on habitat records and a lack of regional records. Therefore, no EPBC Act-listed species are expected to be impacted by the construction of the Project.

Six FFG Act-listed threatened flora species were recorded within the development footprint of the Project area during the native vegetation and flora impact assessment and are considered likely to be impacted. These include:

- Bush Minuria (18 individuals impacted)
- Dwarf Myall (one individual impacted)
- Fragrant Saltbush (11 individuals impacted)
- Frosted Goosefoot (54 individuals impacted)
- Umbrella Wattle (353 individuals impacted, 348 of which occur on public land)
- Yarran (17 individuals impacted, 16 of which occur on public land).

As described in Section 7.3.2, a total of 21 FFG Act-listed threatened flora species have the potential to be impacted by the construction of the Project.

Native vegetation in the study area has historically been cleared to support land uses associated with cropping and agriculture, with remnant vegetation persisting in roadside reserves. Project related impacts to roadsides would be restricted to a narrow strip (a few metres) on the road verge adjoining the road surface during the construction of the underground water supply pipeline. As this would impact only a small proportion of the width of the road reserve, it is not anticipated that habitat fragmentation will occur. Project related impacts are not anticipated to adversely affect habitat critical to the survival of these FFG-listed species, or lead to a long-term decrease in the size of a population. Nonetheless, impacts roadsides should be avoided where possible, and mine site rehabilitation and revegetation should include these FFG-listed species, within the appropriate EVC's, even if these species were not previously recorded at the site.

The implementation of mitigation measures described in Section 7.4.1 would also reduce potential impacts to threatened flora species. These mitigation measures are presented in Section 7.7.

7.4.3 Threatened ecological communities

The construction of the Project is not anticipated to impact any FFG Act-listed threatened communities, however the Plains Mallee Box Woodlands, listed as a threatened ecological community under the EPBC Act, would be impacted. It has been estimated that prior to the implementation of mitigation measures, approximately 11.347 hectares of Plains Mallee Box Woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions (critically endangered) would be lost during the construction of the Project.

There would be no impacts to Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Endangered). No patches of this woodland were identified near the impact footprint of the Project.

The implementation of mitigation measures described in Section 7.4.1 would also reduce potential impacts to threatened flora species. These mitigation measures are presented in Section 7.7.

7.4.4 Offsets

The offset target for the proposed removal of native vegetation for this Project totals 4.819 general habitat units (GHU), plus 531 large trees in patches and 37 large scattered trees (mallee trees), in an area with a strategic biodiversity value score of at least 0.179 in the central CMA region and/or Gannawarra Shire. This includes offsets for all trees that are deemed removed due to TPZ impacts or otherwise assumed lost.

The credit register was searched and three available offset sites were found. The credit options found are presented in EES Technical Report A: Native vegetation and flora impact assessment.

Once offsets are secured, the impacts of the Project will be in line with the overarching objective of the Victorian native vegetation retention controls, namely, there will be 'no net loss' of biodiversity as a consequence of native vegetation removal for the Project.

7.4.5 Fauna ecology

There would not be any direct loss of conservation significant species from the construction of the Project, however construction of the Project has the potential to remove fauna habitat. As described in Section 7.4.1, a maximum of 14.36 hectares of native vegetation would be removed during the construction of the Project, including 531 large trees in patches, 37 large scattered trees and 14 small scattered trees. This loss is referred to as the total extent of loss. Of this 14.36 hectare total extent, 6.8 hectares would actually be removed and approximately seven hectares would be considered assumed lost. Assumed loss refers to encroachments of greater than 10 percent into the tree protection zone or structural root zone. The Assessor's Handbook (DELWP 2018) defines the tree protection zone as 12 times the diameter at breast height at 1.4 metres above the ground. The assumed loss of approximately seven hectares of native vegetation and fauna habitat would remain in situ, however where native vegetation must be removed, visible hollows would be translocated and used for nesting.

Considering this, the removal of native vegetation would result in the direct loss or degradation of fauna habitat and could disrupt the movement of fauna species between areas of habitat. Furthermore, construction activities may result in indirect impacts to fauna species.

Conservation significant species such as Superb Parrot, Black Falcon, Diamond Firetail, Hooded Robin, Samphire Skink, Eastern Bearded Dragon and Eastern Great Egret may utilise fauna habitat in the study area and along the water supply pipeline route. Approximately 6.8 hectares of native vegetation, 440 large trees in patches, 37 large scattered trees and 14 small scattered trees would be removed from Project mine areas, and an additional 0.27 hectares, including 30 large trees in patches would be removed from transport intersections during construction activities. The removal of this potential habitat represents 1.3 percent of native vegetation and fauna habitat mapped as part of the native vegetation and flora impact assessment (541 hectares). The removal of 470 large trees in patches, 37 large scattered trees and 14 small scattered trees from Project mine areas and transport intersections represents 1.13 percent of the total number of trees within the study area, estimated as part of the native vegetation and flora impact assessment (45,911 trees). The impact to roadside vegetation along the pipeline alignment would be confined to a loss of 61 large trees in patches associated with EPBC-listed Plains Mallee Box Woodland of the Murray Darling Depression and Riverina Bioregions Community. The understorey, ground cover and woody debris component would remain in situ. The loss of 61 large trees in patches represents 0.13 percent of all canopy trees available across the study area according to the native vegetation and flora impact assessment.

As such, it is unlikely that impacts would result in a significant removal of potential habitat or cause any significant change to the network of remnant vegetation along road reserves that allow conservation significant species, in particular birds, to move across the landscape to larger conservation reserves. The removal of native vegetation during Project construction is not considered to impact habitat critical to the survival of Commonwealth and State listed fauna species.

Nonetheless, minimising impacts to native vegetation, particularly along road reserves during the construction of the underground pipeline, would ensure potential impacts to listed fauna species are minimised. Habitat enhancement strategies where vegetation is to be retained would be implemented and where fauna habitat is to be removed, fauna salvage would be undertaken by suitably qualified specialists (refer to mitigation measure MM-FE01). The measures described in Section 7.4.1, such as engaging an arborist to assist with micro-siting the underground water supply pipeline, would also minimise potential impacts to native vegetation and fauna habitat. Mitigation measures are presented in Section 7.7.

7.4.6 Kangaroo Lake

At Kangaroo Lake, the pump station would be constructed in the vicinity of the No 47 Channel and existing infrastructure. Habitat in the lake is best characterised as open water mostly fringed by dense emergent vegetation consisting namely of reeds such as Common Reed or Cumbungi (*Phragmites australis*) and Bullrush (*Typha sp.*). In the vicinity of the pump station, fringing vegetation consisted of a 2-4 metre wide monoculture of Common Reed, which reduced in thickness and density into the No 47 Channel. More complex habitat of a greater extent is present in other parts of Kangaroo Lake, including the southwest corner of Kangaroo Lake.

Construction of the pump station on the road reserve adjacent to Kangaroo Lake has the potential to result in the direct loss of aquatic and emergent habitat at Kangaroo Lake. However, the area of loss associated with the footprint of the pump station would be approximately 431 square metres of Plains Savannah (EVC 826) and 422 square metres of wetland vegetation. As such, this loss would be negligible compared to the overall area of habitat in the lake.

Other potential impacts to aquatic fauna species include disturbance to lakebed and banks, reduced water quality as a result of disturbance and vegetation removal and spills during construction. By implementing industry standard measures, such as undertaking works during dry conditions, installing a waterproof sealed bund around the pump works area and by not permitting the storage of chemicals within one kilometre of Kangaroo Lake, the

potential impacts to aquatic fauna species during construction of the pump station at Kangaroo Lake would be negligible.

7.5 Operation impact assessment

The operation of the Project has the potential to impact native vegetation, flora and fauna ecology particularly through indirect impacts. These may include the introduction of weed species, dust deposition, erosion of areas that support native vegetation, contamination of retained native vegetation by saline water and contamination of retained native vegetation by hazardous chemicals or hydrocarbons. Mine operations may also result in the inadvertent removal of native vegetation during minor site or pipeline works. Increased vehicle movements, noise and light generated from mine operations and entrapment may impact fauna ecology.

7.5.1 Weed introduction

Mine operation and vehicle activity within and beyond the mine site would potentially introduce weed seeds and cuttings. This could lead to an increase in the number and extent of weed species in areas adjacent to retained native vegetation. Observations during the native vegetation and flora assessment indicated that the following high threat weeds are potentially of concern:

- African Box-thorn.
- Bridal Creeper.
- Field Dodder.
- Horehound.
- Onion Weed.
- Paterson's Curse.
- Soursob.
- Sticky Ground-cherry.

Mitigation measures such as appropriately designed clean-down areas (refer to mitigation measure MM-BD04) and controlling of high threat weeds (refer to mitigation measure MM-BD05) would reduce potential impacts from introduced weeds. Mitigation measures are presented in Section 7.7.

7.5.2 Inadvertent removal of retained native vegetation

All efforts would be undertaken to avoid inadvertent or accidental removal or damage to retained vegetation. Despite this, while an operational need for vehicles or people to frequent areas of retained vegetation during operation of the mine is not expected, impacts may occur due to vehicle and personnel movements into areas of retained native vegetation leading to the loss or partial loss of ground cover and/or tree canopy.

Vegetation and tree protection zones would be established around native vegetation and all relevant personnel would be appropriately briefed prior to any works being undertaken (refer to mitigation measure MM-BD03). This would ensure that any potential direct impacts to retained areas of native vegetation during minor site or pipeline works would be reduced. Mitigation measures are presented in Section 7.7.

7.5.3 Dust deposition

The deposition of dust has the potential to impact retained native vegetation by inhibiting growth and recruitment. Dust may be generated during mine operations, from vehicle movement and stockpile management.

Potential impacts would be managed via best practice dust management measures, utilising spray and misting systems to supress dust emissions and water spray systems will be utilised where dust from mobile plant material movements and stockpiles cannot otherwise be practically contained. Further information is presented in EES Chapter 12: Air quality.

7.5.4 Erosion

Erosion of areas that support retained native vegetation, as a result of alterations to drainage in mine sites Area 1 and Area 3 may occur. Erosion of retained native vegetation can lead to a loss of groundcover species and reduced water absorption into the soil and uptake of water and nutrients by plants. This could result in the death of vegetation. Erosion may also compromise tree roots and lead to destabilisation.

The proper management of surface water drainage would ensure that erosion at mine site Area 1 and Area 3 is minimised. The management of surface water through the operational life of the mine should be undertaken through a Surface Water Management Plan (SWMP) (refer to mitigation measure MM-SW01 in EES Chapter 13: Surface water). The SWMP will provide a management framework to mitigate potential impacts over the life of mine. Further information on the management of erosion is presented in EES Chapter 13: Surface water.

7.5.5 Contamination

During operation, spills or releases of hazardous chemicals or hydrocarbons to areas of retained native vegetation may have direct impacts to plants and trees.

Hazardous chemicals would be stored and contained appropriately on site, such as in bunded areas to minimise potential impacts. Further information on the management of chemicals and hazardous substances is presented in EES Chapter 13: Surface water.

7.5.6 Surface water drainage

Areas of native vegetation could be contaminated by saline discharge or altered surface water drainage, which may arise during mine operations. This could lead to the death of vegetation which do not tolerate high levels of salt.

Surface water flows from the mine site would be contained within the mine site and the final design of water storages and drainage infrastructure would ensure that nominated storm events can be accommodated. Further information on the management of surface water drainage is presented in EES Chapter 13: Surface water.

7.5.7 Fauna ecology

During operation of the Project, potential impacts to fauna habitat may include the following:

- Vehicle movement.
- Vehicles parked within the tree protection zone.
- Vehicle/wildlife collisions.
- Noise from vehicles and mine operations including the pump station at Kangaroo Lake.
- Lights from vehicles and mine operations.
- Fuel/oil spillages egresses into fauna habitat/roadside native vegetation.
- Processing pond entrapping fauna or suffering ill health due to poor water quality.
- Dust dispersal within fauna habitat/native vegetation.

There is not expected to be any direct impacts to fauna during operation of the mine. Regarding indirect impacts, it is not envisaged that there would be any significant impacts to non-terrestrial species (i.e. birds and bats), however increased vehicle movements and increased lights, noise and dust may disrupt the movement of terrestrial species (i.e. reptiles and mammals). Such indirect impacts may also result in the degradation of habitat, although it is not envisaged that indirect impacts would lead to habitat loss.

To minimise potential indirect impacts to fauna species and habitat, measures such as vehicular speed restrictions, buffers around the mine operations area, maintaining vehicle exhaust systems and utilising Commonwealth Light Pollution Guidelines (2020) for light installation would be implemented and would reduce the likelihood of indirect impacts. Mitigation measures are presented in Section 7.7.

The mine site processing pond, located in Area 1, would be approximately 100 m by 80 m and may attract fauna. The processing pond would hold a mixture of raw water sourced from Kangaroo Lake and water recovered from mineral processing and tailings. The ingestion and build-up of contaminants from processing pond water has the potential to have detrimental health issues for fauna species. To minimise impacts to fauna species, a 1.8 m high chainmesh (35 mm) fence would be built around the processing plant to prevent access of terrestrial fauna species (MM-FE03). The processing pond itself would have wires strung across at 10m intervals with bird deterrent discs hung below the wire at 5 m spacings approx. 50 cm above the water to deter non-terrestrial species (MM-FE03). The discs would also act as an acoustic deterrent to microbats. While in-pit tailings cells may also attract fauna, there would be high levels of activity within proximity to the cells in the form of diggers, haulage trucks, sprinklers and water carts for dust suppression. As such these activities are likely to reduce the desirability of tailings cells to fauna. Mitigation measures are presented in Section 7.7.

7.5.8 Reduced water contribution to downstream receptors

During Project operation, surface water run-off from disturbed areas within the Project boundary would be captured and there would be zero discharge off site.

As presented in EES Chapter 13: Surface water, during a one percent Annual Exceedance Probability (AEP) rainfall event, it was modelled that there would be a slight reduction in flood levels in the overland flow paths leaving Area 1 and Area 3. A one percent AEP event refers to a flood that has a one in a hundred chance of being exceeded in any year.

The most significant decrease in water levels during a one percent AEP rainfall event would occur west of Area 1, where there would be a maximum 12 centimetre decrease in surface water depth. This decrease in water depth during a one percent AEP rainfall event is anticipated to be temporary during the life of the mine and is unlikely to result in significant impact to remnant vegetation west of Area 1.

Further information is presented in EES Chapter 13: Surface water.

7.5.9 Kangaroo Lake

Kangaroo Lake forms part of the Kerang Wetlands Ramsar site, as listed under the EPBC Act. Operation of the Project may reduce the water level of the lake or result in the entrainment and impingement of aquatic fauna species.

Based on data provided by Goulburn Murray Water, the current average lake draw or discharge is approximately 0.15 GL/day. The Project water demand would require only 0.013 GL/day assuming that the Project draws its demand of 4.7 GL/year evenly over 365 days. It is important to note however that the water required for the Project represents less than one percent of the volume of water Goulburn Murray Water allocates from the lake for distribution and use. As such, the additional water usage as a result of Project is likely to have negligible impact to Kangaroo Lake's water height, beyond that already controlled (and allocated to end users) in the lake. Therefore, there would be negligible impact to the aquatic habitat and salinity of Kangaroo Lake from Project operations.

Entrainment is the unwanted passage of fish or small aquatic organisms through a water intake and is generally caused by an absent, or inadequate screen surrounding the water intake. Impingement is the physical contact of a fish with such a screen due to intake velocities which are too high to allow the fish to escape. The pump station at Kangaroo Lake should include an angled fish screen on the inlet that is designed to Australian best practice standards and is able to effectively protect smaller fish and other aquatic fauna from entrainment and impingement, to ensure any potential impacts are minimised.

Overall, it was determined that the Project would not have a significant impact on Kangaroo Lake and the Kerang Wetlands Ramsar site. Further information is provided in EES Technical Report B: Fauna ecology impact assessment.

7.6 Residual impacts

Residual impacts refer to those impacts that remain once mitigation measures have been implemented. During construction of the Project, a total extent of 14.36 hectares of native vegetation would be lost, including 531 large trees in patches, 31 large scattered trees and 14 small scattered trees. Six FFG Act-listed threatened flora species recorded within the development footprint of the Project would be impacted. This 'worst-case' scenario is based on the removal of all native understorey vegetation within mine site Area 1 and Area 3, the transport intersections to be upgraded and it assumes the loss of all native vegetation intersecting the six metre construction corridor along the length of the underground pipeline.

Implementing mitigation measures would ensure that impacts to flora and native vegetation are reduced. For example, micro-siting the underground water supply pipeline would mean that each tree along the pipeline alignment is assessed individually and would be safeguarded as necessary.

The residual impacts on fauna habitat have been considered independently of vegetation loss as defined under Clause 52.17 of the Planning Scheme for scattered trees and 'loss' of canopy trees due to impacts to the TPZ. This is because, under Clause 52.17, it is assumed a canopy tree will not survive if there are impacts such as compaction and trenching in the TPZ protection zone, and if within a patch, understorey flora within the dripline of canopy foliage. Canopy trees, understorey and groundcover flora and woody debris will remain in situ. Therefore, the residual impact to fauna ecology has been restricted to the physical removal of native vegetation and fauna habitat and indirect impacts to fauna habitat use.

As such, the residual impact would entail the removal of 6.8 hectares of native vegetation and fauna habitat from the Project mine areas, consisting of 440 large trees in patches, 31 large scattered trees and 14 small scattered trees and an additional 0.27 hectares from eight transport intersections, include 30 large trees in patches. There would be no removal of vegetation along the 38 km pipeline route, except for the loss of 61 large trees in patches which the arborist has deemed lost, but with the number likely to be lower. Canopy trees, understorey and groundcover would remain in situ and continue to provide fauna habitat.

The residual loss of fauna habitat within the mine areas and transport intersections has the potential to disrupt the movement of terrestrial fauna. Except for the FFG listed Eastern Bearded Dragon, the threatened species considered likely to occur or observed within the 'Project Area' are highly mobile e. birds. Habitat corridors along the road network are expected to continue to facilitate movement of avian fauna across the wider landscape.

This loss of fauna habitat within mine areas and transport intersections would also reduce the availability of food resources, perches, nesting, basking, refugia and tree hollows. The primary residual impacts due to the loss of canopy tree loss would be to nectarivores and insectivorous birds, possums and microbats. The loss of understorey and groundcover vegetation, leaf litter and woody debris would impact on terrestrial species e.g., white-winged chough, crested pigeon, finches, amphibians and reptiles. Due to the mobility of birds and bats, there is likely to be minimal impact to these fauna groups. Impact would be greatest for species with small home ranges and less mobility, i.e. possums and reptiles. Fauna salvage and identifying suitable release sites prior to any vegetation removal would be a critical component of vegetation removal. Habitat enhancement of retained native vegetation would also form a key component of reducing residual impacts to fauna species.

Regarding indirect impacts, it is not envisaged that there would be any significant impacts to non-terrestrial species (i.e. birds and bats), however increased vehicle movements and increased lights, noise and dust may disrupt the movement of terrestrial species (i.e. reptiles and mammals). With the implementation of mitigation measures, the likelihood of indirect impacts to fauna species would be reduced.

With the implementation of mitigation measures, residual construction impacts to Kangaroo Lake (and other areas of the Ramsar wetland) are considered to be negligible. The construction of the pump station on the road reserve adjacent to Kangaroo Lake would result in the removal of approximately 431 square metres of Plains Savannah (EVC 826) and 422 square metres of wetland vegetation. This loss would be negligible compared to the overall area of habitat at the lake. During operation, water demand would have a negligible impact to the aquatic habitat and salinity of Kangaroo Lake. While fish and aquatic fauna may become entrained at the pump station inlet, the pump station at Kangaroo Lake would include an angled fish screen on the inlet that is designed to Australian best practice standards and would be able to effectively protect smaller fish and other aquatic fauna from entrainment, to ensure any potential impacts are minimised.

7.7 Summary of mitigation measures

The mitigation measures to manage potential impacts to terrestrial ecology are presented in Table 7-5.

Table 7-5 Terrestrial ecology mitigation measures

Mitigation measure ID	Mitigation measure	Project phase
Native vegetation and flora		
MM-BD01	<u>Minimise impacts to trees</u> Engagement of an arborist to provide recommendations to avoid or minimise impacts to native vegetation, such as: • Micro-siting of pipeline to avoid trees where possible. • Assessment of trees deemed to be lost in EES to determine whether any additional measures can be taken to avoid adverse impacts to structural root zones and ensure that trees persist in the long term.	Construction
MM-BD02	<u>Minimise impacts to native vegetation:</u> • Any proposed vegetation removal is not undertaken until applicable approvals and permits have been issued. • Vegetation protection zones (aligned with AS 4790) will be established around native vegetation prior to works and will be maintain over the life of the Project. • Required vegetation/habitat offsets, are sourced in accordance with Commonwealth and/or State legislation or policy. • Impacted FFG-listed species to be included in revegetation in relevant EVCs in the mine site rehabilitation phase.	All phases

Mitigation measure ID	Mitigation measure	Project phase
MM-BD03	Minimise impacts to remnant native vegetation in vicinity of work areas. All construction personnel to be appropriately briefed prior to works, and no machinery or equipment to be placed inside vegetation and tree protection zones.	All phases
MM-BD04	Control spread and/or introduction of weeds and/or pathogens – Vehicles: • Ensure an appropriately designed clean-down area(s) is established prior to the commencement of works. • Ensure vehicles, machinery and plant equipment are clean before entering and leaving the site at the designated clean-down area. • Manage waste from clean-down bays by burying the waste below the subsoil.	All phases
MM-BD05	Control spread and/or introduction of weeds and/or pathogens - General: • Prepare controls to ensure material inspected before entry to and exit from site with rejection of material that contains signs of noxious weeds. Control weeds prior to stockpiling of topsoil. • Dispose of weed material on site in the designated burn area if possible or seek permission to transport and dispose of the material at a legal place of disposal. • High threat weeds, namely Common Heliotrope and African Box-thorn to be treated prior to works commencing. • Outbreaks of noxious and/or Weeds of National Environmental Significance (WoNS) within construction and operational areas will be managed. Spread into adjacent land will be prevented. • Dispose of material containing declared noxious weeds in accordance with the Catchment and Land Protection Act 1994.	All phases
Fauna ecology		
MM-FE01	Minimise impact to fauna – fauna salvage: • Fauna salvage to be undertaken by suitably qualified specialist where fauna habitat is to be removed. • Areas suitable to relocate fauna are identified prior to fauna habitat removal. • Habitat enhancement strategies are implemented in areas of fauna habitat to be retained. This may include the translocation of visible hollows from areas where native vegetation is removed.	Construction Operation
MM-FE02	Minimise impact to native vegetation – Kangaroo Lake: • Soil spoil containment areas are identified in consultation with regulatory authorities prior to the commencement of works. • If possible, works at the pump site on Kangaroo Lake are undertaken during dry ground conditions. Alternatively bog mats are to be deployed. • A waterproof sealed bund is to be installed around the pump works area. • Chemicals are not to be stored within one kilometre of Kangaroo Lake. • Equipment is to be checked prior to the commencement of works each morning to check for any chemical leaks. • Any vehicle/equipment leaking chemicals is to be withdrawn from the works area immediately.	Construction Operation
MM-FE03	Minimise impacts to native fauna: • Commonwealth Light Pollution Guidelines (2020) are used as guidance for light installation. • Nearest veterinary clinic and/or wildlife carer contact details are included in any relevant management plans. • Buffers in the form of vegetation and bunds are considered around the mine operations area. • Speed restrictions are established within the proposed transport routes and all employees and contractors' drivers are informed of the speed limits at the site induction. • Vehicles exhaust systems are maintained to limit noise impacts to fauna. • On days of high winds, a water cart is deployed to minimise dust/gravel displacement onto fauna habitat/roadside vegetation. • Processing pond will have wires strung across at 10 metre intervals with bird deterrent discs hung below the wire. • Chain mesh fencing will be erected around the perimeter of mining Area 1 and Area 3 minimising access to terrestrial fauna	All phases

Mitigation measure ID	Mitigation measure	Project phase
MM-FE04	Minimise impact to native fauna – pipeline: • Native fauna specialist provides input to CEMP in regard to strategies to minimise impact and development of a fauna recovery protocol, with periodic review for the duration of the pipeline construction. • Thirty centimetre high fauna fence (constructed from damp course material) is erected adjacent to both sides of open trenches. • Inspection of angled fish screen within 2 years of operation to assess fit for purpose in minimising risk of entrapment/drowning of aquatic fauna.	Construction
MM-FE05	Minimise impact to native fauna – Kangaroo Lake: • Installation of angled fish screen on the inlet that is designed to Australian best practice standards and is able to effectively protect smaller fish and other aquatic fauna from entrainment and impingement. • Undertake a pre-works aquatic fauna / targeted SPSG survey of the area in the vicinity of the pump station to ascertain the actual SPSG and other aquatic fauna usage at that time. Survey to occur in summer to align with SPSG breeding / larvae.	Construction

7.8 Conclusion

Construction activities for the Project would result in the loss of a total extent of 14.36 hectares of native vegetation, including 531 large trees in patches, 37 large scattered trees and 14 small scattered trees.

Six flora species listed as threatened under the state FFG Act were recorded within the development footprint of the during the native vegetation and flora impact assessment and would be impacted by the construction of the Project. These include Fragrant Saltbush (11 individuals), Umbrella Wattle (353 individuals), Yarran (17 individuals), Bush Minuria (18 individuals), Dwarf Myall (one individual) and Frosted Goosefoot (54 individuals). The Plains Mallee Box Woodlands, listed as a threatened ecological community under the Environment Protection and Biodiversity Conservation (EPBC) Act, would also be impacted by the construction of the Project. Prior to the implementation of mitigation measures, approximately 11.347 hectares of Plains Mallee Box Woodlands would be removed.

In the context of fauna habitat, 6.8 hectares of native vegetation would actually be removed as a result of construction activities within Project mining areas, plus an additional 0.27 hectares along transport routes. Fauna species listed as threatened under the commonwealth EPBC Act or state FFG Act may utilise remnant vegetation in the study area to move across the landscape, and the direct removal and fragmentation of vegetation may result in loss of fauna habitat.

The offset target for the proposed removal of native vegetation for this Project totals 4.819 general habitat units (GHU), plus 531 large trees in patches and 37 large scattered trees.

The construction and operation of the Project would result in negligible impacts to Kangaroo Lake and associated aquatic fauna species. Construction of the pump station at Kangaroo Lake would have a relatively small footprint and impact upon low quality habitat. During operation, Project water demand would represent only an 8 percent increase on the lake's current average daily demand.

Opportunities to avoid and minimise impacts to native vegetation have been undertaken at mine site Area 1 and Area 3. This has resulted in the retention of a total extent of 23.868 hectares of native vegetation, including 22.445 hectares in patches and 22 scattered trees at mine site Area 1 and a total extent of 41.375 hectares of native vegetation, including 40.497 hectares in patches and 17 scattered trees at mine site Area 3. Impacts to trees along the proposed underground pipeline alignment were reduced to 61 large trees in patches from 1,844 trees following a preliminary arboricultural impact assessment.

Measures to minimise impacts to native vegetation would include engaging an arborist to assist with micro-siting the underground pipeline during construction and to identify additional measures to avoid adverse impacts to structural root zones and safeguard trees at the mine site and along the pipeline alignment.