

8. Biodiversity

8.1 Flora and Vegetation

8.1.1 Introduction

This chapter describes the flora and vegetation of the Mount Peake Project area and assesses the potential for impact to local and regional biodiversity during the construction and operation of the Project.

A detailed report is provided in Appendix G.

8.1.2 Methodology

Desktop review

Prior to completing field survey a desktop literature and database review was undertaken to gain an understanding of the ecological context of the Project area. Data reviewed included existing broad scale vegetation mapping, land system data, aerial photography, land unit mapping and flora records from NT and Commonwealth ecological databases.

Field survey

The vegetation and flora survey was undertaken in April 2013. Flora survey techniques used were consistent with the *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst *et al.* 2007).

The study area included the proposed mine area, accommodation area, a 1 km wide corridor along the proposed access road and the proposed rail siding facility. Field survey of the proposed borefield, associated pipeline and access road, and road base borrow pit areas were not undertaken as part of this assessment as the locations of these features were not known at the time of the survey.

The study area was first divided into relatively homogenous or discrete vegetation zones using existing vegetation mapping, aerial imagery and lithological data sets. Forty five survey locations were then randomly distributed within each vegetation zone. Data and information was collected through quadrats at each survey location which included habitat information, level of site disturbance, flora species (including introduced and threatened species) and structural information. Further assessments were collected through secondary check sites, aerial surveys and opportunistic collections.

8.1.3 Results

Desktop assessment

Burt Plain Bioregion

The Mount Peake Project will be located entirely within the Burt Plain Bioregion, which is characterised by plains and low rocky ranges with extensive areas of mulga and other acacia woodlands. The bioregion covers an area of 73,605 square kilometres which represents approximately 5% of the Northern Territory (NRETAS 2005). Less than 0.3% of the bioregion is reserved in National Parks and other conservation reserves.

Pastoralism represents the major industry in the bioregion, with pastoral leases occupying approximately 82% of the land area (Neave *et al.* 2006).



Soils of the bioregion are generally shallow sands and massive earths. The bioregion is dominated by undulating plains which are interrupted by major drainage lines associated with terraces and levees, and sporadic hills and rocky ranges. Several ephemeral rivers drain the rocky ranges and flow through the bioregion in a northerly direction into the Tanami Desert.

Five broad vegetation communities have been mapped within the bioregion (Wilson *et al.* 1990), the most abundant being Acacia woodland. Other broad communities include Eucalyptus low woodland with tussock grass understory, Eucalyptus woodland with hummock grass understory, Hummock grassland and Tussock grassland (NRETAS 2005).

The bioregion is known to contain more than 1,100 flora species with three listed as vulnerable under the *Territory Parks and Wildlife Conservation Act 2009* (TPWC Act), with one also listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Additionally 64 species listed as data deficient, 41 listed as near threatened in the NT and seven listed as endemic to the bioregion have been recorded (Neave *et al.* 2006).

There are 16 sites of botanical significance within the bioregion, three of these, Anmatyerr North, Mud Hut Swamp and Wood Duck Swamp, occur within or near to the study area (Neave *et al.* 2006).

Potential and existing threats to biodiversity identified within the bioregion include exotic flora, introduced animals, fire, erosion, land clearing, pastoralism and mining (Neave *et al.* 2006). Exotic predators are widespread and fifteen declared weed species are known to occur. Other exotic plants species, most notably buffel and couch grass, also pose significant threats to some habitats.

The Burt Plain Bioregion is comprised of four sub-regions. The study area occurs mostly within the Burt Plain 1 subregion with a small portion in the south located within the Burt Plain 2 subregion. These subregions have been assessed as being in mostly good condition with native vegetation cover exceeding 90%. A high proportion of both subregions however, have been impacted by grazing and exotic flora species (particularly Buffel Grass) (Neave *et al.* 2006).

Hydrology

The Project is located within the Wiso Surface Water Management Basin, which comprises numerous ephemeral dendritic drainage systems. Key water courses near to the Project include Murray Creek, Bloodwood Creek and the Hanson River. No wetlands within the bioregion are listed in the 'Directory of Important Wetlands in Australia' or under the 'Convention on Wetlands of International Importance' (Ramsar Convention). Mud Hut Swamp, located in the floodout area of Bloodwood Creek, Stirling Swamp (Anmatyerr North Site), an interim floodout area for the Hanson River, and Wood Duck Swamp, 10 km south of the access road and outside of the study area, are listed as wetlands of national conservation significance (NRETAS 2009).

Land systems

The Project area is covered by land system mapping of the Alice Springs area. A total of eight broad land systems have been mapped across the Project area. The majority of the area is covered by two land systems, the Singleton system which is characterised by spinifex sand plains and the Bushy Park system which primarily consist of mulga plains on red earths.

Flora of the Project area

The Northern Territory Government flora records for the locality contain 1,392 records of 494 species (DLRM 2015). These records include one threatened flora species listed under the TPWC Act, the Dwarf Desert Spike-rush *Eleocharis papillosa*, which is also listed as vulnerable under the EPBC Act.



Database records for the locality include 1 vulnerable, 7 near threatened species¹, 6 endemic species and 13 species recorded as being data deficient². A total of 16 exotic species have also been recorded. Table 8-1 provides a list of vulnerable, threatened and data deficient species previously recorded in the locality. The locations of vulnerable and near threatened flora are shown on Figure 8-1.

Ten threatened plant taxa are known to occur in the Burt Plain bioregion. Eight of these are listed under the TPWC Act and four are listed under the EPBC Act. Based on an assessment of habitats present it is unlikely that any of these species occur in the Project area.

No EPBC Act-listed Ecological Communities occur within or near the Project area.

Table 8-1 Threatened flora records within the locality

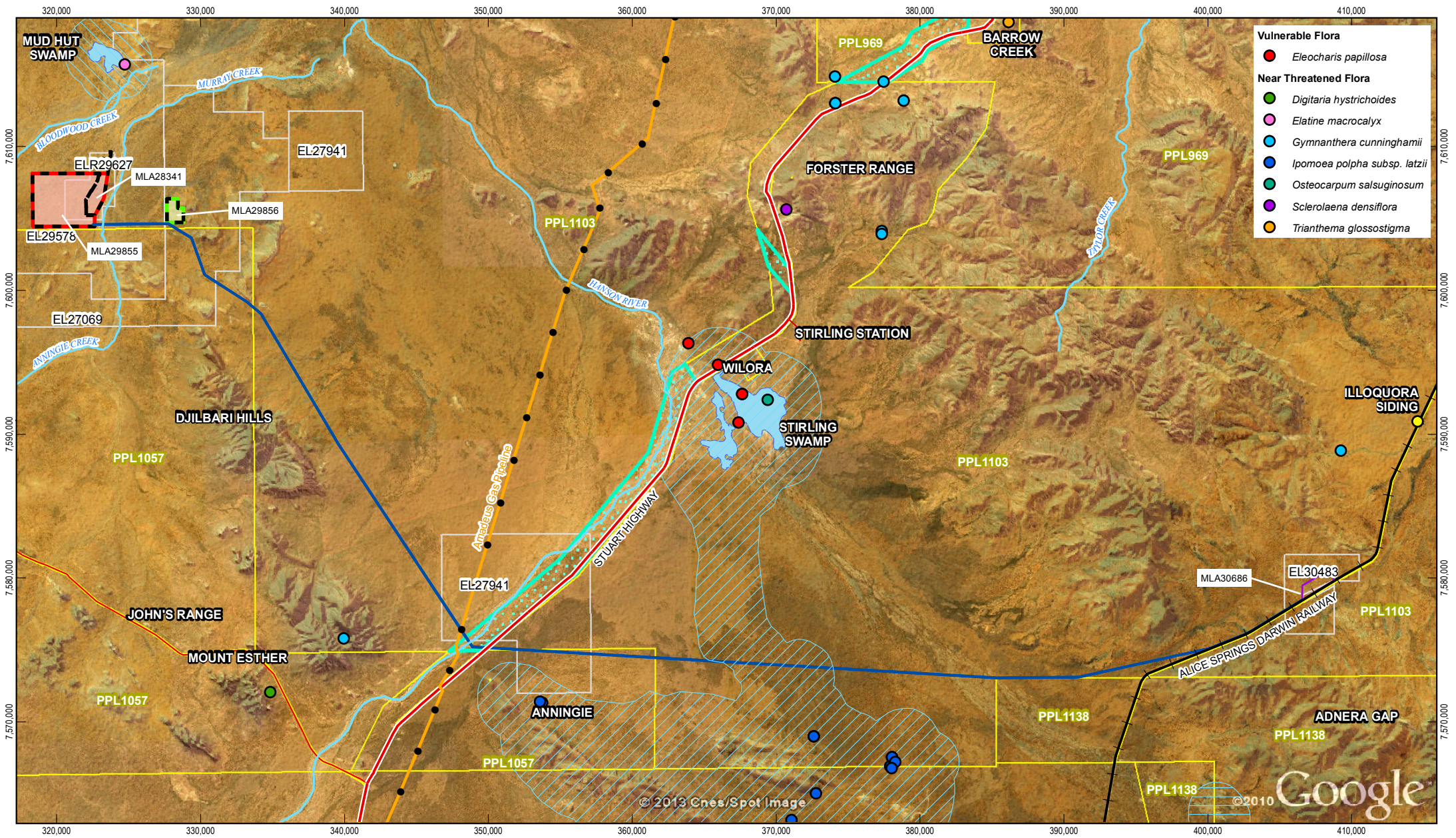
Scientific name	Common name	TPWC Act Conservation Status	EPBC Act Conservation Status	Number of records within locality
<i>Eleocharis papillosa</i>	Dwarf Desert Spike-rush	V	V	5
<i>Goodenia cylindrocarpa</i>	-	dd	-	3
<i>Lawrenzia viridi-grisea</i>	-	dd	-	2
<i>Brachyscome ciliaris</i>	Variable daisy	dd	-	13
<i>Ectrosia schultzei</i> var. <i>schultzei</i>	-	dd	-	3
<i>Acacia oswaldii</i>	Umbrella Wattle	dd	-	4
<i>Acacia incurvaneura</i>	-	dd	-	2
<i>Acacia pteraneura</i>	Mulga	dd	-	1
<i>Eriachne</i> sp <i>Davenport Ranges</i>		dd	-	3
<i>Triumfetta chaetocarpa</i>	Urchins	dd	-	2
<i>Triumfetta deserticola</i>		dd	-	1
<i>Ixiochlamys nana</i>		dd	-	2
<i>Peplidium foecundum</i>		dd	-	1
<i>Swainsona acuticarinata</i>		dd	-	1
<i>Bulbostylis pyrifolmis</i>		nt	-	1
<i>Ipomoea polpha</i> subsp. <i>latzii</i>	Giant Sweet Potato	nt	-	11
<i>Gymnanthera cunninghamii</i>	-	nt	-	-
<i>Osteocarpum salsuginosum</i>	-	nt	-	1
<i>Sclerolaena densiflora</i>	-	nt	-	1
<i>Spartothamnella puberula</i>		nt	-	2
<i>Trianthema flossostigma</i>		nt	-	2

Key: V = vulnerable, dd = data deficient, nt = near threatened

¹ Under IUCN criteria this conservation category is defined as taxa that do not meet the criteria for Critically Endangered, Endangered or Vulnerable at present but is close to qualifying for or is likely to qualify for a threatened category in the near future.

² Under IUCN data deficient taxa are defined as species where there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.





Paper Size A4
 0 2.5 5 7.5 10
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 53



- LEGEND**
- Illoquora Siding
 - Amadeus Gas Pipeline
 - Crown Land
 - Camp Facilities
 - Principal Road
 - Mud Hut Swamp
 - Mount Peake Granted Tenements
 - Anmatyerr North Site of Conservation Significance
 - Minor Road
 - Rail Siding Loading Facility
 - Mount Peake Mineral Leases
 - Mud Hut Swamp Site of Conservation Significance
 - Major Watercourses
 - Mount Peake Mining Area
 - Cadastral Boundaries
 - Wood Duck Swamp Site of Conservation Significance
 - Railway
 - Access Road
 -



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Flora and Sites of Conservation Significance

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Figure 8-1

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 Data source: NRETAS - Vulnerable Flora 2013; TNG - Site of Conservation Significance, Gas / Slurry Pipeline Study Corridor, Camp Facilities, Transport Study Corridor, Mount Peake Mining Area, Mount Peake Granted Tenements (2015), Geoscience Australia - Waterways, mainland, placename, road (2008), Google Earth Pro - Imagery (Date extracted: 13/02/2014), Created by: RB

Sites of Conservation Significance

There are 67 Sites of Conservation Significance (SOCS) across the NT, and there is broad community recognition of the importance of long term protection of conservation values within these sites. Three SOCS are located within or near the study area (Figure 8-1):

- ▶ Mud Hut Swamp is located approximately 7.7 km to the north of the proposed mine pit. Mud Hut Swamp is a large, isolated, gum-barked coolabah (*Eucalyptus vitrix*) swamp that is fed by Bloodwood and Murray Creeks in the south-east and runoff from low hills and rises to the north and west (NRETAS 2009). This is the largest swamp in the Burt Plain bioregion and remains inundated for a relatively long time after flooding, possibly retaining water for several months (NRETAS 2009). The swamp is likely to support a range of wetland birds, fish and plants. Mud Hut Swamp is listed in the “*Inventory of sites of international and national significance for biodiversity values in the Northern Territory*”;
- ▶ the Anmatyerr North site includes Stirling Swamp, a large wetland complex comprised of claypans, lignum swamp, semi-saline samphire and temporary open water as well as parts of the adjacent Hanson River (NRETAS 2009a). The Anmatyerr North site is located across Stirling, Anningie and Ahakeye Stations and extends to the low rocky ranges about 20 km south of Stirling Swamp to encompass the known extent of the near threatened Giant Sweet Potato (*Ipomoea polpha* subsp. *latzii*) as well as a population of the threatened Dwarf Desert Spike-rush (*Eleocharis papillosa*). Stirling Swamp is noted to form occasionally at the northern edge of the Ti Tree Basin, storing flood waters discharged from the Hanson River and the ridges to the east of Wilora. This area is believed to act as an evaporation area for the basin (NRETAS 2009a); and
- ▶ Wood Duck Swamp is located approximately 10 km south of the access road, outside of the study area. Wood Duck Swamp is an ephemeral swamp that may hold water for many months in an otherwise dry landscape. It fills periodically after heavy rain. The swamp is dominated by smooth-barked coolabah *Eucalyptus vitrix*. It is one of the largest such swamps in the Burt Plains bioregion (NRETAS 2009b). Wood Duck Swamp is located entirely on the Mount Skinner pastoral lease.

Field Survey

Flora species

A total of 238 species of flora were recorded within the study area, comprising 233 native species and five exotic species. This represents approximately 22% of all flora species known to occur in the Burt Plain bioregion.

The Poaceae (grass family, 47 species: 45 native, 2 exotic), Fabaceae (pea family, 47 species: 46 native, one exotic), Malvaceae (19 native species) and Amaranthaceae (20 native species) were the most species-rich families recorded.

Flora species recorded and their associated vegetation communities are relatively common in the region with the exception of a few species. Species richness is relatively high with highest diversity recorded in areas of rocky outcrops (43 ± 2) and mulga shrublands (38 ± 6) although plant species were well represented across the study area with a mean species richness of 32 plant taxa per quadrat.

Seventy-seven species recorded during the survey had not previously been recorded on the DLRM database for the locality. These new records combined with the existing NT Government flora records takes the total flora records for the locality to 571 species.

The full list of plant species recorded is presented in Appendix G.



Nationally and state significant flora

No flora species listed as threatened under the TPWC Act or EPBC Act were recorded.

The EPBC PMST and NT herbarium database results indicate that one threatened flora species (*Eleocharis papillosa*, Dwarf Desert Spike-rush) listed as vulnerable under both the TPWC Act and EPBC Act has been recorded within the Project locality.

Dwarf Desert Spike-rush occurs within freshwater and semi-saline ephemeral wetlands, with above-ground plant material emerging from tubers in response to inundation or flooding (DSEWPaC 2008). There are several records of Dwarf Desert Spike-rush from Stirling Swamp, approximately 12 km to the north of the proposed access road. A review of the habitat requirements and ecology also indicates that there is habitat for this species within and surrounding Mud Hut Swamp which is situated approximately 7.7 km north of the proposed mine pit.

The survey identified one species listed as data deficient (*Euphorbia ferdinandii*) under the TPWC Act. *E. ferdinandii* is an upright, sparsely branching herb, up to 30 cm tall. Four records of *E. ferdinandii* were recorded within the study area, all of which were located in Mulga shrubland and Triodia grassland communities along the proposed access road.

Near threatened flora

No flora species classified as near threatened were recorded within the study area, however six species listed as near threatened have been recorded within the Project locality.

Based on a review of habitat requirements and ecology for these species it is likely that one of these species (*Ipomoea polpha* subsp. *latzii*) will occur. Furthermore based on the presence of suitable habitat, there is also a possibility that the following near threatened species may occur:

- ▶ *Elatine macrocalyx*;
- ▶ *Gymnanthera cunninghamii*;
- ▶ *Digitaria hystrichoides*; and
- ▶ *Sclerolaena densiflora*.

Endemic flora

No flora species endemic to the Northern Territory were recorded.

Regionally significant flora

Four species listed as having bioregional conservation significance were recorded. These species have conservation significance due to being either at the limit of their range or being a disjunct population in the bioregion (DLRM 2015). These species and their regional conservation codes are listed in Table 8-2.

Table 8-2 Species with bioregional significance recorded within the study area

Species Name	Common Name	Regional Conservation Code (DLRM 2015)
<i>Acacia murrayana</i>	Colony Wattle, Murrays Wattle	BRT (northern range limit)
<i>Eucalyptus trivalvis</i>	Victoria Spring Mallee	BRT (eastern range limit)
<i>Sclerolaena calcarata</i>	Red Copper Burr, Red Burr	BRT (disjunct), MAC (disjunct)
<i>Spartothamnella teucrifflorea</i>	Mulga Stick-plant, Scented Stick-plant	BRT (northern range limit)



Groundwater dependant ecosystems

Serov *et al.* (2012) defines GDEs as 'ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater'. GDEs are known to occur in almost every environment across the landscape including terrestrial dry land, freshwater, marine and subterranean environments.

Wetlands within the Project area have the potential to be maintained by groundwater. Stirling Swamp is located to the north of the access road. The swamp area is formed from a large network of claypans, lignum swamp, semi-saline samphire and temporary open water, and the adjacent Hanson River. The site also forms part of the Anmatyerr North SOCS (Duguid *et al.* 2005). Stirling Swamp is thought to be connected to groundwater through a topographical low forming a 'window' to the relatively shallow Ti Tree aquifer. This area is thus a discharge zone of the Ti Tree aquifer.

Mud Hut Swamp is located approximately 7.7 km to the north of the mine site. The swamp is formed from a flood-out of the Bloodwood Creek (Duguid *et al.* 2005). Based on its location as an outflow of the Bloodwood Creek, it is unlikely that the swamp is maintained by groundwater (GHD 2015a).

There are no known permanent or semi-permanent water holes along the Hanson River, with any pools formed through surface water flow. These are relatively short lived as they drain to the underlying aquifer and are subject to evaporation.

Eucalyptus trees can access water in deep soil layers and access groundwater by extending roots to the water table. Given the intermittent nature of creek and drainage lines within the study area, Riparian woodlands are also likely to be at least partially dependant on groundwater.

Introduced flora species

Five exotic flora species were recorded:

- ▶ *Cenchrus ciliaris* (Buffel Grass);
- ▶ *Citrullus lanatus* (Bitter Melon);
- ▶ *Eragrostis tenuifolia* (Elastic Grass);
- ▶ *Tribulus terrestris* (Caltrop); and
- ▶ *Vachellia farnesiana* (Mimosa bush).

One of these species (*Tribulus terrestris*) is listed as a Class B (spread must be controlled) and Class C (not to be introduced to the NT) noxious weeds under the NT Weeds Management Act. This species was found in low abundance throughout all vegetation communities within the study area. It is likely that this species is spread by cattle and vehicle movement.

No weeds of national environmental significance (WONS) were recorded.

Introduced flora species, including *Tribulus terrestris* occur in relatively low abundance across the study area. The most abundant exotic species recorded was *Cenchrus ciliaris* (Buffel Grass) which occurs in moderate densities (5 - 25% cover abundance) along creeks and major drainage lines as well as in low abundance (0-5% cover abundance) through the remaining vegetation communities.

Areas of Riparian woodland along watercourses and drainage channels also commonly contain scattered individuals of the exotic species *Vachellia farnesiana* and *Citrullus lanatus*.



Vegetation communities

Native vegetation within the study area is generally in moderate to good condition. High to moderate level impacts from pastoral activities (trampling, grazing and weed invasion) are localised and generally confined to watering points, ephemeral watercourses, wetlands and stockyards. There are numerous cleared tracks, but little other evidence of vegetation clearing. Although low level grazing impacts are evident, vegetation is generally healthy with active seedling recruitment. Some modification to vegetation structure from fires is evident, particularly within Mulga shrublands and Triodia grassland communities.

The study area contains a high level of vegetation/habitat heterogeneity (diversity) including hummock grasslands, shrublands and riparian woodlands. This is largely due to the variety of landforms (watercourses, alluvial plains, eolian plains, alluvial foothill fans, rocky hills).

Based on the fine-scale vegetation mapping and flora sampling, eight broad vegetation communities were identified as occurring within the Project area. Vegetation communities have been described in accordance with the NVIS framework to hierarchical Level V: (Association). The communities are summarised in Table 8-3 and their distributions shown in Figure 8-2. Detailed descriptions of each community are provided in Appendix G.

The dominant communities are Mulga shrublands, which occur on alluvial fans and plains containing clayey red earths and Triodia hummock grasslands which grow on sandy plains and undulating hills. Vegetation across the study area is generally in good condition with little anthropologic disturbance and high species richness. In more fertile riparian areas and associated floodplains there is clear evidence of impacts associated with cattle grazing including weed invasion, reduction in ground cover species and soil erosion. In particular there is a high abundance of the invasive grass *Cenchrus ciliaris* (Buffel Grass).

Table 8-3 Vegetation communities within the study area

Veg. code	Vegetation community	NVIS Description (Level III broad floristic formation)	Area (ha)
VT 1	Low open Eucalyptus woodland on limestone	Triodia hummock grassland	775
VT 2	Mulga shrubland on sandy red earths	Acacia shrubland	11,885
VT 3	Riparian woodland along watercourses and drainage channels	Eucalyptus open woodland	554
VT 4	Low Corymbia woodland on loamy alluvial plains	Tussock grassland	675
VT 5	Floodplains dominated by <i>Eucalyptus victrix</i>	Eucalyptus open woodland	609
VT 6	Triodia grassland on sandy plains	Triodia hummock grassland	8,115
VT 7	Low Acacia shrubland on rocky slopes	Triodia hummock grassland	441
VT 8	Tall Acacia shrubland on stony quartz	Acacia shrubland	223
Total			23,278

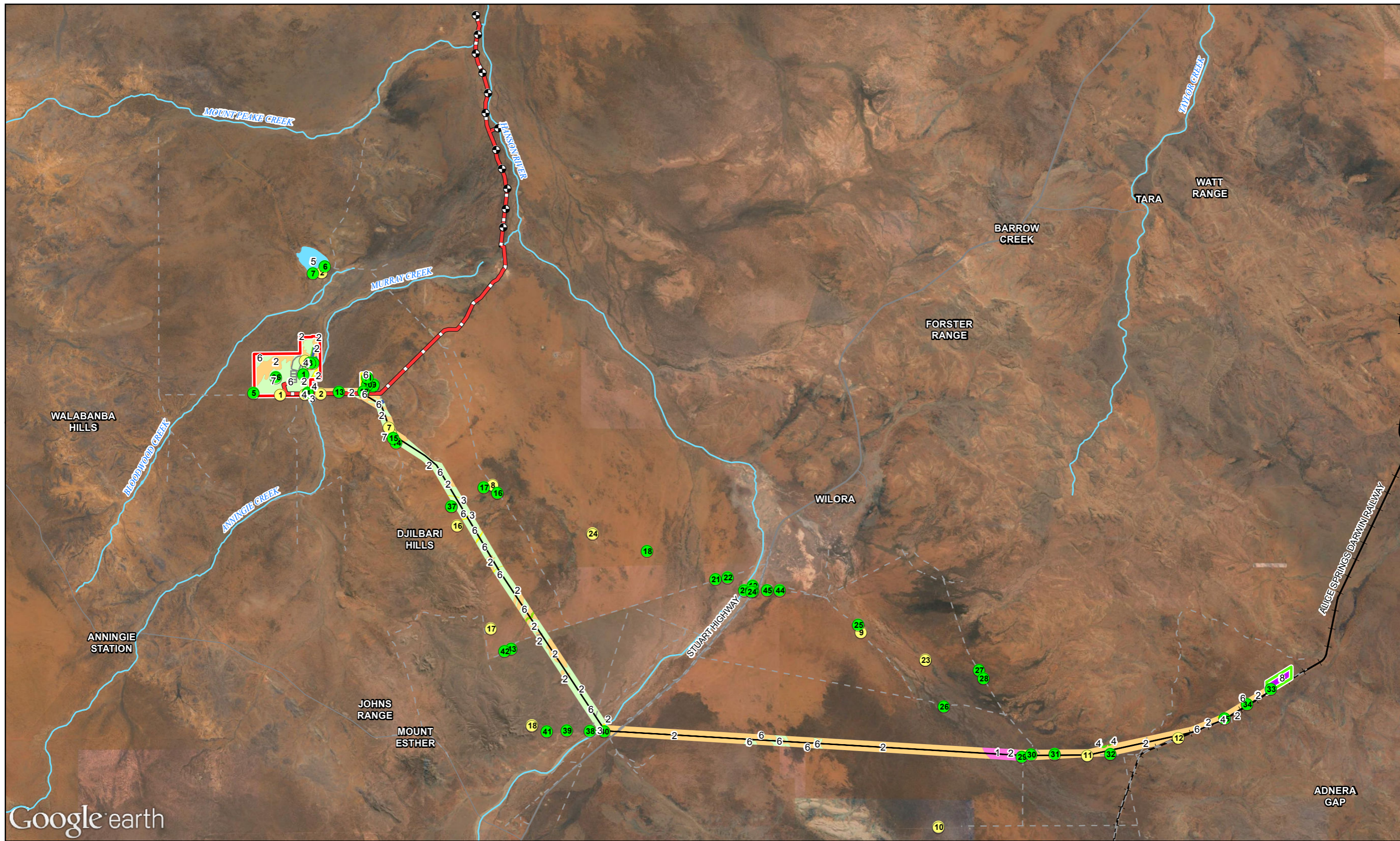
Nationally and regionally significant vegetation communities

No nationally significant vegetation communities were recorded.

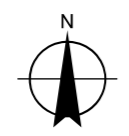
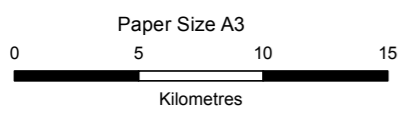
Dominant vegetation communities within the study area include mulga on red earths, woodlands on alluvial flats and hummock grasslands on sand plains. Most of the communities are well represented within the Burt Plain Bioregion, however less than 1% of the Burt Plain bioregion is conserved and thus vegetation communities within the study area are poorly represented in conservation reserves.

A number of less common vegetation communities occur in small patches or along linear drainage lines. These include Riparian woodland (VT 3) dominated by bean trees (*Erythrina vespertilio*) and Tall Acacia shrubland on stony quartz (VT 8).





Google earth



LEGEND

- 1 Flora Survey Locations
- 1 1 Check Sites
- Rail Siding Loading Facility
- Mount Peake Mining Area
- Camp Facilities

- Access Road Corridor
- Tracks (Unverified)
- Major Watercourses
- Principal Road
- Minor Road

Vegetation Communities

- 1 Low open Eucalyptus woodland on limestone ridges
- 2 Mulga shrubland on sandy red earths
- 3 Riparian woodland along watercourses and drainage channels
- 4 Low Corymbia open woodland on loamy alluvial plains
- 5 Floodplains dominated by *Eucalyptus victrix*
- 6 Triodia grasslands and sandy plains
- 7 Low Acacia shrubland on rocky slopes
- 8 Tall Acacia shrubland on stony quartz



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Vegetation communities recorded within the study area Figure 8-2

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Revision A
Date 13 Nov 2015

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Data source: TNG - Gas / Slurry Pipeline Study Corridor, Camp Facilities, Transport Study Corridor, Mount Peake Mining Area, Mount Peake Granted Tenements (2013). Geoscience Australia - Waterways (2008). Google Earth Pro - Imagery (Date extracted: 13/02/2014). GHD - Tracks, Flora Survey Sites, Vegetation Communities (2014). Created by: CM

The NT Land Clearing Guidelines identify a number of sensitive or significant vegetation communities to avoid clearing including rainforests, monsoon vine thicket, riparian or closed forests. Vegetation communities include the Riparian woodland that occurs along creeks and major drainage lines within the Project area.

Riparian vegetation is a key component of the catchment, providing a range of ecosystem services such as filtering contaminants and nutrients, providing habitat for flora and fauna and preventing soil erosion. The Riparian woodland vegetation community is a locally significant community.

Neave *et al.* (2006) provides an overview of important vegetation communities within the Burt Plain Bioregion. These include a number of wetlands and mesic areas, sites of botanical significance and flora and fauna hotspots. The study area does not contain any of these identified sites however Mud Hut Swamp and Stirling Swamp are located near to the study area and considered to contain important vegetation that should be protected during construction and operation of the Project.

Despite most of the vegetation communities within the study area being well represented in the bioregion, Neave *et al.* (2006) recognise that common communities can be regarded as having conservation significance if they meet any of the following criteria:

- ▶ habitat with high species richness that supports a high abundance of native species, and/or is structurally complex;
- ▶ habitat supporting species of high conservation values (e.g. threatened species, endemic species, poorly reserved species and/or rare species);
- ▶ habitat that is of good quality (i.e. its compositional and structural integrity and ecological processes have not been undermined); and
- ▶ habitat that is poorly reserved.

A number of vegetation communities within the study area partially meet these criteria as they are known to support threatened species, including brush-tailed mulgara, black-footed rock-wallaby and grey falcon, which were detected during fauna surveys within or near the Project area (GHD 2015b). All of these habitat types however are well represented in the region and the Project area is not considered to provide unique habitat for any of these species.

8.1.4 Potential Impacts

The proposal has the potential to impact on flora and vegetation, or exacerbate existing threatening processes, through:

- ▶ clearing of flora and vegetation and associated loss of habitat during construction;
- ▶ alteration of hydrological regimes associated with earthworks and construction activities, and associated changes to land surface areas, and/or impediments to surface flows;
- ▶ groundwater drawdown and/or changes to groundwater flows impacting groundwater dependent ecosystems;
- ▶ contamination of surface and/or groundwater;
- ▶ introduction and/or spread of invasive exotic flora species;
- ▶ changes to fire regimes;
- ▶ dust emissions from construction, mining and processing activities; and
- ▶ erosion and sedimentation resulting from vegetation clearing during construction.



Clearing

Approximately 1,058 ha will be disturbed for construction of the pit, waste rock dump, tailings storage facility, accommodation village, access roads, mine infrastructure, stockpile sites and the Adnera Loadout Facility. The location and area of borrow pits still needs to be determined.

Mapped areas of each vegetation community to be impacted by the Project (1,008 ha) are provided in Table 8-4. Vegetation clearing in these communities will involve removal of a moderately diverse range of non-threatened native plants, including mature trees.

Table 8-4 Vegetation communities impacted by the Project

Veg code	Vegetation community	Area to be impacted ¹	% of Project area
VT 1	Low open Eucalyptus woodland on limestone	8.35	0.83
VT 2	Mulga shrubland on sandy red earths	420.25	41.68
VT 3	Riparian woodland along watercourses and drainage channels	2.90	0.29
VT 4	Low Corymbia woodland on loamy alluvial plains	4.61	0.46
VT 5	Floodplains dominated by <i>Eucalyptus victrix</i>	0	0
VT 6	Triodia grassland on sandy plains	558.58	55.40
VT 7	Low Acacia shrubland on rocky slopes	3.50	0.35
VT 8	Tall Acacia shrubland on stony quartz	10.00	0.99
Total		1008.19	

¹ these impact areas do not include vegetation disturbance associated with the borefield and associated pipeline

In addition to the clearing areas included in Table 8-4 the proposal will result in approximately 50 ha of disturbance within the borefield area and associated pipeline and access track. Within this area approximately 20 ha has already been cleared for existing access tracks. The proposal will therefore result in the clearing of an additional 30 ha of native vegetation. The borefield will disturb around 1 ha adjacent to the Hanson River with an 11 ha disturbed to accommodate the pipeline and access track. Although this area was not assessed during the field survey a review of geological and topographic information as well as aerial imagery suggests that vegetation within this area is primarily Triodia grassland on sandy plains (VT 6), Low Corymbia woodland on loamy alluvial plains (VT 4) as well as a small amount of Riparian woodland along water courses (VT 3). A preclearance survey will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no significant or sensitive vegetation communities will be impacted by clearing.

The remaining 18 ha to be cleared is for the pipeline and access track that runs between the borefield and the Raw Water Dam. The majority of this vegetation is likely to include Triodia grassland on sandy plains (VT 6) and Mulga shrubland on sandy red earths (VT 2). There may also be small areas of Riparian woodland along watercourses and drainage channels (VT 3).

No vegetation communities listed as threatened under the EPBC or TPWC Act will be cleared.

The average species richness within vegetation communities present within the Project area varies from 17 within Mulga shrublands (VT 2) to 31 within Riparian woodlands (VT 3). None of the vegetation communities are considered to have high species richness or structural complexity. Vegetation communities present are well represented in the Burt Plain Bioregion.



The two most common vegetation communities within the Project area are *Triodia* grassland on sandy plains (VT 6) and Mulga shrublands on sandy red earths (VT 2). Together these vegetation communities comprise 97 % of the vegetation proposed to be impacted.

Fifty-five percent of the Project area is comprised of *Triodia* grassland on sandy plains. This vegetation community best corresponds to vegetation Map Unit 76 – *Triodia pungens* (Soft Spinifex), *Plectrachne schinzii* (Curly Spinifex) hummock grassland with *Acacia* tall sparse-shrubland overstorey, which covers an area of 1,098,704 ha or 23.17% of the Burt Plain bioregion (Wilson *et al.* 1990, Pert 2006). Removal of 558 ha of this community will represent less than 0.05% of this community within the bioregion.

Mulga shrublands on sandy red earths comprise 41% of the Project area. This vegetation community corresponds to the vegetation Unit 65 – *Acacia aneura* (Mulga) tall open –shrubland with *Eragrostis eriopoda* (Woollybutt) open grassland understorey. There is approximately 2,771,054 ha of this vegetation community mapped within the Burt Plain Bioregion (Wilson *et al.* 1990, Pert 2006). Removal of 420 ha of this community will represent approximately 0.01% of this community within the bioregion.

There are a number of less common vegetation communities that occur in small patches or along linear drainage lines throughout the study area. These include Riparian vegetation (VT 3) dominated by bean trees (*Erythrina vespertilio*) and Tall *Acacia* shrubland on stony quartz (VT 8). These communities are not considered to be rare or threatened at the national or region scale.

Management measure will be adopted to minimise direct and indirect impacts to flora and vegetation during construction and operation (section 8.1.5).

Alteration of hydrological regimes

Vegetation in riparian zones and floodplain areas are likely to be at least partially dependent on surface water flows. The construction of linear infrastructure such as access roads and pipelines has the potential to interfere with natural surface water flows by blocking or disrupting the movement of water across the landscape. These potential impacts are likely to be most significant where the access road crosses the Hanson River and in areas within the borefield area adjacent to the Hanson River.

The Project may also impact surface water flows through changes to areas of inundation, concentration of flows and/or disruption to sheet flow regimes. Changes to flow pathways may change the flow regime experienced by downstream receptors. Flow pathways include drainage channels, distributed channels and sheet flow areas. The key receptors that are vulnerable to changes in environmental flows are vegetation communities that are at least partially dependent on surface water flows including sheet flow (i.e. Mulga shrubland) and the riparian vegetation within drainage channels and Mud Hut Swamp.

Approximately 37% of the Project area is comprised of floodplains and plains that will be subject to seasonal inundation or surface water flows. A reduction in surface water flows has the potential to result in the death of understorey species and also overstorey mulga shrubs during low rainfall periods and may in the long term lead to alterations to community composition (Anderson and Hodgkinson 1997).

Management measure will be adopted to maintain existing hydrological regimes during construction and operation (section 8.1.5).

Groundwater drawdown

A new borefield will be established within the alluvial aquifer of the Hanson River. Six supply bores with two standby bores will provide water for the first four years of the Project with an additional four bores installed from year 5. Bores will be spaced approximately 1,800 m apart and will pump at around 8.5 L/s each. The Project will result in progressive water table drawdown from groundwater extraction.



Changes to the water table can lead to changes in surface vegetation and habitat characteristics. Lowering of the water table has the potential to cause the following impacts on vegetation and flora:

- ▶ decline in availability of water to ecosystems including riparian vegetation resulting in loss of habitat for species relying on riparian habitat; and
- ▶ potential impacts to the threatened species *Eleocharis papillosa* which is known to occur in Stirling Swamp.

Groundwater modelling was undertaken to predict the likely extent of groundwater drawdown from abstraction (GHD 2015a).

Maximum predicted drawdown contours for the borefield at the end of mining are shown in Figure 8-3. The maximum drawdown is modelled as being up to 12 m below current groundwater levels (which are 10 – 12 m below ground level) at the operating bores in the centre of the borefield. The 1 m drawdown contour extends to around 6 km south of the borefield.

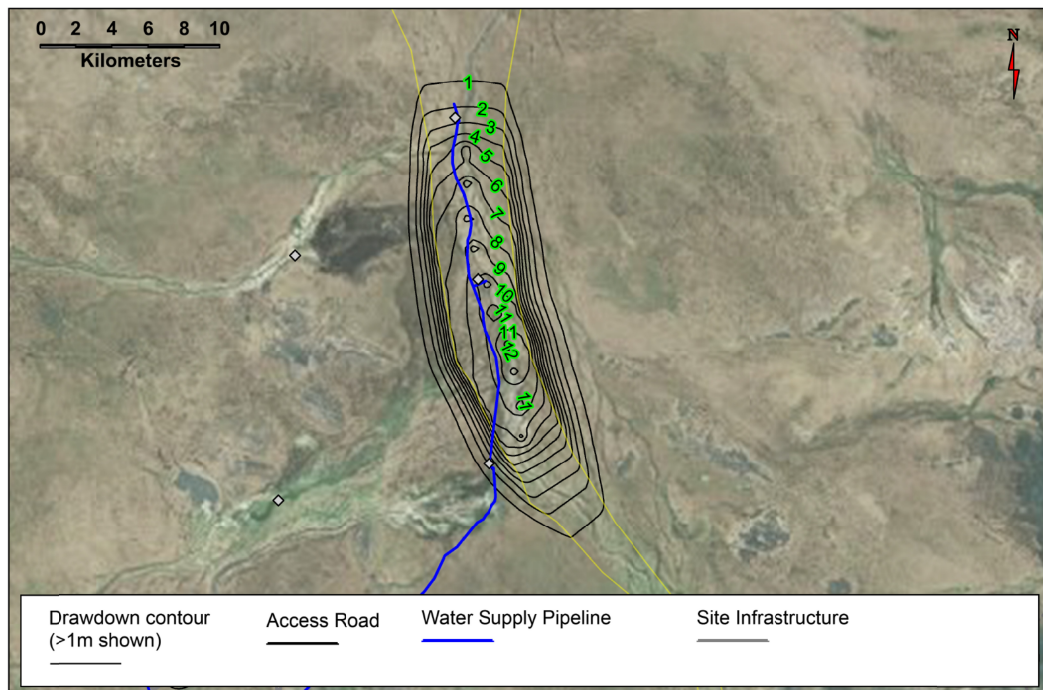


Figure 8-3 Simulated groundwater levels for the borefield at the end of mining (contours are depths below current water table levels)

A drawdown of 12 m below current groundwater levels is likely to result in impacts to groundwater dependent species. This will include *Eucalyptus camaldulensis* (River Red Gum) and *Corymbia aparreninja* (Ghost Gum) that line riparian areas within the Project area. A reduction in groundwater depth has the potential to starve these individuals of water and result in plant death and alterations in the structure of the riparian community.

Groundwater modelling indicates that groundwater levels in the area adjacent to Stirling Swamp and the outflow of the Ti Tree basin will not be impacted by abstraction (GHD 2015a). Mud Hut Swamp will also not be impacted by drawdown associated with pit dewatering (GHD 2015a).

Measures to minimise risks associated with lowering of the water table during groundwater extraction from the borefield will include:

- ▶ further predictive modelling to confirm the extent of groundwater drawdown;
- ▶ establishing a groundwater monitoring program to quantify drawdown during abstraction;
- ▶ monitoring vegetation potentially at risk of impact from a lowering of the water table; and
- ▶ if significant impacts are identified consider mitigation options. This could include modification of the pumping regime to manage groundwater levels.

Contamination of surface and ground waters

There are several risks associated with the construction and operation of the Project that could lead to contamination of surface and groundwater. These include contamination of waterways or groundwater caused by embankment failure or overtopping and subsequent uncontrolled release from storage ponds, the processing site and the TSF. Inappropriate storage and handling of hazardous substances may also result in uncontrolled release, spills or passive discharge into drainage lines.

Geochemical investigations by TNG have not identified the presence of material within the orebody with significant Acid Mine Drainage (AMD) potential.

There are a number of sensitive riparian habitats close to the development footprint, including drainage lines, Bloodwood Creek (and onto Mud Hut Swamp), Murray Creek and the Hanson River. These areas are all sensitive receptors for any adverse impacts on water quality potentially arising from the Project. Vegetation and flora reliant on surface flows and groundwater uptake may also be impacted by surface water and groundwater contamination.

After closure, the mine void will act as a sink concentrating salts. Evaporation exceeds precipitation in the Project area so any lake that forms will be confined to the bottom of the pit.

Project design has incorporated a number of control measures to minimise the potential for the release of contaminants to the environment. These include storage of diesel at the mine site in self bunded tanks.

Within the flood plain of the Hanson River elevated drill pads will be constructed to ensure the well casings, headworks, generators and fuel tanks remain above the 100-year ARI level. Generators and fuel tanks at the borefield will be located within lined and bunded structures constructed on top of the drill pad with bunded storage sufficient to accommodate simultaneously an appropriate ARI wet season rainfall event and failure of a full fuel tank

The site has also been designed so that there will be no process or contaminated water stream discharged to the environment. Clean water will be diverted around the site.

Introduced species

There is the potential for Project activities to introduce or spread of weeds via the transportation of seeds on vehicle tyres and machinery, movement or stockpiling of soil and inappropriate waste management.

A number of weed species are known to be present within the Project area. One of the exotic species (*Tribulus terrestris*), recorded during the survey is a declared weed under the *Weeds Management Act 2001* and buffel grass (*Cenchrus ciliaris*) has been identified as a high threat environmental weed in the Burt Plain Bioregion.

A Weed Management Plan (WMP) has been developed for the Project to minimise the risks associated with the introduction of spread of weeds throughout the site.



Changes to fire regimes

Construction and operational activities, particularly hot works, are potential ignition sources, and could result in a bushfire. In addition, it may be necessary to conduct controlled burns to minimise fuel loads in the vicinity of the mine site. Without adequate fire management in place, there is potential for these activities to result in bushfires. Although wildfire has an influential role in arid zone ecology and is a necessary ecological process in some habitats, fire can have detrimental impacts on vegetation.

A Fire Management Plan has been developed for the Project.

Dust emissions

The following activities are identified as potentially the main generators of dust for the Project:

- ▶ vehicle movements over unsealed surfaces;
- ▶ release of particulates from the handling and transport of materials and product;
- ▶ clearing of vegetation resulting in exposed soils that are more susceptible to wind erosion; and
- ▶ wind erosion mobilising dust from exposed surfaces such as the pit, waste rock dump, tailings storage facility, laydown areas, stockpiles and roads.

Dust deposition on leaf surfaces may physically affect individual plants such as by blocking and damaging stomata, and abrasion of the leaf surface or cuticle which may in turn impact on metabolic processes. Dust could also contribute to cumulative effects such as drought stress on already stressed individuals which may in turn lead to the loss of individual plants.

Dust is unlikely to result in the loss of any vegetation communities within the Project area but may result in impacts on individual plants. It is unlikely that these impacts will be significant in terms of the relative numbers of plants that could be impacted, particularly if management actions are implemented to minimise the impacts of dust (e.g. watering of unsealed roads). Any impacts to vegetation from dust are likely to be relatively minor and largely restricted to areas close to the Project (50 to 100 m).

Industry standard dust control measures will be adopted for the Project.

Erosion and sedimentation

There is potential for the Project to result in the loss of soils in areas that have been stripped of vegetation. Soil erosion has the potential to impact Murray Creek and the downstream Mud Hut Swamp through the release of sediments from site during flow events.

Potential water quality impacts may be associated with sediment runoff from disturbed areas, including vegetation clearing areas, construction lay down areas and access roads if risks are not effectively managed. Concentrated and/or altered water movement within the construction footprint could increase the potential for sediment mobilisation and transport. Negative effects on aquatic habitats may include increases in stream sediment load, changes in channel form and changes in stream hydrology. Infrastructure impinging on a stream channel may also cause increases in sediment input and consequent declines in water quality and stream habitat integrity.

Soil protection measures will be implemented during construction and operation including the implementation of an Erosion and Sediment Control Plan (section 8.1.5).



8.1.5 Flora and Vegetation Management Measures

Detailed Project design will consider options for locating infrastructure footprints to avoid or minimise vegetation clearing. In particular the Project will aim to avoid, where possible, direct impacts to sensitive vegetation communities such as riparian vegetation. However, the Project will result in some unavoidable residual impacts to flora and vegetation. These impacts are not expected to impose a significant negative effect on the local or regional occurrences of vegetation communities or flora species.

Construction phase

Land disturbance and vegetation clearing will be kept to as small an area as practicable. Construction personnel will be briefed during inductions regarding the conservation value of surrounding habitats and their responsibilities with regard to protecting these habitats during construction.

A preclearance survey of the borefield, pipeline route and borrow pit areas will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no threatened species or significant or sensitive vegetation communities are impacted by clearing.

Engineering controls that assist in maintaining surface water flows have been incorporated into road designs to ameliorate potential risks to vegetation and flora due to changes in flow. Design features include installing at-grade flood ways where the access road crosses a water course and culverts to maintain flows under the access road where the drainage line is not well defined.

To control surface runoff and avoid erosion of the perimeter embankment of the TSF, collector drains will be constructed along the downstream toe of the embankment. These drains will collect clean surface runoff and direct the flow away from the TSF.

To limit impacts on riparian areas buffer widths recommended by the NT Land Clearing Guidelines will be adhered to where possible.

A CEMP which will include industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures including:

- ▶ strategies to minimise vegetation clearance where possible;
- ▶ procedures for demarcating the limits of clearing and no-go areas;
- ▶ staged clearing of vegetation to minimise areas of bare ground and clear land only as required;
- ▶ strict vehicle hygiene protocols to prevent new weed incursion and spread, including a vehicle wash down facility on site;
- ▶ fire prevention management protocols to prevent wildfire during clearing activities;
- ▶ maintenance of fire breaks around high-risk areas/activities;
- ▶ use of already-disturbed areas (rather than undisturbed areas) wherever possible (e.g. lay down areas for construction);
- ▶ development and implementation of a land stabilisation and revegetation strategy;
- ▶ progressive revegetation of cleared land as activities are completed;
- ▶ application of industry standard dust control measures;
- ▶ an Erosion and Sediment Control Plan; and
- ▶ a Weed Management Plan.



Operation phase

Measures to minimise risks associated with lowering of the water table during groundwater extraction from the borefield will include:

- ▶ further predictive modelling to confirm the extent of groundwater drawdown;
- ▶ establishing a groundwater monitoring program to quantify drawdown during abstraction;
- ▶ monitoring vegetation potentially at risk of impact from a lowering of the water table; and
- ▶ if significant impacts are identified consider mitigation options. This could include modification of the pumping regime to manage groundwater levels.

Weed control measures will include:

- ▶ regular monitoring of the Project area (including rehabilitated areas) and surrounding vegetation to identify new weed populations and monitor the effectiveness of weed control measures;
- ▶ vehicles and equipment inspected prior to entering the site if there is a risk of importation of soil, seed and plant material;
- ▶ vehicle access restricted to designated roads and access tracks;
- ▶ areas supporting existing weed infestations, or vulnerable to weed infestation, avoided where practicable;
- ▶ topsoil from weed affected areas stockpiled in a designated area with appropriate signage and bunding. Weed infested topsoil will be treated as required to eradicate weeds prior to re-spreading in rehabilitation areas;
- ▶ all staff and contractors informed of weed hygiene measures and weed reporting requirements during the site induction; and
- ▶ ongoing maintenance of erosion and sediment controls.

Fire management measures will include:

- ▶ development of a Fire Management Plan;
- ▶ welding, cutting and grinding works undertaken will require approval via an internal hot works permit;
- ▶ maintenance of fire breaks around high-risk areas / activities;
- ▶ all site personnel will be required to undertake fire control training, including the correct use of extinguishers;
- ▶ all vehicles are required to carry a fire extinguisher and two-way radio;
- ▶ emergency procedures; and
- ▶ active fire management, and the use of cool-season control burns if needed.



Rehabilitation

Progressive rehabilitation undertaken over the Project area will be guided by the following principles:

- ▶ areas not required for ongoing operations will be progressively rehabilitated with local provenance native species;
- ▶ locate and design landforms to be rehabilitated to optimise blending with the surrounding topography;
- ▶ topsoil will be stripped and stockpiled in a designated area, to prevent erosion or run-off;
- ▶ minimise soil erosion particularly on the batters of the waste rock dump;
- ▶ stockpile vegetative material and topsoil for later use;
- ▶ minimise length of stockpiling of vegetation and topsoil;
- ▶ seeds collected for the rehabilitation program will be sourced locally, within a 20 km radius of the Project area, wherever possible;
- ▶ annual monitoring of rehabilitation areas will be undertaken prior to, and following completion of rehabilitation; and
- ▶ if monitoring identifies that completion criteria are not being met, additional rehabilitation and monitoring will be completed until such criteria are met.

Rehabilitated areas will be monitored to ensure the success of the rehabilitation programme and impacts from mining activities. Monitoring of rehabilitated sites will be undertaken annually until completion criteria have been met. Monitoring will assess species diversity, plant density and community structure against agreed completion criteria, which include:

- ▶ species richness, species diversity and plant density of the restored community exceeds the median in the range of values established for baseline vegetation communities; and
- ▶ dominant species in the restored community are also dominant in the baseline vegetation communities.

Closure

A Conceptual Mine Closure Plan has been developed and will be refined as a component of the Mine Management Plan. The plan outlines general and area specific decommissioning and closure measures, completion criteria and post closure monitoring requirements for the Project. The Conceptual Mine Closure Plan aims to ensure that:

- ▶ mining is planned and carried out to ensure a sustainable mine closure outcome is achieved; and
- ▶ self-sustaining native vegetation communities are returned after mining, which in species composition and ecological function are representative of naturally occurring analogue sites.

A post-closure monitoring programme will be initiated, with the aim of confirming that rehabilitation and closure has been effective and the closure criteria satisfied. Post-closure monitoring will include assessments of public safety, geotechnical stability, physical stability, chemical stability and revegetation success.



8.1.6 Summary of Impacts and Conclusions

The current survey identified 238 flora species (233 native and 5 introduced) within the study area.

No threatened flora species were recorded during the survey, although there is potential habitat for one threatened species (*Eleocharis papillosa* Dwarf Desert Spike-rush). This species is listed as vulnerable under both the TPWC Act and EPBC Act.

Eight vegetation communities were mapped within the study area:

- ▶ Mulga shrubland on sandy red earths;
- ▶ Riparian woodland along watercourses and drainage channels;
- ▶ Triodia grassland on sandy plains;
- ▶ Floodplains dominated by *Eucalyptus victrix*;
- ▶ Open Corymbia woodland on loamy alluvial plains;
- ▶ Low Acacia shrubland on rocky slopes;
- ▶ Tall Acacia shrubland on stony quartz; and
- ▶ Low open Eucalyptus woodland on limestone.

All of these vegetation types are well represented at the local scale within the bioregion.

The proposal would result in the removal of approximately 1038 ha of native vegetation. None of the vegetation communities proposed to be removed has national or regional significance. The majority of the vegetation to be cleared for the project would be from two vegetation communities (Mulga shrubland on sandy red earths and Triodia grassland on sandy plains). Both of these communities are well represented at the local and regional scale.

The proposal has the potential to impact on flora and vegetation, or exacerbate existing threatening processes through:

- ▶ clearing of flora and vegetation and associated loss of habitat during construction;
- ▶ alteration of hydrological regimes associated with earthworks and construction activities and associated changes to land surface areas, and/or impediments to surface flows;
- ▶ groundwater drawdown and/or changes to groundwater flows impacting groundwater dependent ecosystems;
- ▶ contamination of surface and/or groundwater;
- ▶ introduction and/or spread of invasive exotic flora species;
- ▶ changes to fire regimes;
- ▶ dust emissions from construction, mining and processing activities; and
- ▶ erosion and sedimentation resulting from vegetation clearing during construction.

Management and mitigation measures would be implemented throughout the construction, operation and decommissioning phases of the Project to ameliorate potential impacts on vegetation and flora. Overall, impacts to flora and vegetation are expected to be low.



8.2 Fauna

8.2.1 Introduction

This chapter describes the fauna of the Mount Peake Project area and assesses the potential for impact to local and regional biodiversity during the construction and operation of the Project.

A detailed report is provided in Appendix H.

8.2.2 Methodology

Desktop review

Prior to completing field survey a desktop literature and database review was undertaken to gain an understanding of the ecological context of the Project area. Data reviewed included fauna records from NT and Commonwealth ecological databases.

Field survey

A baseline fauna survey was undertaken in April 2013. Fauna survey techniques used were consistent with the *Guidelines for assessment of impacts on terrestrial biodiversity* (NT EPA 2013).

The study area included the proposed mine area, accommodation area, a 1 km wide corridor along the proposed access road and the proposed rail siding facility. Field survey of the proposed borefield, associated pipeline and access road, and road base borrow pit areas was not undertaken as part of this assessment as the locations of these features were not known at the time of the survey.

The study area was divided into relatively homogenous or discrete vegetation habitat types using existing vegetation mapping and aerial imagery. Sites were ground-truthed to verify their vegetation/habitat characteristics, or to move them to more appropriate locations. Sites were chosen to maximise the likelihood of detecting fauna, including threatened species. Sixteen survey sites were established proportionately across the five main vegetation types represented. The site survey adopted a number of techniques including habitat assessment, baited Elliot-type traps, baited cage traps, pitfall buckets, funnel traps, Anabat[®] bat call detectors, bird surveys, active diurnal and nocturnal searches, remote surveillance cameras and opportunistic observations.

Due to the absence of water, an aquatic fauna survey was not undertaken.

8.2.3 Results

Desktop assessment

Burt Plain Bioregion

The Project area occurs entirely within the Burt Plain Bioregion.

The bioregion is broadly characterised by plains of Acacia shrubland, tussock and hummock grasslands, Acacia and Eucalyptus woodlands, and mountain ranges in the east, north and west of the bioregion. More than 80% of the bioregion is devoted to pastoralism. The Project area lies mainly within Stirling Station which is currently used for cattle grazing.

Much of the bioregion has been impacted by a range of pervasive factors such as grazing by livestock and/or feral animals, feral predators and weed infestations.



The bioregion has suffered substantial losses of its mammal fauna over the last century and there are ongoing declines of some bird and mammal populations. Exotic predators are widespread. Other exotic plants species, most notably buffel and couch grass, also pose significant threats to some habitats.

Many fauna species have been lost from this bioregion over the last 150 years. Of those that persist, 13 species are currently listed as threatened at the National and/or Territory level.

Sites of Conservation Significance

Three Sites of Conservation Significance have been identified in the vicinity to the Project area.

Mud Hut Swamp (NRETAS 2009) is the largest swamp in the Burt Plains bioregion and is approximately 7.7 km north of the proposed mine area. The swamp is likely to support a range of wetland birds, fish and plants. Any interruption or alteration of surface water drainage in the vicinity of the Project area has the potential to adversely affect the downstream ecosystem, including Mud Hut Swamp.

The Anmatyerr North site includes Stirling Swamp, and is noted to form occasionally at the northern edge of the Ti Tree Basin, storing flood waters discharged from the Hanson River and the ridges to the east of Wilora. This area is believed to act as an evaporation area for the basin (NRETAS 2009a).

Wood Duck Swamp is an ephemeral swamp that may hold water for many months after heavy rain. The swamp is dominated by smooth-barked coolabah *Eucalyptus victrix*. It is one of the largest such swamps in the Burt Plains bioregion (NRETAS 2009b). Wood Duck Swamp is located approximately 10 km south of the access road, outside of the Project area.

Fauna of the Project area

In total, 280 fauna species are identified for the Project area (Appendix H). This species list is derived from a combination of information contained in the PMST report (22 species), DLRM database (249 species), and the GHD baseline fauna survey in April 2013 (116 species). Many of these species would be expected to use one or more of the habitat types in the Project area, either as residents, occasional or seasonal visitors, fly-overs or vagrants. These records include 18 threatened species, 13 of which are listed under the TPWC Act and 16 listed under the EPBC Act.

Database records for the locality include 9 near threatened species³, and two species recorded as being data deficient⁴. Table 8-5 provides a list of threatened and data deficient species previously recorded in the locality. The locations of vulnerable and near threatened species are shown in Figure 8-4.

Based on an assessment of habitats present and known restrictions of populations, 10 out of the 18 threatened species are unlikely or highly unlikely to occur in the Project area. No EPBC Act-listed Ecological Communities occur within or near the Project area.

³ Under IUCN criteria this conservation category is defined as taxa that do not meet the criteria for Critically Endangered, Endangered or Vulnerable at present but is close to qualifying for or is likely to qualify for a threatened category in the near future.

⁴ Under IUCN data deficient taxa are defined as species where there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.

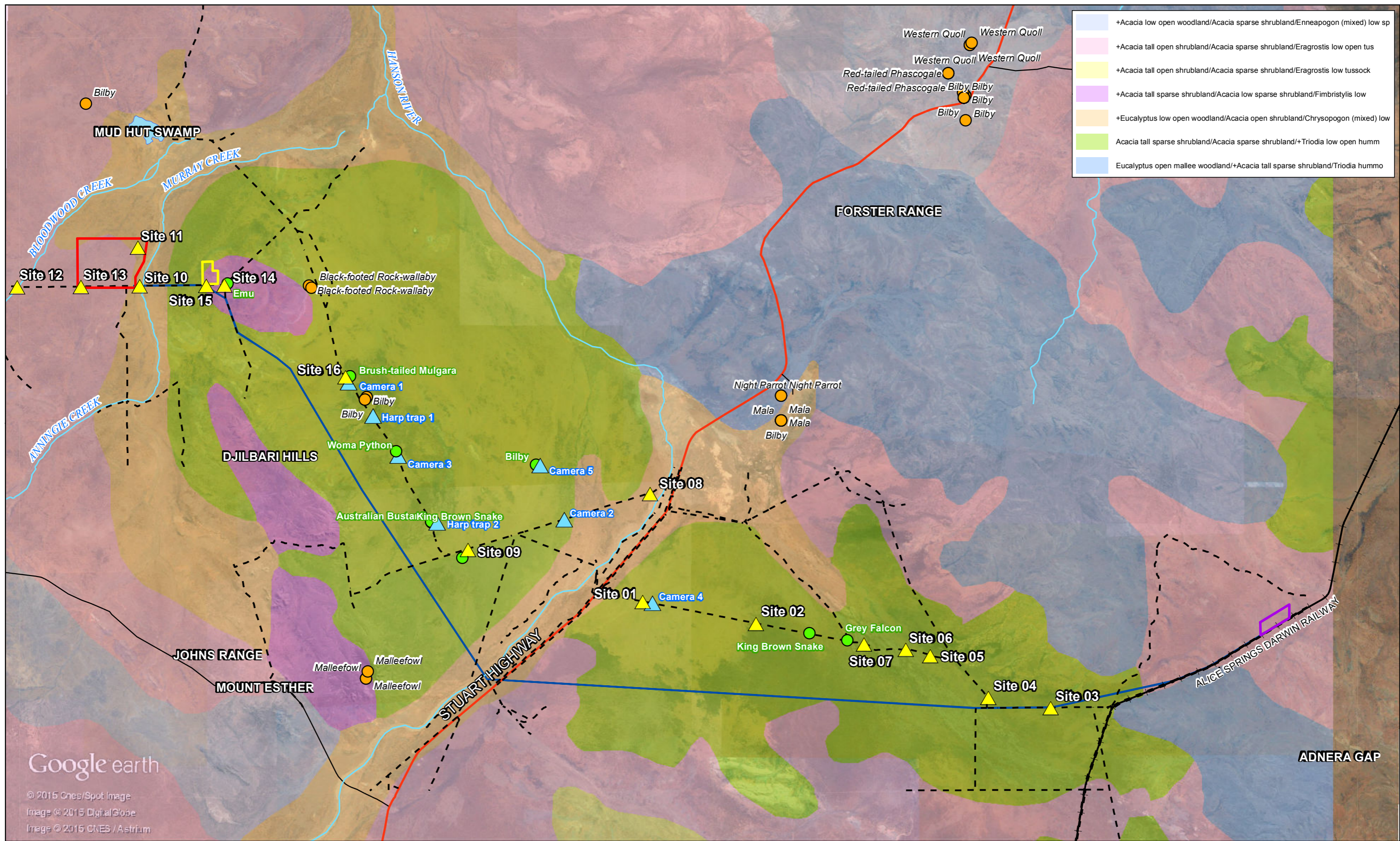


Table 8-5 Threatened fauna records within the locality

Scientific name	Common name	TPWC Act Conservation Status	EPBC Act Conservation Status	Likelihood of Occurrence
<i>Dasycercus blythi</i>	Brush-tailed mulgara	V	V	Present
<i>Dasycercus cristicauda</i>	Crest-tailed mulgara	V	V	Unlikely
<i>Dasyuroides byrnei</i>	Kowari	RX	V	Highly unlikely
<i>Dasyurus geoffroii</i>	Western quoll	RX	V	Highly unlikely
<i>Phascogale calura</i>	Red-tailed phascogale	RX	EN	Highly unlikely
<i>Chaeropus ecaudatus</i>	Pig-footed bandicoot	EX	EX	Highly unlikely
<i>Isoodon auratus</i>	Golden bandicoot	EN	V	Highly unlikely
<i>Macrotis lagotis</i>	Bilby (= greater bilby)	VU	V	Possible/Present
<i>Macrotis leucura</i>	Lesser bilby	EX	EX	Highly unlikely
<i>Trichosurus vulpecula vulpecula</i>	Common brushtail possum (southern N.T.)	EN	-	Possible
<i>Bettongia lesueur</i>	Burrowing bettong	RX	EX	Highly unlikely
<i>Lagorchestes hirsutus</i>	Mala	EW	EN	Highly unlikely
<i>Petrogale lateralis</i>	Black-footed rock-wallaby	NT	V	Present
<i>Notoryctes typhlops</i>	Southern marsupial Mole	V	EN	Unlikely
<i>Notomys longicaudatus</i>	Long-tailed hopping-mouse	EX	EX	Highly unlikely
<i>Leipoa ocellata</i>	Malleefowl	CR	V	Highly unlikely
<i>Erythrotriorchis radiatus</i>	Red goshawk	V	V	Highly unlikely
<i>Falco hypoleucos</i>	Grey falcon	V	-	Present
<i>Rostratula australis</i>	Australian painted Snipe	V	EN	Highly unlikely
<i>Polytelis alexandrae</i>	Princess parrot	V	V	Possible
<i>Pezoporus occidentalis</i>	Night parrot	CR	EN	Possible
<i>Liopholis kintorei</i>	Great desert skink	V	V	Possible
<i>Antechinomys laniger</i>	Kultarr	NT	-	Possible
<i>Lagorchestes conspicillatus</i>	Spectacled hare-wallaby	NT	-	Possible
<i>Onychogalea unguifera</i>	Northern nailtail wallaby	NT	-	Unlikely
<i>Dromaius novaehollandiae</i>	Emu	NT	-	Present
<i>Ardeotis australis</i>	Australian bustard	NT	-	Present
<i>Burhinus grallarius</i>	Bush stone-curlew	NT	-	Possible
<i>Lonchura flaviprymna</i>	Yellow-rumped mannikin	NT	-	Unlikely
<i>Aspidites ramsayi</i>	Woma python	NT	-	Present
<i>Pseudechis australis</i>	King brown snake	NT	-	Present
<i>Platyplectrum ornatus</i>	Ornate burrowing frog	DD	-	Unlikely
<i>Litoria australis</i>	Giant frog	DD	-	Possible

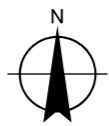
Key: V = vulnerable, EN= endangered, CR= critically endangered, EX= extinct, EW= extinct in the wild, RX= regionally extinct, DD = data deficient, NT = near threatened





1:260,000 @ A3
 0 2.5 5 7.5 10
 Kilometres

Map Projection: Universal Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 53



LEGEND

- ▲ Fauna Survey Sites
- ▲ Camera/Harp Trap Sites
- GHD Threatened Fauna Records
- LRM Threatened Species
- Tracks (Unverified)
- Major Watercourses
- Principal Road
- Minor Road
- Rail Siding Loading Facility
- Mount Peake Mining Area
- Camp Facilities
- Mud Hut Swamp
- Access Road



TNG Limited
 Mount Peake EIS

Job Number | 61-29057
 Revision | A
 Date | 27 Oct 2015

Fauna Site Locations

Figure 8-4

Field Survey

Fauna species

A total of 116 fauna species were recorded within the study area, comprising 112 native species and four introduced species. This includes 24 mammal species (four of which are introduced species), 58 birds and 34 reptiles. Although amphibians were monitored for, their presence was not detected. 18 species detected during the survey were new records for this area and had not previously been recorded on the DLRM database for this area.

Of the eight vegetation types identified from the Project area, five are of importance to fauna: Mulga woodland, Riparian woodland, Rocky rises, Spinifex grassland and Corymbia woodland.

Fauna richness varied between survey site and habitat type (Figure 8-4). Sites with the greatest species richness (Sites 3, 7 and 8) were from different habitat types (mulga woodland, rocky rises and Corymbia woodland, respectively). The lowest species richness was at Sites 13 and 14, both mulga woodland dominated sites. Adjusting for survey effort, the mean number of fauna species by habitat type was:

- ▶ Riparian woodland – 34.0 species;
- ▶ Rocky rises – 25.7 species;
- ▶ Mulga woodland -21.4 species;
- ▶ Corymbia woodland- 19.5 species; and
- ▶ Spinifex grassland- 18.0 species

The full list of fauna species recorded is presented in Appendix H.

Nationally and state significant fauna

Three species listed as threatened under the TPWC Act or EPBC Act were recorded during this baseline survey (Table 8-6). The locations of these sightings or suspected sightings are illustrated in Figure 8-4.

Table 8-6 Observations of threatened fauna

Common Name	Scientific Name	EPBC	TPWC	Evidence of Presence
Mammals				
Brush-tailed mulgara	<i>Dasycercus blythi</i>	VU	VU	At least one active burrow located during baseline survey. Thus species may occur wherever suitable habitat is present in the study area.
Bilby (= Greater bilby)	<i>Macrotis lagotis</i>	VU	VU	Diggings/scratchings observed in suitable habitat during fauna survey are thought to have been made by a Bilby.
Birds				
Grey falcon	<i>Falco hypoleucos</i>		VU	Observed during the baseline survey.

The brush-tailed mulgara was not observed, but is considered likely to be present on the basis of a single burrow observed during the survey at Site 16. Only the crest-tailed is listed as vulnerable under the EPBC Act, however due to historical challenges in differentiating this species from the crest-tailed mulgara (*D. cristicauda*) and the listings being made prior to publication of the two species' currently accepted identification, the brush-tailed records in the Mount Peake area are listed as vulnerable.



Diggings/scratchings, thought to have been made by a bilby/greater bilby were detected in recently burnt spinifex/acacia grassland during the fauna survey. There are numerous historical records of this species around the Project area and the species is considered likely to still be present in this part of the Northern Territory, albeit possibly in small numbers.

The grey falcon was observed during the fauna survey and there are numerous records of this species in the vicinity of the Project area. The grey falcon occurs in most of the drier parts of Australia, including much if not all of the Northern Territory. It is generally scarce wherever it is found.

Near threatened fauna

Four species listed as near threatened under the TPWC Act were recorded during this baseline survey (Table 8-7). The locations of these sightings are illustrated in Figure 8-4.

Table 8-7 Observations of near threatened fauna

Common Name	Scientific Name	TPWC	Evidence of Presence
Birds			
Emu	<i>Dromaius novaehollandiae</i>	NT	Observed at one location during GHD survey.
Australian bustard	<i>Ardeotis australis</i>	NT	Observed at four locations during GHD survey.
Reptiles			
Woma python	<i>Aspidites ramsayi</i>	NT	Observed at one location during GHD survey.
King brown snake	<i>Pseudechis australis</i>	NT	Observed at two locations during GHD survey.

Emu (*Dromaius novaehollandiae*) feathers were observed in a barbed-wire fence at Site 15, although no birds were observed. Emus are likely to be sparse across the entire Project area.

The Australian bustard (*Ardeotis australis*) was recorded on four occasions. A total of 11 birds were recorded, although it is possible or even likely that the same individuals were seen on multiple occasions, since observations tended to occur within the same general location (approximately 3 km north-west of Site 9) on successive days. The bustard is likely to occur in small groups across the entire Project area.

One woma python (*Aspidites ramsayi*) was detected 6.8 km south-west of Site 16. This python occupies a broad variety of arid habitats and is likely to be widespread but sparse across the Project area.

Two king brown snakes (*Pseudechis australis*) were detected. Both were observed on the road while driving between sites, rather than being captured in traps. One large individual was detected very near Site 9, and another smaller individual was seen east of Site 2. The king brown snake occupies a broad variety of arid habitats and is likely to be widespread across the Project area.

Migratory fauna

Seven species (all birds) predicted or known to occur within the Project area are listed as Migratory under the EPBC Act (Table 8-8). Of these, the rainbow bee-eater (*Merops ornatus*) is the only one that is known to occur historically (NT DLRM Database), and this species was detected during the baseline fauna survey. Each of these Migratory species occupies a very broad area that includes much if not all of the Australian mainland, and none is linked strongly to habitats in the Project area likely to be impacted.



Table 8-8 EPBC Act-listed Migratory fauna species identified for the Project area (50 km buffer)

Common Name	Scientific Name	Source
Fork-tailed swift	<i>Apus pacificus</i>	PMST
Great egret	<i>Ardea alba</i>	PMST
Cattle egret	<i>Ardea ibis</i>	PMST
Oriental plover	<i>Charadrius veredus</i>	PMST
Australian painted snipe	<i>Rostratula australis</i>	PMST
Oriental pratincole	<i>Glareola maldivarum</i>	PMST
Rainbow bee-eater	<i>Merops ornatus</i>	DLRM, PMST, GHD

Introduced Fauna Species

Twelve non-native fauna species are identified for the Project area (Table 8-9). Of these, four were observed during the survey including cattle which are currently used as an agricultural asset. Non-native fauna that occur at the site are likely to have had, and to continue to have, an adverse impact on the area's ecology, however the Project area does not appear to be unusually or excessively overrun by feral animals, compared with other parts of the NT or Australia.

Table 8-9 Non-native fauna species identified for the Project area

Common name	Scientific name	DLRM	PMST	GHD
Mammals				
Cat	<i>Felis catus</i>	X	X	X
European rabbit	<i>Oryctolagus cuniculus</i>	X		X
Donkey	<i>Equus asinus</i>	X		X
Dog (domestic)	<i>Canis lupus familiaris</i>		X	
House mouse	<i>Mus musculus</i>	X	X	
Red fox	<i>Vulpes vulpes</i>		X	
Horse	<i>Equus caballus</i>	X		
Pig	<i>Sus scrofa</i>	X		
Cattle	<i>Bos taurus</i>	X	X	X
Camel	<i>Camelus dromedarius</i>		X	
Birds				
Rock dove	<i>Columba livia</i>	X	X	
Reptiles				
Asian house gecko	<i>Hemidactylus frenatus</i>	X	X	



8.2.4 Potential Impacts

Key threatening processes that may impact fauna include:

- ▶ clearing of flora and vegetation (breeding and foraging habitat, habitat fragmentation and creation of barriers to fauna movement);
- ▶ change in water quality (hydrological regimes, contamination of surface and/or groundwater, lowering of the groundwater table);
- ▶ introduction and/or spread of non-native flora and pest animals;
- ▶ changes to fire regimes;
- ▶ dust emissions from construction, mining and processing activities;
- ▶ industrial and domestic wastes;
- ▶ noise disturbance;
- ▶ visual disturbance (including artificial lighting); and
- ▶ risks associated with traffic during construction and operation.

Vegetation clearing

Approximately 1,038 ha of vegetation will be disturbed for construction of the pit, waste rock dump, tailings storage facility, accommodation village, access roads, mine infrastructure, stockpile sites and the Adnera Loadout Facility. The location and area of borrow pits still needs to be determined.

Table 8-4 provides mapped areas of each vegetation community (1,008 ha) impacted by the Project. Vegetation clearing will involve removal of a moderately diverse range of non-threatened native plants, including mature trees. The fauna habitats affected by clearing comprise eight distinct vegetation communities Table 8-10.

Table 8-10 Fauna habitat and vegetation communities impacted by the Project

Fauna habitat	Corresponding vegetation community	Area (ha)	% of area to be impacted
Mulga woodland	Mulga shrubland on sandy red earths (VT 2)	420.25	41.68
	Tall Acacia shrubland on stony quartz plains (VT 8)	10.00	0.99
Riparian woodland	Riparian woodland along watercourses and drainage channels (VT 3)	2.90	0.29
	Floodplains dominated by <i>Eucalyptus victrix</i> (VT 5)	0	0
Rocky rises	Low open Eucalyptus woodland on limestone ridges (VT 1)	8.35	0.83
Spinifex grassland	Triodia grassland on sand plains (VT 6)	558.58	55.40
	Low Acacia shrubland on rocky slopes (VT 7)	3.50	0.35
Corymbia woodland	Low Corymbia open woodland on plains with red earths (VT 4)	4.61	0.46
TOTAL		1008.19	100



A further 30 ha will be required to be cleared for the borefield and associated infrastructure which is likely to be Triodia grassland on sandy plains (VT 6), Low Corymbia woodland on loamy alluvial plains (VT 4) and a small amount of Riparian woodland along water courses (VT 3). A preclearance survey will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no significant or sensitive fauna communities will be impacted by clearing.

Clearing of native vegetation could result in:

- ▶ killing/injuring fauna;
- ▶ displacement of fauna;
- ▶ disruption to nesting/roosting/foraging and/or behaviour;
- ▶ reduction of area of fauna habitat locally and/or regionally;
- ▶ fragmentation of remaining habitat;
- ▶ erosion and sedimentation impacts, including degradation of surface water quality;
- ▶ increasing likelihood of weed establishment in cleared areas;
- ▶ habitat fragmentation and creation of barriers to fauna movement, particularly for small ground-dwelling fauna; and
- ▶ introduction and/or spread of exotic plants (weeds).

This table shows that the two habitat types expected to be most impacted are mulga woodland (~41% of area) and spinifex grassland (~55% of area). These habitats have the potential to support the following threatened species:

- ▶ Mulga woodland – greater bilby, princess parrot and grey falcon; and
- ▶ Spinifex grassland – greater bilby, brush-tailed mulgara, night parrot, princess parrot, grey falcon and great desert skink.

Habitat fragmentation is most likely to impact ground-dwelling fauna, and particularly small fauna that tend not to cover large areas in their normal activities (e.g. foraging, breeding). For this Project, habitat fragmentation is of greatest concern for greater bilby, brush-tailed mulgara and great desert skink.

Management measure will be adopted to minimise direct and indirect impacts to fauna during vegetation clearing for construction and during operation (section 8.2.5).

Water quality

A number of Project activities can lead to potential changes in water quality.

Vegetation in riparian zones and floodplain areas are likely to be at least partially dependent on surface water flows (section 8.1.4). The key receptors that are vulnerable to changes in environmental flows are vegetation communities that are at least partially dependent on surface water flows including sheet flow (i.e. mulga shrubland) and the riparian vegetation within drainage channels and Mud Hut Swamp. Fauna that rely on riparian habitats and that may be impacted by altered hydrology in, and downstream of, the Project area include the common brushtail possum. Management measure will be adopted to maintain existing hydrological regimes during construction and operation (section 8.2.5). This will include the installation of floodways and culverts along the access road to maintain existing water flows.

The tailings dam will contain benign silts and sands and no hazardous substances are expected to be stored in the dam, therefore the potential to contaminate fauna drinking water is a low risk.



Groundwater modelling was undertaken to predict the likely extent of groundwater drawdown from abstraction (GHD 2015a). Maximum predicted drawdown contours for the borefield at the end of mining are shown in Figure 8-3. The maximum drawdown is modelled as being up to 12 m below current groundwater levels and could result in the following impacts to fauna:

- ▶ decline in availability of water to ecosystems including riparian vegetation resulting in loss of habitat for species relying on riparian habitat; and
- ▶ shorter hydroperiod in waterbodies that may provide water for fauna.

Pit modelling indicates that groundwater drawdown will not impact any groundwater dependent ecosystems or wetlands. After decommissioning, the mine void will act as a sink with a shallow lake forming. This feature does not have the potential to impact fauna habitat.

A number of Project related activities could cause potential contamination of surface and groundwater systems. There are a number of sensitive riparian habitats close to the development footprint and vegetation and flora reliant on surface flows and groundwater uptake may also be impacted by contamination. In turn, common and threatened herbivorous species (including the black-footed rock-wallaby and common brushtail possum) may be impacted over time by grazing/browsing on contaminated vegetation. Changes in water quality may also directly affect threatened fauna (e.g. black-footed rock-wallaby and princess parrot) that drink from such water sources.

Introduced species

As detailed in Section 8.1.4, there is potential for Project activities to introduce or spread weeds (resulting in a decline in native fauna habitat quality) and to introduce or increase the spread of animal pests (resulting in a decline in habitat for native fauna, increased competition for resources and increased predation on native fauna). This could occur during construction, operation and closure activities.

Changes to fire regimes

Construction and operational activities, particularly hot works, are potential ignition sources, and could result in a bushfire. In addition, it may be necessary to conduct controlled burns to minimise fuel loads in the vicinity of the mine site.

Fire can benefit some disturbance-tolerant species, but can be detrimental to other types of fauna and fauna habitat, if it occurs at the wrong time of year, or in habitats that do not respond well to fire.

Direct impacts from death or mortality to fauna are possible, as well as behavioural disturbance, reduction and fragmentation of habitats and soil erosion. It is expected that all of the threatened species that do or may occur within the Project area would be affected by fire (both positive and negative impacts). Controlled and strategic cool patch burns of spinifex sandplain habitat could have positive outcomes for species such as the greater bilby (promotes food plants). Extensive burns (as distinct from small-patch burning) of great desert skink and black-footed rock-wallaby habitat could be detrimental to those species as the fire could remove important shelter and food resources. Burning of rocky habitat is unlikely to be beneficial for many species and should be avoided. Continued persistence of the black-footed rock-wallaby in the area will depend on prevention of wildfire in the surrounding rocky habitats. There is limited information regarding the response to fire for mulgara. Woinarski *et al.* (2007) mentions that changes to fire regimes may have been a factor in historic declines. Extensive frequent fire may reduce ground-layer vegetation cover which could increase the likelihood of predation by cats/foxes (Dr R. Paltridge *pers. comm.*).



Dust emissions

As detailed in Section 8.1.4, a number of construction and operational activities could lead to increased dust emissions. There is a paucity of evidence on dust impacts on fauna, but high concentrations have the potential to cause disease, and degradation of habitats and surface water quality through deposition.

It is likely that a range of non-threatened taxa that exist within the vicinity of the mine site could be adversely impacted by dust generated by mine operations. This would include birds, small ground-dwelling mammals and possibly reptiles. However, the majority of the threatened species identified for the Project area (brush-tailed mulgara, greater bilby, common brushtail possum, grey falcon, red goshawk, princess parrot, night parrot and great desert skink) either do not or would not regularly occur in the vicinity of the mine site, and hence would only ever be subjected to very low dust levels mainly from vehicle movements along unsealed roads. There is habitat for the black-footed rock-wallaby within 2 km of the mine site, and this species may be exposed to higher levels of dust.

Industrial and domestic wastes

The Project will generate waste rock from the mine and tailings from the process plant. Both of these waste streams are benign and do not pose a contamination risk.

Domestic refuge could attract non-native pest fauna which could predate threatened fauna, particularly small fauna that spend considerable time on or near the ground (e.g. night parrot, black-footed rock-wallaby, greater bilby, brush-tailed mulgara and the great desert skink).

Noise emissions

Noise emissions have the potential to impact fauna through behavioural changes that can displace fauna toward sub-optimal habitats and cause disruption to life cycles.

The majority of the threatened species that do or may occur within the Project area use habitats that occur some distance from the mine site (generally >10 km) and are unlikely to be affected by construction or operational noise. Vehicle noise along the access road may have localised and isolated low-level impacts.

Most of the area covered by the Project is not typically suitable habitat for the black-footed rock-wallaby, but there are rocky outcrops scattered throughout the area that are likely to be suitable. The species is known to occur in nearby rocky ranges and may occasionally move through the Project area to access different patches of suitable habitat. Noise generated by the mine is likely to preclude rock-wallaby movements through the mine site.

Light emissions

Artificial lighting can cause a range of behavioural responses in fauna including displacement, changing of predator-prey interactions, disorientation and disruption of nesting/roosting activities.

Fauna in the immediate vicinity of the mine site would be most exposed to artificial lighting that could impact 'normal' nocturnal behaviours (e.g. bats, migratory birds). The majority of the threatened species that do or may occur within the Project area tend to occur some distance (>10 km) from the mine site and would be unlikely to be affected by operational lighting.

Most of the area covered by the Project is generally unsuitable habitat for the black-footed rock-wallaby, but there are rocky outcrops scattered throughout the area that are likely to be suitable. The species is known to occur in nearby rocky ranges and may occasionally move through the Project area to access different patches of suitable habitat. Light emitted from the mine site could impact on nocturnal movements of rock-wallabies and could reduce dispersal activities in the immediate vicinity of the mine.



Rock-wallaby habitat occurring at distances of 2 km or more from the mine site is unlikely to be adversely impacted by artificial lighting.

Road traffic

Potential impacts to fauna from road traffic can include direct injury and mortality, dispersal of contaminants, noise emissions, barriers to faunal movement and fragmentation of habitats. Species such as the brush-tailed mulgara, greater bilby, common brushtail possum, black-footed rock-wallaby and great desert skink would potentially be at risk from a road collision.

Risks to threatened species

A risk assessment was undertaken to evaluate individual sources of potential impact for threatened species (Appendix H). The threatened species considered were those that are known to be present or likely to be present within the Project area, even though the presence of some populations is unconfirmed.

Threatened species that occupy similar habitats or that are predicted to be similarly vulnerable to impacts were grouped for the purposes of the risk assessment. These species are likely to encounter similar impacts and be impacted in similar ways, and the management and mitigation measures proposed to reduce the level of risk are likely to be similar. The species considered were:

- ▶ rocky habitats - black-footed rock-wallaby;
- ▶ sandplain ground-dwelling fauna - greater bilby, brush-tailed mulgara, great desert skink, southern marsupial mole;
- ▶ arid-zone avifauna with high mobility - night parrot, red goshawk, princess parrot, grey falcon; and
- ▶ fauna in riparian habitat - common brushtail possum.

The level of risk to fauna from most potential sources of impact without management or mitigation was determined to be very low, low or medium. No extreme risks were identified.

The level of unmitigated risk to some fauna was considered to be high for two sources of impact:

- ▶ an increase in predator numbers (cats, foxes and dingos) through the inadequate management of garbage could increase levels of predation on rock wallaby (particularly of more vulnerable juveniles), sandplain ground-dwelling fauna and avifauna (principally the night parrot which spends the majority of its time at or near the ground); and
- ▶ the introduction or spread of weeds leading to weed-dominated habitats that are generally less favourable for fauna than weed-free habitats, and may introduce additional risks (e.g. more intense fires, less suitable foraging habitat). At risk is the rock wallaby and sandplain ground-dwelling fauna.

Impact significance for threatened species listed under the EPBC Act

Significant impact criteria were used to assess each EPBC Act-listed threatened species against the likely risks and consequences before mitigation. Threatening processes with the potential to pose a medium or higher risk to threatened species before mitigation measures are applied were:

- ▶ impacts from habitat clearing: greater bilby, brush-tailed mulgara, southern marsupial mole and the great desert skink;
- ▶ impacts from habitat fragmentation: greater bilby, brush-tailed mulgara and the great desert skink;
- ▶ impacts associated with management of industrial waste material: greater bilby, brush-tailed mulgara, southern marsupial mole and the great desert skink;



- ▶ indirect impacts associated with inadequate management of domestic waste material: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, princess parrot, night parrot and the great desert skink;
- ▶ impacts associated with vehicle movements (e.g. collisions): greater bilby, brush-tailed mulgara and the great desert skink;
- ▶ impacts associated with invasion by exotic plants and animals, particularly predators: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, southern marsupial mole, princess parrot, night parrot and the great desert skink;
- ▶ impacts associated with inappropriate or ineffective rehabilitation: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, southern marsupial mole and the great desert skink; and
- ▶ impacts of unplanned wildfire: black-footed rock-wallaby, greater bilby, brush-tailed mulgara, southern marsupial mole, princess parrot, night parrot and the great desert skink.

None of the potential impacts identified for the Project pose a medium or high risk to the red goshawk.

Application of appropriate management and mitigation measures is expected to reduce the likelihood and severity of risk to acceptably low levels for all hazards, such that the residual risk is unlikely to be significant according to EPBC Act significant impact guidelines. Impacts to EPBC species are further discussed in Chapter 15.

8.2.5 Fauna Management Measures

Detailed Project design will consider options for locating infrastructure footprints to avoid or minimise impacts to fauna, both directly and indirectly. In particular the Project will aim to minimise clearing of fauna habitat. Although the Project will result in some unavoidable residual impacts to fauna habitat, these impacts are not expected to significantly impact the fauna that inhabit these areas.

Provided below are the key management measures that will be employed to reduce residual impacts to fauna. A comprehensive list is provided in Appendix H.

Construction phase

Land disturbance and vegetation clearing will be kept to as small an area as practicable. Construction personnel will be briefed during inductions regarding the conservation value of surrounding habitats and their responsibilities with regard to protecting these habitats.

A preclearance survey of the borefield, pipeline route and borrow pit areas will be undertaken prior to any clearing works in the area to assist in the final location of infrastructure and ensure that no threatened species or significant or sensitive vegetation communities are impacted by clearing.

Engineering controls that assist in maintaining surface water flows have been incorporated into road designs to ameliorate potential risks to vegetation due to changes in flow. Design features include installing at-grade flood ways where the access road crosses a water course and culverts to maintain flows under the access road where the drainage line is well defined.



A CEMP which will include:

- ▶ strategies to minimise vegetation clearance;
- ▶ procedures for demarcating the limits of clearing and no-go areas;
- ▶ staged clearing of vegetation to minimise areas of bare ground and clear land only as required;
- ▶ vehicle hygiene protocols to prevent new weed incursion and spread, including a vehicle wash down facility on site;
- ▶ strict fire prevention management protocols to prevent wildfire during clearing activities;
- ▶ maintenance of fire breaks around high-risk areas/activities;
- ▶ use of already-disturbed areas (rather than undisturbed areas) wherever possible (e.g. lay down areas for construction);
- ▶ progressive revegetation of cleared land as activities are completed;
- ▶ a Weed Management Plan;
- ▶ pre-clearing fauna surveys prior to mine construction, with qualified ecologists on site to assist/translocate animals that are found during the clearing process and that require assistance in getting to safety;
- ▶ limiting construction and clearing to times of the year when fauna are least sensitive to disturbance (e.g. avoiding breeding period); and
- ▶ ongoing pest-animal control in all areas.

Operation phase

Operation phase management measures for fauna typically adopt measures proposed to manage impacts associated with flora and vegetation. These are outlined in section 8.1.5 and are not repeated here. Specific additional management measures for fauna are provided below.

Waste material and pest control management measures will include:

- ▶ fencing of the landfill used to dispose of putrescible waste;
- ▶ daily covering of putrescible waste;
- ▶ ongoing monitoring for pest species; and
- ▶ baiting or control if pest numbers increase to unacceptable levels.

Noise management measures will include:

- ▶ implement standard noise minimisation measures to reduce noise wherever possible; and
- ▶ restricting high-impact noises to daylight hours only (i.e. avoid excessively loud noises at night, when the majority of relevant threatened species are likely to be active).

Light emission management measures will include:

- ▶ limiting artificial light to areas where it is essential;
- ▶ turning off lights when not required;
- ▶ use of light shields and deflectors to reduce light spill out of Project area;
- ▶ using lower (i.e. closer to the ground) rather than higher lighting installations;



- ▶ using lower wavelengths of light wherever possible i.e. red/yellow lights;
- ▶ using light intensities that are as low as possible without reducing safety or efficiency; and
- ▶ avoiding painting large structures bright or reflective colours and minimise use of bright or reflective construction materials and finishes for large structures.

Traffic management measures will include:

- ▶ keeping the proposed road network to a minimum;
- ▶ upgrade high-use areas to be safer for vehicles and fauna (e.g. no blind curves, wider shrub-free verges);
- ▶ fencing of the access road;
- ▶ providing road safety and awareness training with respect to safe driving in areas where native wildlife is prevalent; and
- ▶ documenting roadkill (location and time of day) of threatened species within the Project area, to determine high-risk periods or locations.

8.2.6 Summary of Impacts and Conclusions

In total, 280 fauna species have been identified for the Project area. The Project area has the potential to support 10 threatened fauna species, including eight listed as vulnerable or endangered under the EPBC Act. These species are:

- ▶ fauna in rocky habitat - black-footed rock-wallaby;
- ▶ ground-dwelling sandplain fauna with limited mobility - greater bilby, brush-tailed mulgara, great desert skink, southern marsupial mole;
- ▶ arid-zone avifauna with high mobility - night parrot, red goshawk, princess parrot, grey falcon; and
- ▶ fauna in riparian habitat - common brushtail possum.

Adjusting for survey effort, the mean number of fauna species by habitat type was:

- ▶ Riparian woodland – 34.0 species;
- ▶ Rocky rises – 25.7 species;
- ▶ Mulga woodland -21.4 species;
- ▶ *Corymbia* woodland- 19.5 species; and
- ▶ Spinifex grassland- 18.0 species.

The proposal would result in the removal of approximately 1,038 ha of native vegetation. The clearing of the most species rich areas (riparian and rocky rises) amount to less than 2% of the Project area (~ 11 ha). These fauna habitats are well represented at the local and regional scale.

The Project has the potential to impact native fauna through:

- ▶ clearing of vegetation and associated loss of habitat, and habitat fragmentation during construction;
- ▶ alteration of hydrological regimes associated with earthworks and construction activities and associated changes to land surface areas, and/or impediments to surface flows;
- ▶ groundwater drawdown and/or changes to groundwater flows impacting groundwater dependent ecosystems;



- ▶ contamination of surface and/or groundwater;
- ▶ introduction and/or spread of weeds and animal pests;
- ▶ changes to fire regimes;
- ▶ dust emissions from construction, mining and processing activities;
- ▶ light spill;
- ▶ noise emissions; and
- ▶ fauna road-kill.

Impacts to threatened fauna species were assessed and it was concluded that no species will be significantly impacted as a result of the Project.

A range of management measures will be implemented throughout the construction, operation and decommissioning phases of the Project to ameliorate potential impacts to native fauna. Overall, impacts to fauna are expected to be low.

