



## Lakewood Mill TSF2

### Native Vegetation Clearing Permit

Prepared for  
**Golden Mile Milling Pty Ltd**

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Project Manager	Ian Mullins Level 1 Bishops SEE, 235 St Georges Terrace Perth WA 6000 08 6218 2200
Prepared by	James Leonard
Reviewed by	Ian Mullins and Jen Longstaff
Approved by	Jen Longstaff
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# 1 Introduction

## 1.1 Development overview and background

Golden Mile Milling Pty Ltd (GMM) is proposing to clear vegetation to construct Tailings Storage Facility 2 (TSF2) within Mining Tenement 26/242 Kalgoorlie, Western Australia ('the Development Area'; **Figure 1**). The Development Area is within the Eastern Goldfield Subregion of Western Australia and is situated approximately 5 km south-east of Boulder and 9 km south-east of Kalgoorlie. The proposal is for the construction of an additional tailings storage facility at the GMM owned Lakewood Mill to accommodate tailings production beyond the current TSF1 capacity. Proposed works include the clearing of vegetation and topsoil, followed by earthworks prior to construction of TSF2. Proposed design of the storage facility is detailed below in **Figure 2**. The removal of up to 38 ha of native vegetation is proposed to be undertaken within the 38.8 ha Development Area. Vegetation is proposed to be removed mechanically using a track mounted dozer.

ELA undertook a flora and vegetation survey site on 8 October 2018 to determine the composition, condition and value of the vegetation currently present within the Development Area and to inform this Native Vegetation Clearing Permit (NVCP) application. The results of the flora and vegetation survey are attached in **Appendix A**. An NVCP was previously granted for a tailings storage facility at the site on 15 November 2012 under section 51E of the *Environmental Protection Act 1986* (EP Act). The permit was granted by the then Department of Mines and Petroleum (Permit number 5297/1) but has since lapsed (lapsed on 1 December 2017). A previous vegetation and flora survey for the Development Area was also undertaken by Recon Environmental (2009) and was also used to inform the 2012 NVCP application.

## 1.2 Purpose of this document

Construction of the proposed TSF2 requires the clearing of native vegetation. This document has therefore assessed the proposed vegetation clearing against the ten native vegetation clearing principles contained in Schedule 5 of the *Environmental Protection Act 1986* (EP Act) as required. This NVCP application has been prepared for the Department of Mines, Industry Regulation and Safety (DMIRS) to address this requirement.



Figure 1: Development Area overview

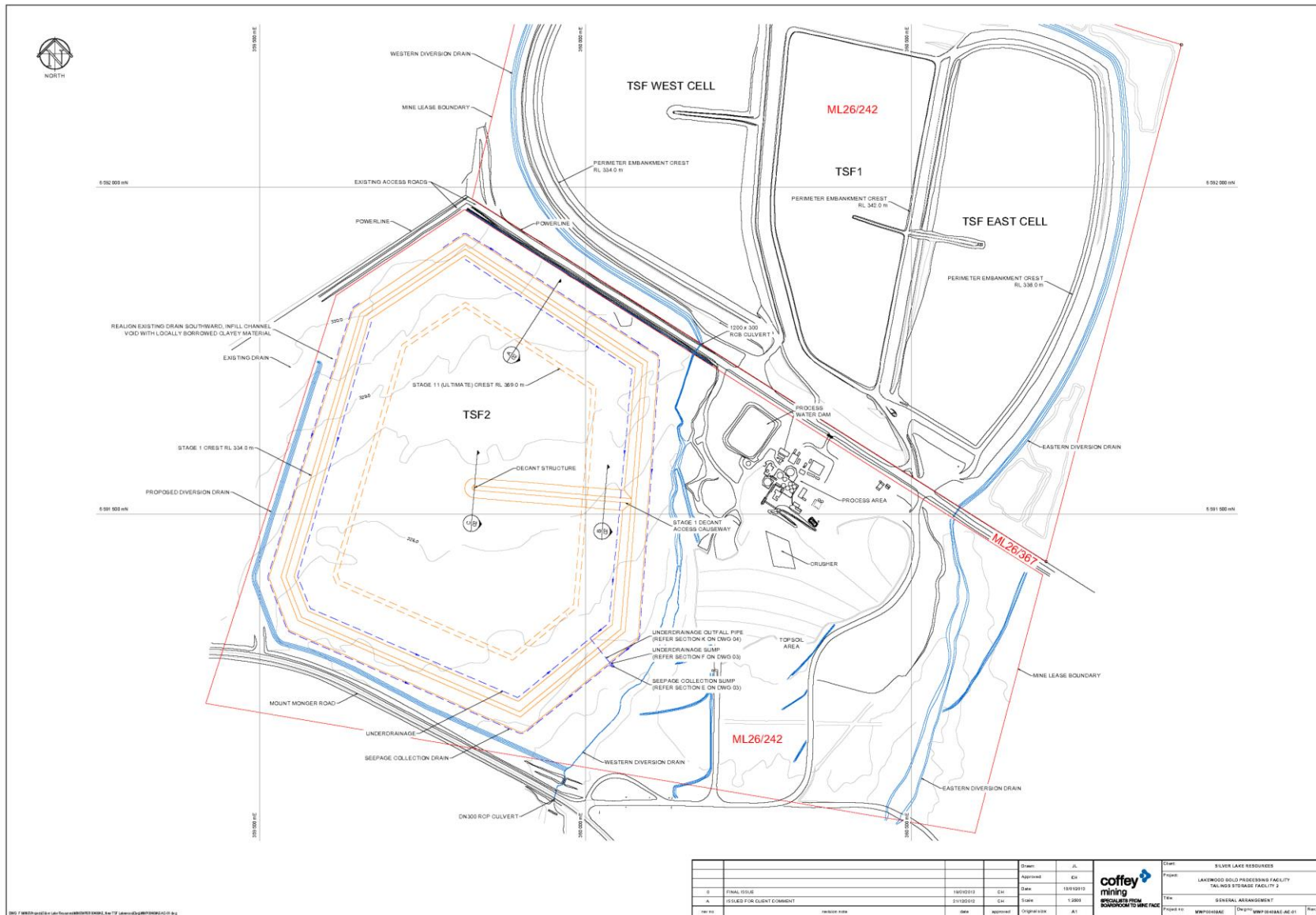


Figure 2: Proposed Tailings Storage Facility 2 design

## 2 Physical Environment

### 2.1 Biogeographic and regional setting

The Development Area is located in the Coolgardie bioregion as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (Department of Energy and Environment [DotEE] 2018a). The Coolgardie Bioregion has been further subdivided into three subregions: Mardabilla subregion (COO1), Southern Cross subregion (COO2) and Eastern Goldfields subregion (COO3). The Development Area is located in the Eastern Goldfields subregion:

- This subregion lies on the Yilgarn Craton's Eastern Goldfields Terrain. The topography is comprised of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and exposure of bedrocks. Calcareous earths are the dominant soil group. There are a series of large playa lakes in the western half of the subregion that are remnants of an ancient drainage line. The vegetation is predominantly comprised of Mallees, Acacia thickets and shrub-heaths on sandplains. Diverse *Eucalyptus* woodlands occur around salt lakes, on ranges and in valleys. Salt lakes support dwarf shrublands of samphire. Woodlands and *Dodonaea* shrublands occur on basic granitoides of the Fraser Range. The climate is arid to semi-arid, with a maximum rainfall of 200-300 mm.

### 2.2 Geology, landform and soils

The Eastern Goldfields subregion has subdued relief and is comprised of gently undulating plains, interrupted in the west with low hills and ridges of Archaean greenstones and in the east by horst of Proterozoic basic granulites. There is an underlying geology of gneisses and granites eroded into a flat plane covered with tertiary soils, with scattered exposures of bedrock. The dominant soil group is calcareous earths, that covers the majority of the plains and greenstone areas (Cowan 2001).

The topography of the Development Area was noted to be flat, with height ranging between 330 to 334 m above sea level. The area is classified as being colluvium and/or residual deposits, talus, scree; boulder, gravel, sand and may include minor alluvial or sand plain deposits, local calcrete and reworked laterite (National Maps 2018).

### 2.3 Hydrology

#### 2.3.1 Surface water

The Development Area is located in the Lake Lefory catchment, which is a Salt Lake Basin. Assessment and mapping of the wider Mining Lease area shows that there are some minor drainage lines adjacent to the eastern boundary of the Development Area (**Figure 2**). There are no permanent watercourses within or surrounding the Development Area, with the closest permanent water sources being Hannah Lake and Douglas Lake, 2.4 km south and 13 km south west of the Development Area respectively.

During the flora and vegetation survey by ELA (2018) it was noted that there had been altered surface water flows through the Mining Tenement due to elevated topographic features adjacent to the site. These features include TSF1 to the north east and the Super Pit to the north west which result in pooling of water across portions of site, mainly within existing drainage lines adjacent to the Development Area following heavy rainfall events (**Figure 2**).



The TSF2 has been designed to avoid these modified drainage lines adjacent to the Development Area so as not to interrupt the current hydrological regime (**Figure 1** and **Figure 2**).

### **2.3.2 Groundwater**

The depth to water surrounding the Development Area ranges from approximately 0.3 m to 12.21 m (Coffey 2018). The Water Table Aquifer is both Alluvium and Calcrete and is described as “Rocks of low permeability, fractured and weathered rocks – intermediate flow systems in Precambrian Rocks” (National Maps 2018).

## 3 Biological Environment

### 3.1 Flora

Database searches using NatureMap (Department of Parks and Wildlife 2018a), and the Department of Energy and Environment (DotEE) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) (DotEE 2018b) were undertaken to determine the presence of Threatened or Priority flora species known from the area surrounding the Development Area. A 10 km buffer of the coordinates -30.80126° S 121.53524° E was used for both searches.

Desktop and database searches and the flora and vegetation survey identified 378 taxa of terrestrial vascular flora representing 57 families with the potential to occur within the Development Area, including 65 introduced species. The most common families were Asteraceae (44 native species, 13 introduced), Chenopodiaceae (48 native species, two introduced) and Fabaceae (38 native species, three introduced).

ELA undertook a flora and vegetation survey of the area and identified that the Development Area was representative of local vegetation but did not contain the level of diversity estimated from desktop assessment. A total of 28 taxa were found to exist within the Development Area and the surrounding Mining Tenement (**Figure 1**).

#### 3.1.1 Threatened and Priority Flora

A likelihood of occurrence assessment for threatened and priority flora species was undertaken (likelihood criteria – **Appendix B** and **Appendix C**). A total of 8 conservation listed flora species were generated from the desktop and database searches (**Appendix C**). ELA did not record any threatened or priority species within the Development Area. Based on flora and vegetation survey by ELA (2018), it is considered that the 8 conservation listed flora species do not occur within the Development Area.

#### 3.1.2 Introduced Species

The desktop assessment identified that there were potentially 65 introduced species occurring within the Development Area. The flora and vegetation survey did not record any introduced species (ELA 2018).

### 3.2 Vegetation

#### 3.2.1 Beard's Vegetation and Pre-European Vegetation Extent

Vegetation type and extent in WA has been mapped at a regional scale by Beard (1978), who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, DAFWA has compiled a list of vegetation extent and types across WA (Shepherd et al. 2002). Two vegetation associations have been mapped within the Development Area:

- Coolgardie vegetation associated 468: Medium woodland; salmon gum and goldfields blackbutt; and
- Coolgardie vegetation association 540: Succulent steppe with open low woodland; sheoak over saltbush

The pre-European and current extent of native vegetation associations in WA has been interpreted by Shepherd et al. (2002) using data from Beard's (1978) regional vegetation mapping, along with other vegetation mapping and satellite imagery and orthophoto interpretation. The Development Area contains 0.003% and 0.075% of Coolgardie 468 and Coolgarde 540 respectively, **Table 1** (Government of WA 2018).

**Table 1: Beard's mapping unit occurring within the Development Area, its current and Pre-European extent within the Coolgardie system and its extent across the Development Area.**

Beard's Mapping Unit (Shepherd vegetation association)	Pre-European extent (ha) (Government of WA 2017)	Current extent (ha) (% remaining) (Government of WA 2017)	Extent within the Development Area (ha) (% of current extent)
Coolgardie 468	65,948.55	61,726.56 (93.60%)	1.89 (0.003%)
Coolgardie 540	50,554.73	48,376.16 (95.69%)	36.9 (0.076%)

### 3.2.2 Vegetation assessment

ELA undertook a flora and vegetation survey in October 2018. Three vegetation associations were identified within the proposed application area (Table 2, Figure 3).

**Table 2: Vegetation associations within the Development Area**

Vegetation associations	Extent (ha)	Portion of Development Area
<b>S1</b> - <i>Atriplex nummularia</i> , <i>Atriplex bunburyana</i> mid isolated chenopod shrubs over <i>Tecticornia indica</i> subsp. <i>bidens</i> , <i>Tecticornia disarticulata</i> low open samphire shrubland and <i>Frankenia cinerea</i> low sparse shrubland	34.26 ha	88.31%
<b>S2</b> - <i>Myoporum montanum</i> tall isolated shrubs over <i>Lycium australe</i> , <i>Maireana pyramidata</i> , <i>Cratystylis subspinescens</i> mid sparse shrubland over <i>Tecticornia indica</i> subsp. <i>bidens</i> , <i>Tecticornia disarticulata</i> low open samphire shrubland and <i>Frankenia cinerea</i> low sparse shrubland	3.89 ha	10.04%
<b>S3</b> - <i>Tecticornia indica</i> subsp. <i>bidens</i> , <i>Tecticornia disarticulata</i> low isolated samphire shrubs	0.60 ha	1.54%
Cleared	0.04 ha	0.11%
<b>Total</b>	<b>38.8 ha</b>	<b>100%</b>

Previous assessment by Recon Environmental (2009) described two broad vegetation communities with the application area:

**Low Chenopod Shrubland (PSAS-D):** Found in the centre of the broad valleys where there is a concentration of water flow. It usually supports a low shrubland of sago bluebush (*Maireana pyramidata*). Mid shrubs include *Lycium australe* and *Atriplex nummularia*. Dominant low shrub species include *Tecticornia indica* subsp. *bidens*, *T. disarticulate* and *Lycium australe*, while other species include *Atriplex vesicaria*, *A. bunburyana*, *Frankenia setosa*, *F. ?tetrapetala*, *Maireana pyramidata* and *M. pentatropis*; and

**Plain Mixed Halophyte Low shrubland (PXHS):** Found on alluvial plains adjoining salt lakes. The dominant layer in this habitat is usually the low shrubs where either samphire and/or pearl bluebush (*Maireana sedifolia*) dominate. Dominant tall shrubs include *?Myoporum montanum*, dominant mid shrubs include *Lycium austral*, *Atriplex nummularia*, *?Myoporum montanum*, and dominant low shrubs include

*Tecticornia indica* subsp. *bidens*, and *T. disarticulata*. Other species include *Maireana pyramidata*, *M. triptera*, *M. ?georgei*, *Atriplex bunburyana*, *Frankenia* sp., *Disphyma crassifolium*, and *Zygophyllum auraniticum*.

### 3.2.3 Vegetation condition

The condition of vegetation present during the ELA (2018) site survey was assessed as Degraded to Good using the scale contained in Keighery (1994), with the most prevalent disturbance being previous clearing and tracks (**Figure 4**).

**Table 3: Vegetation condition within the Development Area (ELA 2018)**

Vegetation associations	Condition	Area (ha)
<b>S1</b> - <i>Atriplex nummularia</i> , <i>Atriplex bunburyana</i> mid isolated chenopod shrubs over <i>Tecticornia indica</i> subsp. <i>bidens</i> , <i>Tecticornia disarticulata</i> low open samphire shrubland and <i>Frankenia cinerea</i> low sparse shrubland	Good	33.56 ha
	Degraded	0.70 ha
<b>S2</b> - <i>Myoporum montanum</i> tall isolated shrubs over <i>Lycium australe</i> , <i>Maireana pyramidata</i> , <i>Cratystylis subspinescens</i> mid sparse shrubland over <i>Tecticornia indica</i> subsp. <i>bidens</i> , <i>Tecticornia disarticulata</i> low open samphire shrubland and <i>Frankenia cinerea</i> low sparse shrubland	Good	3.69 ha
	Degraded	0.20 ha
<b>S3</b> - <i>Tecticornia indica</i> subsp. <i>bidens</i> , <i>Tecticornia disarticulata</i> low isolated samphire shrubs	Degraded	0.60 ha
Cleared	Completely Degraded	0.04 ha
<b>Total</b>		<b>38.8 ha</b>

Previous surveys undertaken by Recon Environmental (2009) found that the vegetation within the Development Area was Degraded to Completely Degraded. The change in vegetation condition from 2009 to 2018 can be attributed to limited disturbance from land use and high rainfall prior to the ELA (2018) survey.

### 3.2.4 Threatened and Priority Ecological Community

No State or Federally listed Threatened or Priority Ecological Communities were identified during the field survey conducted by Recon Environmental (2009) or ELA (2018).

Database searches found that there were no threatened ecological communities found to be within 10 km of the Development Area.

## 3.3 Terrestrial Fauna

### 3.3.1 Terrestrial fauna habitat

The fauna habitat can be classified as Chenopod Shrubland and *Tecticornia* drainage lines. The habitat present is not considered significant in a local or regional context. The quality of the habitat ranges from Completely Degraded to Good. Due to the homogeneity of the fauna habitat and relatively degraded nature, there is reduced opportunity to support a diverse range of fauna species. This fauna habitat is common throughout the Kalgoorlie and wider surrounding area and is well represented outside the Development Area.

### 3.3.2 Terrestrial fauna species

Database searches using NatureMap (Department of Parks and Wildlife 2018a), and the DotEE EPBC Act PMST (DotEE 2018b) were undertaken to determine the presence of Threatened or Priority fauna species known from the area surrounding the Development Area. A 10 km buffer of the coordinates - 30.80126° S 121.53524° E was used for both searches.

A total of 246 taxa were identified as potentially occurring within the vicinity of the Development Area, of which 59 taxa were considered to be conservation significant and 16 were identified as being introduced. All marine mammals, Whales and other Cetaceans, fish and marine reptiles have not been included in this assessment as the Development Area is terrestrial in nature.

The flora and vegetation survey undertaken by ELA (2018) and analysis in **Table 1** demonstrate that vegetation types and thus fauna habitats within the Development Area are well represented both locally and regionally.

### 3.3.3 Threatened and priority fauna

A likelihood of occurrence assessment for threatened and priority fauna species was undertaken (**Appendix A** and **Appendix D**). A total of 20 conservation listed fauna species were generated from the desktop and database searches and flora and vegetation survey (**Appendix D**). Of the 20 conservation listed fauna species, three species are considered to have the potential to occur within the Development Area including Fork-tailed Swift (*Apus pacificus* - IA), Rainbow Bee-eater (*Merops ornatus* M, S5) and Grey Wagtail (*Motacilla cinerea* M, S5). These species may potentially use the site for foraging however given the highly mobile nature of the species they are likely to occur within the Development Area as vagrants. Migratory birds that frequent the ocean and beach may also occasionally fly over the Development Area but would not utilise the habitats in this area.

Figure 3: Vegetation associations of the Development Area

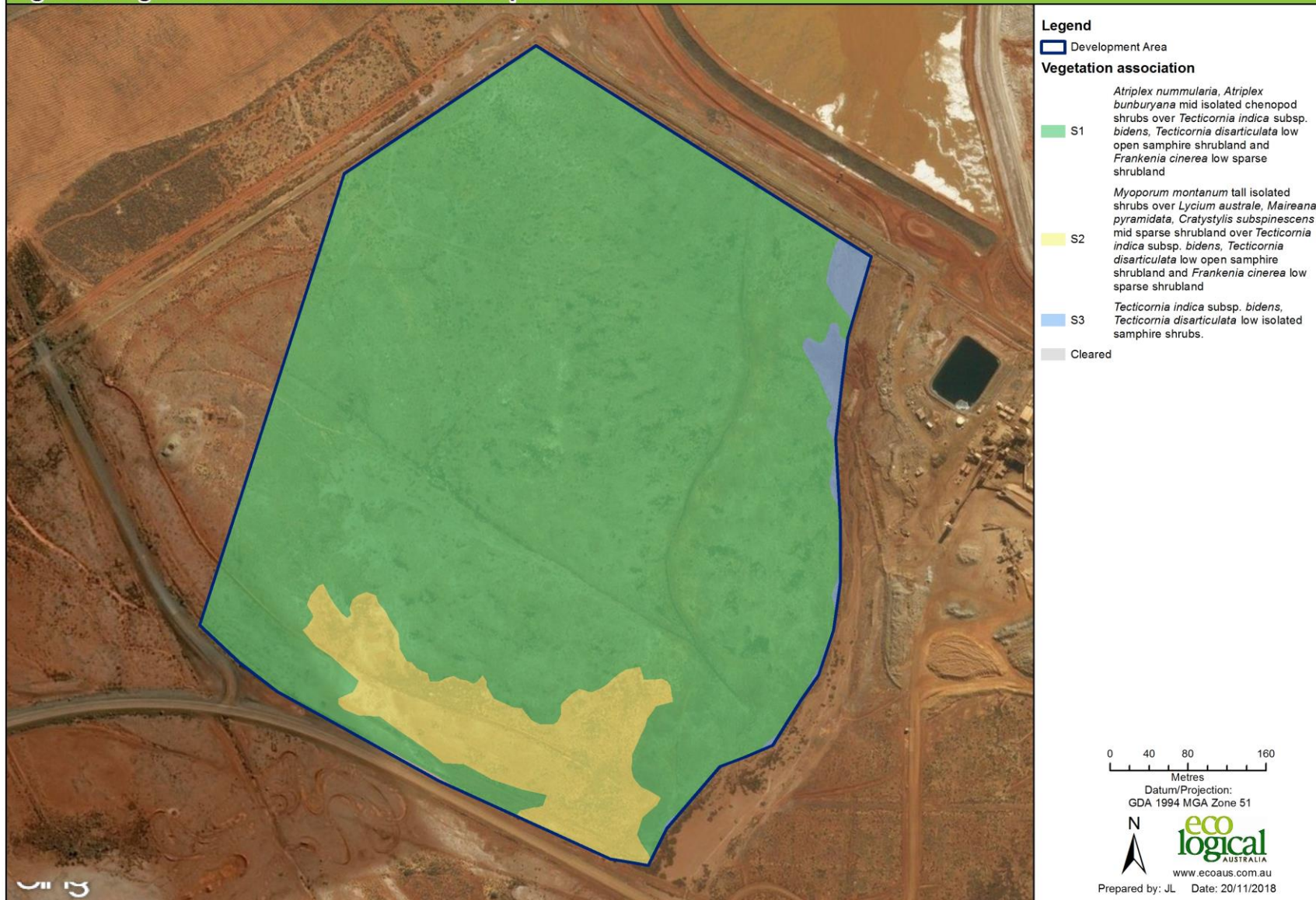


Figure 3: Vegetation associations of the Development Area

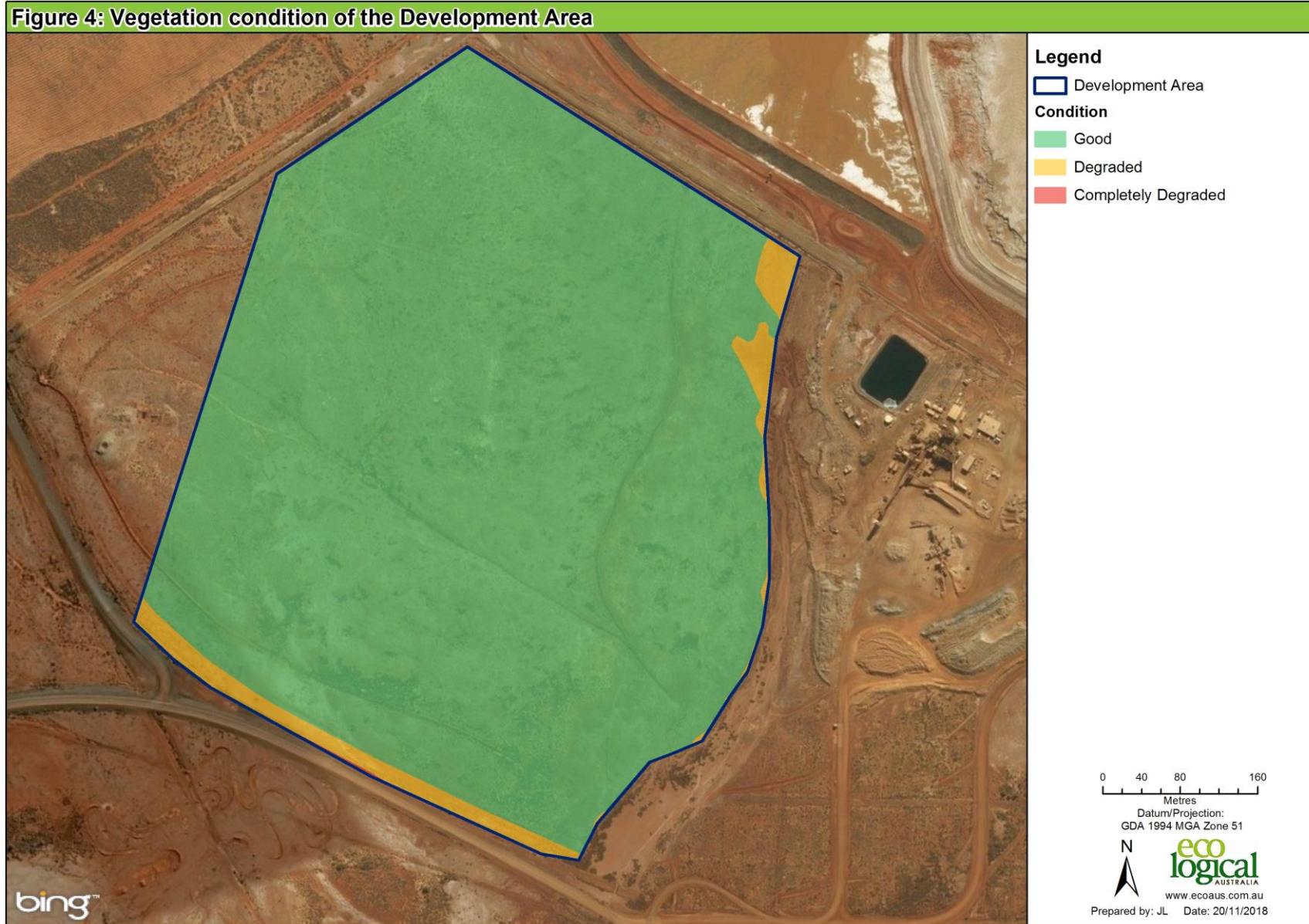


Figure 4: Vegetation condition of the Development Area

## 4 Assessment against the Ten Clearing Principles

An assessment of the proposed vegetation clearing against the ten native vegetation Clearing Principles contained in Schedule 5 of the EP Act is provided in **Sections 4.1 to 4.10**. **Table 4** contains a summary of the assessment.

The proposed development is not considered to be at variance with all Ten Clearing Principles.

**Table 4: Summary of assessment against the ten clearing principles**

Clearing Principle	Is not at variance	May be at variance
a) Native vegetation should not be cleared if it comprises a high level of biological diversity	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of Rare flora	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d) Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of a threatened ecological community (TEC)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e) Native vegetation should not be cleared if it is significant as remnant vegetation in an area that has been extensively cleared	<input checked="" type="checkbox"/>	<input type="checkbox"/>
f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	<input checked="" type="checkbox"/>	<input type="checkbox"/>
g) Native vegetation should not be cleared if the clearing of vegetation is likely to cause appreciable land degradation	<input checked="" type="checkbox"/>	<input type="checkbox"/>
h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area	<input checked="" type="checkbox"/>	<input type="checkbox"/>
i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	<input checked="" type="checkbox"/>	<input type="checkbox"/>
j) Native vegetation should not be cleared if the clearing of vegetation is likely to cause, or exacerbate, the incidence of flooding	<input checked="" type="checkbox"/>	<input type="checkbox"/>



#### 4.1 Comprises high level of biological diversity

*Principle (a): Native vegetation should not be cleared if it comprises a high level of biological diversity.*

ELA (2018) undertook an flora and vegetation survey of the vegetation within the Development Area to determine composition, condition and value (**Figure 3, Figure 4**). The assessment identified three vegetation associations within the Development Area, described in **Table 2** and mapped in **Figure 3**. The condition of vegetation present within the wider Mining Tenement was assessed as Completely Degraded to Good using the scale contained in Keighery (1994). Within the Development Area, the condition of the vegetation to be cleared is described in **Table 3** shown in **Figure 4**. The majority of this vegetation was assessed as Good condition with smaller portions of Degraded vegetation. Previous surveys by Recon Environmental (2009) found that the condition of the vegetation was Completely Degraded to Degraded. The change in vegetation condition from 2009 to 2018 is likely attributed to limited disturbance from land use since 2009 coupled with high rainfall prior to the ELA 2018 survey.

The initial desktop assessment identified 378 taxa, however, the flora and vegetation survey identified a total 28 taxa within and surrounding the Development Area. The vegetation within the Development Area has a lower biodiversity than suggested by the initial desktop assessment. No conservation significant species were recorded in either of the flora and vegetation surveys undertaken by Recon Environmental (2009) or ELA (2018). No State or Federally listed TECs or PECs have been recorded within the Development Area. Database searches found no records of threatened ecological communities within 10 km of the Development Area.

The Development Area is not considered to contain an unusually high level of biological diversity or significant species for this region and the proposed clearing is not considered to be at variance with this principle.

#### 4.2 Potential impact to any significant habitat for fauna indigenous to Western Australia

*Principle (b): Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.*

Three conservation significant species were considered to potentially occur within the Development Area as vagrants – Fork-tailed Swift (*Apus pacificus* - IA), Rainbow Bee-eater (*Merops ornatus* M, S5) and Grey Wagtail (*Motacilla cinerea* M, S5).

The fauna habitat that occurs within the Development Area (Chenopod Shrubland and Tecticornia drainage lines) is common to the Kalgoorlie area and is well represented outside the Development Area. The aerial nature and large home range of Fork-tailed Swift, Rainbow Bee-eater and Grey Wagtail means the Development Area would only be used on an occasional basis by these species, if at all. The habitat present is not considered significant in a local or regional context for these species.

Due to the homogeneity of the fauna habitat and relatively degraded nature, it is unlikely that the Development Area supports fauna assemblages. Impacts to this habitat and conservation significant species that may use it are not significant due to the small area being cleared in a local context and the absence of significant values within the Development Area. No trees occur within the Development Area and fauna habitat in the Development Area is not considered to be significant for fauna as it is common throughout the surrounding areas.

The proposed removal of up to 38 ha of native vegetation within an application area of 38.8 ha is not considered to represent a significant impact to fauna or fauna habitat and will not impact on critical feeding or breeding habitat for any conservation significant fauna.

The proposed Development is therefore not considered to be at variance with this Principle.

#### **4.3 Potential impact to any rare flora**

*Principle (c): Native vegetation should not be cleared if it includes, or is necessary for the continued existence of Rare flora.*

No conservation significant flora species were recorded in the Development Area (ELA 2018). The proposed clearing is therefore not considered at variance with this Principle.

#### **4.4 Potential of any threatened ecological communities**

*Principle (d): Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of a threatened ecological community (TEC).*

There are no State or Federally listed TECs present in the Development Area or wider Mining Tenement (ELA 2018). The proposed clearing is therefore not considered at variance with this Principle.

#### **4.5 Significance as a remnant of native vegetation in the area that has been extensively cleared**

*Principle (e): Native vegetation should not be cleared if it is significant as remnant vegetation in an area that has been extensively cleared.*

The Development Area intersects two vegetation associations defined by Shepherd et al. (2002), Coolgardie 468 – Medium woodland; salmon gum & goldfields blackbutt and Coolgardie 540 - Succulent steppe with open low woodland; sheoak over saltbush.

The Development Area contains 0.03% of the current extent of Coolgardie 468 and 0.076% of the current extent of Coolgardie 540 (Government of WA 2018). Coolgardie 468 and Coolgardie 540 have 61,726.56 ha (93.6%) and 48,376.16 ha (95.7%) remaining respectively.

The State Government is committed to the National Objectives and Targets for Biodiversity Conservation (Commonwealth of Australia 2001) that includes a target that prevents a clearance of ecological communities with an extent below 30% of that present prior to European settlement. The Development will not reduce the extent of either of these vegetation communities below 30% of its pre-European extent.

The proposed clearing is therefore not considered at variance with this Principle.

#### **4.6 Impact on any watercourses and/or wetlands**

*Principle (f): Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.*

There are no permanent watercourses within or surrounding the Development Area, the closest permanent water sources being Hannah Lake and Douglas Lake, 2.4 km south and 13 km south west of the Development Area respectively. Minor drainage lines occur adjacent to the eastern boundary of the Development Area that only flow following heavy rainfall and drain water from more elevated features to the north, including TSF1 and the Super Pit. Surface water, is therefore only present for short periods of

time. Regardless, the proposed TSF2 has been designed to avoid these drainage features and maintain current hydrological functions and native vegetation associated with these drainage features (**Figure 1** and **Figure 2**).

Given the separation distance of the site to the nearest permanent watercourse or wetland, and the avoidance of the modified drainage lines adjacent to the Development Area, the proposed clearing is not considered to be at variance to this Principle.

#### **4.7 Potential to cause appreciable land degradation**

*Principle (g): Native vegetation should not be cleared if the clearing of vegetation is likely to cause appreciable land degradation.*

The Development Area will be cleared for construction of the TSF2. The potential impacts of clearing and construction, such as land degradation from erosion and sedimentation, will be managed by undertaking the standard avoidance and mitigation measures applicable to construction activities, such as the installation of wind fencing around the perimeter of the site.

The development is not anticipated to cause appreciable land degradation and therefore, the proposed clearing is not considered to be at variance to this Principle.

#### **4.8 Potential to impact on the environmental values of adjacent or nearby conservation areas**

*Principle (h): Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.*

There are no conservation areas within or adjacent to the Development Area. The nearest conservation area is Lakeside Timber Reserve, located approximately 3.8 km to the south east of the Development Area. Given there are no conservation areas within the immediate area, the Development is not anticipated to impact any environmental values of conservation areas.

Therefore, the proposed clearing is not considered to be at variance to this Principle.

#### **4.9 Potential deterioration in the quality of surface or underground water**

*Principle (i): Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.*

The application area is not located within a Public Drinking Water Source Area (DWER 2018a). The application area is located within the proclaimed Goldfields groundwater area under the Rights in Water and Irrigation Act 1914 (DWER 2018b). Any groundwater extraction and/or taking or diversion of surface water for the purposes other than domestic and/or stock watering is subject to licence by the Department of Water and Environmental Regulation (DWER).

There are no permanent watercourses or wetlands located within the Development Area. The closest permanent water features are Hannah Lake and Douglas Lake, 2.4 km south and 13 km south west of the Development Area respectively. Minor drainage lines occur adjacent to the eastern boundary of the Development Area that only flow following heavy rainfall and drain water from more elevated features to the north, including TSF1 and the Super Pit. Surface water surrounding the site, is therefore only present for short periods of time. The potential impacts of clearing and construction, such as land degradation from erosion and sedimentation, will be managed by undertaking the standard avoidance and mitigation

measures applicable to construction activities, such as the installation of wind fencing around the perimeter of the site.

The depth to the groundwater surrounding the Development Area varies between 0.3 m and 12.1 m (Coffey 2018). The Water Table Aquifer is both Alluvium and Calcrete and is described as “Rocks of low permeability, fractured and weathered rocks – intermediate flow systems in Precambrian Rocks” (National Maps 2018). The soils of the Development Area are porous gravels and sands, hence it is likely that the surface water rapidly infiltrates the soil, though large rainfall events are likely to result in surface run off. Appropriate chemical and hydrocarbon storage and handling will ensure protection of groundwater and surface water quality during the vegetation clearing and construction.

The application area has a groundwater salinity that ranges hypersaline to anoxic conditions (35,000 - 60,000 milligrams/Litre Total Dissolved Solids (TDS) (DWER 2018c). The proposed clearing of up to 37.2 ha of native vegetation over an application area of 37.9 ha is unlikely to further deteriorate the quality of underground water.

The development is therefore not anticipated to cause deterioration in surface and underground water quality and consequently the proposed clearing of the site is not considered to be at variance to this Principle.

#### **4.10 Potential of clearing to cause, or exacerbate, the incidence of flooding**

*Principle (j): Native vegetation should not be cleared if the clearing of vegetation is likely to cause, or exacerbate, the incidence of flooding.*

The application experiences an arid to semi-arid climate, with an average annual rainfall of approximately 270 mm per year (BoM 2018). Based on an average annual evaporation rate of 2,400 - 2,800 mm (BoM, 2018), any surface water resulting from rainfall events is likely to be relatively short lived. The soils of the Development Area are porous gravels and sands; hence it is likely that the surface water would rapidly infiltrate the soil rather than form sheet flow (with the exception of large rainfall events, which are likely to result in some surface run off).

There are no watercourses or wetlands located within the Development Area. Some minor drainage lines are present along the eastern boundary of the Development Area and some pooling of water has been observed during heavy rain events. Surface water management has been considered as part of the proposed works and as such the footprint of TSF2 is not proposed to be within the existing drainage lines. This will allow the flow of surface water to continue as per the current regime.

Given the size of the area to be cleared (38 ha) it is not likely that the proposed clearing will lead to an appreciable increase in run off, and subsequently cause or exacerbate the incidence or intensity of flooding.

The development is not anticipated to cause or exacerbate flooding and consequently the proposed clearing is not considered to be at variance to this Principle.

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# Appendix A - Lakewood Mill TSF2 Flora and Vegetation Reconnaissance Survey (ELA 2018)

# Appendix B - Likelihood of Occurrence Criteria

## Likelihood of Occurrence Criteria for Flora and Fauna of Conservation Significance

- Likelihood: Recorded.
  - The species has previously been recorded within Site from Parks and Wildlife database search results and/or from previous surveys of the Site, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
- Likelihood: Likely.
  - The species has not previously been recorded within the Site. However:
    - the species has been recorded in proximity (<5 km) to the Site, and occurs in similar habitat to that which occurs within the Site
    - core habitat and suitable landforms for the species occur within the Site either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present
    - there is a medium to high probability that a species uses the Site.
- Likelihood: Potential.
  - The species has not previously been recorded within the Site. However,
    - targeted surveys may locate the species based on records occurring in proximity to the Site (5-15 km) and suitable habitat occurring in the Site
    - the Site has been assessed as having potentially suitable habitat through habitat modelling
    - the species is known to be cryptic and may not have been detected despite extensive surveys
    - the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys.
  - The species has been recorded in the Site by a previous consultant survey or there is historical evidence of the species' occurrence within the Site. However,
    - doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution)
    - coordinates are doubtful.
- Likelihood: Unlikely.
  - The species has been recorded locally through Parks and Wildlife database searches. However, it has not been recorded within the Site and
    - it is unlikely to occur due to the Site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded
    - it is unlikely to occur due to few historical record/s and no other current collections in the local area.



- The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the Site through Parks and Wildlife database searches.
- The species has not been recorded in the Site despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.
- Likelihood: No.
  - The species is not known to occur within the bioregion based on current literature and distribution.
  - The Site lacks important habitat for a species that has highly selective habitat requirements.
  - The species has been historically recorded within Site or locally; however it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

## Appendix C - Flora Likelihood of occurrence assessment

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
<i>Gastrolobium graniticum</i>	EN	S3	PMST	An erect open shrub that grows to 2.5m high. It has yellow, orange and red flowers from August to September. It occurs on sand, sandy loam and granite. It does also occur on rock outcrops and along drainage lines. It has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur
<i>Eremophila praecox</i>		P1	Naturemap	Broom like shrub that grows between 1.5 to 3m. It has purple flowers between October and December. It grows on red/ brown sandy loam across undulating plains. It has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur
<i>Ptilotus procumbens</i>		P1	Naturemap	Spreading procumbent annual herb. It grows to 0.1 m and has pink/ white flowers during November. It is found on red clays. It has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur
<i>Elachanthus pusillus</i>		P2	Naturemap	Ascending or decumbent annual herb. It grows to 0.15m high and flowers between August to October. It has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur
<i>Lepidium fasciculatum</i>		P3	Naturemap	Erect annual herb that grows up from 0.3 to 0.6 m. It has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
<i>Melaleuca coccinea</i>		P3	Naturemap	A shrub with multiple branches. It grows between 1.5 to 2.6 m high with leaf blade elliptic to ovate. The leaves are approximately 2 times as long as wide. It produces red flowers between September to November/ January. It grows on sandy loam over granite and granite outcrops. It also grows on sandplains and river valleys. It has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur
<i>Eucalyptus x brachyphylla</i>		P4	Naturemap	A tree that grows up to 4 m in height. It has rough bark and flakes off. Produces white flowers in June. The species grows on sandy loam soils and granite outcrops. It has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur
<i>Frankenia glomerata</i>		P4	Naturemap	Prostrate shrub that has pink/ white flowers in November. It grows on white sand and has been recorded in Kalgoorlie-Boulder (DBCA 2018).	No	Preferred habitat does not occur

CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

<sup>2</sup>Species listed in Western Australia under the *Wildlife Conservation Act 1950* (WC Act) or by the Department of Biodiversity, Conservation and Attractions (DBCA).

S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora (CR) under the WC Act.

S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora (EN) under the WC Act.

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora (VU) under the WC Act.

P1 = Priority 1: Poorly-known species – species that are known from one or a few locations (generally five or less) which are potentially at risk (DBCA).

P2 = Priority 2: Poorly-known species – species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation (DBCA).

P3 = Priority 3: Poorly known species – species that are known from several locations, and the species does not appear to be under imminent threat (DBCA).

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring (DBCA).

<sup>3</sup>NatureMap = NatureMap database search (DBCA 2007-2018).

PMST = EPBC Act Protected Matters Search Tool (DotEE 2018).

## Appendix D - Fauna likelihood of occurrence assessment

All marine mammals, Whales and other Cetaceans, fish and marine reptiles have not been included in this likelihood of occurrence assessment as the Site is terrestrial in nature.

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
<i>Ogyris subterrestris</i> subsp. <i>petrina</i> – Arid Bronze Azure Butterfly	CE	S1	Naturemap	The species is only known from two localities in Western Australia – Avon Wheatbelt in remnant vegetation adjacent to Barbalin Nature Reserve and the second is at Lake Douglas, 12km Southwest of Kalgoorlie but this population has been reported to be extinct since 1993 (DotEE 2015).	No	The Site is not present within the range of the two known populations.
<i>Pezoporus occidentalis</i> – Night Parrot	EN	S1	PMST	Little is known on the ecological requirements of the Night Parrot due to the cryptic behaviour this species has previously shown. Roosting habitat is thought to be long unburnt stands of spinifex hummocks ( <i>Triodia</i> spp.) particularly large hummocks that are ring forming that would form a certain level of protection from predators. Foraging habitat requirements are also largely unknown; however, some favoured sites, particularly in Western Australia, seem to be in close association of chenopod communities, principally the succulents of <i>Sclerolaena</i> . These succulents are possibly a source of moisture for the Night Parrot given their preference for the arid regions of Australia and the probable lack of free standing water Murphy (2015).	No	Preferred habitat is not present.
<i>Calidris ferruginea</i> - Curlew Sandpiper	CR & IA	S3	PMST	This species is migratory. Known habitat includes intertidal mudflats in sheltered coastal areas, such as estuaries and non-tidal swamps and lakes near the coast. The species has been recorded less often inland around lakes, dams and bore drains with bare edges of mud	No	Preferred habitat is not present.

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
				or sand. The distribution of the species is limited by land clearing and disturbance at roost and feeding sites (DotEE 2018c).		
<i>Calyptrorhynchus latirostris</i> - Carnaby's Cockatoo	EN	S2	NatureMap	Known habitat includes remnant eucalypt woodlands, and shrubland or Kwongan heathland dominated by proteaceous species. The species is also known from the Perth metropolitan area and in remnant patches of native vegetation on land cleared for agriculture (DotE 2015b). Known to utilise <i>C. calophylla</i> , * <i>C. citriodora</i> , <i>E. patens</i> , <i>E. marginata</i> , <i>X. preissii</i> and <i>A. fraseriana</i> as a foraging plant, <i>C. calophylla</i> as breeding habitat and <i>C. calophylla</i> and <i>E. marginata</i> as roosting habitat (DotEE 2018c).	Unlikely	Preferred habitat is not present.
<i>Myrmecobius fasciatus</i> - Numbat	EN	S2	Naturemap	he numbat is diurnal (active during the day) and feeds almost exclusively on termites which it obtains by uncovering galleries on the forest floor. It nests in hollow logs, tree hollows or in burrows. Previously widespread in arid and semi-arid Australia, the species is now restricted to two isolated wild populations in south-west Western Australia and a number of translocations to predator proof locations (DotEE 2018c).	Unlikely	Preferred habitat is not present.
<i>Dasyurus geoffroii</i> - Chuditch, Western Quoll	VU	S3	PMST, NatureMap	Current habitat largely restricted to the southwest forests of WA. The species prefers to rest in hollow logs and earth burrows during the day, and will predominately forage along the ground at night. The distribution of the species is limited by land clearing and predation by feral cats and foxes (DotEE 2018c).	Unlikely	Preferred habitat is not present.
<i>Leipoa ocellata</i> - Malleefowl	VU	S3	PMST, Naturemap	This species is found principally in the semi-arid to arid zone in shrublands and low woodlands dominated by mallee and associated habitats such as Broombush and Scrub Pine. In Western Australia,	Unlikely	Preferred habitat is not present.

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
				they are also found in some shrublands dominated by acacia, and occasionally in woodlands dominated by eucalypts (DotEE 2018).		
<i>Macrotis lagotis</i> – Bilby, Dalgyte	V	S3	Naturemap	The Bilby occupies a wide range of vegetation types including open tussock grasslands on hills, mulga woodland/ shrubland and hummock grasslands. Bilbies are a solitary species, sheltering in burrows, which may be up to 3 m deep and often descend in a spiral. Burrows are usually isolated. In Western Australia, the bilby is now largely restricted to the Gibson, Little Sandy and Great Sandy Deserts, and parts of the Pilbara, Dampierland, Central Kimberley and Ord-Victoria Plains bioregions. It also occurs across to the Tanami Desert in the Northern Territory, and there are disjunct subpopulations in Queensland.	Unlikely	Preferred habitat is not present.
<i>Actitis hypoleucos</i> – Common Sandpiper	IA	-	PMST	This species is a migratory species. During the non-breeding season, the population migrates from the Russian far east. The Common Sandpiper mainly inhabit wetlands, predominately coastal but occasionally inland as well. This species is commonly found in areas of muddy margins or rocky shores where they forage with the protection of obstacles from varying substrates (DotEE 2018c).	Unlikely	Preferred habitat is not present.
<i>Apus pacificus</i> – Fork-tailed Swift	IA	-	PMST	This species is almost exclusively aerial. They are most common over inland plains but sometimes over foothills in coastal areas. It is thought they roost aerially but are occasionally observed to land. There is one record of them roosting in a tree, using a bare exposed branch emergent above the foliage (DotEE 2018).	Potential	This species may potentially use the site for foraging but given its vagrant nature, is unlikely to

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
						remain for a prolonged period.
<i>Ardea alba</i> – Great Egret	IA	S5	PMST	This species has been reported in a wide range of wetland (inland, coastal, saline, freshwater etc.), swamp and marsh habitats. They prefer shallow waters and may retreat to permanent wetlands or coastal areas when other wetlands are dry (DotEE 2018c).	Unlikely	Preferred habitat is not present.
<i>Ardea ibis</i> – Cattle Egret	M	-	PMST	The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation (DotEE 2018c).	Unlikely	Preferred habitat is not present.
<i>Calidris acuminata</i> - Sharp-tailed sandpiper	IA	S5	PMST	Habitat for this species is muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes inland. They also occur in salt works and sewage farms and use flooded paddocks, sedgeland and other ephemeral wetlands, but leave when they dry.	Unlikely	Preferred habitat is not present.

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
				They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season (DotEE 2018c).		
<i>Calidris melanotos</i> – Pectoral Sandpiper	IA	-	PMST	This is a migratory species. Known habitat includes shallow wetlands either fresh or saline usually in coastal/near coastal habitats but can be found further inland. Prefers areas with low, emergent or fringing vegetation with open fringing mud flats. During the non-breeding season, the species occurs mainly the Eastern part of Australia, rarely being sighted in Western Australia (DotEE 2018c).	Unlikely	Preferred habitat is not present.
<i>Merops ornatus</i> – Rainbow Bee-eater	M	S5	PMST	The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (DotEE 2018c)	Potential	The species has a preference for disturbed, open, sandy areas
<i>Thinornis rubricollis</i> – Hooded Plover	M	-	PMST	The species primarily inhabits sandy, ocean beaches, with the highest densities on beaches with large amounts of beach-washed seaweed, that are backed by extensive open dunes. Western Australia the species also inhabits inland and coastal salt lakes (BirdLife International 2016a).	No	The Site is terrestrial and not adjacent to the ocean – there is no suitable habitat



Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
						present on site.
<i>Motacilla cinerea</i> - Grey Wagtail	M	S5	PMST	This species inhabits fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. It is also found in more lowland watercourses, even canals, where there are artificial waterfalls, weirs, millraces or lock gates. Outside of the breeding season it occupies a wider variety of habitats, including farmyards, sewage farms, forest tracks, tea estates and even town centres (IUCN 2017).	Potential	This species may potentially use the site for foraging but given its vagrant nature, is unlikely to remain for a prolonged period.
<i>Calidris alba</i> - Sanderling	M		Naturemap	In Australia, the species is almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed. Sanderlings also occur on beaches that may contain wave-washed rocky outcrops. Less often the species occurs on more sheltered sandy shorelines of estuaries, inlets and harbours. Rarely, they are recorded in near-coastal wetlands, such as lagoons, hypersaline lakes, saltponds and samphire flats. There are rare inland records from sandy shores of ephemeral brackish lakes and brackish river-pools (DotEE 2018c). They are known to roost on bare sand, clumps of washed-up kelp, coastal dunes and rocky reefs. They breed in the Northern Hemisphere	No	The Site is terrestrial and not adjacent to the ocean – there is no suitable habitat present on site.

Species	Conservation code		Source <sup>3</sup>	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Listing <sup>1</sup>	WA Listing <sup>2</sup>				
<i>Chalcites osculans</i> – Black-eared Cuckoo	M		PMST	This species can be found throughout Australia. It is known to occur in Forests and shrublands. It prefers subtropical and tropical conditions (Birdlife International 2016).	Unlikely	Preferred habitat is not present.
<i>Tringa glareola</i> - Wood Sandpiper	M		Naturemap	In Western Australia the species is widespread but scattered in most regions (DotEE 2018c). The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially Melaleuca and River Red Gums Eucalyptus camaldulensis and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops.	Unlikely	Preferred habitat is not present.

<sup>1</sup>Species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

<sup>2</sup>Species listed in Western Australia under the *Wildlife Conservation Act 1950* (WC Act) or by the Department of Biodiversity, Conservation and Attractions (DBCA).

S1 = Schedule 1: Fauna that is rare or likely to become extinct as critically endangered fauna (CR) under the WC Act.

S2 = Schedule 2: Fauna that is rare or likely to become extinct as endangered fauna (EN) under the WC Act.

S3 = Schedule 3: Fauna that is rare or likely to become extinct as vulnerable fauna (VU) under the WC Act.

S7 = Schedule 7: Other specially protected fauna (OS) under the WC Act.

P2 = Priority 2: Poorly-known species – species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation (DBCA).

P3 = Priority 3: Poorly known species – species that are known from several locations, and the species does not appear to be under imminent threat (DBCA).

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring (DBCA).

<sup>3</sup>NatureMap = NatureMap database search (DBCA 2007-2018).

PMST = EPBC Act Protected Matters Search Tool (DotEE 2018).



eco  
logical  
AUSTRALIA



**HEAD OFFICE**

Suite 2, Level 3  
668-672 Old Princes Highway  
Sutherland NSW 2232  
T 02 8536 8600  
F 02 9542 5622

**CANBERRA**

Level 2  
11 London Circuit  
Canberra ACT 2601  
T 02 6103 2314  
F 02 9542 5622

**COFFS HARBOUR**

22 Ray McCarthy Drive  
Coffs Harbour NSW 2450  
T 02 6651 5484  
F 02 6651 6890

**PERTH**

Level 1, Bishop's See  
235 St Georges Terrace  
Perth WA 6000  
T 08 6218 2200  
F 02 9542 5622

**MELBOURNE**

Level 1, 436 Johnston St  
Abbotsford, VIC 3076  
T 9290 7173  
F 02 9542 5622

**SYDNEY**

Level 3  
101 Sussex Street  
Sydney NSW 2000  
T 02 9259 3729  
F 02 9542 5622

**NEWCASTLE**

Suites 28 & 29, Level 7  
19 Bolton Street  
Newcastle NSW 2300  
T 02 4910 3412  
F 02 9542 5622

**ARMIDALE**

92 Taylor Street  
Armidale NSW 2350  
T 02 8081 2685  
F 02 9542 5622

**WOLLONGONG**

Suite 204, Level 2  
62 Moore Street  
Austinmer NSW 2515  
T 02 4201 2203  
F 02 9542 5622

**BRISBANE**

Level 5, 12 Creek Street  
Brisbane QLD 4000  
T 07 3503 7192  
F 02 9542 5622

**HUSKISSON**

Unit 1, 51 Owen Street  
Huskisson NSW 2540  
T 02 4201 2264  
F 02 9542 5622

**NAROOMA**

5/20 Canty Street  
Narooma NSW 2546  
T 02 4302 1266  
F 02 9542 5622

**MUDGEES**

Unit 1, Level 1  
79 Market Street  
Mudgee NSW 2850  
T 02 4302 1234  
F 02 6372 9230

**ADELAIDE**

Level 2, 70 Pirie Street  
Adelaide SA 5000  
T 08 8470 6650  
F 02 9542 5622

1300 646 131

[www.ecoaus.com.au](http://www.ecoaus.com.au)