APPENDIX I: MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Document Control

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Version 1	5th April 2019	Dennis Lindgren	DWER (EPA) and DoEE
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A likelihood of occurrence assessment was undertaken for each of the listed Matters of National Environmental Significance (MNES) with potential to occur within the WMDE, the Bauxite Transport Corridor and the CBME (refer to **Appendix A** and **Appendix B** and summarised **in** Tables 15 Section 4.1.3.1 and Table 19 Section 4.2.3.1). The assessment was based on distributions, database records, survey records and habitat availability.

The following tables present MNES that offer a likelihood of occurrence of higher than 'Unlikely to Low Occurrence' within the Preliminary Assessment Area. With respect to Threatened flora this includes only those species identified as occurring within the Preliminary Assessment Area. The assessment of EPBC Act listed Threatened Ecological Communities (TECs), includes any TEC known or with potential to occur within 20km radius of the Preliminary Assessment Area. This has been identified via interrogation of the EPBC Act Protected Matters Search Tool (PMST). Species and community information provided below has been sourced from Department of the Environment's Species Profile and Threats Database, except where otherwise referenced.

Impacts from the proposed continuation of existing operations (for example, habitat fragmentation, noise and air emissions associated with existing operations i.e. existing conveyors, Bauxite Residue Disposal Areas (BRDAs), Refinery operation) which are being referred for operation post approval of the Project expansions, revisions and amendments are also included below where this is warranted by the level of ongoing and / or cumulative risk to the environment associated with these continuing operations.

For those species where impacts are highly unlikely to impact specific habitat values that are critical for the occurrence of the species, they have been excluded from the tables. Further detail regarding those species relevant to the Preliminary Assessment Area can be accessed via **Appendix A** and **B.** This includes riparian habitat associated with the Hotham River, Augustus River, tributaries, major drainage lines and the Worsley Refinery Freshwater Lake representing habitat potentially suitable for species including the Australasian Bittern *Botaurus poiciloptilus*, Australian Painted Snipe *Rostratula australis,* Eastern Curlew *Numenius madagascariensis* and Curlew Sandpiper *Calidris ferruginea,* refer to **Appendix B** for further detail. It is to be noted that *t*hese habitat values are proposed to be protected by application, where practicable of the Worsley Protected Areas Procedure (Worsley 2013b).

Eight migratory species have been highlighted as potentially occurring within the Preliminary Assessment Area. Each of the migratory species are highly mobile. Two of the eight species (Fork-tailed Swift *Apus pacificus* and Grey Wagtail *Motacilla cinerea)* are non-breeding migrants, three species (Cattle Egret *Ardea ibis,* Rainbow Bee-eater *Merops ornatus* and *Ardea modesta*) are listed marine and six of the species (Eastern Osprey *Pandion cristatus*, Common Sandpiper *Actitis hypoleucos*, Sharp-tailed Sandpiper *Calidris acuminata*, Pectoral Sandpiper *Calidris melanotos*) rely on wetland habitat and resource environments that are not expected to be impacted by the Proposal.

All species have been assessed against the 'Draft referral guideline for 14 birds listed as migratory species under the EPBC Act' (Commonwealth of Australia, 2015). The conservation objectives of the guidelines for the 14 species listed as migratory species under the EPBC Act is '…to retain the habitats and resources necessary for them to successfully migrate and, where appropriate, breed throughout their natural range in Australia.' Assessment against the criteria determined that there is low potential for impact upon the Rainbow Bee-eater *Merops ornatus* (discussed in the Migratory/Marine species table below), however, the Proposal is unlikely to impact upon the remainder of the migratory species as it is unlikely '…to have a substantial effect on important habitat' (Commonwealth of Australia, 2015), unlikely to '…seriously disrupt the lifecycle of an ecologically significant proportion of any of the migratory species population' (Commonwealth of Australia, 2015) and is unlikely to '…result in invasive species that are harmful to the migratory species becoming established in an area of important habitat' (Commonwealth of Australia, 2015). A full list of EPBC Act listed migratory species identified in the PMST, including the PMST searches can be viewed in **Appendix B**.

Fauna Impact Table

Species – Forest Red-tailed Black-Cockatoo (FRTBC) *Calyptorhynchus banksii naso*

EPBC Conservation Status: Vulnerable

Description:

The FRTBC is a large black cockatoo (55-60 cm in length and 570-870 g in weight) distinguished from the other Western Australian black cockatoos by it's red, orange or yellow barring in the tail. The species is endemic to the South-West of Western Australia with an area of occupancy estimated to be 20 000 km². The species distribution is bound by Gingin, Mt Helena, Christmas Tree Well, West Dale, North Bannister, Mt Saddleback, Kojonup, Rocky Gully, upper King River and Green Range (east of Albany). Also known to occur as small breeding populations on the Swan Coastal Plain and increasingly in the Perth metropolitan area.

The FRTBC inhabits the dense jarrah, karri and marri forests receiving more than 600 mm average rainfall annually mainly in the hilly interior of the South-West. Ninety percent of the FRTBC total diet consists of marri and jarrah seeds and it depends on both feed trees during breeding periods. The species has been observed breeding at less than four years of age and is monogamous, pairing to probably form a lifetime bond. Breeding has been recorded in every month with peaks in autumn-winter (April-June) and spring (August-October). FRTBC mainly nests in old veteran and stag marri, often nesting in clusters in the landscape. Flocks spend the night roosting in trees and leave at sunrise, splitting into smaller family groups. They feed for 10-12 hours before moving off to creeks or dams to drink. At dusk, they return to their roosts.

Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of an important population of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The anticipated disturbance from the Proposal is the temporary loss of foraging and potential breeding habitat for FRTBC. It is unlikely that the Proposal will lead to a long-term decrease in the size of an important population of the species. Black-Cockatoo species feed on a diverse range of native and introduced plant material. They are considered primarily granivorous, but their diets also consist of fruit, flowers, nectar and invertebrates (Johnstone & Kirkby 1999; Johnstone, Kirkby & Sarti 2017; Mawson 1995; Valentine & Stock 2008). The WMDE area is comprised of a significant area of cleared and agricultural lands (approximately 45% or 12,500ha). The agricultural lands support remnant tree stands (shelterbelts) usually devoid of understorey that offer limited habitat for the species. State Forest and higher quality remnant native habitat, including jarrah/marri forests, wandoo woodlands, and native heaths, provide suitable foraging habitat. Additional foraging habitat is available in some highly modified habitats such as plantations, orchards, and remnant tree stands in the agricultural landscape.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

		Worsley' existing mining operations operate by progressively rehabilitating areas disturbed for mining. Rehabilitated areas constitute approximately 11% (approx. 2,997 ha) of the WMDE. Mine rehabilitation has been shown to provide suitable foraging habitat for black-cockatoo and can provide substantial diversity in food types (Lee, J, Finn & Calver 2013). The successional process of rehabilitation results in revegetation going through distinct phases where community structures change from low open shrubland, dense tall heath, tall shrubland, low forest and forest. The changes in vegetation assemblage and the presence of different successional stages in the landscape will ensure long term foraging habitats are available for all three species of black-cockatoo (Doherty et al. 2016; Lee, Finn & Calver 2010a). The Proposal is likely to have a short-term reduction in foraging habitat prior to rehabilitation although this is mitigated by the continuous addition of rehabilitated areas as part of the Worsley mining process. In agreement with landholders or where applicable on Worsley Joint Venture owned land, some of the agricultural lands to be mined will be rehabilitated with native species increasing the local foraging value for the species. Natural and artificial water resources are available to all species of black-cockatoo at both WMDE and CBME from a variety of sources including freshwater reservoirs, farm dams and drainage systems. Impact on water resources are not expected as a result of the Proposal. The loss of breeding habitat is to be mitigated by a Black-Cockatoo pre-clearance process (Worsley, 2018) designed for the management of potential habitat trees (PHT). This process follows the mitigation hierarchy discussed in Section 4.2.6 and **Appendix B**. A medium-term loss of potential breeding habitat is expected until these can be provided through rehabilitation. Individuals of the species are expected to move into the forest, remnants and existing rehabilitation surrounding the operation during the period of short and mid-term impacts.	
	CBME: **Unlikely**	As per above however, the CBME is a much smaller area located within State Forest with low agricultural values in proximity. The native vegetation foraging habitat is predominantly jarrah/marri forest. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

Will the proposal reduce the area of occupancy of an important population	WMDE / Bauxite Transport Corridor: **Unlikely**	The temporary loss of foraging and breeding habitat will temporarily reduce the area of occupancy of the species. Progressive rehabilitation and mitigation measures to manage breeding habitat will reduce this temporary loss. Individuals are expected to be displaced into the forest, remnants and existing rehabilitation surrounding the Proposal area.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As per above. Additionally, the CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal fragment an existing important population into two or more populations	WMDE / Bauxite Transport Corridor: **Unlikely**	FRTBC are a highly mobile species. Further evidence is being provided from studies being undertaken by Murdoch University for the Black Cockatoo Tracking Project. This study has tracked FRTBC in significant flocks travelling between the eastern extents of the Jarrah Forest near Boddington as far as Inglehope near Dwellingup, a distance of approximately 40km. It is unlikely that the Proposal will fragment an existing population into two or more populations.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As per above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: Likely	The Proposal area is situated in State Forest of the Northern Jarrah Forest comprised of large expanses of the species critical habitat. The Proposal is expected to temporarily impact foraging habitat and potential breeding habitat and therefore affect habitat that is critical to the survival of the species locally. Loss of habitat will be on a temporary basis until progressive rehabilitation presents a foraging and breeding resource critical to the survival of the species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Likely**	The Proposal is situated in the Harris River State Forest of the Northern Jarrah Forest comprised of large expanses of the species critical habitat. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by FRTBC. During the period of temporary impact, it is expected that individuals will utilise the forest and remnants surrounding the Proposal area until progressive rehabilitation presents a foraging and breeding resource for the species. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal disrupt the breeding cycle of an important population	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal will potentially temporarily impact breeding habitat and therefore the breeding cycle of individuals of the species as opposed to an important population of the species. During the period of temporary impact, it is expected that individuals will utilise the forest and remnants surrounding the Proposal area until progressive rehabilitation presents a foraging and breeding resource for the species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

	CBME: **Unlikely**	As per above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal is unlikely to cause species decline as a result of modification, destruction, removal, isolation or a decrease in the quality of habitat. Temporary impacts as a result of the Proposal are likely to temporarily reduce foraging and potential breeding habitat for the species in areas of State Forest and remnant habitat. Breeding and foraging habitat for the species within the wider Boddington and Northern Jarrah Forest is generally abundant with significant areas of native forest in the region. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by FRTBC. The Proposal is an expansion of the existing Worsley operation that has been in operation since the early 1980's. Areas of moderate to high quality remnant habitat and progressively rehabilitated land (rehabilitation up to 35 years of age) remain within the WMDE supporting foraging and breeding resources for the species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Breeding and foraging habitat for the species within the wider Harris River State Forest is generally abundant with significant areas of native forest locally and regionally. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by FRTBC. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal is unlikely to result in an invasive species that are harmful to FRTBC and all three Threatened Black-Cockatoo species becoming established in the species habitat. This refers to competition of nest hollows by the European Honey Bee, increase in weeds that may impact on foraging resources and introduced predators that may impact upon the species. The European Honey Bee has been recorded and is established in the Northern Jarrah Forest, forest remnants and agricultural areas within and surrounding the Proposal area. The extent of this threat is similar within the surrounding area. Mattiske Consulting have monitored Worsley forest plots and rehabilitation for greater than 35 years. Mattiske (2019) consider that 'the majority of weeds are short term annual species that establish on disturbed agricultural lands and although some establish in the early phase of rehabilitation, the majority are quickly outgrown by more perennial and larger native shrub and tree species'.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

		Worsley's existing BFMP (**Appendix H**) requires Worsley to manage invasive species. Worsley currently implements annual 1080 baiting, weed control and dieback/hygiene management within existing Worsley operational areas.	
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Disease is not a listed threat to FRTBC. The Proposal is unlikely to cause the introduction of a disease that may cause the species to decline. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (*Phytophthora cinnamomi* and *Armillaria luteobubalina*). Dieback and *Armillaria* status is mapped prior to any vegetation clearing and ground disturbance activities. Worsley implements hygiene management procedures (Worsley 2014a) to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas. Historically until 2016, Worsley have supported a Black Cockatoo Health and Population Demographics Project relevant to FRTBC, Baudin's and Carnaby's Black-Cockatoo investigating disease and the management of disease in the Black-Cockatoo species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, supporting research that contributes to the recovery of the species.
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Interfere substantially with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal is unlikely to interfere with the recovery of FRTBC. Recovery actions are outlined in the FRTBC (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan (DEC 2008). Worsley supports the Black-Cockatoo Recovery Plan and is committed to managing impacts preventing further decline of the species. This includes implementation of existing procedures that will manage impacts of the Proposal under the Worsley Black-Cockatoo Pre-Clearance Management Process (Worsley, 2018) and BFMP (**Appendix H**). Additionally, Worsley contributes to the Recovery Plan by supporting research with a focus on sections (DEC, 2008):	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, supporting research that contributes to the recovery of the species.

		14.7 determine and implement ways to minimise the effects of mining and urban development on habitat loss 14.8 determine and implement ways to manage forest for the conservation of forest Black-Cockatoos 14.12 Determine the patterns and significance of movement. Current research includes support of a 5-year industry and multi-stakeholder collaboration with Murdoch University 'Black Cockatoo Ecology and Tracking Project' and historically the 'Black Cockatoo Health and Demographics Project'.	
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

Species – Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*

EPBC Conservation Status: Endangered

Description:
Carnaby's Black-Cockatoo is a large black cockatoo (53 to 58 cm in length, with a wingspan of approximately 110 cm, and a mass of 520 to 790 g). It is mostly brownish-black or greyish-black in colour with narrow off-white margins on the feathers; a large patch over the ear coverts that is off-white or cream to brownish-white in males and yellowish-white (and slightly larger) in females; and broad white panels in the tail.

The species is endemic to, and widespread in, the south-west of Western Australia. It has an extent of occurrence estimated at 180,000km^2 and area of occupancy between 10,000 km^2 and 86,000 km^2 occurring from the wheatbelt, in areas that receive between 300 and 750 mm of rainfall annually, across to wetter regions in the extreme south-west, including the Swan Coastal Plain and the southern coast. Its range extends from Cape Arid in the south-east to Kalbarri in the north, and inland to Hatter Hill, Gibb Rock, Narembeen, Noongar, Wongan Hills, Nugadong, near Perenjori, Wilroy and Nabawa.

Breeding mainly occurs in the wheatbelt, from the Stirling Ranges north-west to near Three Springs. Over the past 50 years, the distribution of Carnaby's Cockatoo has shifted considerably westwards and southwards. There are now numerous breeding records from the jarrah-marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. There are also indications that the species is expanding its breeding range into the far south-east, in areas such as Lake Cronin, Lake King and the Ravensthorpe region.

Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of a population of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The anticipated disturbance from the Proposal is the temporary loss of foraging and potential breeding habitat for Carnaby's Black Cockatoo. It is unlikely that the Proposal will lead to a long-term decrease in the size of a population of the species. Black-Cockatoo species feed on a diverse range of native and introduced plant material. They are considered primarily granivorous, but their diets also consist of fruit, flowers, nectar and invertebrates (Johnstone & Kirkby 1999; Johnstone, Kirkby & Sarti 2017; Mawson 1995; Valentine & Stock 2008). The WMDE area is comprised of a significant area of cleared and agricultural lands (approximately 45% or 12,500ha). The agricultural lands support remnant tree stands (shelterbelts) usually devoid of understorey that offer limited habitat for the species. State Forest and higher quality remnant native habitat, including jarrah/marri forests, wandoo woodlands, and native heaths, provide suitable foraging habitat. Additional foraging habitat is available in some highly modified habitats, for example plantations, orchards, and remnant tree stands in the agricultural landscape.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

		Worsley' existing mining operations operate by progressively rehabilitating areas disturbed for mining. Rehabilitated areas constitute approximately 11% (approx. 2,997 ha) of the WMDE. Mine rehabilitation has been shown to provide suitable foraging habitat for black-cockatoo and can provide substantial diversity in food types (Lee, J, Finn & Calver 2013). The successional process of rehabilitation results in revegetation going through distinct phases where community structures change from low open shrubland, dense tall heath, tall shrubland, low forest and forest. The changes in vegetation assemblage and the presence of different successional stages in the landscape will ensure long term foraging habitats are available for all three species of black-cockatoo (Doherty et al. 2016; Lee, Finn & Calver 2010a). The Proposal is likely to have a short-term reduction in foraging habitat prior to rehabilitation although this is mitigated by the continuous addition of rehabilitated areas as part of the Worsley mining process. In agreement with landholders some of the agricultural lands to be mined will be rehabilitated with native species increasing the local foraging value for the species Natural and artificial water resources are available to all species of black-cockatoo at both WMDE and CBME from a variety of sources including freshwater reservoirs, farm dams and drainage systems. Impact on water resources are not expected as a result of the Proposal. The Carnaby's Black-Cockatoo Species Recovery Program (Department of Parks and Wildlife, 2013) states that there has been an apparent expansion in the breeding range to include areas further west and south of what was considered typical breeding habitat for the species with a more rapid increase in the past 10-30 years into the Jarrah-Marri forests and the coastal tuart forests south of Perth. Carnaby's Black Cockatoo have been recorded breeding within the WMDE. The DBCA Threatened species data indicates a confirmed breeding area for Carnaby's black-cockatoo encompassing much of the northern half of the WMDE (refer to **Appendix B**). Additional records are located south of this breeding area within the WMDE. The loss of breeding habitat is to be mitigated by a Black-Cockatoo pre-clearance process (Worsley, 2018) designed for the management of potential habitat trees (PHT). This process follows the mitigation hierarchy discussed in Section 4.2.6 and **Appendix B**. A medium-term loss of potential breeding habitat is expected until these can be provided through rehabilitation. Individuals of the species are expected to move	

		into the forest, remnants and existing rehabilitation surrounding the operation during the period of short and mid-term impacts.	
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal reduce the area of occupancy of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	The temporary loss of foraging and breeding habitat will temporarily reduce the area of occupancy of the species. Progressive rehabilitation and mitigation measures to manage breeding habitat will reduce this temporary loss. Individuals are expected to be displaced into the forest, remnants and existing rehabilitation surrounding the Proposal area.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As per above. Additionally, the CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal fragment an existing population into two or more populations	WMDE / Bauxite Transport Corridor: **Unlikely**	Carnaby's Black-Cockatoo are a highly mobile species and display seasonal migratory patterns that are linked to breeding. Breeding occurs in the inland parts of its distribution, in areas receiving between 300 and 750 mm of annual average rainfall (Saunders 1974). The Department of Parks and Wildlife (2013) state that during the non-breeding season (January to July) the majority of the birds move to the higher rainfall coastal regions of their range including the Midwest coast, Swan Coastal Plain and South coast. It is unlikely that impacts associated with the Proposal will fragment an existing population of Carnaby's Black-Cockatoo into two or more populations.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As per above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: **Likely**	Department of Parks and Wildlife (2013) Species Recovery Program summarises habitat critical to survival for Carnaby's cockatoos as: - The eucalypt woodlands that provide nest hollows used for breeding, together with nearby vegetation that provides feeding, roosting and watering habitat that supports successful breeding; - Woodland sites known to have supported breeding in the past and which could be used in the future, provided adequate nearby food and/or water resources are available or are re-established;	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

		- In the non-breeding season, the vegetation that provides food resources as well as the sites for nearby watering and night roosting that enable the cockatoos to effectively utilise the available food resources. The Proposal area is situated in State Forest of the Northern Jarrah Forest comprised of large expanses of the species critical habitat. The Proposal is expected to temporarily impact foraging habitat and potential breeding habitat and therefore affect habitat that is critical to the survival of the species locally. Loss of habitat will be on a temporary basis until progressive rehabilitation presents a foraging and breeding resource critical to the survival of the species.	
	CBME: **Likely**	The Proposal is situated in the Harris River State Forest of the Northern Jarrah Forest comprised of large expanses of the species critical habitat. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by Black-Cockatoo species. During the period of temporary impact, it is expected that individuals will utilise the forest and remnants surrounding the Proposal area until progressive rehabilitation presents a foraging and breeding resource for the species. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal disrupt the breeding cycle of a population	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal will potentially temporarily impact breeding habitat and therefore the breeding cycle of individuals of the species. During the period of temporary impact, it is expected that individuals will utilise the forest and remnants surrounding the Proposal area until progressive rehabilitation presents a foraging and breeding resource for the species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As per above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal is unlikely to cause species decline as a result of modification, destruction, removal, isolation or a decrease in the quality of habitat. Temporary impacts as a result of the Proposal are likely to temporarily reduce foraging and potential breeding habitat for the species in areas of State Forest and remnant habitat. Breeding and foraging habitat for the species within the wider Boddington and Northern Jarrah Forest is generally abundant with significant areas of native forest in the region. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by the Black-Cockatoo species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

		The Proposal is an expansion of the existing Worsley operation that has been in operation since 1980. Areas of moderate to high quality remnant habitat and progressively rehabilitated land (rehabilitation up to 35 years of age) remain within the WMDE supporting foraging and breeding resources for the species.	
	CBME: **Unlikely**	Breeding and foraging habitat for the species within the wider Harris River State Forest is generally abundant with significant areas of native forest locally and regionally. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by Black-Cockatoo species. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	Refer to the above section relevant to the FRTBC and common to all three Threatened Black Cockatoo species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, Worsley implements targeted 1080 baiting within existing Worsley operational areas.
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Many aspects of the disease status of wild Carnaby's cockatoo populations remain unknown, however, recent research has highlighted the potential importance of the role of disease in the conservation of Carnaby's cockatoos (Saunders et al. 2011; Le Souëf 2012, Department of Parks and Wildlife, 2013). The Proposal is unlikely to cause the introduction of a disease that may cause the species to decline. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (*Phytophthora cinnamomi* and *Armillaria luteobubalina*). Dieback and *Armillaria* status is mapped prior to any vegetation clearing and ground disturbance activities. Worsley implements hygiene management procedures (Worsley 2014a) to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas. Historically until 2016, Worsley have supported research in collaboration with Murdoch University entitled 'The Black Cockatoo Health and Population Demographics Project' relevant to the three Threatened Black-Cockatoo species. This study highlighted the	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, Worsley supports research that contributes to the recovery of the species.

		potential importance of the role of disease in the conservation of Carnaby's cockatoos. This information has been directly referred to in the Carnaby's Black-Cockatoo Species Recovery Plan (Department of Parks and Wildlife, 2013).	
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Interfere with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal is unlikely to interfere with the recovery of Carnaby's Black-Cockatoo. Recovery actions are outlined in the Carnaby's Black-Cockatoo Recovery Plan (Department of Parks and Wildlife, 2013), the objective of which is to stop further decline in the distribution and abundance of Carnaby's Black-Cockatoo by protecting the birds throughout their life stages and enhancing habitat critical for survival throughout their breeding and non-breeding range, ensuring that the reproductive capacity of the species remains stable or increases. Worsley supports the Carnaby's Black-Cockatoo Recovery Plan and is committed to managing impacts preventing further decline of the species. This includes implementation of existing procedures that will manage impacts of the Proposal under the Worsley Black-Cockatoo Pre-Clearance Management Process (Worsley, 2018) and BFMP (**Appendix H**). Additionally, Worsley contributes to the Recovery Plan by supporting research that is referred to in the Recovery Plan, for example 'The Black Cockatoo Health and Population Demographics Project' discussed above and ongoing research including support of a 5-year industry and multi-stakeholder collaboration with Murdoch University entitled 'The Black Cockatoo Ecology and Tracking Project'.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, supporting research that contributes to the recovery of the species.
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

Species – Baudin's Black-Cockatoo *Calyptorhynchus baudinii*

Conservation Status: Endangered

Description

Baudin's Black-Cockatoo is a large cockatoo species (with a wingspan of approximately 110 cm, and a mass of 560–770 g) endemic to the south-west of Western Australia. It is mostly dull black in colour, with pale whitish margins on the feathers, large, rounded patches (white to yellowish-white in the female and dusky-white to brownish-white in the male) on the ear coverts, and rectangular white panels in the tail. It has a large bill distinguishing it from the Carnaby's Black-Cockatoo.

The range of Baudin's Cockatoo varies substantially between the breeding and non-breeding seasons. During the breeding season (from October to January), the species nests in the far south-west of WA within jarrah, marri and karri forests, with one breeding population in the southern wheatbelt near Kojonup. The range then expands during the non-breeding season (from February) as flocks forage more widely, congregating on the central and northern parts of the Darling plateau, as far as Mundaring and Gidgegannup. Some flocks also move on to the southern Swan Coastal Plain and south coast during the non-breeding season, although there are also pockets of breeding around Augusta, Northcliffe, Walpole, Denmark and Albany. The area of occupancy is estimated at 25 000 km² with a declining trend.

Baudin's Cockatoo mainly occurs in eucalypt forests, especially Jarrah, Marri and Karri forest. The species is less frequently in woodlands of Wandoo (*E. wandoo*), Blackbutt (*Eucalyptus patens*), Flooded Gum (*Eucalyptus rudis*), Yate (*Eucalyptus cornuta*), partly cleared farmlands and urban areas, including roadside trees and house gardens. Baudin's Cockatoo breeds in the jarrah, marri and karri forests of the far south-west in areas averaging more than 750 mm of rainfall annually. Breeding generally occurs in woodland or forest but may also occur in former woodland or forest now present as isolated trees. Areas of breeding are also known from the southern Swan Coastal Plain, the south coast region and the southern wheatbelt region around Kojonup. The species is locally resident, but at the end of the breeding season (January), birds leave the nesting areas and family groups come together to form larger foraging flocks. This movement is in response to changing food resources. The flocks begin to arrive at non-breeding traditional roosts in the central and northern parts of the Darling plateau (from about Collie north to Mundaring) in early February and March.

Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of a population of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The anticipated disturbance from the Proposal is the temporary loss of foraging habitat for Baudin's Black-Cockatoo. It is unlikely that the Proposal will lead to a long-term decrease in the size of a population of the species. Black-Cockatoo species feed on a diverse range of native and introduced plant material. They are considered primarily granivore, but their diets also consist of fruit, flowers, nectar and invertebrates (Johnstone & Kirkby 1999; Johnstone, Kirkby & Sarti 2017; Mawson 1995; Valentine & Stock 2008). The WMDE area is comprised of a significant area of cleared and agricultural lands (approximately 45% or 12,500ha). The agricultural lands support remnant tree stands (shelterbelts) usually devoid of understorey that offer limited habitat for the species. State Forest and higher quality	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

		remnant native habitat, including jarrah/marri forests, wandoo woodlands, and native heaths, provide suitable foraging habitat. Additional foraging habitat is available in some highly modified habitats, for example plantations, orchards, and remnant tree stands in the agricultural landscape. Worsley' existing mining operations operate by progressively rehabilitating areas disturbed for mining. Rehabilitated areas constitute approximately 11% (approx. 2,997 ha) of the WMDE. Mine rehabilitation has been shown to provide suitable foraging habitat for black-cockatoo and can provide substantial diversity in food types (Lee, J, Finn & Calver 2013). The successional process of rehabilitation results in revegetation going through distinct phases where community structures change from low open shrubland, dense tall heath, tall shrubland, low forest and forest. The changes in vegetation assemblage and the presence of different successional stages in the landscape will ensure long term foraging habitats are available for all three species of black-cockatoo (Doherty et al. 2016; Lee, Finn & Calver 2010a). The Proposal is likely to have a short-term reduction in foraging habitat prior to rehabilitation although this is mitigated by the continuous addition of rehabilitated areas as part of the Worsley mining process. In agreement with landholders some of the agricultural lands to be mined will be rehabilitated with native species increasing the local foraging value for the species Natural and artificial water resources are available to all species of black-cockatoo at both WMDE and CBME from a variety of sources including freshwater reservoirs, farm dams and drainage systems. Impact on water resources are not expected as a result of the Proposal. Although Baudin's Black-Cockatoo are known to breed in the Jarrah Forest, the WMDE and Bauxite Transport Corridor are located outside of the predicted breeding range of the species. (refer to Figure 2 of Department of Environment and Energy (2017)). Confirmed breeding of Baudin's Black-Cockatoo has not been recorded within the Proposal area. The loss of breeding habitat is to be mitigated by a Black-Cockatoo pre-clearance process (Worsley, 2018) designed for the management of potential habitat trees (PHT). This process follows the mitigation hierarchy discussed in Section 4.2.6 and **Appendix B**. A medium-term loss of potential breeding habitat is expected until these can be provided through rehabilitation. Individuals of the species are expected to move	

		into the forest, remnants and existing rehabilitation surrounding the operation during the period of short and mid-term impacts.	
	CBME: **Unlikely**	In addition to the above, the Proposal area is located within the predicted breeding distribution for Baudin's Black-Cockatoo (refer to Figure 2 of Department of Environment and Energy (2017)). The anticipated disturbance from the Proposal is the temporary loss of foraging and potential breeding habitat for Baudin's Black Cockatoo. It is unlikely that the Proposal will lead to a long-term decrease in the size of a population of the species. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal reduce the area of occupancy of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	The temporary loss of foraging habitat will temporarily reduce the area of occupancy of the species. Progressive rehabilitation and mitigation measures to manage foraging habitat will reduce this temporary loss. Individuals are expected to be displaced into the forest, remnants and existing rehabilitation surrounding the Proposal area.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As per above. Additionally, the Proposal is located within the predicted breeding range of the species. Therefore, there is potential for loss of potential foraging and breeding habitat within the CBME. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal fragment an existing population into two or more populations	WMDE / Bauxite Transport Corridor: **Unlikely**	Baudin's Black-Cockatoo are a highly mobile species and display seasonal migratory patterns that are linked to breeding. Breeding occurs in the southern area of their distribution (refer to Figure 2 of Department of Environment and Energy (2017)) outside of the Proposal area. The Proposal area represents foraging and wintering habitat for the species. It is unlikely that impacts associated with the Proposal will fragment an existing population of Baudin's Black-Cockatoo into two or more populations.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As per above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the	WMDE / Bauxite Transport Corridor: **Likely**	The Proposal area is situated in State Forest of the Northern Jarrah Forest comprised of large expanses of the species critical habitat. The Proposal is expected to temporarily impact foraging habitat and therefore affect habitat that is critical to the survival of the species locally. Loss of habitat will be on a temporary basis until	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

survival of a species		progressive rehabilitation presents a foraging resource critical to the survival of the species.	
	CBME: **Likely**	The Proposal is situated in the Harris River State Forest of the Northern Jarrah Forest comprised of large expanses of the species critical habitat. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by Black-Cockatoo species. During the period of temporary impact, it is expected that individuals will utilise the forest and remnants surrounding the Proposal area until progressive rehabilitation presents a foraging and breeding resource for the species. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal disrupt the breeding cycle of a population	WMDE / Bauxite Transport Corridor: **Unlikely**	Breeding occurs in the southern area of the distribution of Baudin's Black-Cockatoo (refer to Figure 2 of Department of Environment and Energy (2017)). Breeding has not been recorded within and adjacent to the Proposal area. It is unlikely that the Proposal will disrupt the breeding cycle of a population of Baudin's Black-Cockatoo.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The Proposal will potentially temporarily impact breeding habitat and therefore the breeding cycle of individuals of the species. During the period of temporary impact, it is expected that individuals will utilise the forest and remnants surrounding the Proposal area until progressive rehabilitation presents a foraging and breeding resource for the species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal is unlikely to cause species decline as a result of modification, destruction, removal, isolation or a decrease in the quality of habitat. Temporary impacts as a result of the Proposal are likely to temporarily reduce foraging and wintering habitat for the species in areas of State Forest and remnant habitat. Foraging and wintering habitat for the species within the wider Boddington and Northern Jarrah Forest is generally abundant with significant areas of native forest in the region. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by the Black-Cockatoo species. The Proposal is an expansion of the existing Worsley operation that has been in operation since 1980. Areas of moderate to high quality remnant habitat and progressively rehabilitated land (rehabilitation up to 35 years of age) remain within the WMDE supporting foraging and wintering resources for the species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

	CBME: **Unlikely**	Breeding and foraging habitat for the species within the wider Harris River State Forest is generally abundant with significant areas of native forest locally and regionally. Progressive rehabilitation of temporarily disturbed areas will over time return these resources (foraging resources in the shorter term) for use by Baudin's Black-Cockatoo. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	Refer to the above section relevant to the FRTBC and common to all three Threatened Black Cockatoo species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, Worsley implements targeted 1080 baiting within existing Worsley operational areas.
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Refer to the above section relevant to the FRTBC and common to all three Threatened Black Cockatoo species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, supporting research that contributes to the recovery of the species.
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal Interfere with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	Refer to the above section relevant to the FRTBC, common also to Baudin's Black-Cockatoo species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6 Additionally, supporting research that contributes to the

			recovery of the species.
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Species – Chuditch *Dasyurus geoffroii*			
EPBC Conservation Status: Vulnerable			
Description: The Chuditch is Western Australia's largest carnivorous marsupial. The species is wide ranging with relatively large home ranges and high dispersal rates. The species is distinguishable from other mammals within its distribution its white spotted brown fur, large round ears, pointed muzzle and non-hopping gait. The Chuditch has suffered a substantial decline in its distribution across Western Australia. Its original distribution extended over much of Australia including arid and semi-arid zones but did not seem to extend east of the dividing range in eastern Australia. The decline resulted from the clearing and fragmentation of habitat, and the introduction of herbivores and predators. One of the confounding factors in the conservation of this species is the impact of introduced predators in forests. The control of predators, specifically the fox has proven beneficial to the species. Most Chuditch are now found in varying densities throughout the Jarrah Forest and south coast of Western Australia (Department of Environment and Conservation, 2012). They are capable of travelling long distances and have large home ranges, and even at their most abundant, Chuditch are generally present in low numbers (Department of Environment and Conservation, 2012). The WMDE is a highly fragmented environment for native fauna. Survey effort in and surrounding the WMDE has confirmed the variable density of Chuditch populations. Low density has been recorded in the areas of the Worsley operation south of the Hotham River (where the operation is fragmented by agriculture, forest blocks, forestry, historical grazing, rehabilitation and mining operations) and higher densities in State Forest surrounding NBG most likely due to the larger area of relatively contiguous forest. This area is surrounded by extensive forested areas of the Dwellingup State Forest to the west, north and east with the eastern and southern extent bound by agricultural lands. Although recorded in variable density throughout the Proposal area, the density of Chuditch records in the northern area of the WMDE suggest a potentially important population of the species.			
Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of an important population of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal is unlikely to lead to a long-term decrease in the size of an important population of the Chuditch. Most Chuditch are now found in varying densities throughout the Jarrah Forest and south coast of Western Australia (Department of Environment and Conservation, 2012). They are capable of travelling long distances and have large home ranges, and	Section 4.1.6 Section 4.2.6

		even at their most abundant, Chuditch are generally present in low numbers (Department of Environment and Conservation, 2012). The WMDE is a highly fragmented environment for native fauna. Survey effort in and surrounding the WMDE has confirmed the variable density of Chuditch populations. Low density has been recorded in the areas of the Worsley operation south of the Hotham River (where the operation is fragmented by agriculture, forest blocks, forestry, historical grazing, rehabilitation and mining operations) and higher densities in State Forest surrounding NBG most likely due to the larger area of relatively contiguous forest. This area is surrounded by extensive forested areas of the Dwellingup State Forest to the west, north and east with the eastern and southern extent bound by agricultural lands. Although recorded in variable density throughout the Proposal area, the density of Chuditch records in the northern area of the WMDE suggest a potentially important population of the species. The National Chuditch Recovery Plan (Department of Environment and Conservation, 2012) states that the higher density populations of Chuditch have been found in riparian Jarrah forest. Riparian habitat and associated buffer forms a Protected Area of the Worsley Protected Areas Procedure (Worsley 2013b). This procedure is relevant to the Proposal and includes the riparian habitat of the Hotham River, a significant connective ecological corridor in the fragmented landscape between the NBG area, remnant habitat and State Forest. The temporary and staged nature of the Proposal is likely to have a short to mid-term impact on the Chuditch populations. Development will encourage dispersal of individuals into the adjoining State Forest habitat, however, this is unlikely to lead to a long-term decrease in the local population. Implementation of a Threatened Species Management Program, ecological linkages within the mine planning process and fauna underpasses for long term infrastructure and progressive rehabilitation designed to include ecological requirements for Chuditch i.e. fauna habitat structures; will reduce the impact duration with an outcome reducing the potential of leading to a long-term decrease in the size of the local population. In agreement with landholders or where applicable on Worsley Joint Venture owned land, some of the agricultural areas mined and restored to a forest ecosystem have the potential to provide a long-term increase in foraging, denning and commuting habitat suitable for the species.	

	CBME: **Unlikely**	Historical records and surveys for areas around the CBME suggest that the Chuditch is not common or in high densities within and surrounding the CBME. In addition to the commentary above, habitat for the species surrounding the CBME within the wider Harris River State Forest is generally abundant with significant areas of native forest locally and regionally. The temporary loss of habitat within the CBME is likely to have a short to medium-term impact on a local population, however, is considered unlikely to lead to a long-term decrease in the size of an important population of the Chuditch. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal reduce the area of occupancy of an important population	WMDE / Bauxite Transport Corridor: **Temporary – Short to mid-term impact**	The temporary loss of habitat suitable for the Chuditch will temporarily reduce the area of occupancy of the local population of the species and the potentially important population in the northern area of the WMDE. Chuditch have relatively large home ranges and high dispersal rates. The Proposal is expected to temporarily displace individuals of the local population into the forest, remnants and existing rehabilitation surrounding the operation. The area of occupancy will reduce until rehabilitation matures to support recolonization of the species. Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) and sufficient prey biomass (large invertebrates, reptiles and small mammals) to survive (Department of Environment and Conservation 2012). Worsley implements a program of progressive rehabilitation including the Standard Operating Rehabilitation Procedure of constructed fauna habitats (logs, rocks and forest debris combined to form potential fauna habitats at a target density of 9 per hectare (WAPL, 2017). The rehabilitation and constructed fauna habitats present potential Chuditch denning, refuge and foraging habitat. Agricultural areas mined and restored to a forest ecosystem have the potential to provide a long-term increase in foraging, denning and commuting habitat suitable for the species, potentially leading to a long-term increase in the area of occupancy of the local population.	Section 4.1.6 Section 4.2.6 Specific areas of agricultural property that have been mined to be rehabilitated utilising State Forest rehabilitation seed mix and Worsley rehabilitation protocols.
	CBME: **Temporary – Short to mid-term impact**	As per above, temporary loss of habitat suitable for the Chuditch will temporarily reduce the area of occupancy of the local population of the species, however, is unlikely to reduce the area of occupancy of an important population. Individuals of the local population are expected to be displaced into the adjoining forest habitat until rehabilitation develops and matures to support recolonization of the species from the local population. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6

Will the proposal fragment an existing important population into two or more populations	WMDE / Bauxite Transport Corridor: **Likely**	Although variable density throughout the Proposal area, the density of Chuditch records in the northern area of the WMDE suggest a potentially important population of the species. Mining operations, and the proposal of a long-term transport corridor in the northern area of the Proposal, has the potential to fragment an existing important population into two or more populations. Mitigation measures to reduce the impact on an important population, for example designed fauna crossings of the transport corridor will aid in reducing this impact. Existing conveyors, long-term infrastructure and mine operations (including associated noise) associated with ongoing operations of the BBM and Refinery have the potential to fragment existing populations of the species.	Section 4.1.6 Section 4.2.6 Designed fauna crossings for long-term infrastructure, for example, Bauxite Transport Corridor.
	CBME: **Unlikely**	The CBME area of the Proposal is unlikely to fragment an existing important population into two or more populations. Historical surveys at the CBME and surrounding area suggest low densities of Chuditch and low likelihood of an important population of the Chuditch. The Harris River State Forest surrounding the CBME offers significant habitat of similar quality to that of the CBME. Habitat connectivity remains surrounding the operation and within areas of riparian habitat that will remain intact under the Worsley Protected Areas Procedure environment management program (Worsley 2013b). Progressive rehabilitation of mined areas will minimise the period of impact. The CBME will only be impacted in the event the emergency bauxite supply is required. Existing conveyors, BRDAs and long-term infrastructure associated with the ongoing operations (including associated noise) of the Worsley Refinery have the potential to fragment existing populations of the species.	Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: **Likely**	WMDE: The Proposal will adversely affect habitat critical to the survival of the species, however, as discussed above this is of a temporary nature until the role of rehabilitation and integration into the native forest is realised. Chuditch have historically been present in a large variety of habitats so it is not possible to list a set of characteristic habitats that should be preserved for Chuditch (Department of Environment and Conservation, 2012). However, some key aspects are required for Chuditch survival in an area. These are: adequate den resources (e.g. hollow logs, burrows or rock crevices), adequate prey resources (particularly large invertebrates) and sizeable areas (> 20 000 ha.) (Department of Environment and Conservation, 2012). The species has been identified at varying densities throughout the WMDE and is known to travel large distances and occupy a large home range. It is therefore, likely that the population also utilises suitable alternative	Section 4.1.6 Section 4.2.6

		habitat immediately adjacent to the Proposal area which is extensive in the northern areas, to the south-east and the west.	
	CBME: **Likely**	As above. The Harris River State Forest surrounding the CBME offers significant habitat of similar quality to that of the CBME. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal disrupt the breeding cycle of an important population	WMDE / Bauxite Transport Corridor: **Moderate Potential**	WMDE: The Proposal has some potential to disrupt the breeding cycle of an important population of the Chuditch particularly in the northern extent where higher densities of the species have been recorded. Female Chuditch in breeding condition or with young have been captured during surveys throughout and surrounding the WMDE. Habitat fragmentation and loss is likely to impact upon breeding and denning opportunity for Chuditch and therefore potential breeding opportunities of the northern WMDE population. However, it is expected that individuals of the population will disperse into the adjoining habitat with the continuation of breeding. This is supported by the placement of ecological linkages as part of the mine planning process and fauna underpasses for long term infrastructure. As discussed above, Worsley includes the establishment of constructed fauna habitats in rehabilitation. The direct purpose of these habitats is to offer potential foraging, refuge and breeding opportunities for native fauna with a focus on Chuditch installed as a method of mitigating the loss of similar features in the native forest.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The CBME is not considered to support a potentially important population of the Chuditch. It is unlikely that the Proposal associated with the CBME will disrupt the breeding cycle of an important population of the Chuditch. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Moderate Potential**	There is moderate potential that the WMDE Proposal will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Chuditch is likely to decline. The fragmentation and loss of habitat is likely to have a short to mid-term impact on the species, however, there is extensive State Forest and habitat of a similar quality immediately surrounding the Proposal area. Progressive rehabilitation and mitigative actions are expected to reduce this impact providing habitat connectivity, potential commuting, foraging and/or breeding habitat. Post-mined rehabilitated agricultural lands to forest-like ecosystems have the potential to increase the area of occupancy of the species.	Section 4.1.6 Section 4.2.6

	CBME: **Unlikely**	It is unlikely that the CBME Proposal will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Chuditch is likely to decline. In addition to the comments above with respect to the WMDE, the Harris River State Forest surrounding the CBME offers significant habitat of similar quality to that of the CBME and rehabilitation is expected over time to provide potential commuting, foraging and/or breeding habitat for Chuditch. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	Invasive species (feral cats and foxes) have contributed to the decline of the Chuditch. Both invasive species have been recorded throughout the WMDE and are established in the surrounding habitat of the WMDE. Feral pig also negatively contribute to habitat degradation, cause native competition and have the potential to transmit disease within local species populations. As feral cat, pig and fox populations are already established, it is unlikely that the Proposal will increase predation of Chuditch by the feral cat or fox or the introduction of new invasive species. Worsley undertakes 1080 baiting in accordance with the BFMP of existing mine operations complying with 1080 baiting protocols.	Section 4.1.6 Section 4.2.6 Additionally, Worsley implements targeted 1080 baiting within existing Worsley operational areas.
	CBME: **Unlikely**	As per above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Disease is not considered a key threatening process to the Chuditch. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (refer to Worsley BFMP **Appendix H** and Section 4.1.6). Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Interfere substantially with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	It is unlikely that the Proposal will interfere substantially with the recovery of the species. The temporary impact has some potential to have a local impact on the Chuditch population. However, retaining areas of remnant habitat, progressive rehabilitation and	Section 4.1.6 Section 4.2.6

		mitigative actions are expected to reduce this impact providing habitat connectivity, potential commuting, foraging and/or breeding habitat. Post-mined rehabilitated agricultural lands to forest-like ecosystems have the potential to increase the area of occupancy of the species.	
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Species – Red-tailed Phascogale *calura*			
EPBC Conservation Status: Vulnerable			
Description: The Red-tailed Phascogale is a small carnivorous/insectivorous Dasyurid marsupial originally found across much of southern Australia. The western population has contracted to less than 1% of its original range and is found in fragmented populations in drier remnant woodlands in the Avon Wheatbelt bioregion but is also known from the Jarrah Forest and extends into the margins of the Mallee and Esperance Plains bioregions. In Western Australia, this species is often associated with the drier Wandoo woodlands with Rock Sheoak (*Allocasuarina huegeliana*) but is known from a wider range of habitats. It will readily utilise hollows in Wandoo as denning and nesting sites but has also been known to inhabit the grass skirts of Balga (*Xanthorrhoea* spp.) and hollows in dead stumps and logs (Short, Hide & Stone 2011). This species was not known from any of the areas surveyed within the WMDE boundaries. During a biodiversity survey of Quindanning Timber Reserve, 13 individuals were captured (Cannella et al. 2018). This represented the first capture of this species on South32 leases since surveys began in 1982. The area in which these individuals were captured were atypical mosaic of Jarrah/Marri creating a relatively open canopy cover with the occasional Wandoo and stands of Western Sheoak. The Red-tailed Phascogale appears to be adapted to small remnants which has allowed it to exist throughout its range (Short & Hide 2012; Short, Hide & Stone 2011). It is thought to be an eruptive species, that is, populations quickly growing during periods of high resource availability. Its occurrence in Quindanning Timber Reserve and its use of an atypical habitat can lead to successful management of this species.			
Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of an important population of a species	WMDE / Bauxite Transport Corridor: **Moderate Potential - locally important population**	The DoE (2019a) states that no overall population size or trend data are available for the species. Population numbers are unknown (there are no published estimates) and reaching a statistically accurate estimate is very difficult as the species exists as many small, scattered subpopulations. The species also demonstrates annual male die-off, so population size fluctuates within and between years (DEC 2007, DoE 2019a). During a biodiversity survey of Quindanning Timber Reserve (QTR) (south eastern extent of the WMDE Proposal area) in 2017 and 2018 undertaken by Biostat (2019),	Section 4.1.6 Section 4.2.6 Avoidance mitigation. Progressive adapted design of rehabilitation specifically targeted to consider the habitat

		13 individual Red-tailed Phascogale were captured. This was the first capture of this species on South32 leases and areas within the WMDE since surveys began in 1982, including a similarly intense survey effort undertaken of the same QTR survey sites in 2002. The Red-tailed Phascogale is thought to be an eruptive species, that is, populations quickly grow during periods of high resource availability. The species is likely to be restricted to the eastern portions of the WMDE in mosaic of jarrah/marri, Wandoo with Western Sheoak, also in Wandoo dominated woodlands with Western Sheoak. In the absence of other recent records, this potentially represents a locally important population of the species. The Red-tailed Phascogale appears to be adapted to small remnants which has allowed it to exist throughout its range (Short & Hide 2012; Short, Hide & Stone 2011). The WMDE overlaps the western portion of the QTR also divided by the Pinjarra Williams Road, however, a larger portion of the Reserve to the east remains external to the Proposal area. Biostat (2019) advise that the area in which these individuals were captured is an atypical mosaic of Jarrah/Marri creating a relatively open canopy cover with the occasional Wandoo and stands of Western Sheoak. Suitable alternative habitat occurs in the adjoining remainder of the QTR where individuals of the population would disperse. The species use of an atypical habitat can lead to successful management of the species. Avoidance mitigation of this atypical habitat within the WMDE and progressive adapted design of rehabilitation specifically targeted to consider the habitat requirements of the Red-tailed Phascogale will reduce the potential for a long-term decrease in the size of a potentially important local population. Friend and Scanlon (1996) found a close correlation between Red-tailed Phascogale numbers in autumn and total rainfall the previous year. They found that during dry years there is a high juvenile mortality and, as females live for a maximum of only three years, several consecutive dry seasons could increase the risk of local extinction (DoE, 2019a) Fire causes high mortality amongst resident Red-tailed Phascogales (Friend & Friend 1993) and populations do not recover for years after fire events (DEC 2007, DoE 2019a).	requirements of the species.

		It is not expected that the Proposal will lead to an increase in fire or modification of the existing fire regime of the area.	
	CBME: **Unlikely**	The CBME is to the west of the modelled distribution of the species (DoE 2019a) and there is limited suitable habitat for the species within the CBME. Therefore, it is very unlikely that the Red-tailed Phascogale would occur in the CBME. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal reduce the area of occupancy of an important population	WMDE / Bauxite Transport Corridor: **Likely**	The area of occupancy of a potentially important local population of Red-tailed Phascogale will likely be reduced (temporary short-medium term) as a result of the Proposal. Species use of an atypical habitat in the local area can lead to successful management of the species and targeted rehabilitation will consider the specific habitat requirements of the species.	Section 4.1.6 Section 4.2.6 Avoidance mitigation. Progressive adapted design of rehabilitation specifically targeted to consider the habitat requirements of the species.
	CBME: **Unlikely**	The species is unlikely to occur in the CBME area. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal fragment an existing important population into two or more populations	WMDE / Bauxite Transport Corridor: **Moderate Potential – locally important population**	The Proposal has the potential to fragment an existing locally important population into two or more populations. Existing arboreal connectivity between the east and west of the QTR has been fragmented by the Pinjarra Williams Road. The WMDE overlaps the western portion of the QTR, however, a larger portion of the Reserve to the east remains external to the Proposal area. The role of avoidance mitigation, establishment of ecological corridors linking suitable habitat and progressive rehabilitation will reduce the potential of long-term fragmentation.	Section 4.1.6 Section 4.2.6 Avoidance mitigation. Progressive adapted rehabilitation design.
	CBME: **Unlikely**	The species is unlikely to occur in the CBME area. Habitat surrounding the operation is relatively contiguous within the Harris River State Forest. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the	WMDE / Bauxite Transport Corridor: **Likely**	The WMDE Proposal will adversely affect habitat critical to the survival of the species. This area of impact is restricted to the QTR area of the Proposal where the local population of the species has been identified.	Section 4.1.6 Section 4.2.6 Avoidance mitigation.

survival of a species			Progressive adapted rehabilitation design.
	CBME: **Unlikely**	The species is unlikely to occur in the CBME area as there is limited suitable habitat. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal disrupt the breeding cycle of an important population	WMDE / Bauxite Transport Corridor: **Unlikely**	In Western Australia, this species is often associated with the drier Wandoo woodlands with Rock Sheoak (*Allocasuarina huegeliana*) but is known from a wider range of habitats. It will readily utilise hollows in wandoo as denning and nesting sites but has also been known to inhabit the grass skirts of Balga (*Xanthorrhoea* spp.) and hollows in dead stumps and logs (Short, Hide & Stone 2011). Although there is potential for the loss of breeding habitat, the Proposal area overlaps a smaller area of the QTR than will remain. This remaining habitat provides representative habitat similar to that within the WMDE. The Proposal is unlikely to disrupt the breeding cycle of an important population.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The species is unlikely to occur in the CBME area as there is limited suitable habitat. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Although the proposal will impact upon and decrease the availability of habitat within the QTR, it is unlikely that this will be to an extent that the species is likely to decline. Individuals of the population would be expected to disperse into the adjoining habitat of the QTR. The retention of ecological corridors and progressive rehabilitation would further reduce this impact.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The species is unlikely to occur in the CBME area as there is limited suitable habitat. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	Invasive species (feral cats and foxes) have contributed to the decline of the Red-tailed Phascogale. Both invasive species have been recorded throughout the WMDE and are established in the surrounding habitat of the WMDE. The QTR area has a network of fire breaks and tracks that contribute towards the movement of invasive species through the QTR. Retaining arboreal connectivity in a network of ecological corridors will be required to reduce the impact on the QTR in this area and reduce further potential for predation pressure. As cat and fox populations are already established, it is unlikely that the Proposal will increase predation of Red-tailed Phascogale by the feral cat or fox or the introduction of new invasive species.	Section 4.1.6 Section 4.2.6

		Worsley undertakes 1080 baiting in accordance with the BFMP of existing mine operations complying with 1080 baiting protocols.	
	CBME: **Unlikely**	The species is unlikely to occur in the CBME area as there is limited suitable habitat. Baiting protocols require the buffering of water bodies and drainage lines reducing the opportunity for deployment of 1080 baits within the Refinery area. However, Worsley currently supports baiting of Worsley managed land external to the Worsley Refinery. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Disease is not a recognised threat to the Red-tailed Phascogale. Worsley will comply with regulatory requirements with respect to the introduction of diseases and implement best practice hygiene management actions which are designed to prevent the introduction of disease to the Proposal area.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Interfere substantially with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	Species recovery objectives for the Red-tailed Phascogale outlined in DoE (2019a) include: - determining suitable management regimes; - retention of current distribution and abundance; and - increase abundance (and range) by reintroduction to suitable large conservation reserves. The population that has been identified in the QTR is on the western extent of the species distribution. There is potential for impact on the distribution locally, however it is unlikely that the Proposal will interfere substantially with the recovery of the species.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Unlikely as the species is unlikely to occur in the CBME area as there is limited suitable habitat to support the species. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6

Species – **Woylie *Bettongia* *penicillata ogilbyi***

Conservation Status: Endangered

Description:
The Woylie is a small native marsupial 1-1.5 kg in weight. Head and body length is 280-360mm and tail length is between 290-360mm. Their fur can be grey to reddish brown and they have strongly clawed fore feet used for digging for food and nest making (Yeatman and Groom, 2012). They rest during the day in a well-concealed nest, built over a shallow depression that is most commonly constructed of long strands, preferably grasses, but also other material such as strips of bark (in the forest) (Yeatman and Groom, 2012). The species was once abundant in the south-west region of Western Australia but has declined dramatically since European settlement. The Woylie distribution is concentrated in the south west of Western Australia however there are also translocated populations reaching as far north as Shark Bay and as far east as the New South Wales and South Australian border. The last four remaining indigenous populations are all in south west Western Australia (Yeatman and Groom, 2012).

The Woylie is a cryptic species that is often difficult to detect effectively. The species is found in a variety of habitats, but long-unburnt tall Eucalyptus species forest and woodland are regarded as one of the key habitats for this species (Yeatman & Groom 2012). It feeds on tubers, bulbs and fungi, often creating rabbit-like diggings in search of its food.

The Woylie is widely distributed in the Jarrah forests but occurs patchily (Biostat, 2019). The Jarrah forest within and outside of the Proposal area offers potential for the species to occur. Woylie were recorded in 2012 during biodiversity surveys of the NBG at the northern extent of the WMDE. There is potential that this population is the remnant of a translocated population where the translocation outcome has not been determined. Evidence supporting this claim can be viewed in the Woylie National Species Recovery Plan (refer to distribution mapping (Figure 2 (Yeatman and Groome, 2012)), however, this has not been confirmed. The location forms an isolated population that may be at '… greater risk from catastrophic events and declining genetic diversity (Pacioni et al. (2010))'.at the northern extent of the WMDE and Bauxite Transport Corridor is considered suitable habitat for this species. Although other areas of habitat are considered suitable for example QTR and MTR, however, the species has not been recorded during extensive recent surveys of the remaining areas of the WMDE.

Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of a population of a species	WMDE / Bauxite Transport Corridor: **Moderate Potential – locally important population**	The Woylie is widely distributed in the Jarrah forests but occurs patchily (Biostat, 2019). The Jarrah forest within and outside of the Proposal area offers potential for the species to occur. Woylie were recorded in 2012 during biodiversity surveys of the NBG at the northern extent of the WMDE. There is potential that this population is the remnant of a translocated population where the translocation outcome has not been determined. Evidence supporting this claim can be viewed in the Woylie National Species Recovery Plan (refer to distribution mapping (Figure 2 (Yeatman and Groome, 2012)), however, this has not been confirmed. The location forms an isolated population that may be at '… greater risk from catastrophic events and declining genetic diversity (Pacioni et al. (2010))'.at the northern extent of the WMDE and Bauxite Transport Corridor is considered suitable habitat for this species. Although	Section 4.1.6 Section 4.2.6

		other areas of habitat are considered suitable for example QTR and MTR, however, the species has not been recorded during extensive recent surveys of the remaining areas of the WMDE. The population within the WMDE is considered locally important. The national Woylie recovery program (Yeatman and Groome, 2012) state that the most important woylie populations in Western Australia are '…the four genetically distinct indigenous populations at Dryandra woodland, Tutanning nature reserve, Perup and Kingston (Pacioni et al. 2010). The population at Karakamia Wildlife Sanctuary is also important as it is the only relatively large mainland population that has not shown evidence of a decline.' Dryandra woodland is the closest of these important populations, located approximately 50 km to the east of the WMDE and Bauxite Transport Corridor. The Proposal has potential to impact upon a population of the species that is not deemed an important population under the Woylie National Species Recovery Plan, however, has potential to cause a long-term decrease in the size of a locally important population. The retention of ecological corridors, proposed fauna underpasses and progressive rehabilitation would further reduce this impact.	
	CBME: **Unlikely**	Woylie have not been identified during biodiversity surveys of the CBME Proposal area neither during surveys of the Worsley Refinery and surrounds. the Proposal. There is habitat suitable for the species within the CBME and records in proximity to the Proposal area. Important populations highlighted by Yeatman and Groome (2012) are located approximately 100km to the south-east and to the north-east. Although habitat is suitable for the species, there is significant representative habitat surrounding the CBME in the Harris River State Forest, therefore, it is considered unlikely that the Proposal will cause a long-term decrease in the size of a population of the Woylie. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal reduce the area of occupancy of the species	WMDE / Bauxite Transport Corridor: **Likely - locally important population**	Individuals of the local population in the northern extent of the WMDE and Bauxite Transport Corridor are expected to move into the surrounding forest areas to the west of the Proposal area where the species has been recorded. Clearing associated with the Proposal will reduce the area of occupancy of the locally important population however, not a nationally recognised important population. Progressive rehabilitation is expected in the mid-long term to support the species and providing landscape connectivity.	Section 4.1.6 Section 4.2.6 Retention of ecological corridors during mine operations.

	CBME: **Unlikely**	The CBME Proposal area is not deemed an important population under the Yeatman and Groome (2012) National Species Recovery Program. The species has not been recorded in any biodiversity surveys of the CBME and adjacent habitat immediately surrounding the Proposal area, however, there is potential for the species to occur. It is unlikely that the Proposal will reduce the area of occupancy of a Nationally important population of the Woylie, however, may reduce the area of the species locally within the Harris River State Forest. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal fragment an existing population into two or more populations	WMDE / Bauxite Transport Corridor: **Likely - locally important population**	The population identified within the northern section of the Proposal area is located approximately 50 km from the nearest important population at Dryandra Reserve recognised under the National Species Recovery Plan for the Woylie (Yeatman and Groome, 2012). The Bauxite Transport Corridor of the Proposal is likely to fragment an existing population into two or more populations. Mitigation measures to reduce the impact on the population, for example progressive rehabilitation, retention of ecological corridors and designed fauna crossings of the transport corridor will aid in reducing this impact. Existing conveyors, long-term infrastructure and mine operations (including associated noise) associated with ongoing operations of the BBM and Refinery have the potential to fragment existing populations of the species.	Section 4.1.6 Section 4.2.6 Retention of ecological corridors. Fauna underpasses designed for mid and long-term infrastructure Feral management in accordance with the BFMP.
	CBME: **Unlikely**	The adjoining Harris River State Forest surrounding the Proposal area offers significant comparable habitat to that within the CBME. It is considered unlikely that the proposal will fragment an existing locally important population into two or more populations. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: **Likely**	WMDE: Although habitat suitable for the woylie varies across its current range, Yeatman and Groome (2012) state that '…a number of key habitat requirements appear to be essential for the persistence of the species within this range. Woylies may persist in the following habitats where there is adequate introduced predator (fox and cat) control or exclusion: - tall Eucalypt forest and woodland; - dense myrtaceous shrubland; and, - Kwongan (proteaceous) or Mallee heath. All habitat meeting these key requirements within the current range, which is either known to be occupied by woylies or to have the identified potential to be occupied by woylies, is considered habitat critical to the survival of the species (Pacioni et al.,	Section 4.1.6 Section 4.2.6 Retention of ecological corridors. Feral management in accordance with the BFMP.

		2010); Yeatman and Groome, 2012).' Clearing within the State Forest of the northern section of the WMDE and the Bauxite Transport Corridor is likely to adversely affect habitat critical to the survival of the species.	
	CBME: **Possible**	Although not recorded during historical biodiversity surveys of the area, there are records in proximity to the CBME. Suitable habitat and moderate to high potential for the Woylie to occur. Clearing for the CBME has moderate to high potential to adversely affect habitat critical to the survival of the species. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6 Feral management in accordance with the BFMP.
Will the proposal disrupt the breeding cycle of a population	WMDE / Bauxite Transport Corridor: **Unlikely**	Woylies can breed continuously throughout the year (Sampson 1971, Yeatman and Groome, 2012). It is expected that individuals in the northern extent of the WMDE Proposal area will utilise habitat within the Dwellingup State forest to the east where individuals of the population have been recorded. It is unlikely that there will be disruption to the breeding cycle of the population.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As above. Significant comparable habitat in the Harris River State Forest surrounds the Proposal area. It is unlikely that the Proposal associated with the CBME will disrupt the breeding cycle of a potentially occurring population of the Woylie. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	There is potential for the Proposal to isolate and decrease the quality and extent of habitat suitable for Woylie in the northern extent of the WMDE and Bauxite Transport Corridor. The Bauxite Transport Corridor has potential to isolate areas of suitable habitat. However, the Proposal area is not known to support a large population of Woylie and it is unlikely that the impact will be to an extent that it will cause the species to decline. Progressive rehabilitation, connective ecological corridors, maintaining ecological values of the adjoining State Forest habitat and minimising the Proposal footprint will reduce the likelihood of species decline.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Significant comparable habitat in the Harris River State Forest surrounds the Proposal area. It is unlikely that the Proposal associated with the CBME will decrease the availability and quality of habitat to the extent that the species is likely to decline. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal Result in invasive species that are harmful to an	WMDE / Bauxite Transport Corridor: **Unlikely**	Invasive species (feral cats and foxes) have contributed to the decline of the Woylie. Both invasive species have been recorded throughout the WMDE and are established in the surrounding habitat of the Proposal area. Feral pig is also listed as a threatening process to the Woylie as they negatively contribute to habitat degradation, cause	Section 4.1.6 Section 4.2.6

endangered species becoming established in the endangered species' habitat		native competition, increase predation pressure and have the potential to transmit disease within native species populations. As feral cat, pig and fox populations are already established, it is unlikely that the Proposal will increase predation of Woylie by these species or the introduction of new invasive species. The National Species Recovery Program (Yeatman and Groome, 2012) highlights the success of fox baiting and the Western Shield program stating that '…a number of woylie populations demonstrated a spectacularly positive response after the implementation of fox control under the Western Shield Program (Orell 2004; Yeatman and Groome, 2012). Worsley undertakes 1080 baiting in accordance with the BFMP of existing mine operations complying with 1080 baiting protocols.	Feral management in accordance with the BFMP.
	CBME: **Unlikely**	In addition to the above, baiting protocols require the buffering of water bodies and drainage lines reducing the opportunity for deployment of 1080 baits within the Refinery area. However, Worsley supports aerial baiting of Worsley managed land external to the Worsley Refinery. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Disease has been implicated as a possible agent in recent decline of the Woylie including viral, bacterial, haemaparasitic, endoparasitic, ectoparasitic and nutritional disease. 'Monitoring of populations in the Upper Warren region has shown that poor health of woylies may be associated with the decline of the species' (Pacioni et al., 2010). Discussed above, feral pigs have the potential to act as vectors of disease transmission in native species populations. Vegetation change caused by the root pathogen *Phytophthora cinnamomi* also has the potential to threaten the persistence of woylie populations. Dense vegetation provides woylies with shelter from predators and changes in the structure of natural habitats can increase predation risks. *Phytophthora* infection also has a negative impact on fungal community structure and biodiversity (Anderson et al. 2010, Yeatman and Groome, 2012) potentially impacting directly on the availability of food resources for the woylie. (Pacioni et al. (2010)). Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (refer to Worsley BFMP **Appendix H** and Section 4.1.6). Dieback status is mapped prior to any vegetation clearing and ground disturbance	Section 4.1.6 Section 4.2.6

		activities. Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas.	
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Interfere with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Woylie has been recorded utilising habitat in the northern extent of the WMDE Proposal. This location is in proximity to the operating NBG with monitoring suggesting that the population continues to persist. The proposal is unlikely to interfere with the Yeatman and Groome (2012) National Species Recovery Plan and the recovery of the species.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6

Species – Western Ringtail Possum *Pseudocheirus occidentalis*			
EPBC Conservation Status: Critically Endangered			
Description: The Western Ringtail Possum is a small nocturnal (0.8 to 1.3kg) arboreal marsupial characterised by a slender prehensile tail (up to 40cm long) with a white tip. It is usually dark brown (though sometimes dark grey) above, with cream or grey fur on the belly, chest and throat (DPW, 2017). It differs from the more frequently seen Common Brushtail Possum by being smaller in size and an exclusive herbivore, whereas brushtail possums will eat small mammals. The Western Ringtail Possum is common in long unburnt remnant of Peppermint (*Agonis flexuosa*) and Tuart (*Eucalyptus gomphocephala*) woodlands on the coastal plains of the south-west of Western Australia. It has also been recorded in jarrah/marri forests and woodlands, coastal heath, Bullich (*Eucalyptus megacarpa*) dominated riparian zones and Karri Forests. The drier forest areas of the eastern section of the Northern Jarrah Forest bioregion is not considered as typical habitat for this species. One juvenile was recorded from the BGM/Boddington area in 1998. This species has not been recorded in any of the surveys undertaken within the WMDE and Bauxite Transport Corridor since 1982. It is known from the Overland Bauxite Conveyor corridor but from areas closer to Worsley Alumina Refinery near Collie. There are no records of the Western Ringtail Possum from the survey carried out in CBME in 2000-2001. There is one record of an individual within the Refinery Lease boundary. The most recent records for this species are from 2018 in the Wellington National Park approximately 10km to the south-west of the CBME.			
Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of a population of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The WMDE and Bauxite Transport Corridor is located in the dryer eastern areas of the Northern Jarrah Forest bioregion which is not considered typical habitat for this species. The Proposal area is located outside of the key management zones and distribution of the species (refer to Figure 2 of Department of Parks and Wildlife (2017)). A single juvenile was recorded from the NBG/Boddington area in 1998 (Biostat, 2019), however the species or evidence of the species has not been recorded in any of the extensive surveys of the WMDE.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	There are no records of the Western Ringtail Possum from the survey carried out in CBME in 2000-2001 and from minor assessments and surveys targeting Western Ringtail Possum have historically been conducted within the Refinery Lease. There is one record of an individual within the Refinery Lease boundary (Biostat, 2019). Western Ringtail Possum are more likely to utilise the more mesic woodland and forest areas within and adjacent to the CBME. Specifically, the most suitable habitat type is found in low lying areas less likely to contain bauxite. The most likely habitat to be utilised by this species is the Blackbutt habitats (BB) surrounding the Freshwater Lake within the CBME. Habitat suitable for the species is well represented locally adjacent to the CBME and Harris River State Forest.	Section 4.1.6 Section 4.2.6

		In addition, the CBME will only be impacted in the event the emergency bauxite supply is required. It is unlikely that the Proposal will lead to a long-term decrease in the size of a population of the species.	
Will the proposal reduce the area of occupancy of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, it is unlikely that a population persists within the WMDE.	Section 4.1.6 Section 4.2.6
	CBME: **Possible**	There are limited records within the Worsley Refinery Lease to determine the importance of the population. The Harris River State Forest provides a significant area of habitat comparable in quality and suitability for Western Ringtail Possum with that of the CBME. The CBME will only be impacted in the event the emergency bauxite supply is required, whereby the area of occupancy of the species will potentially be reduced.	Section 4.1.6 Section 4.2.6
Will the proposal fragment an existing population into two or more populations	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Although limited, there are records of Western Ringtail Possum within the Worsley Refinery Lease and therefore a population is present. The Harris River State Forest surrounding the Proposal area provides a significant area of habitat comparable in quality and suitability for Western Ringtail Possum. It is unlikely that the Proposal will fragment an existing important population into two or more populations. The CBME will only be impacted in the event the emergency bauxite supply is required. Existing conveyors and long-term infrastructure (including associated noise) associated with the ongoing operations of the Worsley Refinery have the potential to fragment existing populations of the species.	Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Habitat critical to survival for western ringtail possums is not well understood, and based on occurrence records, appears to vary between key management zones (Department of Parks and Wildlife, 2017). The CBME is most closely associated by geography with the Swan Coastal Management zone however, CBME is more closely represented by habitats of the Southern Forest Management Zone. Habitat critical to survival comprises forests with limited anthropogenic disturbance (unlogged or lightly logged, and a low intensity and low frequency fire history), that are intensively fox-baited and have low indices of fragmentation (Wayne et al. 2005, Wayne et al. 2006, Department of Parks and Wildlife, 2017). The proposal area will adversely affect	Section 4.1.6 Section 4.2.6

		habitat of this quality, however further evidence is required to determine the status of Western Ring-Tail Possum within the CBME. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal disrupt the breeding cycle of a population	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The Western Ringtail Possum Recovery Plan (Department of Parks and Wildlife, 2017) suggests that breeding occurs throughout the year in some coastal populations and with seasonal peaks in May and June and October and November in inland jarrah forest areas (i.e. near Manjimup). Reproductive output is apparently related to habitat quality (Department of Parks and Wildlife, 2017). Areas of habitat with low foliage nitrogen content tend to result in lower numbers of births. Peppermint woodlands have higher foliage nitrogen content relative to jarrah forest habitats, which may be why lower numbers of births are observed in the jarrah forest (Jones et al. 1994; Department of Parks and Wildlife, 2017). This would likely influence density of the species in this habitat type. It is expected that any individuals in the Proposal area will disperse into adjoining and surrounding comparable habitat of the Harris River State Forest. It is unlikely that the Proposal will cause the disruption of the breeding cycle of a population within the Proposal area. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The Harris River State Forest and extensive habitat surrounding the Proposal area provides a significant area of comparable habitat for the species. Records for the species within the Proposal area and adjoining habitat are low suggesting a low population density restricted to specific areas of the Proposal area that are unlikely to be impacted by the Proposal. The CBME will only be impacted in the event the emergency bauxite supply is required. Therefore, it is unlikely that the impact on habitat associated with the Proposal would be to an extent that the Western Ring-tail Possum would be likely to decline. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6

Will the proposal Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor. Worsley undertakes 1080 baiting of the existing mine operations in accordance with the BFMP, complying with 1080 baiting protocols.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Invasive species (feral cats, dogs and foxes) have contributed to the decline of the Western Ringtail Possum. The Western Ringtail Possum Recovery Plan (Department of Parks and Wildlife, 2017) states that both the fox and feral cat are known major predators, exacerbated by the predator naivety they display. These predators have been implicated in the disappearance of natural and translocated populations and they are likely to be responsible for the lack of translocation success. Both invasive species have been recorded and are established in the surrounding habitat of the Proposal area. As cat and fox populations are already established, it is unlikely that the Proposal will increase predation of Western Ringtail Possum by the feral cat or fox or the introduction of new invasive species. Worsley supports 1080 baiting of Worsley managed land external to the Worsley Refinery Baiting protocols require the buffering of water bodies and drainage lines reducing the opportunity for deployment of 1080 baits directly within the Worsley Refinery and Proposal area. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (refer to Worsley BFMP **Appendix H** and Section 4.1.6). Dieback status is mapped prior to any vegetation clearing and ground disturbance activities. Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The Western Ringtail Possum Recovery Plan (Department of Parks and Wildlife, 2017) states that the species can be at a greater risk of disease due to human disturbance and through the exposure to exotic species and pathogens. Cat predation toxoplasmosis transmission and physiological diseases resulting from environmental stresses are also highlighted as potential disease risks to the species. Vegetation change caused by the root pathogen *Phytophthora cinnamomi* also has the potential to threaten the persistence of Western Ringtail Possum populations.	Section 4.1.6 Section 4.2.6

		Dense vegetation provides the species with shelter from predators and changes in the structure of natural habitats can increase predation risks. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (refer to Worsley BFMP **Appendix H** and Section 4.1.6). Dieback status is mapped prior to any vegetation clearing and ground disturbance activities. Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal Interfere with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The recovery plan for the Western Ringtail Possum (Department of Parks and Wildlife, 2017) includes: - slowing the decline in population size, extent and area of occupancy through managing major threatening processes in the key management zones - improve conservation status leading to a reduction in threat status - to ensure that threatening processes do not compromise the ongoing viability of the Western Ringtail Possum population. Bauxite mining in the Jarrah Forest is a recognised threat to the species. The CBME will only be impacted in the event the emergency bauxite supply is required. Due to the low potential for impact on the species as a result of the Proposal and the existence of significant comparable habitat surrounding and adjoining the CBME, it is considered unlikely that the Proposal will interfere with the recovery of the species.	Section 4.1.6 Section 4.2.6

Species – Quokka *Setonix brachyurus*			
EPBC Conservation Status: Vulnerable			
Description: The Quokka is a small wallaby with thick, coarse, grey-brown fur with lighter underparts. Its snout is naked and its ears are short. Its short tail (25.8–31 cm long) tapers towards the end and is close-haired. The quokka was once very common in the south-west of Western Australia until the arrival of European settlers. A combination of habitat clearing, hunting and the introduction of predators and stock have decimated its populations on the mainland. The Quokka is confirmed from ten locations, in which there are seven distinct sub-populations. These seven sub-populations are: Rottnest island, Bald Island, Northern Jarrah Forests, Central Jarrah Forests, Southern Jarrah-Karri Forests, South Coast and Stirling Range. All populations are considered important for the long-term survival of the species. The distribution of this species is severely fragmented and there is little to no migration between populations. Area of occupancy has been estimated at between 5700 km² and 11 800 km².			
Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of an important population of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Department of Environment and Conservation (2013) Species Recovery Program highlights several sub-populations of Quokka including the Northern Jarrah Forest sub-population. This broad sub-population geographic area overlaps the WMDE and Bauxite Transport Corridor. However, the eastern extent of the sub-population experiences a significant difference in climate, is heavily fragmented from agricultural land-use and there is limited suitable habitat for the species recorded locally. This is also evident in the distribution mapping of Department of the Environment (2019). All records for Quokka obtained for the Proposal area database search are from the more mesic Jarrah forest areas along the western Darling Range (Biostat, 2019). The species has not been recorded during extensive biological surveys of the WMDE and Bauxite Transport Corridor. In addition to desktop review, Biostat (2019) conclude that following extensive field habitat assessment and survey, the species is unlikely to occur within the Proposal area comprised of the WMDE and Bauxite Transport Corridor.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Quokka are a cryptic species and difficult to survey (Bain et al., 2014; Biostat, 2019). They have not been recorded within the CBME, however they have been identified within the Refinery Lease Area and road-kill individuals have been recorded along Gastaldo Road, the main access into Worsley Alumina Refinery within 5 km from the Proposal area. Quokka are more likely to utilise the more mesic woodland and forest areas within and adjacent to the CBME (Biostat, 2019). Specifically, the most suitable	Section 4.1.6 Section 4.2.6

		habitat type is found in low lying areas less likely to contain bauxite, for example the densely vegetated understorey BB habitats surrounding the Freshwater Lake within the CBME. These low-lying areas in close proximity to drainage and freshwater reservoirs are unlikely to support bauxite resource. Habitat suitable for the species is well represented locally, adjacent to the CBME and Harris River State Forest. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal reduce the area of occupancy of an important population	WMDE / Bauxite Transport Corridor: **Unlikely**	Database review and extensive survey within the WMDE suggest Quokka are unlikely to occur within the Proposal area.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The CBME will only be impacted in the event the emergency bauxite supply is required. Occupancy is expected in the more mesic and low-lying areas of the Proposal area which is unlikely contain bauxite. This reduces the potential of impact on the core habitat of any individuals or population and area of occupation of the species.	Section 4.1.6 Section 4.2.6
Will the proposal fragment an existing important population into two or more populations	WMDE / Bauxite Transport Corridor: **Unlikely**	Quokka are unlikely to occur within the Proposal area therefore the Proposal is unlikely to fragment a population into two or more populations.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	There are limited records within the Worsley Refinery Lease to determine the importance of the population. The Harris River State Forest surrounding the Proposal area provides a significant area of habitat comparable in quality and suitability for Quokka. It is unlikely that the Proposal will fragment an existing important population into two or more populations The CBME will only be impacted in the event the emergency bauxite supply is required. Existing conveyors, BRDAs and long-term infrastructure (including associated noise) associated with the ongoing operations of the Worsley Refinery have the potential to fragment existing populations of the species.	Section 4.1.6 Section 4.2.6
Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	Quokka are unlikely to occur within the Proposal area therefore it is unlikely that the Proposal will adversely affect habitat critical to the survival of the Quokka.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The Department of Environment and Conservation (2013) Species Recovery Program states that Quokkas occur in a variety of habitats. The Proposal area is located within the Central Jarrah sub-population. Although the Species Recovery Program highlights habitat critical to the survival of the species in the majority of sub-populations, this information is not available for the Central Jarrah sub-population.	Section 4.1.6 Section 4.2.6

		Habitat critical to survival in the Northern Jarrah Forest includes areas of natural vegetation where the understorey is sufficiently thick and complex to provide a predation refuge close to more open, recently burnt vegetation which is used as a food source. Habitat changes seasonally, in wetter months after wetlands become inundated the quokkas core home range shifts toward the periphery of the swamp, leaving the quokka more exposed to predation (Hayward *et al*. 2004). When this habitat is altered, and in the presence of feral predators, the carrying capacity of a site may also be reduced (Kinnear *et al.* 2002). Habitat considered most suitable for Quokka in the CBME is located in low lying areas less likely to contain bauxite, for example the densely vegetated understorey blackbutt habitats (BB) surrounding the Freshwater Lake. These low-lying areas in close proximity to drainage and freshwater reservoirs are unlikely to support bauxite resource. Habitat suitable for the species is well represented locally, adjacent to the CBME and Harris River State Forest. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal disrupt the breeding cycle of an important population	WMDE / Bauxite Transport Corridor: **Unlikely**	Quokka are unlikely to occur within the Proposal area therefore it is unlikely that the Proposal will disrupt the breeding cycle of individuals or populations of the Quokka	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The Department of Environment and Conservation (2013) Quokka Species Recovery Program states that female Quokka are polyoestrous and capable of breeding throughout the year. Quokkas undergo embryonic diapause, whereby, if the first pouch young dies, the second embryo will resume development and be born 24 to 27 days later. Habitat considered most suitable for Quokka in the CBME is located in low lying areas less likely to contain bauxite, for example the densely vegetated understorey BB habitats surrounding the Freshwater Lake. These low-lying areas in close proximity to drainage and freshwater reservoirs are unlikely to support bauxite resource. Habitat suitable for the species is well represented locally, adjacent to the CBME and Harris River State Forest. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the	WMDE / Bauxite Transport Corridor: **Unlikely**	Quokka are unlikely to occur within the Proposal area therefore it is unlikely that the Proposal will disrupt the breeding cycle of individuals or populations of the Quokka	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Habitat considered most suitable for Quokka in the CBME is located in low lying areas less likely to contain bauxite, for example the densely vegetated understorey BB habitats surrounding the Freshwater Lake. These low-lying areas in close proximity to drainage and freshwater reservoirs are unlikely to support bauxite resource.	Section 4.1.6 Section 4.2.6

species is likely to decline		Habitat suitable for the species is well represented locally, adjacent to the CBME and Harris River State Forest. It is unlikely that the Proposal will impact the availability or quality of habitat to the extent that the species is likely to decline. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	Quokka are unlikely to occur within the Proposal area therefore it is unlikely that the Proposal will disrupt the breeding cycle of individuals or populations of the Quokka. Worsley undertakes 1080 baiting of the existing mine operations in accordance with the BFMP, complying with 1080 baiting protocols.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Invasive species (feral cats and foxes) have contributed to the decline of the Quokka. Both invasive species have been recorded within and surrounding the CBME and are established in the surrounding habitat of the Proposal area. Feral pig is also listed as a threatening process to the Quokka as they negatively contribute to habitat degradation, create pathways which facilitate access for other feral animals i.e. foxes and have the potential to transmit disease within native species populations. The effect of feral pigs on quokka abundance and distribution has not been quantified. As feral cat, pig and fox populations are already established, it is unlikely that the Proposal will increase the pressures on a local population of Quokka by these species or the introduction of new invasive species. Worsley undertakes 1080 baiting in accordance with the BFMP of existing mine operations complying with 1080 baiting protocols. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	As discussed above, following extensive fauna surveys of the WMDE, it is unlikely that a population persists within the WMDE and Bauxite Transport Corridor. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (refer to Worsley BFMP **Appendix H** and Section 4.1.6). Dieback status is mapped prior to any vegetation clearing and ground disturbance activities. Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	Disease has not been demonstrated as an important factor in the decline of the Quokka, however, it has been implicated as responsible for deaths of individuals (de Tores et al. 2007).	Section 4.1.6 Section 4.2.6

		Vegetation change caused by the root pathogen *Phytophthora cinnamomi* also has the potential to threaten the persistence of Quokka populations. Dense vegetation provides the species with shelter from predators and changes in the structure of natural habitats can increase predation risks. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (*Phytophthora* and *Armillaria*). Dieback and *Armillaria* status is mapped prior to any vegetation clearing and ground disturbance activities. Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal Interfere substantially with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	Quokka are unlikely to occur within the Proposal area therefore it is unlikely that the Proposal will interfere with the recovery of the species.	Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	The Department of Environment and Conservation (2013) Species Recovery Program states that the overall long-term objective of the recovery program is to at least maintain the current distribution and abundance of the Quokka. Habitat considered most suitable for Quokka in the CBME is located in low lying areas less likely to contain bauxite, for example the densely vegetated understorey blackbutt habitats (BB) surrounding the Freshwater Lake. These low-lying areas in close proximity to drainage and freshwater reservoirs are unlikely to support bauxite resource. Habitat suitable for the species is well represented locally, adjacent to the CBME, within the Harris River State Forest. It is unlikely that the Proposal will interfere substantially with the recovery of the species and the recovery plan objectives of the Species Recovery Plan. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.1.6 Section 4.2.6

Species – Carter's Freshwater Mussel *Westralunio carteri*

EPBC Conservation Status: Vulnerable

Description:
Carter's Freshwater Mussel is an elongate-shelled bivalve mollusc that can grow to 100 mm long, but rarely exceeds 90 mm. This species is endemic to southwestern Australia where its current distribution is patchy and extends from around Gingin south to Waychinicup. Formerly its distribution extended into the interior of the south-west, but now it rarely occurs more than 50 km inland. It inhabits freshwater lakes, river systems, and other waterways having favourable sandy or muddy sediments and often associated with woody debris (Klunzinger et.al 2012). New-born mussel larvae are less than 0.5 mm in length and have larval "teeth" used for temporary attaching to host fish gills. This is an important mechanism in the lifecycle that enables the mussel larvae to disperse upstream. After several weeks the juvenile mussels detach from the host fish and settle into creek bed sediment or other suitable river bed substrate where they begin filter-feeding and growing (Klunzinger et.al 2012). Mussels burrow into substrate and can move short distances using a muscular foot that is extended from the shell. They can also disperse downstream via water flow. This species can aestivate by burrowing deep into river beds during natural seasonal cycles when rivers dry. The lifespan is potentially in excess of 50 years.

The decline of Carter's Freshwater Mussel in the southwest region has been due to increased salinity within the river systems (Klunzinger et.al 2015). Major river system that have been severely impacted by salinity, and as a result species distribution and number include: Moore, Avon, Blackwood, Murray, Williams, Upper Warren, Upper Kent, Frankland, Bow and Lower Canning Rivers. Widespread increase in river salinity in the southwest has resulted in a 50 percent reduction in this species' range (Klunzinger et.al 2015).

There are few recent records of Carters' Freshwater Mussel of local or regional significance to the Proposal area. Most of the records in the vicinity of the Proposal area range from 1905 to 1971. There are several recent records from the vicinity of the CBME including: Augustus River recorded in 2017 approximately 4 km east north east of the CBME; 8.5 km west of the CBME in 2010, and records from the Collie River and Wellington Dam catchment area approximately 10 km south of the CBME in 2009 to 2011. Hale et.al (1999) recorded the species at two locations within the Worsley Refinery artificial freshwater lake during water quality monitoring. A further record from the Augustus River is documented for a location approximately 1 km northwest of the CBME during a 2004 survey (WRM 2005).

Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of an important population of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Proposal area is located near the eastern limit of the species current range. Due to salinity, river systems to the eastern former range of the species (former habitat) are no longer considered suitable habitat for this species (GHD, 2019). River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow within and downstream of the Proposal area, therefore the action is unlikely to lead to long term decrease in the size of an important population' (GHD, 2019).	Section 4.2.6 Section 4.3.6 Section 4.4.6

	CBME: **Unlikely**	Carter's Freshwater Mussel *Westralunio carteri* was recorded during the WRM (2005) aquatic fauna surveys of the Augustus River downstream of the Augustus River and Hale et al (1999) surveys of the Augustus River and Freshwater Lake of the Worsley Refinery. The stream flow of the Augustus River has historically been modified by retention of water in the Freshwater Lake. River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow for the Proposal area, therefore the action is unlikely to lead to long term decrease in the size of an important population' (GHD, 2019). The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6
Will the proposal reduce the area of occupancy of an important population	WMDE / Bauxite Transport Corridor: **Unlikely**	The species has not been recorded in the most recent surveys of the Hotham River and tributaries within and adjacent to the Proposal area. The former range of this species included extensive major river systems east of the Proposal area prior to increases in salinity within these river systems. The Proposal area is located near the eastern limit of the species current range. It is unlikely that the Proposal will reduce the area of occupancy of an important population (GHD, 2019). River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow within and downstream of the Proposal area.	Section 4.2.6 Section 4.3.6 Section 4.4.6
	CBME: **Unlikely**	The species is known to occur within the Augustus River in proximity and downstream of the Proposal area. It has also been recorded in the Freshwater Lake associated with the Worsley Refinery. The stream flow of the Augustus River has historically been modified by retention of water in the Freshwater Lake. The area of occupancy has declined by 49% of its estimated former range largely due to salinity. Whilst salinity is not normally associated with bauxite mining activities, other threatening processes potentially resulting from the action, for example sedimentation and water extraction causing altered flow rates could potentially impact on the species (GHD, 2019). River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in	Section 4.2.6 Section 4.3.6 Section 4.4.6

		place that avoid water contamination, sedimentation and altered stream flow of the Augustus River and the Freshwater Lake. It is considered unlikely that the Proposal will reduce the area of occupancy of an important population of the species. The CBME will only be impacted in the event the emergency bauxite supply is required.	
Will the proposal fragment an existing important population into two or more populations	WMDE / Bauxite Transport Corridor: **Unlikely**	The former range of this species included extensive major river systems east of the Proposal area prior to increases in salinity within these river systems. The Proposal area is located near the eastern limit of the species current range. Therefore, the Proposal area does not intersect two or more populations, and for this reason, the Proposal is unlikely to fragment an existing important population (GHD, 2019).	Section 4.2.6 Section 4.3.6 Section 4.4.6
	CBME: **Unlikely**	As above, additionally the Proposal area is in the upper catchment of the Augustus River and Freshwater Lake, whereby the Proposal area is unlikely to intersect two or more populations. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6
Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: **Unlikely**	The species has not been recorded in the most recent surveys of the Hotham River and tributaries within and adjacent to the Proposal area. The former range of this species included extensive major river systems east of the Proposal area prior to increases in salinity within these river systems (GHD, 2019). Salinity has adversely affected habitat critical to the survival of the species and it is unlikely that the Proposal will further adversely affect habitat critical to the survival of the species (GHD, 2019). River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow within and downstream of the Proposal area.	Section 4.2.6 Section 4.3.6 Section 4.4.6
	CBME: **Unlikely**	The species is known to occur within the Augustus River in proximity and downstream of the Proposal Area where critical habitat for the species occurs. River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow of the Augustus River and the Freshwater Lake, therefore the Proposal is unlikely to adversely affect habitat critical to the survival of the species' (GHD, 2019). The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6

Will the proposal disrupt the breeding cycle of an important population	WMDE / Bauxite Transport Corridor: **Unlikely**	The species has not been recorded in the most recent surveys of the Hotham River and tributaries within and adjacent to the Proposal area. The former range of this species included extensive major river systems east of the Proposal area prior to increases in salinity within these river systems (GHD, 2019). Salinity has adversely affected habitat critical to the survival of the species and it is unlikely that the Proposal will lead to the disruption of the breeding cycle of an important population. River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow within and downstream of the Proposal area.	Section 4.2.6 Section 4.3.6 Section 4.4.6
	CBME: **Unlikely**	The species is known to occur within the Augustus River in proximity to and downstream of the Proposal Area. While there is an abundance of other river systems in the southwest region, the occurrence of this species within the Augustus River system represent local habitat in which the species breeds and contributes to recruitment and maintained survival of the population (GHD, 2019). River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow of the Augustus River and the Freshwater Lake. It is unlikely that the Proposal will lead to the disruption of the breeding cycle of an important population of Carter's Freshwater Mussel. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	The species has not been recorded in the most recent surveys of the Hotham River and tributaries within and adjacent to the Proposal area. The former range of this species included extensive major river systems east of the Proposal area prior to increases in salinity within these river systems (GHD, 2019). Salinity has adversely affected habitat critical to the survival of the species and it is unlikely that the Proposal will lead to modification, destruction, removal or isolation or decrease the availability or quality of habitat to the extent that the species is likely to decline. River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow for the Proposal area.	Section 4.2.6 Section 4.3.6 Section 4.4.6

	CBME: **Unlikely**	The occurrence of the species within the Augustus River downstream of the CBME indicates this riparian habitat is of suitable quality for the continued existence of the species in the local area. Drainage impacts are not expected. River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow of the Augustus River and the Freshwater Lake. It is unlikely that the Proposal will lead to modification, destruction, removal or isolation or decrease the availability or quality of habitat to the extent that the species is likely to decline' (GHD, 2019). The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6
Will the proposal Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	The feral pig and cattle are listed as a present and future threat to the species contributing to habitat degradation (TSSC 2018). Feral pigs currently occur through the southwest forests, have been recorded throughout the Proposal area and are established in the surrounding habitat of the Proposal. Measures to control pig numbers and exclude cattle from waterways would be a positive outcome for this vulnerable species (GHD, 2019). Feral freshwater fish species are established in the region and four of these species have been confirmed as host fish for Carter's Freshwater Mussel (Krunzinger et.al 2012), aiding the mussel's reproductive cycle and juvenile's dispersal. It is unlikely that the Proposal will increase or facilitate the introduction of invasive species harmful to the Carter's Freshwater Mussel (GHD, 2019).	Section 4.2.6 Section 4.3.6 Section 4.4.6
	CBME: **Unlikely**	As above. Additionally, the CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	The species has not been recorded in the most recent surveys of the Hotham River and tributaries within and adjacent to the Proposal area. The former range of this species included extensive major river systems east of the Proposal area prior to increases in salinity within these river systems (GHD, 2019). Dieback (*Phytophthora cinnamomic)* is an established forest pathogen within the southwest and is a potential indirect threat that has the potential to reduce riparian habitat quality and availability (GHD, 2019). Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease	Section 4.2.6 Section 4.3.6 Section 4.4.6

		including forest disease (refer to BFMP **Appendix H**). Dieback status is mapped prior to any vegetation clearing and ground disturbance activities. Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas. The Proposal is unlikely to increase the current level of threat or introduce disease that may cause the species to decline (GHD, 2019).	
	CBME: **Unlikely**	As above. The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6
Will the proposal Interfere substantially with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	The species has not been recorded in the most recent surveys of the Hotham River and tributaries within and adjacent to the Proposal area. The former range of this species included extensive major river systems east of the Proposal area prior to increases in salinity within these river systems (GHD, 2019). A recovery plan has not been documented for this species. Conservation advice issued by TSSC (2018) provides sufficient direction and management actions that are relevant to the action. Although the species is unlikely to occur within the Proposal area, river, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow within and downstream of the Proposal area.	Section 4.2.6 Section 4.3.6 Section 4.4.6
	CBME: **Unlikely**	A recovery plan has not been documented for this species. Conservation advice issued by TSSC (2018) provides sufficient direction and management actions that are relevant to the action. Recovery is dependent on avoiding salinity and habitat loss by maintaining freshwater flow and groundwater discharge, avoiding clearing and damage to riparian vegetation and river systems, and pollutant and sediment runoff and contamination into waterway habitat. River, drainage and riparian habitat buffers will be managed under the Worsley Protected Areas Procedure (Worsley 2013b) and '…mitigative measures will be in place that avoid water contamination, sedimentation and altered stream flow of the Augustus River and the Freshwater Lake. It is unlikely that the Proposal will substantially interfere with the recovery of the species' (GHD, 2019). The CBME will only be impacted in the event the emergency bauxite supply is required.	Section 4.2.6 Section 4.3.6 Section 4.4.6

Flora Impact Table			
Species – *Caladenia hopperiana*			
EPBC Conservation Status: Endangered			
Description: *Caladenia hopperiana* (formerly known as *Caladenia* sp. Quindanning) is an erect orchid species growing to 35cm in height. It has one to four yellowish to creamy-white flowers to 6cm across with flowering period between late September and October (Mattiske 2019). *Caladenia hopperiana* has been recorded on the Mooradung Nature Reserve 32448, near tracks off the Pinjarra to Williams Road, near the Williams to Quindanning Road and on Timber Reserve 17125. (Mattiske, 2019). The species has been extensively surveyed by staff from the Botanic Gardens and Parks Authority, Department of Environment and Conservation and members of the West Australian Native Orchid Study and Conservation Group (Department of Environment and Conservation, 2012). *Caladenia hopperiana* occur within and outside the WMDE in the south eastern section of the Proposal area (Mattiske, 2019). The species has been recorded associated with the vegetation community *Eucalyptus wandoo* woodland on the margins of seasonal creeks and swamps with *Melaleuca viminea, Chorizandra enodis, Craspedia variabilis* and other orchid species including *Caladenia longicauda* subsp. *redacta, Diuris laxiflora* and *Prasophyllum gracile*. Mattiske (2019) state that 20 individual plants have been recorded within the Proposal area and 261 outside in a total of 7 locations. The occurrence at Boddington, within and near the QTR, is relatively restricted to a local area, according to the distribution available from the Florabase (Western Australian Herbarium, 1998).			
Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal lead to a long-term decrease in the size of a population of a species	WMDE / Bauxite Transport Corridor: **Moderate Potential**	*Caladenia hopperiana* (formerly known as *Caladenia* sp. Quindanning) has been recorded on the Mooradung Nature Reserve 32448, near tracks off the Pinjarra to Williams Road, near the Williams to Quindanning Road and on Timber Reserve 17125. (Mattiske, 2019). The species has been extensively surveyed by staff from the Botanic Gardens and Parks Authority, Department of Environment and Conservation and members of the West Australian Native Orchid Study and Conservation Group (Department of Environment and Conservation, 2012). *Caladenia hopperiana* occur within and outside the WMDE in the south eastern section of the Proposal area (Mattiske, 2019). The species has been recorded associated with the vegetation community *Eucalyptus wandoo* woodland on the margins of seasonal creeks and swamps with *Melaleuca viminea, Chorizandra enodis, Craspedia variabilis* and other orchid species including *Caladenia longicauda* subsp. *redacta*, *Diuris laxiflora* and *Prasophyllum gracile*. Mattiske (2019) state that 20 individual plants have been recorded within the Proposal area and 261 outside in a total of 7 locations. The occurrence at Boddington, within and near the QTR, is relatively restricted to a local	Section 4.1.6 Local catchment, surface water and groundwater investigation/research required.

		area, according to the distribution available from the Florabase (Western Australian Herbarium, 1998). Worsley has conducted surveys within the specific habitat associations where the species has been recorded to identify any new individuals or populations. Worsley maintains a record of the location of the populations and individuals of the species and protect the populations and individuals within approved Worsley lease areas under the Worsley Protected Areas Procedure (Worsley 2013b). Any new individuals and sub-populations will be protected under this procedure. The specific sub-populations and individuals are protected from the direct impact of clearing associated with mine operations via the Worsley Protected Areas Procedure (Worsley 2013b), however, other threats including hydrological changes of the local catchment, surface and groundwater that maintains the habitat of the species requires further investigation to determine likelihood of impact and mitigation.	
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6
Will the proposal reduce the area of occupancy of the species	WMDE / Bauxite Transport Corridor: **Moderate Potential**	The area of occupancy is relatively restricted with sub-populations and individuals within the Proposal area protected from direct impact under the Worsley Protected Areas Procedure (Worsley 2013b). Therefore, it is unlikely that the Proposal will reduce the area of occupancy of the species. The specific sub-populations and individuals are protected from the direct impact of clearing associated with mine operations via the Worsley Protected Areas Procedure (Worsley 2013b), however, other threats including hydrological changes of the local catchment, surface and groundwater that maintains the habitat of the species requires further investigation to determine likelihood of impact and mitigation.	Section 4.1.6 Local catchment, surface water and groundwater investigation/research required.
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6
Will the proposal fragment an existing population into two or more populations	WMDE / Bauxite Transport Corridor: **Unlikely**	A record of the location of individuals and populations of the species are maintained by Worsley. These locations are protected under the Worsley Protected Areas Procedure (Worsley 2013b) within the Proposal area. This ensures that the populations will not be directly impacted by current operations and the Proposal. It is highly unlikely that the Proposal will fragment an existing population into two or more populations.	Section 4.1.6
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6

Will the proposal adversely affect habitat critical to the survival of a species	WMDE / Bauxite Transport Corridor: **Moderate Potential**	The Department of Environment and Conservation (2012) describes habitat critical to the survival of *Caladenia hopperiana* to include: - the area of occupancy of populations of the species - areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators) - additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations, and; - the local catchment for the surface and/or groundwater that maintains the habitat of the species. The specific sub-populations and individuals are protected from the direct impact of clearing associated with mine operations and the Proposal via the Worsley Protected Areas Procedure (Worsley 2013b), however, other threats including hydrological changes of the local catchment, surface and groundwater that maintains the habitat of the species requires further investigation to ensure habitat critical to the survival of the species is maintained and managed accordingly.	Section 4.1.6 Local catchment, surface water and groundwater investigation/research required.
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6
Will the proposal disrupt the breeding cycle of a population	WMDE / Bauxite Transport Corridor: **Moderate Potential**	The species flowers in late September to November with seed set during late-October to mid-November (Mattiske, 2019). The species exhibits clonal reproduction associated with clumping. As with other orchid species mycorrhizal relationships are required for germination and annual growth. Direct and indirect impacts have the potential to disrupt the breeding cycle which has potential to be attributed to the Proposal. Direct clearing is avoided under the Worsley Protected Areas Procedure (Worsley 2013b).	Section 4.1.6
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6
Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	WMDE / Bauxite Transport Corridor: **Moderate Potential**	*Caladenia hopperiana* have been extensively surveyed by staff from the Botanic Gardens and Parks Authority, Department of Environment and Conservation and members of the West Australian Native Orchid Study and Conservation Group (Department of Environment and Conservation, 2012). Additional surveys since this period have targeted the species for monitoring and to identify and protect any new individuals or sub-populations. The specific sub-populations and individuals are protected from the direct impact of clearing associated with mine operations via the Worsley Protected Areas Procedure (Worsley 2013b), however, other threats including hydrological changes of the local	Section 4.1.6 Local catchment, surface water and groundwater investigation/research required.

		catchment, surface and groundwater that maintains the habitat of the species requires further investigation to determine likelihood of impact and mitigation.	
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6
Will the proposal Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	WMDE / Bauxite Transport Corridor: **Unlikely**	The Department of Environment and Conservation (2012) state key threats that may be attributed to the impact of invasive species include grazing and trampling. The feral pig is a potentially significant threat to the species contributing to habitat degradation and has high potential to contribute to the decline of the population of the species. Feral pig have been recorded throughout the WMDE and are established in the surrounding habitat of the WMDE. As feral pig populations are already established, it is unlikely that the Proposal will increase the impact of feral pig on the species or the introduction and establishment of new invasive species in the Threatened species habitat. Historically Worsley has supported feral pig control in and around the Worsley operations, however, this has currently drawn to a close.	Section 4.1.6
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6
Will the proposal Introduce disease that may cause the species to decline	WMDE / Bauxite Transport Corridor: **Unlikely**	Disease is not considered a key threatening process to *Caladenia hopperiana*. Worsley complies with regulatory requirements under current operations and those required for the Proposal with respect to the introduction and management of disease including forest disease (refer to Worsley BFMP **Appendix H** and Section 4.1.6). Worsley implements hygiene management procedures to prevent the spread of the disease and for the prevention of introduction into any previously uninfested areas.	Section 4.1.6
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6
Will the proposal Interfere with the recovery of the species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Department of Environment and Conservation (2012) outlines recovery actions for the species. Worsley supports the recovery actions developed by the Department of Environment and Conservation (2012) and aim to provide supporting research and investigations relevant to the recovery plan.	Section 4.1.6
	CBME: **Unlikely**	The species is restricted to a local area within and near the QTR in the Boddington region. It is highly unlikely to occur outside of this localised area.	Section 4.1.6

Migratory Species Impact Table			
Species – Rainbow Bee-eater *Merops ornata*			
EPBC Conservation Status: Marine, Migratory			
Description: The Rainbow Bee-eater is a medium-sized bird (22-25cm in length), and the only species of Bee-eater in Australia. The adults have green or blue-green colouring on the forehead and chestnut on the back of the head. There is a bold black stripe across the eye that is bordered below by a narrower blue stripe and bright yellow colouring on the chin and cheeks that changes to chestnut around the throat and that is bordered by a conspicuous, crescent-shaped black patch on the front of the neck. The tail is black with blue edging on the upper surface and two long, wire-like central feathers (termed streamers) that project beyond the tip of the tail. Rainbow Bee-eaters have a long, slender and decurved black bill, red iris, dark grey skin around the eye and blackish legs and feet. The Rainbow Bee-eater is widely distributed throughout Australia and eastern Indonesia. In Australia it is distributed across much of the mainland, usually seen in pairs or small flocks, although when migrating it may occur in groups of up to 500 birds or more. The Rainbow Bee-eater is not considered globally threatened. Trends in the extent of occurrence have not been quantified, but records indicate that the distribution of the species (and, hence, the extent of occurrence) has expanded in south-western Australia. The number of locations that the Rainbow Bee-eater occurs in is unknown and has not been estimated. The concept of discrete locations is difficult to apply to the Rainbow Bee-eater because of its widespread distribution and its ability to undertake long-distance movements. The Rainbow Bee-eater occurs in a wide range of habitats including riparian, floodplain or wetland vegetation assemblages, sand dune systems in coastal areas, semi-evergreen mesophyll vine forest and semi-deciduous vine thicket, open woodland and shrublands, including Mallee, and in open forests that are usually dominated by Eucalypts and in cleared and semi-cleared habitats, orchards, vineyards, roadside vegetation, quarries and gravel pits. In Australia, the breeding season extends from August to January. The nest is located in an enlarged chamber at the end of long burrow or tunnel in flat or sloping ground, in the banks of rivers, creeks or dams, in roadside cuttings, in the walls of gravel pits or quarries, in mounds of gravel, or in cliff-faces. Nesting areas are often re-used and banding studies indicate that at least some migrant birds return to the same nesting area each year. However, pairs usually excavate a new nesting burrow for each breeding season.			
Impact Criteria	**Response**	**Reasoning**	**Mitigation - Referral Supporting Document Section**
Will the proposal substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of	WMDE / Bauxite Transport Corridor: **Low to Moderate Potential**	The Rainbow Bee-eater has an extremely broad Australian distribution. Following substantial fauna surveys since 1982 including systematic seasonal bird surveys the Rainbow Bee-eater has been recorded infrequently in Jarrah, Marri and Wandoo habitats and in close proximity to riparian habitat, rivers, creeks and dams. No evidence of breeding has been recorded. The Rainbow Bee-eater's broad distribution, presence in a wide range of habitats, the mobility of the species, large population and few seasonal records from the Proposal area suggest that the Proposal has a low to moderate potential to substantially modify,	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

important habitat for a migratory species		destroy or isolate important habitat for the species. All habitats within the Proposal Area utilised by Rainbow Bee-eater are well-represented locally and regionally.	
	CBME: **Low to Moderate Potential**	As above	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	WMDE / Bauxite Transport Corridor: **Unlikely**	The Cane Toad is the only known threat to the Rainbow Bee-eater and that species does not occur in the South-West of Western Australia, it is unlikely that the Proposal will result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Unlikely**	As above	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
Will the proposal seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	WMDE / Bauxite Transport Corridor: **Low Potential**	The Rainbow Bee-eater has an extremely broad Australian distribution. Following substantial fauna surveys since 1982 including systematic seasonal bird surveys the Rainbow Bee-eater has been recorded infrequently in Jarrah, Marri and Wandoo habitats and in close proximity to riparian habitat, rivers, creeks and dams. No evidence of breeding has been recorded. Riparian habitat and associated buffering forms a Protected Area of the Worsley Protected Areas Procedure (Worsley 2013b). This procedure is relevant to the Proposal and includes the riparian habitat of the Hotham River.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6
	CBME: **Low Potential**	As above. In addition, riparian habitat and associated buffering forms a Protected Area of the Worsley Protected Areas Procedure (Worsley 2013b). This procedure is relevant to the Proposal and includes the riparian habitat associated with the Augustus River.	Section 4.2.3.1 Section 4.1.6 Section 4.2.6

MNES Threatened Ecological Communities Recorded near or within the Proposal Area (EPBC Act Protected Matters Search Tool (PMST) 20 km radius from the Proposal Area)			
Threatened Ecological Community	**Status: EPBC Act**	**WMDE and Bauxite Transport Corridor**	**CBME**
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	**Unlikely** – there is potential that the TEC occurs on the eastern fringes of the Northern Jarrah Forest however, not identified in the Proposal area of the WMDE and Bauxite Transport Corridor	**Unlikely** as the Proposal area is not near Western Australian Wheatbelt.
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	**Unlikely** as expansion areas occur on eastern sections of the northern Jarrah Forest (not the Swan Coastal Plain and therefore not in expansion areas	**Unlikely** as expansion areas occur on eastern sections of the northern Jarrah Forest (not the Swan Coastal Plain and therefore not in expansion areas)