Appendix L. Example photos from Squirrel Glider arboreal camera surveys

Figure 12-1 Common Brushtail Possum

Figure 12-2 Tawny Frogmouth

Figure 12-3 Feral Goats

Figure 12-4 Sacred Kingfisher

Figure 12-5 Laughing Kookaburra

Figure 12-6 Blue-faced Honeyeater

Figure 12-7 Sugar Glider

Figure 12-8 Sugar Glider

Figure 12-9 Tree Skink

Appendix M. Significance assessment for EPBC Act-listed flora

EPBC Act	Below are the significant impact criteria for flora species identified during the PMST search that are listed under the EPBC Act as Vulnerable and Critically Endangered **NB – What is an important population of a species?** An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species' range **Endangered species - Significant impact criteria** An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will: • Lead to a long-term decrease in the size of a population • Reduce the area of occupancy of the species • Fragment an existing population into two or more populations • Adversely affect habitat critical to the survival of a species • Disrupt the breeding cycle of a population • Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat • Introduce disease that may cause the species to decline, or • Interfere with the recovery of the species. **Vulnerable species - Significant impact criteria** An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will: • Lead to a long-term decrease in the size of an important population of a species • Reduce the area of occupancy of an important population • Fragment an existing important population into two or more populations • Adversely affect habitat critical to the survival of a species • Disrupt the breeding cycle of an important population • Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat • Introduce disease that may cause the species to decline, or • Interfere substantially with the recovery of the species.

Table 12-1 Assessment of Significance under EPBC Act for all threatened flora species

Scientific Name	Status	Habitat	Likelihood of Occurrence/Impact	Assessment of Significance under EPBC Act
Amphibromus fluitans River Swamp Wallaby-grass	VU	Largely confined to permanent swamps, principally along the Murray River between Wodonga and Echuca, uncommon to rare in the south (e.g. Casterton, Moe, Yarram), probably due to historic drainage of wetlands (RBGV 2016).	**Construction footprint** **Possible.** No previous records, but suitable habitat present within project area. Cryptic species responding to inundation events, occurs in low lying areas (ponds), and near flood ways, species was not evident during current survey, but has been previously recorded inundation area (Biosis, 2014). **Inundation area** **Present.** Recorded by Biosis 2014b within the inundation area confined to swamps and waterways.	**It is unlikely that the proposed works will have a significant impact on this species.** ▪ The population of the species within Guttrum and Benwell Forests could be considered 'important' as it is near the limit of the species' range heading west. The proposed construction works will not lead to a long-term decrease in the size of the population. Limited potential habitat is present within the construction footprint due to existing disturbance along access tracks. The operational phase of the project is likely to improve habitat quality in the project area and benefit the population in Guttrum and Benwell Forests. ▪ The population of the species within Guttrum and Benwell Forests could be considered 'important' as it is near the limit of the species' range heading west. The proposed construction works will not reduce the area of potential occupancy of the population. Limited potential habitat is present within the construction footprint due to existing disturbance along access tracks. The operational phase of the project is likely to improve habitat quality in the project area and benefit the population in Guttrum and Benwell Forests. ▪ The proposed construction works will not fragment an existing population into two or more populations. The construction footprint is approximately 200 m from the closest population and only limited potential habitat is present within the construction footprint due to existing disturbance along access tracks. The operational phase of the project is likely to improve habitat quality in the project area and benefit the population in Guttrum and Benwell Forests. ▪ The proposed construction works will not adversely affect habitat critical to the survival of the species. The construction footprint is approximately 200 m from the closest population and only limited potential habitat is present within the construction footprint due to existing disturbance along access tracks. The operational phase of the project is likely to improve habitat quality in the project area and benefit the population in Guttrum and Benwell Forests. ▪ The population of the species within Guttrum and Benwell Forests could be considered 'important' as it is near the limit of the species' range heading west. The proposed construction works will not impact the lifecycle of the species. ▪ The proposed construction works will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. Limited potential habitat is present within the construction footprint due to existing disturbance along access tracks. The operational phase of the project is likely to improve habitat quality in the project area and benefit the population in Guttrum and Benwell Forests.

				▪ It is unlikely that the proposed construction works will result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline.
Austrostipa metatoris Spear Grass	VU	NSW species. Grows in sandy areas of the Murray Valley	**Construction Footprint** **Highly unlikely.** No previous records. Suitable sandy mallee habitat not present within construction footprint. **Inundation Area:** **Highly unlikely.** No previous records. Suitable sandy mallee habitat not present within inundation area	It is unlikely that the proposed works will have a significant impact on this species. ▪ The species has not been recorded at Guttrum-Benwell Forests, and in fact is only known to occur in NSW. Therefore there are no important populations of the species present or likely to be impacted by the proposed works. ▪ As the species is known only to occur in NSW, it's unlikely that any sandy areas potentially containing suitable habitat, would be considered critical to the survival of the species. ▪ As the species has not been recorded in Victoria, it is unlikely that the proposed works would impact the lifecycle of this species, or that the works would modify, destroy, remove or isolate or decrease the availability or quality of habitat for this species. ▪ As the species is known only to occur in NSW, it is unlikely that the proposed works would result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline. ▪ As the species is known only to occur in NSW, it's unlikely that the proposed works would interfere with the recovery of the species.
Austrostipa wakoolica *Spear grass*	EN	Not recorded in Victoria. Confined to the floodplains of the Murray River tributaries of central-western and south-western NSW. Habitat includes the edges of lignum swampy box and mallee woodlands (NSW OE&H 2019).	**Construction footprint** **Highly Unlikely.** Species recorded in upper tributaries of the Murray River in NSW and limited suitable box woodland present in construction footprint **Inundation area** **Highly Unlikely.** Species recorded in upper tributaries of the Murray River in NSW and limited suitable box woodland present in inundation area.	It is unlikely that the proposed works will have a significant impact on this species. ▪ The species has not been recorded at Guttrum-Benwell Forests, and in fact is only known to occur in NSW. Therefore there are no important populations of the species present or likely to be impacted by the proposed works. ▪ As the species is known only to occur in NSW, it's unlikely that any sandy areas potentially containing suitable habitat, would be considered critical to the survival of the species. ▪ As the species has not been recorded in Victoria, it is unlikely that the proposed works would impact the lifecycle of this species, or that the works would modify, destroy, remove or isolate or decrease the availability or quality of habitat for this species. ▪ As the species is known only to occur in NSW, it is unlikely that the proposed works would result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline. ▪ As the species is known only to occur in NSW, it's unlikely that the proposed works would interfere with the recovery of the species.
Caladenia tensa Greencomb Spider-orchid	EN	In Victoria found mainly in the Little Desert area (also with an isolated record for near Wood Wood) in	**Construction Footprint:** **Highly unlikely.** No previous records within 150 km of site and	It is unlikely that the proposed works will have a significant impact on this species. ▪ The species has not been recorded at Guttrum-Benwell, and in fact is only known to occur within the vicinity of Little Desert National Park, over 150 km to the south-west. Therefore there are no populations of the species present or likely to be impacted by the proposed works.

		Eucalyptus/Callitris woodland on well-drained sandy soil (Walsh & Entwisle 1994).	no suitable habitat present within construction footprint. **Inundation Area:** **Highly unlikely.** No previous records within 150 km of site and no suitable habitat present within inundation area.	▪ As the species has not been recorded within 150 km of the project area, the works will not decrease the size of a population of this species, reduce the area of occupancy of the species, or fragment an existing population of the species. ▪ As the species is not known to occur within 150 km of the project area, the proposed works are unlikely to affect critical habitat for the species, or to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. ▪ As the species is not known to occur within 150 km of the project area, it is unlikely that the proposed works would impact the lifecycle of individuals within a known population of the species. ▪ As the species is known only to occur in the Little Desert National Park region in Victoria, it is unlikely that the proposed works would result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline. ▪ As the species is not known to occur within 150 km of the project area, it's unlikely that the proposed works would interfere with the recovery of the species.
Lepidium monoplocoides Winged Peppercress	EN	Uncommon in north western quarter of state, mostly on heavy soils near lakes and watercourses. Flowers mostly spring-summer (Walsh & Entwisle 1996).	**Construction Footprint:** **Possible.** Records within study area (10 km from project area in Lower Gunbower Forest) and potential habitat present in the outer areas of forest where Black Box chenopod vegetation occurs.. **Inundation Area:** **Possible.** Records within study area (10 km from project area in Lower Gunbower Forest) and potential habitat present in the outer areas of forest where Black Box chenopod vegetation occurs.	It is unlikely that the proposed works will have a significant impact on this species. ▪ The species has not been recorded at Guttrum-Benwell Forests, and the closest population is 10 km south-east in the Lower Gunbower Forest. The species was not recorded during targeted surveys and limited habitat exists within the construction footprint. It is therefore unlikely that an important population of the species is present or likely to be impacted by the proposed works. The operational phase of the project is likely to improve habitat quality in the project area and any potential unrecorded populations. ▪ The species has not been recorded at Guttrum-Benwell Forests, and the closest population is 10 km south-east in the Lower Gunbower Forest. The species was not recorded during targeted surveys and limited habitat exists within the construction footprint. It is therefore unlikely that an important population of the species is present or likely to be impacted by the proposed works. The operational phase of the project is likely to improve habitat quality in the project area and any potential unrecorded populations. ▪ As the species was not recorded during targeted surveys, and limited habitat exists within the construction footprint, it is unlikely that the proposed works would impact the lifecycle of this species, or that the works would modify, destroy, remove or isolate or decrease the availability or quality of habitat for this species. ▪ As the species was not recorded during targeted surveys, and limited habitat exists within the construction footprint, it is unlikely that the proposed works would result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline. ▪ As the species was not recorded during targeted surveys, and limited habitat exists within the construction footprint, it's unlikely that the proposed works would interfere with the recovery of the species.

Maireana cheelii Chariot Wheels	VU	Occurs on seasonally wet, heavy red loam or clay soils. Fruits mostly Sep.-Nov. (Walsh and Entwisle 1996)	**Construction footprint** **Unlikely.** No previous records and very limited suitable habitat present within project area. **Inundation area** **Unlikely.** No previous records and very limited suitable habitat present within project area.	It is unlikely that the proposed works will have a significant impact on this species. ▪ The species has not been recorded at Guttrum-Benwell Forests, and the closest population is greater than 20 km south-west in the Victorian Riverina bioregion. Therefore, there are no important populations of the species present or likely to be impacted by the proposed works. ▪ As the species has not been recorded within 20 km and there is limited suitable habitat present in the project area, it's unlikely that any grasslands potentially containing suitable habitat, would be considered critical to the survival of the species. ▪ As the species has not been recorded within 20 km and there is limited suitable habitat present in the project area, it is unlikely that the proposed works would impact the lifecycle of this species, or that the works would modify, destroy, remove or isolate or decrease the availability or quality of habitat for this species. ▪ As the species has not been recorded within 20 km and there is limited suitable habitat present in the project area, it is unlikely that the proposed works would result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline. ▪ As the species has not been recorded within 20 km and there is limited suitable habitat present in the project area, it's unlikely that the proposed works would interfere with the recovery of the species.
Sclerolaena napiformis Turnip Copperburr	EN	Known only from a few populations in remnant grassland on clay-loam soils in north-central Victoria in the Echuca-Nathalia area, and between Donald and Stawell in the west. Fruits Nov.-May. (Walsh and Entwisle 1996)	**Construction footprint** **Unlikely.** No previous records and very limited suitable habitat present within project area. **Inundation area** **Unlikely.** No previous records and very limited suitable habitat present within project area.	It is unlikely that the proposed works will have a significant impact on this species. ▪ The species has not been recorded at Guttrum-Benwell Forests, and the closest population is greater than 50 km south in the Victorian Riverina bioregion Therefore there are no important populations of the species present or likely to be impacted by the proposed works. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it's unlikely that any grasslands potentially containing suitable habitat, would be considered critical to the survival of the species. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it is unlikely that the proposed works would impact the lifecycle of this species, or that the works would modify, destroy, remove or isolate or decrease the availability or quality of habitat for this species. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it is unlikely that the proposed works would result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it's unlikely that the proposed works would interfere with the recovery of the species.

Swainsona murrayana Slender Darling-pea	VU	Rare species, apparently restricted to a few sites in north-central Victoria (mostly between Bendigo and the Murray River) where it grows in grassland on heavy red soils and is now almost confined to roadside remnants (Walsh and Entwisle 1999).	**Construction footprint:** **Unlikely.** No previous records and very limited suitable habitat present within project area. **Inundation area:** **Unlikely.** No previous records and very limited suitable habitat present within project area.	It is unlikely that the proposed works will have a significant impact on this species. ▪ The species has not been recorded at Guttrum-Benwell Forests, and the closest population is greater than 50 km south in the Victorian Riverina bioregion Therefore there are no important populations of the species present or likely to be impacted by the proposed works. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it's unlikely that any grasslands potentially containing suitable habitat, would be considered critical to the survival of the species. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it is unlikely that the proposed works would impact the lifecycle of this species, or that the works would modify, destroy, remove or isolate or decrease the availability or quality of habitat for this species. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it is unlikely that the proposed works would result in invasive species invading habitat for the species, or introducing disease that may cause the species to decline. ▪ As the species has not been recorded within 50 km and there is limited suitable habitat present in the project area, it's unlikely that the proposed works would interfere with the recovery of the species.

Appendix N. Significance assessment for EPBC Act-listed fauna

Below are the significant impact criteria for species listed under the EPBC Act as Vulnerable, Endangered and Critically Endangered. The criteria are addressed below for:

EPBC Act Vulnerable (VU) listed

- Painted Honeyeater (Grantiella picta),
- Superb Parrot (*Polytelis swainsonii*),
- South-eastern Long-eared Bat (*Nyctophilus corbeni*),
- Growling Grass Frog (*Litoria raniformis*) and
- Murray Cod (*Maccullochella peelii*).

EPBC Act Endangered (EN) listed

- Australasian Bittern (*Botaurus poiciloptilus*)
- Australian Painted Snipe (*Rostratula australis*)

Critically Endangered

- Silver Perch (*Bidyanus bidyanus*).

NB – What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species' range

Painted Honeyeater (*Grantiella picta*) EPBC Act – Vulnerable, FFG Act – Listed, Victorian Advisory List - Vulnerable
Lead to a long-term decrease in the size of an important population of a species
Painted Honeyeater is considered to have potential to utilise habitats within the proposed construction footprint and broader inundation area. This species has not been previously recorded within the study area, and very few records exist across the local landscape. They are known to be highly mobile and have the potential to rarely forage in the Guttrum and Benwell Forests. The proposed construction footprints are however not likely to significantly impact any areas of important habitat to this extremely mobile nomadic species, which forages widely over large areas in pursuit of mistletoe and flowering eucalypts. **No significant impact**
Reduce the area of occupancy of an important population
This species has not been previously recorded within the study area, and very few records exist across the local landscape. They are known to be highly mobile and have the potential to rarely forage in the Guttrum and Benwell Forests. The proposed construction footprints are however not likely to reduce the area of occupancy of an important population. The proposed construction footprint is centred on existing tracks and degraded areas wherever possible. This will not significantly reduce the area of occupancy of any population as most structures will be established on previously disturbed tracks and clearances. The area does not represent core habitat or range for this species. **No significant impact**
Fragment an existing important population into two or more populations

The project is highly unlikely to result in the fragmentation of important Painted Honeyeater habitat (large trees supporting abundant mistletoe) as Guttrum and Benwell Forests consists of 1,149 ha of contiguous habitat, with the proposed construction footprint located on existing tracks and disturbed areas within an unbroken canopy of open woodland vegetation. The area does not represent core habitat or range for this species. **No significant impact**
Adversely affect habitat critical to the survival of a species
This species has not been previously recorded within the study area, and very few records exist across the local landscape. They are known to be highly mobile and have the potential to rarely forage in the Guttrum and Benwell Forests. The proposed construction footprints are however not likely to reduce the area of occupancy of an important population. The proposed construction footprint is centred on existing tracks and degraded areas wherever possible. This will not significantly reduce the area of occupancy of any population as most structures will be established on previously disturbed tracks and clearances. The area does not represent core habitat or range for this species. **No significant impact**
Disrupt the breeding cycle of an important population
The proposed construction footprint represents small, isolated and discreet areas of habitat within an extensive area of potentially suitable, but largely marginal habitat for this highly mobile species, and it is extremely unlikely to disrupt the breeding cycle of any population of this species. The area does not represent core habitat or range for this species. **No significant impact**
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The proposed construction footprint represents small, isolated and discreet areas of habitat within an extensive area of potentially suitable, but largely marginal habitat for this highly mobile species, and it is extremely unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. The area does not represent core habitat or range for this species. The proposed construction works will not impact known or potential nesting trees or suitable foraging habitat, and therefore will not significantly modify, destroy, remove, isolate or decrease the availability or quality of Painted Honeyeater habitat within the area. **No significant impact**
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Weed infiltration is possible from the proposed works, within the limited areas of construction. Appropriate systems must be set in place and followed to minimise the possibility of weed dispersal and exotic predator control, and will be included in a Construction Environmental Management Plan (CEMP). Impacts to this species from invasive species have not been identified as a threatening process previously and are highly unlikely in this case. **No significant impact**
Introduce disease that may cause the species to decline
The proposed construction works are not expected to introduce any avifauna diseases to any potential Painted Honeyeater populations within the study area (the greatest chance for this to occur will be transmittal of disease from captive birds to wild birds, with a very low chance of this occurring), particularly with hygiene protocols for vehicles/machinery/staff that will be further described in a CEMP that will be prepared for the project. **No significant impact**

Interfere substantially with the recovery of the species.
The proposed construction activities will not interfere substantially with the recovery of the species, as this species and its breeding and foraging habitats will not be impacted by the proposed works, directly or indirectly. The project is likely to enhance habitat for this species, by promoting healthy woodlands suitable for foraging (Seran BL&A 2018) **No significant impact**

Superb Parrot (*Polytelis swainsonii*) EPBC Act – Vulnerable, FFG Act – Listed, Victorian Advisory List - Endangered
Lead to a long-term decrease in the size of an important population of a species
Superb Parrot is considered to have potential to utilise habitats within the proposed construction footprint and broader inundation area. Although extensive suitable Red Gum forest habitat exists, this species has not been previously recorded within the study area, with the closest and main population known from Barmah State Forest 50-100 km further east upstream of the Murray River. The proposed construction footprint represents a very small, low quality area of foraging habitat for this highly mobile species, and is considered highly unlikely to lead to a long-term decrease in the size of an important population of this species. The area does not represent core habitat or range for this species. **No significant impact**
Reduce the area of occupancy of an important population
The proposed construction footprint is centred on existing tracks and degraded areas wherever possible. This will not significantly reduce the area of occupancy of any population as most structures will be established on previously disturbed tracks and clearances. The area does not represent core habitat or range for this species. **No significant impact**
Fragment an existing important population into two or more populations
The project is highly unlikely to result in the fragmentation of important Superb Parrot habitat (nesting trees) as the species has not been recorded in the study area. Guttrum and Benwell Forests consists of 1,149 ha of contiguous habitat, with the proposed construction footprint located on existing tracks and disturbed areas. **No significant impact**
Adversely affect habitat critical to the survival of a species
The proposed construction footprint will not adversely affect habitat critical to the survival of this species, as it represents small, isolated and discrete areas of habitat within an extensive area of rarely used habitats for this highly mobile and infrequently recorded species. Critical habitat for the species is known to occur within Barmah State Forest further upstream of the Murray River. **No significant impact**
Disrupt the breeding cycle of an important population
The species is not known to breed in Guttrum and Benwell Forests. The proposed construction footprint represents small, isolated and discreet areas of habitat within an extensive area of potentially suitable, but largely marginal habitat for this highly mobile species, and it is extremely unlikely to disrupt the breeding cycle of any population of this species. The species is not known to breed in Guttrum and Benwell Forests. **No significant impact**

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The proposed construction footprint represents small, isolated and discreet areas of habitat within an extensive area of potentially suitable, but largely marginal habitat for this highly mobile species, and it is extremely unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. The area does not represent core habitat or range for this species. The proposed construction works will not impact known or potential nesting trees or suitable foraging habitat, and therefore will not significantly modify, destroy, remove, isolate or decrease the availability or quality of Superb Parrot habitat within the area. **No significant impact**
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Weed infiltration is possible from the proposed works, within the limited areas of construction. Appropriate systems must be set in place and followed to minimise the possibility of weed dispersal and exotic predator control, and will be included in a Construction Environmental Management Plan (CEMP). Impacts to this species from invasive species have not been identified as a threatening process previously and are highly unlikely in this case. **No significant impact**
Introduce disease that may cause the species to decline
The proposed construction works are not expected to introduce any avifauna diseases to any potential Superb Parrot populations within the study area (the greatest chance for this to occur will be transmittal of disease from captive birds to wild birds, with a very low chance of this occurring), particularly with hygiene protocols for vehicles/machinery/staff that will be further described in a CEMP that will be prepared for the project. **No significant impact**
Interfere substantially with the recovery of the species.
The proposed construction activities will not interfere substantially with the recovery of the species, as this species and its breeding and foraging habitats will not be impacted by the proposed works, directly or indirectly. The project is likely to enhance habitat for this species, by promoting healthy woodlands suitable for foraging (Seran BL&A 2018) **No significant impact**

South-eastern Long-eared Bat (*Nyctophilus corbeni*) EPBC Act – Vulnerable, FFG Act – Listed, Victorian Advisory List - Endangered
Lead to a long-term decrease in the size of an important population of a species
The South-eastern or Corben's Long-eared Bat is considered unlikely to occur within the construction footprint or inundation area of the Guttrum and Benwell Forests, and has not been recorded previously within the study area. It has however been considered further due to its relatively poorly understood status in Victoria in regards to habitat preferences and use. The species has not been recorded in the project area and was not recorded during bat surveys in the construction footprint in 2017 (GHD 2017). The closest records in Victoria to the project area are in old growth mallee vegetation around the Hattah township and Hattah-Kulkyne National Park, over 150 km to the north/west. It is considered unlikely that this species utilises Red Gum forests and woodland habitats within the Guttrum-Benwell project area.

In the unlikely occurrence of this species occurring in the construction footprint, impacts as a result of vegetation removal and potential habitat loss will be localised, and therefore resultant impacts to the species are expected to be very low. However, broader mitigation measures for hollow-dependent species as outlined in Section 9 will also apply to threatened bats including South-eastern Long-eared Bat, including pre-clearance surveys and hollow-bearing tree management. **No significant impact**
Reduce the area of occupancy of an important population
It is considered unlikely that this species utilises Red Gum forests and woodland habitats within the Guttrum-Benwell project area, and that if it does occur, it is likely to be in extremely low numbers that would not be impacted by the proposed works or could be mitigated by preclearance surveys and hollow-bearing tree management protocols in the highly unlikely event that an *N. corbeni* is encountered during site development. In the unlikely occurrence of this species occurring in the construction footprint, impacts as a result of vegetation removal and potential habitat loss will be localised, and therefore resultant impacts to the species are expected to be very low. However, broader mitigation measures for hollow-dependent species as outlined in Section 9 will also apply to threatened bats including South-eastern Long-eared Bat, including pre-clearance surveys and hollow-bearing tree management. **No significant impact**
Fragment an existing important population into two or more populations
It is considered unlikely that this species utilises Red Gum forests and woodland habitats within the Guttrum-Benwell project area, and that if it does occur, it is likely to be in extremely low numbers that would not be impacted by the proposed works or could be mitigated by preclearance surveys and hollow-bearing tree management protocols in the highly unlikely event that an *N. corbeni* is encountered during site development. In the unlikely occurrence of this species occurring in the construction footprint, impacts as a result of vegetation removal and potential habitat loss will be localised, and therefore resultant impacts to the species are expected to be very low. However, broader mitigation measures for hollow-dependent species as outlined in Section 9 will also apply to threatened bats including South-eastern Long-eared Bat, including pre-clearance surveys and hollow-bearing tree management. **No significant impact**
Adversely affect habitat critical to the survival of a species
It is considered unlikely that this species utilises Red Gum forests and woodland habitats within the Guttrum-Benwell project area, and that if it does occur, it is likely to be in extremely low numbers that would not be impacted by the proposed works or could be mitigated by preclearance surveys and hollow-bearing tree management protocols in the highly unlikely event that an *N. corbeni* is encountered during site development. In the unlikely occurrence of this species occurring in the construction footprint, impacts as a result of vegetation removal and potential habitat loss will be localised, and therefore resultant impacts to the species are expected to be very low. However, broader mitigation measures for hollow-dependent species as outlined in Section 9 will also apply to threatened bats including South-eastern Long-eared Bat, including pre-clearance surveys and hollow-bearing tree management. **No significant impact**
Disrupt the breeding cycle of an important population
It is considered unlikely that this species utilises Red Gum forests and woodland habitats within the Guttrum-Benwell project area, and that if it does occur, it is likely to be in extremely low numbers that would not be impacted by the proposed works or could be mitigated by preclearance surveys and hollow-bearing tree management protocols in the highly unlikely event that an *N. corbeni* is encountered during site development. The proposed construction footprint represents small, isolated and discreet areas of habitat within an extensive area of potentially suitable, but largely marginal habitat for this highly mobile species, and it is

extremely unlikely to disrupt the breeding cycle of any population of this species. The area does not represent core habitat or range for this species. **No significant impact**
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The proposed construction footprint represents small, isolated and discreet areas of habitat within an extensive area of potentially suitable, but largely marginal habitat for this highly mobile species, and it is extremely unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. The area does not represent core habitat or range for this species. In the unlikely occurrence of this species occurring in the construction footprint, impacts as a result of vegetation removal and potential habitat loss will be localised, and therefore resultant impacts to the species are expected to be very low. However, broader mitigation measures for hollow-dependent species as outlined in Section 9 will also apply to threatened bats including South-eastern Long-eared Bat, including pre-clearance surveys and hollow-bearing tree management. **No significant impact**
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Weed infiltration is possible from the proposed works, within the limited areas of construction. Appropriate systems must be set in place and followed to minimise the possibility of weed dispersal and exotic predator control, and will be included in a Construction Environmental Management Plan (CEMP). Impacts to this species from invasive species have not been identified as a threatening process previously and are highly unlikely in this case. **No significant impact**
Introduce disease that may cause the species to decline
The proposed construction works are not expected to introduce any avifauna diseases to any potential Painted Honeyeater populations within the study area (the greatest chance for this to occur will be transmittal of disease from captive birds to wild birds, with a very low chance of this occurring), particularly with hygiene protocols for vehicles/machinery/staff that will be further described in a CEMP that will be prepared for the project. **No significant impact**
Interfere substantially with the recovery of the species.
The proposed construction activities will not interfere substantially with the recovery of the species, as this species and its breeding and foraging habitats will not be impacted by the proposed works, directly or indirectly. The project is likely to enhance habitat for this species, by promoting healthy woodlands suitable for foraging (Seran BL&A 2018) **No significant impact**

The following assessment against the Significant Impact Guidelines for the Growling Grass Grog (*Litoria raniformis*) listed as Vulnerable under the EPBC Act was made (DEWHA 2009):

Growling Grass Frog (*Litoria raniformis*) EPBC Act – Vulnerable, FFG Act – Listed, Victorian Advisory List - Endangered
Habitat degradation in area supporting an important population
The Growling Grass Frog is considered to have potential to utilise habitats within the broader inundation area. The species has been recorded once in the project area but not within the last 30 years. It has been recorded

four times previously within the study area, most recently in 2009 on a farm dam 5 km to the south-west of the project area. Despite the long absence of records of this species, the presence of suitable habitat, and the ability of this species to recolonise areas suggest that it has potential to occur in the area, and a reintroduction of more suitable ecological watering regimes may help facilitate this.

The project will not result in the loss of any of the EVCs (wetland-dependent EVCs) that have the potential to support this species within the construction footprint and will not degrade an area supporting an important population.

No significant impact

Isolation and fragmentation of important populations.
The project will not significantly reduce the area of occupancy of any population should it exist, as the structures will be established on already disturbed tracks and levees. The project will not result in the fragmentation of important Growling Grass Frog habitat as the park is unlikely to presently support a population of this species and contains very limited potential habitat. The area does not represent core habitat or range for this species. If external populations of this species recolonise the area, there is the potential to provide an increased and improved area of habitat that may help link otherwise disjointed populations upstream and downstream of the Guttrum and Benwell project area, thereby the works may increase connectivity for this species across the landscape. **No significant impact**

Murray Cod (*Maccullochella peelii*) - EPBC Act – Vulnerable, FFG Act – Listed, Victorian Advisory List - Vulnerable

Lead to a long-term decrease in the size of an important population of a species
The Murray Cod is known to occur in the Murray River alongside the project area and is considered a main channel specialist. Murray Cod occurs naturally in the waterways of the Murray-Darling Basin (ACT, SA, NSW and Vic) and is known to live in a wide range of warm water habitats from clear, rocky streams to slow flowing turbid rivers and billabongs (TSSC, 2003). The closest records for Murray Cod are located within the Murray River upstream of the project area at less than 1 km from Guttrum Forest and a further three records upstream within 6km of the project area at Barham, Koondrook and on the edge of the Gunbower State Forest (VBA, 2020). The species may enter the forest areas during inundation events, but seasonally inundated semi-permanent forest wetlands do not provide suitable long term habitat. Regardless of the records, presence within the main channels adjacent the site should be assumed. The proposed construction footprint is in predominantly dry areas, and it is considered unlikely that the proposed actions will lead to a long-term decrease in the size of an important population of this species. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Murray Cod to avoid potential localised impacts. A construction specific aquatic fauna management plan should be developed for all works around waterways. During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Murray Cod entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel.

It is unlikely that the construction and operation phase of the project will lead to a long-term decrease in size of a population due to the minimal construction impacts and mitigation measures for operation.

No significant impact

Reduce the area of occupancy of the species

The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will lead to a reduction in the area of occupancy of a population of this species. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Murray Cod. A construction specific aquatic fauna management plan should be developed for all works around waterways.

During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Murray Cod entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel.

It is unlikely that the construction and operation phase of the project will reduce the area of occupancy of the species due to the minimal construction impacts and mitigation measures for operation.

No significant impact

Fragment an existing important population into two or more populations

The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will fragment an existing population into two or more populations Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Murray Cod. A construction specific aquatic fauna management plan should be developed for all works around waterways.

During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Murray Cod entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel.

It is unlikely that the construction and operation phase of the project will fragment an existing important population into two or more populations due to the minimal construction impacts and mitigation measures for operation.

No significant impact

Adversely affect habitat critical to the survival of a species

The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will affect habitat critical to the survival of the species. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Murray Cod. A construction specific aquatic fauna management plan should be developed for all works around waterways.

During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Murray Cod entering the floodplain. Fine fish screens will be fitted to pipe inlets used to

water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel.

It is unlikely that the construction and operation phase of the project will adversely affect habitat critical to the survival of the species due to the minimal construction impacts and mitigation measures for operation.

No significant impact

Disrupt the breeding cycle of a population

The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions disrupt the breeding cycle of a population. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Murray Cod. A construction specific aquatic fauna management plan should be developed for all works around waterways.

During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Murray Cod entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel. Furthermore, spawning of most native fish occurs from mid spring onwards (SKM 2003), so avoiding pumping from mid spring onwards will also minimise the likelihood of eggs and larvae present in the water column of the Murray River from being entrained

It is unlikely that the construction and operation phase of the project will disrupt the breeding cycle of a population due to the minimal construction impacts and mitigation measures for operation.

No significant impact

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will decrease the availability or quality of habitat to the extent that the species is likely to decline. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Murray Cod. A construction specific aquatic fauna management plan should be developed for all works around waterways.

During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Murray Cod entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel.

It is unlikely that the construction and operation phase of the project will decrease the availability or quality of habitat to the extent that the species is likely to decline due to the minimal construction impacts and mitigation measures for operation. **No significant impact**
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered of critically endangered species' habitat
Eleven alien fish species are now established in the Murray-Darling River system, with Carp *Cyprinus carpio*, Redfin Perch *Perca fluviatilis*, Goldfish *Carassius auratus* and Eastern Gambusia *Gambusia holbrooki* the most widespread (NMCRT, 2010). These species are already established in the vicinity of the project site. The construction phase of the project is not likely to lead to an increase in these species. Inundation of floodplain habitat during the operational phase has a high likelihood of increasing carp populations within wetland habitat and also in aquatic habitat that remains following flood events. Wetlands are not the preferred habitat for the species and the inundation events will mimic natural over-bank flows. That said, the impact of operation will create conditions that are likely to benefit carp, which may negatively impact Silver Perch. Following recommended mitigation measures (see DELWP, 2018) to control carp may minimise their colonisation. This could include measures such as implementing a winter fill regime, developing a native fish exit strategy to strand carp and drying of weltands with high carp density. **No significant impact**
Introduce disease that may cause the species to decline
Silver perch are highly susceptible to several diseases including Epizootic Haematopoietic Necrosis Virus (EHNV) (Langdon 1989). The likelihood of the introduction of disease during the construction phase is minimal if standard hygiene protocols are implemented. **No significant impact**
Interfere with the recovery of the species.
The proposed construction activities will not interfere substantially with the recovery of the species, as potential impacts to this species and its breeding and foraging habitats will be mitigated through a construction specific aquatic fauna management plan, design of infrastructure and adapative management of risks associated with blackwater, water quality and carp as is currently implemented on other watering projects (e.g. Hattah Lakes TLM works). **No significant impact**

EPBC Act listed Critically Endangered Species:

Silver Perch (*Bidyanus bidyanus*) - EPBC Act – Critically Endangered, FFG Act – Listed, Victorian Advisory List - Vulnerable
Lead to a long-term decrease in the size of a population
Silver Perch is known to occur in the River Murray, with the closest VBA (2020) record approximately 5 km south east of the project area and upstream of the Koondrook Weir. They are regularly encountered in the Murray River upstream and downstream of the project area and the Murray River in vicinity of project area has been mapped as possible habitat by NSW Fisheries. They are a main channel specialist and are expected to be present in the Murray River in the project area from time to time. Although the species has not been recorded within the semi-permanent wetlands of the project area, they may enter the forest areas during natural inundation events, but the seasonally inundated semi-permanent forest wetlands do not provide suitable long term habitat. As such, the species is considered as a possible occurrence within the construction footprint and inundation extent The proposed construction footprint is in predominantly dry areas, and it is considered unlikely that the proposed actions will lead to a long-term decrease in the size of an important population of this species. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Silver Perch to avoid potential localised impacts. A construction specific aquatic fauna management plan should be developed for all works around waterways. During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Silver Perch entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel. It is unlikely that the construction and operation phase of the project will lead to a long-term decrease in size of a population due to the minimal construction impacts and mitigation measures for operation. **No significant impact**
Reduce the area of occupancy of the species
The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will lead to a reduction in the area of occupancy of a population of this species. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Silver Perch. A construction specific aquatic fauna management plan should be developed for all works around waterways. During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Silver Perch entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel. It is unlikely that the construction and operation phase of the project will reduce the area of occupancy of the species due to the minimal construction impacts and mitigation measures for operation.

No significant impact
Fragment an existing important population into two or more populations
The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will fragment an existing population into two or more populations Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Silver Perch. A construction specific aquatic fauna management plan should be developed for all works around waterways. During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Silver Perch entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel. It is unlikely that the construction and operation phase of the project will fragment an existing important population into two or more populations due to the minimal construction impacts and mitigation measures for operation. **No significant impact**
Adversely affect habitat critical to the survival of a species
The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will affect habitat critical to the survival of the species. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Silver Perch. A construction specific aquatic fauna management plan should be developed for all works around waterways. During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Silver Perch entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel. It is unlikely that the construction and operation phase of the project will adversely affect habitat critical to the survival of the species due to the minimal construction impacts and mitigation measures for operation. **No significant impact**
Disrupt the breeding cycle of a population
The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions disrupt the breeding cycle of a population. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Silver Perch. A construction specific aquatic fauna management plan should be developed for all works around waterways. During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Silver Perch entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native

fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel. Furthermore, spawning of most native fish occurs from mid spring onwards (SKM 2003), so avoiding pumping from mid spring onwards will also minimise the likelihood of eggs and larvae present in the water column of the Murray River from being entrained It is unlikely that the construction and operation phase of the project will disrupt the breeding cycle of a population due to the minimal construction impacts and mitigation measures for operation. **No significant impact**
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
The proposed construction footprints are in predominantly dry areas, and it is considered unlikely that the proposed actions will decrease the availability or quality of habitat to the extent that the species is likely to decline. Consideration of any in-stream works such as coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprints must consider Silver Perch. A construction specific aquatic fauna management plan should be developed for all works around waterways. During operations, the project area will receive water via pumping meaning there is a very low likelihood of large numbers of Silver Perch entering the floodplain. Fine fish screens will be fitted to pipe inlets used to water the floodplain, preventing the introduction of species to the floodplain. A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish to exit the wetlands to prevent stranding. Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. Low return flows during the maintenance and drawdown periods of environmental watering are planned to be approximately 25 ML/d for both Guttrum and Benwell (DHI 2014, cited in North Central CMA 2020) to reduce any potential blackwater impacts to the main Murray River channel. It is unlikely that the construction and operation phase of the project will decrease the availability or quality of habitat to the extent that the species is likely to decline due to the minimal construction impacts and mitigation measures for operation. **No significant impact**
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered of critically endangered species' habitat
Eleven alien fish species are now established in the Murray-Darling River system, with Carp *Cyprinus carpio*, Redfin Perch *Perca fluviatilis*, Goldfish *Carassius auratus* and Eastern Gambusia *Gambusia holbrooki* the most widespread (NMCRT, 2010). These species are already established in the vicinity of the project site. The construction phase of the project is not likely to lead to an increase in these species. Inundation of floodplain habitat during the operational phase has a high likelihood of increasing carp populations within wetland habitat and also in aquatic habitat that remains following flood events. Wetlands are not the preferred habitat for the species and the inundation events will mimic natural over-bank flows. That said, the impact of operation will create conditions that are likely to benefit carp, which may negatively impact Silver Perch. Following recommended mitigation measures (see DELWP, 2018) to control carp may minimise their colonisation. This could include measures such as implementing a winter fill regime, developing a native fish exit strategy to strand carp and drying of weltands with high carp density. **No significant impact**
Introduce disease that may cause the species to decline

Silver perch are highly susceptible to several diseases including Epizootic Haematopoietic Necrosis Virus (EHNV) (Langdon 1989). The likelihood of the introduction of disease during the construction phase is minimal if standard hygiene protocols are implemented. **No significant impact**
Interfere with the recovery of the species.
The proposed construction activities will not interfere substantially with the recovery of the species, as potential impacts to this species and its breeding and foraging habitats will be mitigated through a construction specific aquatic fauna management plan, design of infrastructure and adapative management of risks associated with blackwater, water quality and carp as is currently implemented on other watering projects (e.g. Hattah Lakes TLM works). **No significant impact**

Appendix O. Significance assessment for Migratory Species

Below are the significant impact criteria for EPBC Act listed migratory species used to determine whether there is a chance of a significant impact. They were applied to all species identified by the VBA and PMST database searches. The likelihood of occurrence, and likelihood of impact for these species has also been considered for the fonstruction footprint and inundation area (Table 5-6).These species are Fork-tailed Swift (*Apus pacificus*), Yellow Wagtail (*Motacilla flava*), Satin Flycatcher (*Myiagra* cyanoleuca), Common Sandpiper (*Actitis hypoleucus*), Sharp-tailed Sandpiper (*Calidris acuminata*), Curlew Sandpiper (*Calidris ferruginea*), Pectoral Sandpiper (*Calidris melanotos*), Eastern Curlew (*Numenius madagascariensis*), Common Greenshank (*Tringa nebularia*). Latham's Snipe (*Gallinago hardwickii*) and Glossy Ibis (*Plegadis falcinellus*).

Important information regarding migratory species includes the following (taken from DAWE Significant Impact guidelines 2013):

What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

a. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or

b. habitat that is of critical importance to the species at particular life-cycle stages, and/or

c. habitat utilised by a migratory species which is at the limit of the species range, and/or

d. habitat within an area where the species is declining.

What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

What is the population of a migratory species?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
Twelve migratory species were identified as having the potential to occur within the construction footprint (PMST and VBA). Most of these species are either highly unlikely to occur (e.g. Curlew Sandpiper, Eastern Curlew) or would very rarely use airspace over these footprints (e.g. Fork-tailed Swift, Yellow Wagtail). It is highly unlikely that the construction footprint supports habitat that would be considered important for migratory species foraging or breeding activity or support an ecologically significant proportion of a population of migratory species. Given that the proposed construction footprint does not provide important habitat for listed migratory species, it is considered unlikely that the planned works would disrupt the lifecycle of an ecologically significant proportion of a population of a migratory species. **No significant impact**
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species
Within the proposed construction footprint it is unlikely that the proposed Guttrum and Benwell Forests Project will result in the introduction of invasive species that might be harmful to migratory species. A Construction Environmental Management Plan will be developed for the project that will include measures such as vehicle hygiene protocols to mitigate the potential spread of weeds. There is potential for the introduction of environmental water to lead to an increase in abundance of feral predators (cats, foxes), herbivores (e.g. goats) and omnivores (e.g. pigs) due to the associated increase in productivity. Some of the species such as cats and foxes could potentially prey on migratory waterbirds. An accompanying feral animal management and control program would need to be implemented within the inundation extent. **No significant impact**
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.
Given that the proposed construction footprint does not provide important habitat for listed migratory species, it is unlikely that the planned works would disrupt the lifecycle of an ecologically significant proportion of a population of a migratory species. **No significant impact**

Appendix P. Fish Assessment – Guttrum and Benwell Forests Floodplain Restoration Project

Jacobs

Memorandum

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Subject	**Guttrum and Benwell Forests Floodplain Restoration Project - Fish Assessment**	**Project Name**	Victorian Murray Floodplain Restoration Project – Guttrum and Benwell Forests (IS297722)
From	Simon Treadwell (R8), Bronwyn Gwyther (R8)		
Date	29 July 2020		
Copies to	**Sarah Hale (R8), Tim Shanahan (VMFRP)**		

Fish assessment

This memo has been developed as an Appendix to the Victorian Murray Floodplain Restoration Project Flora and Fauna Assessment - Guttrum and Benwell Forests Floodplain Restoration Project (R8, 2020). It addresses specific risk to the native fish community from the Guttrum and Benwell Forests Floodplain Restoration Project (the project).

Exec summary

Summary

The investigation of potential impacts of the project on fish identified a range of native fish with the potential to be present in the project area (project construction footprint and inundation area). Of these, five are *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) (Commonwealth) listed fish and seven are *Flora and Fauna Guarantee Act 1988* (FFG) (Victorian) listed. There is also one FFG listed threatened fish community with the potential to occur in the project area.

An assessment of risks to threatened fish and fish communities as a result of construction activities and operation of the project identified potential for the loss of some Murray River bank habitat associated with the construction of pump inlets and outfall regulators. Operation of the project has the potential to entrain fish in pumps, strand fish on floodplains during manged drawdown and expose fish to poor water quality in return flows to the Murray River and reduce organic matter inputs to the river. Mitigation measures built into the design, construction and operation of the project to manage potential impacts will reduce the risks to all identified fish species of conservation significance to low during both construction and operation of the project.

Recommendations for mitigation

Recommended construction mitigation measures include the use of only partial coffer dams to isolate small areas of bank from construction works, relocation of any habitat within works areas to the same river reach and adoption of sediment control and accidental spill measures. If the capture, handling or translocation of fish is required during construction (e.g. dewatering work sites) or operation of the

project, persons undertaking these activities will need to hold the appropriate permit or licence under the Fisheries Act 1995. Any capture of fish must be carried out by a qualified aquatic ecologist.

Recommended operational mitigation measures include the installation and maintenance of appropriately sized fish screens on inlet pumps, management of inundation and drawdown to minimise the likelihood of fish stranding on the floodplain by ensuring opportunities for fish movement during managed drawdown, management of the timing of inundation and drawdown to minimise blackwater risks, enable entrainment of organic matter during flooding events and to ensure appropriate dilution of return flows if low dissolved oxygen is evident.

Mitigation measures associated with construction need to be documented in an Aquatic Fauna Management Plan as part of the Construction Environmental Management Plan to manage impacts to aquatic values – with emphasis on threatened fish species that may be present in vicinity of construction sites or which access floodplain environments.

Mitigation measures associated with operation of the project have been documented in a fish exit strategy as part of the Operating Plan (North Central CMA, 2020) to manage risk associated with fish stranding on the floodplain. This will include requirements for pump design to include fish screens to minimise impacts to fish during pumping events and managed drawdown to cue fish movement off the floodplain. The project's Operating Plan will also need to include measures to reduce the potential for poor water quality of return flows.

1. Introduction

The project objectives are to increase the frequency and duration of inundation of the floodplain forest and semi-permanent wetlands to achieve preferred inundation regimes by pumping water from the Murray River to these floodplain features in years where inundation is required but natural flood events do not occur. A detailed description of the works and design features of the project is provided in the main body of the Flora and Fauna Assessment report for the project (Section 1.3 of R8, 2020).

Aspects of the project which have the potential to cause fish impacts are:

- The construction of new pump stations (two to service the Guttrum Forest and one to service the Benwell Forest) on the Murray River southern bank to transfer water to the floodplain and semi-permanent wetlands.
- The construction of new regulated outlets (drop structures) from the forest to the Murray River to enable managed drawdown of inundated areas and to also allow natural flood events to enter the forests (1 main regulator outlet for each forest on the Murray River southern bank, plus several smaller regulator outlets that are proposed for construction on existing channels that ultimately discharge to the Murray River).
- The construction of a number of containment banks, pipelines, tracks and regulators within each forest.
- Operational activities associated with full River Red Gum floodplain inundation, semi-permanent wetland inundation, hybrid inundation (combination of natural inflows and managed drawdown) and return flows from the floodplain to the Murray River.

1.1 Operating scenarios

Three operating scenarios have been identified for water delivery to the Guttrum and Benwell Forests:

1) Forest floodplain watering – broader floodplain (River Red Gum flood dependent understorey and semi-permanent wetlands). The flooding would replicate a 26,000 ML/day natural event in Guttrum Forest and a 24,000 ML/day event in Benwell Forest. The target frequency for forest floodplain watering based on water regime requirements is on average eight years in 10 for between three to five months. Pumping would be required on average three years in 10 to achieve the target eight years in 10 years inundation frequency, with inundation in other years provided through natural inundation and Basin Plan 2750 flows. Return flows (e.g. manged outflows) from the forests to the Murray River would occur during managed River Red Gum watering events. Planned inundation would occur in late Winter with a Spring drawdown, and a target period inundation of four months.
2) Semi-permanent wetland watering – targeted water delivery to wetlands only. The target inundation regime for semi-permanent wetlands is nine years in 10 for a duration of six months. Top up watering events after natural inflow events (under Basin Plan 2750 flows) to semi-permanent wetlands would be required on average seven years in 10 to achieve this inundation regime. This pumping would be in addition to the forest floodplain watering scenario which would also inundate the semi-permanent wetlands on average three years in 10. Both scenarios combined would require pumping to semi-permanent wetlands every year, which would achieve the target nine years in 10 years inundation frequency. Manged outflows would not be undertaken in managed semi-permanent wetland watering events.
3) Hybrid events – top up watering of the floodplain with environmental water following natural flood peaks, and/or flood capture to achieve the required flooding duration and extent to meet floodplain vegetation and bird breeding hydrological requirements. Three hybrid opportunities have been identified in the project operating plan; however, other hybrid water delivery opportunities may also arise and be undertaken. The hybrid flow opportunities described in the operating plan (NCCMA 2020) are:

    - Follow up watering of the forest floodplain following natural flow peaks and/or flood capture to achieve required flooding extent and/or duration where natural flood event extent or duration is inadequate to achieve ecological objectives.
    - Top-up watering of the semi-permanent wetlands following natural flow peaks to achieve required flooding duration where natural flood event duration is inadequate to achieve ecological objectives.
    - Delivering a waterbird breeding scenario in association with environmental cues including topping up wetlands to support natural bird breeding events when required.

There are two options for extending the duration of natural floods that inundate the broader forest:

- Flood capture to retain floodwater on the floodplain for the required duration by closing the outlet regulators and low-lying inlet regulators from the River Murray after the river flow peak has passed
- Pumped deliveries of up to 125 ML/ day at each of the three pump stations to top up the natural inflows with additional volume of water from the river.

The key operational activities and operating (environmental watering) scenarios are outlined further in the Guttrum Forest & Benwell Forest Operating Plan (NCCMA 2020) and the volume and timing of the environmental watering events are provided in Appendix A of this document.

1.2 Fish passage and exit

As there is limited permanent wetland habitat in the forests (one small wetland near the River Murray bank in Guttrum Forest) the project focuses on providing benefits to in-channel native fish, rather than encouraging fish to enter the floodplain during managed events. However, fish may still enter the floodplain, predominantly via natural flood events.

A fish exit strategy has been developed to encourage and enable fish to move off the floodplain during drawdown. A sharp drop in water level will be provided during the drawdown phase of hybrid forest watering events, as a way of cueing native fish to exit the floodplain and enter the River Murray. Following the sharp drop, flows will be increased for a short period and a second drop provided to cue any remaining fish to exit the floodplain. During this period, pumped inflows will continue for a time to retain connectivity across the floodplain to allow fish to migrate to outlet points before inflows cease and connectivity across the floodplain is lost. Minimum inflows during drawdown will be determined on an event-by-event basis and refinement of the fish exit strategy will be ongoing in response to monitoring and will be undertaken in consultation with fish ecologists (NCCMA 2020).

The design of all regulators and drop structures allows for passive fish passage. Guttrum Main Regulator, Benwell Main Regulator and Benwell East Regulator are all dual leaf gate regulators and therefore will be designed to regulate and pass outflows at different water levels (i.e. they will not just be open or closed). This will ensure that passive fish passage can be achieved in overshot mode with water passing over the gates. A plunge pool at these three regulators will also be provided immediately downstream of the gate for safe fish passage. All other regulator structures would be operated either in fully open or fully closed position. When water is released with the regulator gate in fully open position, fish have passage through the regulator both in managed release and natural flood scenarios. Structures have also been designed to have flow velocities appropriate for fish passage (based on O'Connor et. al, 2015). During watering events, fish will be able to move across all submerged areas.

All pumps will contain screens on the pump inlets with a 2 mm hole aperture, a screen approach velocity of <0.12 m/s and automatic screen cleaning mechanisms.

1.3 This memo

The following sections:

- Outline the state and commonwealth legislation pertinent to the protection of threatened fish during construction and operation of the project (Section 2).
- Document the threatened fish species considered likely to be present in the Murray River or Guttrum and Benwell Forests floodplain environment within the project area (Section 3).
- Provide an assessment of risks to fish associated with construction activities (pumps and drop structures on the Murray River and structures within the forest areas (areas of inundation) and operational activities (floodplain and semi-permanent wetland watering), and recommended mitigation measures (Section 4).

2. Relevant legislation

This section outlines additional state legislation and approval requirements relevant to the protection of fish and their habitat during construction and operation of the project.

2.1 Commonwealth Legislation

2.1.1 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The EPBC Act is the Australian Government's key piece of environmental legislation, focused on the protection of matters of national environmental significance (MNES), with the states and territories having responsibility for matters of state and local significance. The EPBC Act is the legislative mechanism for the protection of threatened species at a federal level.

The following EPBC Act listed fish species may be present at the project areas and potentially impacted by construction and/or operation of the Project:

- Silver Perch *(Bidyanus bidyanus)* – critically endangered
- Murray Hardyhead *Craterocephalus fluviatilis*) – endangered
- Flat-headed Galaxias (*Galaxias rostratus*) – critically endangered
- Murray Cod (*Maccullochella peelii*) - vulnerable
- Macquarie Perch (*Macquaria australasica*) – endangered.

2.2 Victorian State Legislation

2.2.1 *Environment Effects Act 1978* (EE Act)

The EE Act provides for the assessment of proposed projects (works) that are capable of having a significant effect on the environment. Criteria are used to determine whether referral under the EE Act is warranted and hence whether an Environmental Effects Statement (EES) may be required. The relevant criteria for referral include matters relating to long-term impacts to native vegetation, threatened species, listed wetlands, freshwater, estuarine or marine ecosystems, community health and greenhouse gas emissions. This assessment considers those criteria which are relevant to threatened fish species, namely matters listed under the Flora and Fauna Guarantee Act 1988 such as critical habitat and genetically important populations of endangered or threatened species.

2.2.2 *Flora and Fauna Guarantee Act 1988* (FFG Act)

The FFG Act is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. The FFG Act places importance on prevention to ensure that more species do not become threatened in the future. The Act has recently been amended (*Flora and Fauna Guarantee Amendment Act 2019*) with potential implications likely to become apparent in July 2020. Of particular importance is the requirement for public authorities to consider matters protected under the FFG Act when planning projects.

The following FFG Act listed fish species and fish community may be present at the project areas and potentially impacted by construction and/or operation of the Project:

- Macquarie Perch
- Murray Cod
- Unspecked hardyhead (*Craterocephalus stercusmuscarum fulvus*)
- Murray Hardyhead
- Silver Perch

- Freshwater catfish (*Tandanus tandanus*)
- Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*)
- Lowland riverine fish community of the southern Murray Darling Basin.

2.2.3 Other relevant legislation

There are a number of other potential legislative implications for the project that may result from the removal of native vegetation and/or fauna habitat within the construction footprint. These are discussed in more detail in Section 10 of the Flora and Fauna Assessment - Guttrum and Benwell Forests Floodplain Restoration Project (R8, 2020) and include:

- *Wildlife Act 1975*
- *Environment Protection Act 1970*
- *Fisheries Act 1995*
- *Water Act 1989*

2.3 NSW State Legislation

While the relevance of NSW legislation to the project has been referenced here, a detailed assessment has not been undertaken as the focus of this memo is Victorian and Commonwealth legislation.

2.3.1 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The Murray River in the project area has the potential to support three threatened fish, one threatened population and one threatened ecological community, as listed under Schedule 4, 4A and 5 of the FM Act:

- Silver perch
- Murray hardyhead
- Flat headed galaxias
- Murray-Darling Basin population of freshwater catfish
- Lower Murray River aquatic ecological community

Issues that may be pertinent to the construction and operation of the project under the FM Act include loss of habitat, barriers to fish movement and changes to river flows. An assessment of the project against these issues has not been completed as part of this assessment.

3. Species present

Threatened aquatic species listed under the Commonwealth EPBC Act, the Victorian FFG Act and the NSW Fisheries Management Act are potentially present in the project area (project construction footprint and inundation area), including the Murray River. Table 3-1 provides a summary of the threatened fish species that may be present, drawn from a list presented in the Ecology report (Section 6.3 of R8, 2020), which included data sourced from the Protected Matters Search Tool (PMST) and the Victorian Biodiversity Atlas (VBA) (as detailed in Section 3 of R8 2020), and has been augmented with

information from the NSW Fisheries threatened species distribution habitat mapping (NSW DEPI 2020).

The following terminology is used throughout the table:

- **PRESENT** – Species known to occur within the construction footprint and inundation area.
- **POSSIBLE** – Potentially suitable habitat occurs within the construction footprint and inundation area and species' known range encompasses these areas. Species recorded historically in the 10 km search area, within the last 30 years.
- **UNLIKELY** – Species' known range encompasses the construction footprint and inundation area, but suitable habitat does not occur within these areas, or occurs within these areas but with generally low quality and quantity. Species recorded historically within 10 km of project area but not within the last 30 years.
- **HIGHLY UNLIKELY** – No historical records of the species within the last 30 years and/or no suitable habitat in the 10 km project area.

Table 3-1. Likelihood of occurrence for threatened fish considered potentially present within either the construction footprint or inundation area (adapted from R8 2020).

Scientific name	Common Name	EPBC Act	FFG Act	DELWP Advisory	NSW threatened species	Likelihood of Occurrence
Bidyanus bidyanus	Silver Perch	CR	Listed	vu	vu	**Possible.** The species is a main-channel specialist with suitable habitat limited to the Murray River. While they have been recorded in a wide range of habitats, they have been noted to prefer fast flowing waters, and open waters more than heavily snagged (DSE, 2005). While there are no recent records from the immediate vicinity of the project area, they are regularly encountered in the Murray River upstream and downstream of the project area and the Murray River in vicinity of project area has been mapped as possible habitat by NSW Fisheries. They are expected to be present Murray River in the project area from time to time. May enter forest areas during inundation events, but seasonally inundated semi-permanent forest wetlands do not provide suitable long term habitat.
Craterocephalus fluviatilis	Murray Hardyhead	EN	Listed	cr	cr	**Very unlikely.** The Murray Hardyhead occurs in still and slow-flowing waters including billabongs, lakes and margins and backwaters of lowland rivers and may exhibit a preference for inland waters with elevated salinity (Backhouse et al, 2008). The Project area is within the likely former distribution of the species and is within 50 km of current population (at Round Lake, Swan Hill) (Backhouse et al, 2008) and Lake Elizabeth (near Kerang) but there are no records from the project area. The Murray River in vicinity of project area has been mapped as possible habitat by NSW Fisheries, but there have been no recent records. Seasonally inundated floodplain forest wetlands are unlikely to provide suitable habitat.
Craterocephalus stercusmuscarum fulvus	Unspecked Hardyhead		Listed			**Possible.** Preferred habitat is margins of slow flowing rivers, backwaters and wetlands (Lintermans, 2007). Has been recorded from Little Murray River and Gunbower Creek in the past 10 years, so it is possible that individuals are present in the Murray River.
Galaxias rostratus	Flat-headed Galaxias	CR	Ineligible	vu	cr	**Unlikely.** Preferred habitat is margins of slow flowing rivers, backwaters and wetlands (Lintermans, 2007). Was last recorded in the Kerang Lakes areas in 1963. The Murray River in the vicinity of project area has been mapped as possible habitat by NSW Fisheries (edge of range). Recent records are only from the Goulburn River and upper Murray Catchments. Unlikely to be present in project area.
Maccullochella peelii	Murray Cod	VU	Listed	vu		**Present.** The species occurs in a range of flowing and standing waters, from small, clear, rocky streams to large, turbid, meandering slow-flowing rivers, as well as and lakes and larger billabongs. While it will make use of inundated floodplain channels, it is considered a main-channel specialist (National Murray Cod Recovery Team, 2010). It has been frequently recorded from the Murray River upstream and downstream of the project area. Presence in the Murray River at the project area should be assumed. May enter forest areas during inundation events, but seasonally inundated semi-permanent forest wetlands do not provide suitable long term habitat.
Macquaria ambigua	Golden Perch			nt		**Present.** The species is are a main-channel specialist with suitable habitat limited to the Murray River. Has been frequently recorded from the Murray River upstream and downstream of the project area. Presence in the Murray River at the project area should be assumed.

Scientific name	Common Name	EPBC Act	FFG Act	DELWP Advisory	NSW threatened species	Likelihood of Occurrence
						May enter forest areas during inundation events, but seasonally inundated semi-permanent forest wetlands do not provide suitable long term habitat..
Macquaria australasica	Macquarie Perch	EN	Listed	en	en	**Very unlikely.** The species is a main-channel specialist. As not been recorded from the Murray River since 1970. Current records are from the upper Goulburn and Mitta Mitta catchments in Victoria and the Murrumbidgee catchment in NSW. The Murray River in the project area has not been mapped as potential habitat for Macquarie perch. Is very unlikely to be present in the project area.
Melanotaenia fluviatilis	Murray Darling Rainbowfish		Listed	vu		**Possible.** Preferred habitat is margins of slow flowing rivers, backwaters and wetlands (Lintermans, 2007). Has been recorded from Little Murray River and nearby tributaries of the Murray River in the past 10 years, so it is possible that individuals are present in the Murray River. May enter forest areas during inundation events, but seasonally inundated semi-permanent forest wetlands may provide suitable long term habitat if water is frequently retained for long durations.
Tandanus tandanus	Freshwater catfish		Listed	en	en (Murray-Darling Basin population)	**Possible.** A benthic species that prefers slow-flowing streams and lake habitats (Lintermans, 2007). Has been recorded from Little Murray River and Gunbower Creek wetlands in the past 10 years. The Murray River in vicinity of project area has been mapped as possible habitat by NSW Fisheries. It is possible that individuals are present in the Murray River.

In addition to individual species, there are two threatened communities within the project area on the Victorian and NSW sides:

- Lowland riverine fish community (FFG listed)

  The FFG listed fish community Lowland Riverine Fish Community of the Southern Murray-Darling Basin is also present and potentially impacted by the Project. This community is characteristic of the geographical area that defines its distribution (broadly defined as lowland river reaches and associated floodplains of the Murray River tributaries in Victoria that drain the northern slopes of the Great Dividing Range, together with the lowland section and floodplain of the Murray River upstream of the South Australian border), and by a selected suite of native fish taxa that is typical of and largely restricted to the area. Species include Agassiz's Chanda Perch (*Ambassis agassizii*), Silver Perch, Murray Hardyhead, Non-specked Hardyhead, Flat-headed Galaxias, Western Carp Gudgeons (*Hypseleotris klunzingeri*, now considered to be a species complex), Trout Cod (*Maccullochella macquariensis*), Murray Cod, Golden Perch, Macquarie Perch, Murray Darling Rainbow Fish, Southern Purple-spotted Gudgeon (*Mogurnda adspersa*), Bony Bream (*Nematalosa erebi*), Flat-headed Gudgeon (*Philypnodon grandiceps*) and Freshwater Catfish.

  Other widespread or uncommon species may also occur over parts of the distribution of this community: Southern Pigmy Perch (*Nannoperca australis*), River Blackfish (*Gadopsis marmoratus*), Two-spined Blackfish (*Gadopsis bispinosus*), Australian Smelt (*Retropinna semoni*), Short-headed Lamprey (*Mordacia mordax*), Short-finned Eel (*Anguilla australis*), Broad-finned Galaxias (*Galaxias brevipinnis*) and Barred Galaxias (*Galaxias fuscus*) (https://www.environment.vic.gov.au/__data/assets/pdf_file/0018/50418/04072019-Flora-and-Fauna-Guarantee-Characteristics-of-Threatened-Communities-3.pdf).

  Not all of the species listed in the Lowland riverine fish community are expected to be present in the actual study area.

- Lower Murray River aquatic ecological community (NSW Endangered Ecological Community)

  The lower Murray aquatic ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut Rivers, as well as all their tributaries and branches (NSW DPI 2007). The geographical range of this community includes the Murray River in the project area. This ecological community is listed as an endangered ecological community in NSW, meaning that it is likely to become extinct in nature in NSW, unless the circumstances and factors threatening its survival and evolutionary development cease to operate. The listing of the lower Murray River aquatic ecological community has several legal implications, including the establishment of heavy penalties for harming (without appropriate authority) species or habitats that form part of the community. Potential impacts on the ecological community must be considered during development assessment processes. Threats to the community include:

  - Modification of natural river flows and temperature regimes,
  - Predation, competition, diseases and habitat modification from introduced fish species,
  - Degradation of the riparian (riverbank) zone through stock access and clearing of native vegetation, leading to loss of shelter and increased sedimentation,
  - Removal of in-stream large woody debris
  - Poor land management practices and associated water quality impacts
  - Over-fishing

3.1 Habitat grouping

As any potential impact to fish species from the Project will depend on the habitat they utilise during construction and operation of the project, the listed fish species will be referred to by the following groupings subsequently in this report: main channel specialists and wetland specialists.

3.1.1 Main channel specialists

Main channel specialists are larger bodied fish that prefer flowing and deeper water habitats such as the Murray River alongside the project area. This includes three threatened fish species considered potentially present within the project area: Murray cod, Silver perch and Golden perch. There are records of both Golden Perch and Silver perch within 10 km of the project area. Other large bodied native fish once present in the region include Macquarie perch and trout cod, however neither have been recorded since the 1970s and are no longer considered to be present in the study area. All these species are considered as main-channel specialist with suitable habitat limited to the Murray River (as outlined in Table 3-1).

3.1.2 Wetland specialists

The Murray hardyhead, Unspecked hardyhead and Flat-headed Galaxias, Murray-Darling rainbowfish and Freshwater catfish are considered wetland specialists, given their preference for slow-flowing and still waters. However, they may also be found in main channel habitats from time to time (for example the Murray River has been classified as potential habitat for freshwater catfish and flatheaded galaxias adjacent to the project area). Plus, these species are likely to re-distribute across floodplain wetlands via the main channel during natural inundation events. It is likely that they can re-colonise semi-permanent floodplain wetlands following natural inundation events and persist in those environments during wet phases.

4. Impact assessment

4.1 Approach

Risks to fish are associated with construction activities and operational activities. Direct construction activities are separated into two types; construction of pumps and drop structures on the bank of the Murray River and construction of regulators, pipelines and containment banks within the floodplain. Operational impacts are separated into three types; entrainment in pump infrastructure, floodplain inundation and drying, and impacts associated with water quality of return flows to the Murray River during managed drawdown. Each of these risk pathways and potential impacts to fish communities are detailed below.

The assessment uses a qualitative approach to evaluate the level of risk based on exposure (or likelihood) and consequence (Table 4-1) (definitions of exposure and consequence, taking into consideration the likelihood/extent of potential exposure are provided in Table 4-2 and a description of the risk categories are provided in Table 4-3).

Mitigation measures that have already been agreed to through the design process (e.g. coffer dams, screens on pumps etc) are included in the assessment of impact/risk. Risks that are rated low or very low are considered to be acceptable and do not require further mitigation. However, for moderate, high and very high impacts/risks, additional mitigation measures may be required. A revised risk rating is determined based on implementing the mitigation measures.

Table 4-1. Matrix for defining risk to values.

	Consequence	High	Medium	Low
Exposure (likelihood)	Low	Moderate	Low	Very low / no impact
	Minor	High	Moderate	Low
	Moderate	Very high	High	Moderate
	Strong	Very high	Very high	High

Table 4-2. Exposure and consequence rating descriptions.

Risk Component	Rating	Description
Exposure (likelihood)	Low	▪ Exposure is remotely likely and/or weak and/or occurs to an insignificant spatial extent. ▪ Only occurs in exceptional circumstances
	Minor	▪ Exposure is rare and/or mild and/or occurs in a localised or patchy spatial extent. ▪ Could occur in a few circumstances but not expected.
	Moderate	▪ Exposure is common and/or intense and/or occurs broadly. ▪ Could occur, not uncommon ▪ Evidence to support it will happen
	Strong	▪ Exposure is frequent or constant and/or intense and/or widespread. ▪ Is expected to occur in most circumstances.
Consequence	Low	▪ Minimal or no loss of habitat considered critical for the survival of a population ▪ Area affected negligible compared to area of total population
	Medium	▪ Moderate modification, destruction, removal or decrease of local habitat, however not considered critical for survival of a significant population as a whole ▪ Population in other locations not impacted ▪ Loss of connectivity between habitats at a local scale
	High	▪ Loss of habitat considered critical for the survival of a significant population ▪ Major reduction or loss of significant population ▪ Serious and significant impact on Matter of National Environmental Significance

Table 4-3. Description of risk categories.

Rating	Risk
Very low	▪ No reasonable prospect that existing values will be impacted.
Low	▪ Localised impacts on species that are common and widespread across the landscape. ▪ No specific risk management actions required
Moderate	▪ Loss of species of local or regional conservation significance at the site scale but with no consequence for the species at the regional scale ▪ The threat (e.g. blackwater in return flows) has the potential to occur but it is not likely to cause significant environmental harm. ▪ Impacts can be easily mitigated.
High	▪ Impact on *EPBC Act 1999* or *FFG Act 1988* listed species / communities at the site scale but with no consequence for the species at the regional scale. ▪ The threat (e.g. blackwater in return flows) will occur and will have harmful consequences or objectives will be significantly compromised. ▪ Risk management is essential but is likely to be successful at mitigating impacts.
Very High	▪ Impact on *EPBC Act 1999* or *FFG Act 1988* listed species / communities at the site scale and with consequence for the species at the regional scale. ▪ The threat is likely to occur and will have very harmful consequences. ▪ Risk management may not be sufficient to mitigate impacts.

4.2 Construction impacts

Construction impacts include the potential for loss of habitat, barriers to fish movement and degradation of water quality associated with sediment runoff or accidental spills. Table 4-4 summarises the construction threats and ranks risks.

Overall the construction related risks associated with the project are considered low provided mitigation measures proposed as part of the project's construction are implemented. Mitigation measures to be undertaken during the construction of the project include the use of coffer dams to isolate sections of bank where works will take place. Coffer dams will not extend across the channel and hence will not constitute a barrier to fish movement. Any habitat (e.g. snags) within the works area will be relocated with the same river reach. Standard construction site mitigation measures will be implemented to manage sediment runoff and accidental spills. Works on the floodplain will occur during dry phases when fish will not be present.

An Environmental Management Framework will be prepared as part of the project and will require development of a Construction Environmental Management Plan (CEMP). The CEMP must include management actions specific to the protection of aquatic fauna for all works around waterways (e.g. relocation of habitat, translocation of any individuals trapped within works areas).

Table 4-4. Short term impacts on significant environmental values associated with construction.

		Risk		
Value	**Description of potential outcome**	**Consequence**	**Likelihood**	**Overall risk rating**
Pump and Murray River regulator/outfall construction				
Main channel specialists (e.g. Murray cod, Silver perch)	Construction activities in the Murray River will be restricted to localised bank areas on the Victorian side. Construction involves the isolation of the works area with a coffer dam, excavation of bank material, installation of pump or regulator infrastructure, rectification of banks and removal of coffer dams. Bank protection may be provided in the form of rock beaching around outlets to prevent erosion. Construction activities have the potential to result in habitat loss (e.g. removal of snags or other habitat on the river bank), mobilisation of sediment, accidental spills, interruptions to fish movement, trapping of individual fish within the coffer dam areas. Mitigation measures are ensuring coffer dams do not extend across the full width of the river, any habitat within the construction zone is relocated within the reach, any fish that are trapped in the work zone are relocated directly to the river outside the work zone, standard sediment controls are implemented. Mitigation measures, contingency and emergency response measures should be documented in a Construction Environmental Management Plan.	**Low** Area potentially impacted is small relative to the overall area of available habitat. The use of coffer dams that do not extend across the river will ensure fish passage is maintained. Water quality impacts will be managed through a Construction Environmental Management Plan.	**Minor** Where possible, exposure will be avoided through detailed design. If exposure does occur, it is minor in the context of the fish community as a whole. Exposure is also short term, for the duration of construction.	**Low** Assuming nominated mitigation measures are implemented as part of the implementation of a Construction Environmental Management Plan.

		Risk		
Value	Description of potential outcome	Consequence	Likelihood	Overall risk rating
Floodplain regulator, containment bank and pipeline construction				
Wetland specialists (e.g. Murray Darling rainbowfish, Murray hardy head etc)	Construction activities involve ground disturbance and potential loss of habitat in construction footprint. Construction activities are limited to floodplain areas that are not critical fish habitat and will be undertaken during dry conditions when no aquatic biota would be present on the floodplain. However, there is still potential for mobilisation of sediments that may discharge into wetland habitats during rainfall events. Mitigation measures, contingency and emergency response measures should be documented in a Construction Environmental Management Plan.	**Low** Construction will take place during dry conditions	**Low** Exposure will be avoided because of dry conditions	**No impact**

4.3 Operational (inundation) impacts

Operational impacts include the potential for entrainment of fish in pump infrastructure, exposure to poor water quality during inundation events, stranding during managed drawdown events and exposure to poor water quality in return flows to the Murray River during managed drawdown and changes to Murray River flows as a result of pump diversions. Overall impacts to fish are expected to be low provided mitigation measures proposed as part of the project operation are implemented. Recommended operational mitigation measures include the installation and maintenance of appropriately sized fish screens on inlet pumps, management of inundation and drawdown to minimise the likelihood of fish stranding on the floodplain by ensuring opportunities for fish movement during managed drawdown, management of the timing of inundation and drawdown to minimise blackwater risks and to ensure appropriate dilution of return flows if low dissolved oxygen is evident. Table 4-5 summarises the threats and ranks risks and more detail for each threat is provided below.

An Operation Plan will be prepared as part of the project and will include mitigation measures specific to the protection of aquatic fauna for operation of the project (e.g. fish exit strategy and management of return flows). The Environmental Water Management Plans for Guttrum and Benwell Forests will also include mitigation measures to manage the risk associated with the delivery of environmental water (e.g. poor water quality).

Table 4-5. Impacts on significant environmental values associated with operations.

		Risk		
value	Description of potential outcome	Consequence	Likelihood	Overall risk rating
Pump entrainment				
Main channel specialists (Murray cod, Silver perch)	Fish present in the Murray River in the vicinity of pumps have the potential to be entrained in pumps during operation. Pumps will be screened to minimise the likelihood of entrainment and mortality.	**Low** Inlet screens will minimise entrainment.	**Low** Pumping is timed to occur during periods when eggs and larvae are unlikely to be present in significant	**Low** Assuming pump screens are effective and maintained.

		Risk		
value	Description of potential outcome	Consequence	Likelihood	Overall risk rating
			numbers in the water column.	
Floodplain and semi-permanent wetland inundation and drying				
Wetland specialists (Murray Darling rainbowfish, Murray hardy head etc.)	Manged inundation of floodplain forest will not occur in every year. When events do occur the inlet screens on pumps will minimise the likelihood of fish entering the floodplain and semi-permanent wetlands during managed inundation events. However, fish that do enter the floodplain during inundation have the potential to be impacted during drawdown and by a dry phase. During floodplain drawdown fish will be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. However, some individuals may get trapped in semi-permanent wetlands once forest drawdown is complete. These individuals may die as the wetland dries (depending on whether full drying occurs). On this basis there is a risk to any individuals present in these wetlands during drawdown. However, the establishment of semi-permanent wetlands has the potential to create additional habitat for wetland specialists, especially if some of these wetlands retained water between inundation events. Furthermore, the species likely to be present are also present more broadly across the landscape and the floodplain wetlands at Guttrum and Benwell Forests are not critical habitat for any of these species so risk to the fish community at the individual species scale and at the regional scale the risks are low.	**Minor** Screens on pumps will minimise the number of fish that enter the floodplain during managed inundation events. There will be opportunities to move out of drying habitats via downstream regulators during managed drawdown.	**Minor** Exposure will be minimised because few fish will be present on floodplain environments during managed events	**Low** Assuming pump screens are effective and maintained and opportunities are provided for movement off the floodplains during managed drawdown.
Exposure to poor water quality in return flows to the Murray River				
Main channel specialists (Murray cod, Silver perch)	During managed drawdown water on the floodplain may have become low in dissolved oxygen due to organic matter decomposition and elevated in salinity due to leaching from soils. Water containing low dissolved oxygen or elevated salinity has the potential to impact on fish as it returns to the Murray River. The degree of impact depends on the extent of dissolved oxygen decline in return waters and the relative volumes of return water to passing flows in the Murray River (and hence dilution potential). The relevant impact pathways associated with return flows during operation of the project are associated with poor water quality (blackwater, low dissolved oxygen and/or high salinity) entering the Murray River as return flows following environmental watering.	**Low** Return flow volumes are small (approx. 25 ML/d) and will occur at a time of year when passing flows in the Murray River are high (i.e. during the irrigation season).	**Low** Any water low in DO will be quickly mixed with Murray River flow and re-oxygenated. Fish that are in the immediate vicinity of return flow will be able to move to areas of higher oxygenation within the Murray River channel. On this basis the likelihood of exposure to poor quality water is low.	**Low** Risks are likely to be low, but could be further managed through monitoring of the return flows during drawdown and manipulating the release rates to ensure that suitable mixing occurs with the Murray River if DO in return water is low.
Changes in Murray River flow				
Main channel specialists (Murray cod, Silver perch)	The diversion of environmental flows from the Murray River to the Project Area could potentially impact main channel specialists, if the diversion was large in relation to river flows. However, the proposed diversion volume (maximum 375 ML/day) is small in relation to Murray River flows and will not noticeably reduce river levels to the extent that there would be a reduction of river depths or loss of access to bank habitat for fish.	**Low**	**Low**	**No impact**

4.3.1 Pump entrainment

Entrainment of fish through pumps has the potential to result in mortality and loss of eggs and larvae that could diminish riverine populations. To minimise impacts fish screens will be installed on pump inlets. The fish screens on the project pumps will have a maximum aperture size of 2 mm, a maximum screen approach velocity of 0.12 m/s and automatic screen cleaning mechanisms. This is consistent with recommendations for screen size and approach velocity to minimise risks to Murray-Darling Basin native fish (Boys et al. 2013; Stock et al. 2019).

Timing of pumping can also influence the likelihood of entrainment of fish, especially eggs and larvae, with winter pumping also less likely to entrain eggs and larvae of carp (Brown et al. 2014). Furthermore, spawning of most native fish occurs from mid spring onwards (SKM 2003), so avoiding pumping from mid spring onwards will also minimise the likelihood of eggs and larvae present in the water column of the Murray River from being entrained.

Although some mortality still may occur, the overall impacts to fish populations is expected to be low provided screens are maintained.

4.3.2 Inundation and drawdown

Manged inundation of floodplain forest (including semi-permanent wetlands) will occur 3 years in 10 and managed inundation of semi-permanent wetlands will occur an additional 4 years in 10 (providing 7 years in 10 inundation of semi-permanent wetlands). The Project has been designed to exclude fish from the floodplain wetlands as far as practicable (through fish exclusion screens and a pumping-only inundation method), however it is possible that some fish may make it onto the floodplain through the pumps. There is also the potential for fish to be present in floodplain wetlands from previous natural inundation events (NCCMA 2014b). Outlet regulators will provide for unrestricted fish passage during manged drawdown and natural floodplain inundation events. This provides any fish on the floodplain with the opportunity to exit the floodplain as inundation recedes (either natural or through managed drawdown). However, there is a risk than some fish could still become stranded on the floodplain or within semi-permanent wetlands. Note that this is risk associated with natural drying events as well and managed events. Despite potential risks during drawdown, the establishment of semi-permanent wetlands has the potential to create additional habitat for wetland specialists, especially if some of these wetlands retain water between inundation events.

The combination of screens on pump inlets to minimise fish entry to the floodplain during a managed event and the provision of fish passage from the floodplain to the river during managed drawdown is likely to minimise risks to fish populations, although some individuals may still become stranded (as is the case with natural inundation events). However, the overall risk to populations is considered low (NCCMA 2014a). Furthermore, a detailed Operation Plan (including fish exit strategy) and Environmental Watering Management Plans for Guttrum and Benwell Forests with clear objectives around the timing of inundation events and managed drawdown and a monitoring and evaluation program will be implemented to monitor and adaptively manging any risks that do arise.

4.3.3 Return flows

Natural and managed inundation of floodplains has the potential to result in poor water quality as a result of the decomposition of organic carbon and consequent decrease in dissolved oxygen levels, and also increases in salinity due to leaching of salt from inundated soils. Exposure to poor water quality has the potential to impact on fish, especially if that water is returned to the Murray River. Each of these risks is discussed below.

Blackwater

If warm water and high organic carbon levels on the floodplain during inundation create high organic and microbial load, blackwater with low dissolved oxygen and pH (and possibly toxic solutes) may result. Disposal of any blackwater to the Murray River through return flows during or following a managed inundation event will involve the management of outflow rates to ensure appropriate dilution, as well as increased flood frequency to prevent high organic load build up (NCCMA 2014a). Risks may be higher for hybrid flow events as the timing of the flood will not be able to be controlled and may start as late as mid Spring, leading to floodplain inundation during the hotter months and a higher risk of stratification and low dissolved oxygen levels (NCCMA 2020).

When risks of blackwater are higher, (e.g. due to a long interval since the last flood and associated organic matter build up), the forests may be inundated in mid-May as a way of leaching the organic matter prior to the start of a planned River Red Gum watering event in July of that year. Flows would be returned to the Murray River prior to hypoxia occurring. This flushing flow would reduce the risk of blackwater occurring during the July event but would also result in some loss of floodplain productivity. It is expected that these flushing flows would be required less once a more frequent floodplain inundation regime was established through operation of the project. Minimum inflows will also be used to maintain water quality on the floodplain (NCCMA 2020).

Return flows to the Murray River from the Guttrum and Benwell Forest floodplain will be in the order of 5,500 ML in total for each full River Red Gum watering event (note that watering of the semi-permanent wetlands does not result in return flows), which is planned for 3 years in 10. Return flows during the maintenance and drawdown periods of environmental watering are modelled to be around 25 ML/d for each site (DHI 2014, cited in NCCMA 2020) during the August and November period. No return flows are planned during the filling period. The volume of return flows planned is likely to be very low in comparison to Murray River flows. If compared with flow rates downstream of the Torrumbarry Weir during the period 1974 – 2020 which ranged between 1,300 – 59,905 ML/d (MDBA 2020), return flows represent 0.00042 – 0.019 % of the Murray River flows. Note that the Project has been designed with maximum possible outflows of 200 ML/day for Guttrum Forest and approximately 75 ML/day and 1500 ML/day at the Benwell East and Benwell Main outlets respectively (DHI 2014, cited in NCCMA 2020). This additional outflow capacity has been provided for risk management purposes (e.g. infrastructure failure). Return flows during the maintenance period aim to provide freshening inflows to manage water quality and provide a continuous carbon and organic matter rich outflow to the Murray River (NCCMA 2020).

Within the project area, the risk of blackwater was considered to be low once mitigation measures were in place (NCCMA 2014a). This suggests that there is minimal risk of low dissolved oxygen levels occurring within the Murray River as a result of blackwater from the forests entering via return flows.

Mitigation measures included:

- timing of inundation in winter and early spring when temperatures are low and risk of excessive decomposition is low
- monitoring organic matter loads on the floodplain prior to inundation
- monitoring quality of water coming into the inundation area
- monitoring risk factors (e.g. dissolved oxygen and temperature)
- managing through-flows and flooding to manage risk

- managing outflow rates to ensure dilution with Murray River flows
- managing flood frequency to prevent high organic load build-up.
- retaining blackwater on the floodplain in the unlikely scenario that River Murray flows are inadequate to safely dilute the blackwater (NCCMA 2014a).

Salinity

Elevated salinity associated with return flows to the Murray River has the potential to pose a short-term risk to main channel specialists (during the period of return flow to the river). A semi-quantitative assessment of the potential salinity impacts of environmental watering activities at the Guttrum and Benwell Forests was undertaken. Mobilisation of salt from either the soil surface or from shallow groundwater to return to the Murray River was considered to be negligible for the forests. The estimated salinity impact at Morgan under the operating scenarios was found to be <0.01 µS/cm EC (Jacobs 2014, cited in NCCMA 2014a). Therefore, salinity from return flows represents a low risk to fish.

4.3.4 Reduction in nutrient and organic matter inputs

Retaining floodwaters on the floodplain as part of a hybrid watering event could prevent organic matter and nutrients from being delivered to the Murray River from the floodplain via entrainment in flood flows that would normally occur during a natural floodplain inundation event. This pulse of organic material and nutrients to the river is important for delivering potential food resources for macroinvertebrates and fish that live in the main channel.

While the Guttrum and Benwell Forests only represent a small portion of the potential floodplain inundated during a natural flood event, if large portions of the floodplain were to have natural floodwaters retained on the floodplain then the cumulative impacts could be large. The impact to fish of the Project in isolation is expected to be insignificant however. Enhancing River Murray native fish populations by increasing access to productive floodplain outflows is an objective of the Project (NCCMA 2014c,d). Mitigation of this potential risk is to operate the Project Area as a through flow system during natural inundation events (leaving regulators in the open position) until after the flood peak has passed, then close regulators (while allowing return flows) and maintain the desired floodplain inundation extent and duration using pumped inflows. This will allow the floodwaters to entrain organic matter and nutrients and return these to the river during through flow, prior to retaining the remaining water on the floodplain or releasing it at a slower rate during return flows.

4.3.5 Reduced Murray River flows

The diversion of environmental flows from the Murray River to the Project Area could potentially impact main channel specialists, if the diversion was large in relation to river flows. However, the proposed maximum diversion volume (375 ML/day) is small in relation to Murray River flows, which have ranged between 1,300 – 59,905 ML/d downstream of the Torrumbarry Weir during the period 1974 – 2020 (MDBA 2020). A daily maximum pumping rate of 375 ML/d will not noticeably reduce river levels to the extent that there would be a reduction of river depths or loss of access to bank habitat for fish. It is also proposed that the environmental water requirements for the project (and all VMFRP sites) will be added to the existing river flows and therefore managed to ensure minimal, if any, changes in flows are experienced downstream of the project.

4.3.6 Management of reduced flows and return flows in the Murray River

Any upstream or downstream hydrological changes or impacts (including downstream water quality impacts from return flows) in the Murray River associated with the delivery of environmental water to the Guttrum and Benwell Forests will be assessed and managed by the River Murray Operations Committee (RMOC) as part of their responsibility to oversee the operation of the river which is managed by the Murray Darling Basin Authority on behalf of the relevant State and Commonwealth Governments.

Delivery of environmental water in the Murry River system is undertaken by the RMOC in accordance with a risk based approach to minimise impact to river users and the Commonwealth Environmental Water Holder's Framework for Determining Commonwealth Environmental Water Use (CEWO 2013) which requires environmental watering to consider the potential environmental risk, including downstream environmental risk, which may result from applying environmental water; and measures that may be taken to minimise those risks.

Any water quality impacts associated with return flows will be managed by the RMOC under the MDBA Basin Plan statutory water quality requirements including compliance with the State Environment Protection Policy (Waters) (DELWP, 2018) and the Basin Salinity Management 2030 – BSM2030 (Murray-Darling Basin Ministerial Council, 2015).

The waterway mangers and water authority will also work with the RMOC to ensure that the planning and delivery of environment water delivery is undertaken to achieve ecological objectives and minimise adverse impacts on river hydrology and incorporate which will be informed by a monitoring program.

Further modelling of the cumulative change to flows in the Murray River as a result of the VMFRP program of works will be undertaken by the River Murray Operations Committee to inform the risk based approach to management of environmental water delivery when some, if not all, VMFRP projects are confirmed to proceed based on the outcomes of the approvals process.

5. Legislative implications

5.1 Environment Protection and Biodiversity Conservation Act 1999

Five EPBC listed fish have been identified as potentially occurring within the project area (Murray cod, Silver perch, Macquarie perch, Murray hardyhead and Flat headed galaxias). Of these, only Murray cod and Silver perch are likely to be present in the Murray River. Risk to threatened fish species include loss of habitat and barriers to movement during construction and entrainment and mortality on pump inlets, floodplain stranding and exposure to poor water quality during managed inundation events. With the suite of mitigation measures detailed in Section 4 in place, risks to critical habitat and important populations of threatened fish are considered unlikely and with no significant impact.

It is unlikely that the project will result in a significant impact to a fish related MNES, however as a conservative measure, an EPBC referral will be submitted for this project for a determination under the EPBC Act.

5.2 Flora and Fauna Guarantee Act 1988

Six fish species listed under the FFG Act (Macquarie Perch, Murray Cod, Unspecked hardyhead, Murray Hardyhead, Silver Perch, Freshwater catfish and Murray-Darling Rainbowfish) have been identified with

the potential to occur in the project area. Of these, only Murray Cod, Silver perch, Freshwater catfish and Murray-Darling rainbowfish are likely to be present in the Murray River and of these only, Murray-Darling rainbowfish is likely to utilise floodplain wetlands. Impacts to these species are likely to be low. One FFG Act listed fish community is considered to occur within the project area: Lowland riverine fish community of the southern Murray Darling Basin. Impacts to this community are also likely to be low. Mitigation measures are proposed for construction and inundation works that will minimise risks.

5.3 Environment Effects Act 1978

An assessment of the project has been made against the relevant criteria under the EE Act:

- *Potential loss of a significant proportion of known remaining habitat or population of a threatened species within Victoria*:

  No threatened fish or populations listed under the FFG Act are considered to have critical habitat within the Guttrum and Benwell Forest construction footprint or the area of inundation and the assessment concludes that the project will not result in the loss of a significant population of any FFG listed fish species.

- *Potential loss of a genetically important population of an endangered or threatened species:*

  No threatened fish listed under the FFG Act are considered to have critical habitat within the Guttrum and Benwell Forest construction footprint or the area of inundation. Fish present in the project area do not form part of a genetically important population. The assessment concludes that there will no loss of a genetically important population of an endangered or threatened species.

Although the project does not meet these criteria, a broader ecological assessment (R8, 2020) has determined that the project is likely to require the removal of more than 10 hectares of native vegetation, which is a criterion for referral under the EE Act. Hence, a referral to the Victorian Minister for Planning for a determination under the EE Act as to whether an Environment Effects Statement is required, is being developed for the project.

6. Summary and Recommendations

6.1 Summary

The investigation of potential impacts of the project on fish identified a range of native fish with the potential to be present in the project area. Of these, five are listed under the Commonwealth EPBC Act, seven are listed under the Victorian FFG Act and six are listed under the NSW Fisheries Act. There is also one threatened fish community listed under the FFG Act and one threatened aquatic community listed under the NSW Fisheries Act with the potential to occur in the project area.

An assessment of risks to threatened fish and fish communities as a result of construction activities and operations of the proposed scheme identified potential for the loss of some Murray River bank habitat associated with the construction of pump inlets and outfall regulators. Operation of the scheme has the potential to entrain fish in pumps, strand fish on floodplains during managed drawdown, expose fish to poor water quality in return flows to the Murray River and reduce organic matter inputs to the river. Mitigation measures built into the design, construction and operation of the project to manage potential impacts will reduce the risks to all identified fish species of conservation significance to low during both construction and operation of the project.

6.2 Recommendations for mitigation

Recommended construction mitigation measures include the use of only partial coffer dams to isolate small areas of back from construction works, relocation of any habitat within works areas to the same river reach and adoption of sediment control and accidental spill measures. If the capture, handling or translocation of fish is required during construction (e.g. dewatering work sites) or operation of the project, persons undertaking these activities will need to hold the appropriate permit or licence under the Fisheries Act 1995. Any capture of fish must be carried out by a qualified aquatic ecologist.

Recommended operational mitigation measures include the installation and maintenance of appropriately sized fish screens on inlet pumps, management of inundation and drawdown to minimise the likelihood of fish stranding on the floodplain by ensuring opportunities for fish movement during managed drawdown, management of the timing of inundation and drawdown to minimise blackwater risks, enable entrainment of organic matter during natural flooding events and to ensure appropriate dilution of return flows if low dissolved oxygen is evident.

Mitigation measures associated with construction of the project need to be documented in an Aquatic Fauna Management Plan as part of the Construction Environmental Management Plan to manage impacts to aquatic values – with emphasis on threatened fish species that may be present in vicinity of construction sites or which access floodplain environments.

Mitigation measures associated with operation of the project have been documented in a fish exit strategy as part of the draft Operating Plan (NCCMA 2020) to manage risk associated with fish stranding on the floodplain. This includes requirements for pump design to include fish screens to minimise impacts to fish during pumping events and managed drawdown to cue fish movement off the floodplain. The project's Operating Plan will also need to include measures to reduce the potential for poor water quality of return flows.

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Appendix A. Environmental watering events / regime

Based on Basin Plan 2750 & Project Business Case	Forest Floodplain Watering (River Red Gum) Events (includes watering of SPWs)							
	Guttrum Forest				Benwell Forest		Total Both Forests	
	Guttrum West PS		Guttrum East PS		Benwell PS		All 3 Pump Stations	
	Fill	Maintain	Fill	Maintain	Fill	Maintain	Fill	Maintain
Frequency (yrs)	3 in 10		3 in 10	3 in 10	3 in 10	3 in 10	3 in 10	3 in 10
Flow Rate (ML/d)	125		125	90	125	70	375	160
Duration (days)	16		16	110	20	110	16 to 20	110
Volume (ML)	2,000	0	2,000	9,900	2,500	7,700	6,500	17,600
Total Volume (ML)	2,000		11,900		10,200		24,100	
Total Pumped Volume (ML)	**13,900**				**10,200**		**24,100**	
Return Flow to Murray (ML)	2,750				2,750		5,500	
Total Dry Fill Watering Use (ML)	**11,150**				**7,450**		**18,600**	

Based on Basin Plan 2750 & Project Business Case	Semi-Permanent Wetland Watering Top-Up Events (in additon to full FFW Watering Events)							
	Guttrum Forest				Benwell Forest		Total Both Forests	
	Guttrum West PS		Guttrum East PS		Benwell PS		All 3 Pump Stations	
	SPW Fill	Maint/Top Up	SPW Fill	Maint/Top Up	SPW Fill	Maint/Top Up	SPW Fill	Maint/Top Up
Frequency (yrs)	7 in 10	7 in 10	7 in 10	7 in 10	7 in 10	7 in 10	7 in 10	7 in 10
Flow Rate (ML/d)	High	15	High	7	High	8	High	30
Duration (days)	River	141	River	113	River	127	River	84 to 112
Volume (ML)	0	2,115	0	791	0	1,016	0	3,922
Total Volume (ML)	2,115		791		1,016		3,922	
Total Pumped Volume (ML)	**2,906**				**1,016**		**3,922**	
Return Flow to Murray (ML)	0		0	N/A	0		0	
Total Dry Fill Watering Use (ML)	**2,906**				**1,016**		**3,922**	

Based on Basin Plan 2750	Average Annual Water Use (averaged over 10 years)		
	Guttrum Forest	Benwell Forest	Total Both Forests
Average Annual Water Use (ML)	**5,379**	**2,946**	**8,325**

Based on Basin Plan 2750 (Project Business Cases)		Event Water Use Summary (ML)		
Watering Event Year Nett Use		Guttrum Forest	Benwell Forest	Total Both Forests
Forest Floodplain Watering	**(3 yrs in every 10 yrs)**	**11,150**	**7,450**	**18,600**
Semi-Permanent Wetland Top-ups	**(7 yrs in every 10 yrs)**	**2,906**	**1,016**	**3,922**
Average Annual Water (ML)		**5,379**	**2,946**	**8,325**

Appendix Q. Native Vegetation Removal Report (NVRR)

Scenario test – native vegetation removal

This report provides offset requirements for internal testing of different proposals to remove native vegetation. **This report DOES NOT support an application to remove, destroy or lop native vegetation under Clause 52.16 or 52.17 of planning schemes in Victoria.** A report must be obtained from the Department of Environment, Land, Water and Planning (DELWP).

Date of issue: **12/05/2020**
Time of issue: **9:16 am**

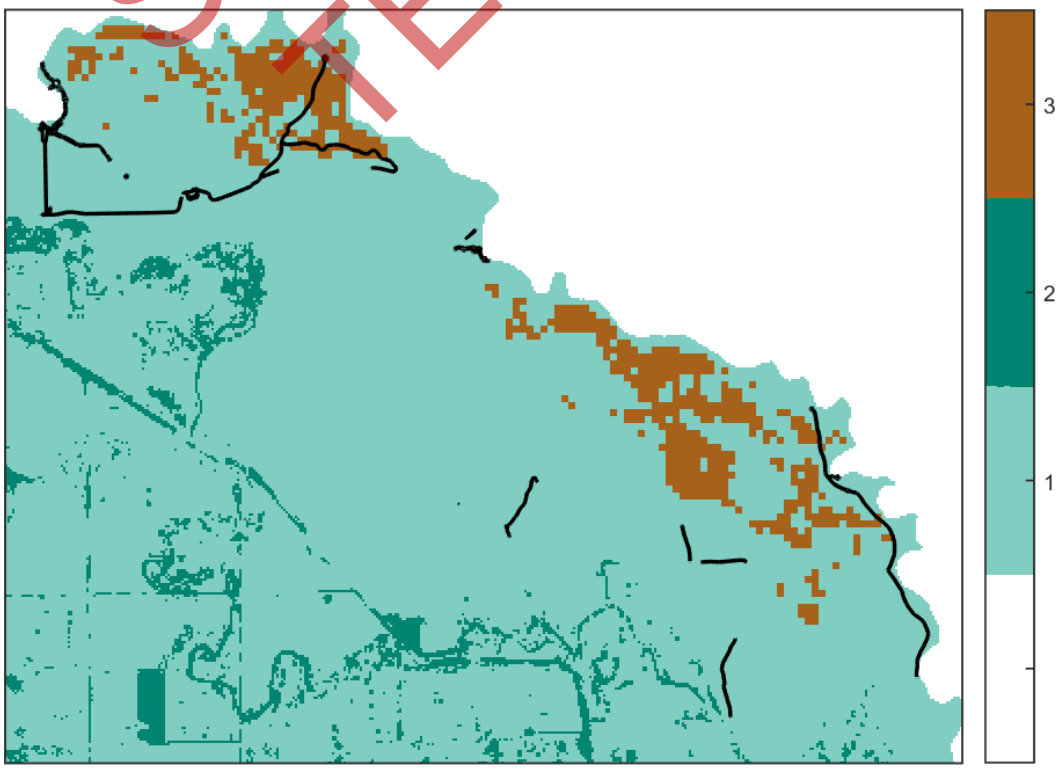
Report ID: Scenario Testing

Project ID	GuttBen_Ensym_VICGRIDv2

Assessment pathway

Assessment pathway	**Detailed Assessment Pathway**
Extent including past and proposed	13.715 ha
Extent of past removal	0.000 ha
Extent of proposed removal	13.715 ha
No. Large trees proposed to be removed	143
Location category of proposed removal	Location 3 The native vegetation is in an area where the removal of less than 0.5 hectares could have a significant impact on habitat for one or more rare or threatened species.The native vegetation is also in an area mapped as an endangered Ecological Vegetation Class (as per the statewide EVC map); and a wetland designated under the Convention on Wetlands of International Importance (the Ramsar Convention); and a wetland listed in the Directory of Important Wetlands of Australia; and an internationally important site for Migratory Shorebirds of the East Asian-Australasian Flyway.

1. Location map



Scenario test – native vegetation removal

Offset requirements if a permit is granted

Any approval granted will include a condition to obtain an offset that meets the following requirements:

Species offset amount[1]	16.189 species units of habitat for Baillon's Crake, *Porzana pusilla palustris* 6.050 species units of habitat for Red-chested Button-quail, *Turnix pyrrhothorax* 10.537 species units of habitat for Murray-Darling Rainbowfish, *Melanotaenia fluviatilis* 10.089 species units of habitat for Silver Perch, *Bidyanus bidyanus* 10.089 species units of habitat for Freshwater Catfish, *Tandanus tandanus* 15.810 species units of habitat for Wavy Marshwort, *Nymphoides crenata* 14.126 species units of habitat for Stiff Groundsel, *Senecio behrianus* 15.927 species units of habitat for Fuzzy New Holland Daisy, *Vittadinia cuneata var. hirsuta* 12.601 species units of habitat for Cotton Sneezeweed, *Centipeda nidiformis*
Large trees	143 trees

NB: values within tables in this document may not add to the totals shown above due to rounding

Appendix 1 includes information about the native vegetation to be removed

Appendix 2 includes information about the rare or threatened species mapped at the site.

Appendix 3 includes maps showing native vegetation to be removed and extracts of relevant species habitat importance maps

1 The species offset amount(s) required is the sum of all species habitat units in Appendix 1.

Scenario test – native vegetation removal

Next steps

Any proposal to remove native vegetation must meet the application requirements of the Detailed Assessment Pathway and it will be assessed under the Detailed Assessment Pathway.

This report DOES NOT support an application to remove, destroy or lop native vegetation under Clause 52.16 or 52.17 of planning schemes in Victoria.

If you wish to remove the mapped native vegetation you must submit the related shapefiles to the Department of Environment, Land, Water and Planning (DELWP) for processing, by email to ensymnvrtool.support@delwp.vic.gov.au. DELWP will provide a *Native vegetation removal report* that is required to meet the permit application requirements in accordance with *Guidelines for the removal, destruction or lopping of native vegetation* (Guidelines).

Appendix 1: Description of native vegetation to be removed

The species-general offset test was applied to your proposal. This test determines if the proposed removal of native vegetation has a proportional impact on any rare or threatened species habitats above the species offset threshold. The threshold is set at 0.005 per cent of the mapped habitat value for a species. When the proportional impact is above the species offset threshold a species offset is required. This test is done for all species mapped at the site. Multiple species offsets will be required if the species offset threshold is exceeded for multiple species.

Where a zone requires species offset(s), the species habitat units for each species in that zone is calculated by the following equation in accordance with the Guidelines:

Species habitat units = extent x condition x species landscape factor x 2, where the species landscape factor = 0.5 + (habitat importance score/2)

The species offset amount(s) required is the sum of all species habitat units per zone

Where a zone does not require a species offset, the general habitat units in that zone is calculated by the following equation in accordance with the Guidelines:

General habitat units = extent x condition x general landscape factor x 1.5, where the general landscape factor = 0.5 + (strategic biodiversity value score/2)

The general offset amount required is the sum of all general habitat units per zone.

Native vegetation to be removed

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
19-HZe	Patch	muf_0816	Depleted	0	no	0.580	0.000	0.000	0.920	0.770	0.000	10050 Baillon's Crake *Porzana pusilla palustris*
										0.620	0.000	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.690	0.000	502287 Wavy Marshwort *Nymphoides crenata*
										0.690	0.000	503101 Stiff Groundsel *Senecio behrianus*
										0.690	0.000	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
22-HZf	Patch	muf_0814	Depleted	0	no	0.630	0.008	0.008	0.920	0.770	0.009	10050 Baillon's Crake *Porzana pusilla palustris*
										0.620	0.008	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.690	0.008	502287 Wavy Marshwort *Nymphoides crenata*
										0.690	0.008	503101 Stiff Groundsel *Senecio behrianus*

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Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
										0.690	0.008	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
23-HZh	Patch	muf_0295	Vulnerable	0	no	0.640	0.054	0.054	0.895	0.770	0.061	10050 Baillon's Crake *Porzana pusilla palustris*
										0.618	0.056	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.685	0.058	502287 Wavy Marshwort *Nymphoides crenata*
										0.685	0.058	503101 Stiff Groundsel *Senecio behrianus*
										0.685	0.058	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
19-HZe	Patch	muf_0816	Depleted	0	no	0.580	0.000	0.000	0.920	0.770	0.000	10050 Baillon's Crake *Porzana pusilla palustris*
										0.620	0.000	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.690	0.000	502287 Wavy Marshwort *Nymphoides crenata*
										0.690	0.000	503101 Stiff Groundsel *Senecio behrianus*
										0.690	0.000	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
21-HZf	Patch	muf_0814	Depleted	0	no	0.630	0.000	0.000	0.920	0.770	0.000	10050 Baillon's Crake *Porzana pusilla palustris*
										0.620	0.000	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.690	0.000	502287 Wavy Marshwort *Nymphoides crenata*
										0.690	0.000	503101 Stiff Groundsel *Senecio behrianus*
										0.690	0.000	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
14-HZb	Patch	muf_0810	Depleted	2	no	0.740	0.010	0.010	0.820	0.790	0.013	10050 Baillon's Crake *Porzana pusilla palustris*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										1.000	0.015	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										1.000	0.015	528544 Silver Perch *Bidyanus bidyanus*
										1.000	0.015	528545 Freshwater Catfish *Tandanus tandanus*
										0.770	0.013	502287 Wavy Marshwort *Nymphoides crenata*
										0.770	0.013	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
12-HZe2	Patch	muf_0816	Depleted	0	no	0.580	0.015	0.015	0.770	0.770	0.015	10050 Baillon's Crake *Porzana pusilla palustris*
										0.610	0.014	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.660	0.014	502287 Wavy Marshwort *Nymphoides crenata*
										0.660	0.014	503101 Stiff Groundsel *Senecio behrianus*
										0.660	0.014	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
16-HZd	Patch	muf_0295	Vulnerable	2	no	0.570	0.008	0.008	0.820	0.780	0.008	10050 Baillon's Crake *Porzana pusilla palustris*
										0.680	0.008	502287 Wavy Marshwort *Nymphoides crenata*
										0.680	0.008	503101 Stiff Groundsel *Senecio behrianus*
										0.680	0.008	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.680	0.008	505616 Cotton Sneezeweed *Centipeda nidiformis*
17-HZd	Patch	muf_0295	Vulnerable	0	no	0.570	0.042	0.042	0.684	0.741	0.042	10050 Baillon's Crake *Porzana pusilla palustris*
										0.025	0.039	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.602	0.038	502287 Wavy Marshwort *Nymphoides crenata*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.602	0.038	503101 Stiff Groundsel *Senecio behrianus*
										0.602	0.038	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
7-HZt	Patch	muf_0816	Depleted	1	no	0.760	0.062	0.062	0.810	0.830	0.087	10050 Baillon's Crake *Porzana pusilla palustris*
										0.820	0.086	502287 Wavy Marshwort *Nymphoides crenata*
										0.820	0.086	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
1-HZy	Patch	muf_0810	Depleted	2	no	0.740	0.079	0.079	0.810	0.830	0.107	10050 Baillon's Crake *Porzana pusilla palustris*
										0.806	0.106	502287 Wavy Marshwort *Nymphoides crenata*
										0.403	0.105	503101 Stiff Groundsel *Senecio behrianus*
										0.806	0.106	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.362	0.105	505616 Cotton Sneezeweed *Centipeda nidiformis*
8-HZw	Patch	muf_0816	Depleted	1	no	0.720	0.116	0.116	0.810	0.830	0.153	10050 Baillon's Crake *Porzana pusilla palustris*
										0.792	0.150	502287 Wavy Marshwort *Nymphoides crenata*
										0.757	0.150	503101 Stiff Groundsel *Senecio behrianus*
										0.792	0.150	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.748	0.150	505616 Cotton Sneezeweed *Centipeda nidiformis*
2-HZa1	Patch	muf_0814	Depleted	4	no	0.790	0.173	0.173	0.810	0.810	0.248	10050 Baillon's Crake *Porzana pusilla palustris*
										0.073	0.274	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.073	0.274	528544 Silver Perch *Bidyanus bidyanus*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.073	0.274	528545 Freshwater Catfish *Tandanus tandanus*
										0.816	0.248	502287 Wavy Marshwort *Nymphoides crenata*
										0.760	0.249	503101 Stiff Groundsel *Senecio behrianus*
										0.816	0.248	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
19-HZa	Patch	muf_0814	Depleted	65	no	0.730	0.138	0.138	0.820	0.810	0.182	10050 Baillon's Crake *Porzana pusilla palustris*
										0.914	0.202	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.914	0.202	528544 Silver Perch *Bidyanus bidyanus*
										0.914	0.202	528545 Freshwater Catfish *Tandanus tandanus*
										0.703	0.178	502287 Wavy Marshwort *Nymphoides crenata*
										0.703	0.178	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.703	0.178	505616 Cotton Sneezeweed *Centipeda nidiformis*
20-HZa	Patch	muf_0814	Depleted	0	no	0.730	2.626	2.626	0.831	0.801	3.453	10050 Baillon's Crake *Porzana pusilla palustris*
										0.716	3.834	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.716	3.834	528544 Silver Perch *Bidyanus bidyanus*
										0.716	3.834	528545 Freshwater Catfish *Tandanus tandanus*
										0.747	3.349	502287 Wavy Marshwort *Nymphoides crenata*
										0.326	3.428	503101 Stiff Groundsel *Senecio behrianus*
										0.747	3.349	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.655	3.349	505616 Cotton Sneezeweed *Centipeda nidiformis*
17-HZa	Patch	muf_0814	Depleted	0	no	0.730	0.290	0.290	0.910	0.816	0.385	10050 Baillon's Crake *Porzana pusilla palustris*
										0.637	0.361	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.792	0.380	502287 Wavy Marshwort *Nymphoides crenata*
										0.792	0.380	503101 Stiff Groundsel *Senecio behrianus*
										0.792	0.380	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.705	0.379	505616 Cotton Sneezeweed *Centipeda nidiformis*
18-HZa	Patch	muf_0814	Depleted	0	no	0.730	0.089	0.089	0.960	0.830	0.119	10050 Baillon's Crake *Porzana pusilla palustris*
										0.710	0.111	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.830	0.119	502287 Wavy Marshwort *Nymphoides crenata*
										0.830	0.119	503101 Stiff Groundsel *Senecio behrianus*
										0.830	0.119	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.830	0.119	505616 Cotton Sneezeweed *Centipeda nidiformis*
5-HZk	Patch	muf_0295	Vulnerable	2	no	0.580	0.299	0.299	0.719	0.800	0.312	10050 Baillon's Crake *Porzana pusilla palustris*
										0.308	0.286	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.780	0.309	502287 Wavy Marshwort *Nymphoides crenata*
										0.780	0.309	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*

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Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
6-HZl	Patch	muf_0295	Vulnerable	4	no	0.470	0.552	0.552	0.727	0.802	0.468	10050 Baillon's Crake *Porzana pusilla palustris*
										0.302	0.428	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.780	0.462	502287 Wavy Marshwort *Nymphoides crenata*
										0.780	0.462	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
21-HZc	Patch	muf_0816	Depleted	0	no	0.600	0.092	0.092	0.795	0.798	0.099	10050 Baillon's Crake *Porzana pusilla palustris*
										0.166	0.110	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.166	0.110	528544 Silver Perch *Bidyanus bidyanus*
										0.166	0.110	528545 Freshwater Catfish *Tandanus tandanus*
										0.770	0.098	502287 Wavy Marshwort *Nymphoides crenata*
										0.642	0.098	503101 Stiff Groundsel *Senecio behrianus*
										0.770	0.098	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.642	0.098	505616 Cotton Sneezeweed *Centipeda nidiformis*
22-HZc	Patch	muf_0816	Depleted	0	no	0.600	0.670	0.670	0.819	0.792	0.721	10050 Baillon's Crake *Porzana pusilla palustris*
										0.674	0.805	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.674	0.805	528544 Silver Perch *Bidyanus bidyanus*
										0.674	0.805	528545 Freshwater Catfish *Tandanus tandanus*
										0.743	0.701	502287 Wavy Marshwort *Nymphoides crenata*
										0.631	0.699	503101 Stiff Groundsel *Senecio behrianus*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.743	0.701	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.224	0.678	505616 Cotton Sneezeweed *Centipeda nidiformis*
15-HZc	Patch	muf_0816	Depleted	46	no	0.600	0.010	0.010	0.818	0.791	0.011	10050 Baillon's Crake *Porzana pusilla palustris*
										0.945	0.012	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.945	0.012	528544 Silver Perch *Bidyanus bidyanus*
										0.945	0.012	528545 Freshwater Catfish *Tandanus tandanus*
										0.770	0.011	502287 Wavy Marshwort *Nymphoides crenata*
										0.042	0.011	503101 Stiff Groundsel *Senecio behrianus*
										0.770	0.011	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.042	0.011	505616 Cotton Sneezeweed *Centipeda nidiformis*
16-HZc	Patch	muf_0816	Depleted	0	no	0.600	0.268	0.268	0.820	0.789	0.287	10050 Baillon's Crake *Porzana pusilla palustris*
										0.923	0.321	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.923	0.321	528544 Silver Perch *Bidyanus bidyanus*
										0.923	0.321	528545 Freshwater Catfish *Tandanus tandanus*
										0.704	0.283	502287 Wavy Marshwort *Nymphoides crenata*
										0.075	0.275	503101 Stiff Groundsel *Senecio behrianus*
										0.704	0.283	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
4-HZq1	Patch	muf_0295	Vulnerable	3	no	0.670	1.071	1.071	0.902	0.823	1.309	10050 Baillon's Crake *Porzana pusilla palustris*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.481	1.436	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.501	1.436	528544 Silver Perch *Bidyanus bidyanus*
										0.481	1.436	528545 Freshwater Catfish *Tandanus tandanus*
										0.782	1.279	502287 Wavy Marshwort *Nymphoides crenata*
										0.365	1.295	503101 Stiff Groundsel *Senecio behrianus*
										0.782	1.279	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.084	1.300	505616 Cotton Sneezeweed *Centipeda nidiformis*
3-HZb1	Patch	muf_0816	Depleted	11	no	0.840	0.960	0.960	0.766	0.783	1.437	10050 Baillon's Crake *Porzana pusilla palustris*
										0.403	1.612	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.403	1.612	528544 Silver Perch *Bidyanus bidyanus*
										0.403	1.612	528545 Freshwater Catfish *Tandanus tandanus*
										0.750	1.411	502287 Wavy Marshwort *Nymphoides crenata*
										0.326	1.440	503101 Stiff Groundsel *Senecio behrianus*
										0.750	1.411	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.077	1.420	505616 Cotton Sneezeweed *Centipeda nidiformis*
4-HZb1	Patch	muf_0816	Depleted	0	no	0.840	0.114	0.114	0.810	0.629	0.156	503101 Stiff Groundsel *Senecio behrianus*
										0.594	0.156	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
13-HZa	Patch	muf_0814	Depleted	0	no	0.730	0.013	0.013	0.850	0.820	0.017	10050 Baillon's Crake *Porzana pusilla palustris*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.800	0.017	502287 Wavy Marshwort *Nymphoides crenata*
										0.800	0.017	503101 Stiff Groundsel *Senecio behrianus*
										0.800	0.017	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.800	0.017	505616 Cotton Sneezeweed *Centipeda nidiformis*
14-HZa	Patch	muf_0814	Depleted	0	no	0.730	0.010	0.010	0.820	0.815	0.013	10050 Baillon's Crake *Porzana pusilla palustris*
										1.000	0.015	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										1.000	0.015	528544 Silver Perch *Bidyanus bidyanus*
										1.000	0.015	528545 Freshwater Catfish *Tandanus tandanus*
										0.792	0.013	502287 Wavy Marshwort *Nymphoides crenata*
										0.792	0.013	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.792	0.013	505616 Cotton Sneezeweed *Centipeda nidiformis*
15-HZb	Patch	muf_0810	Depleted	0	no	0.740	0.003	0.003	0.820	0.790	0.004	10050 Baillon's Crake *Porzana pusilla palustris*
										1.000	0.004	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										1.000	0.004	528544 Silver Perch *Bidyanus bidyanus*
										1.000	0.004	528545 Freshwater Catfish *Tandanus tandanus*
										0.770	0.004	502287 Wavy Marshwort *Nymphoides crenata*
										0.770	0.004	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
19-HZc	Patch	muf_0816	Depleted	0	no	0.600	0.012	0.012	0.820	0.790	0.013	10050 Baillon's Crake *Porzana pusilla palustris*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										1.000	0.014	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										1.000	0.014	528544 Silver Perch *Bidyanus bidyanus*
										1.000	0.014	528545 Freshwater Catfish *Tandanus tandanus*
										0.770	0.012	502287 Wavy Marshwort *Nymphoides crenata*
										0.770	0.012	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
20-HZc	Patch	muf_0816	Depleted	0	no	0.600	0.008	0.008	0.800	0.797	0.009	10050 Baillon's Crake *Porzana pusilla palustris*
										0.350	0.010	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.350	0.010	528544 Silver Perch *Bidyanus bidyanus*
										0.350	0.010	528545 Freshwater Catfish *Tandanus tandanus*
										0.770	0.009	502287 Wavy Marshwort *Nymphoides crenata*
										0.501	0.009	503101 Stiff Groundsel *Senecio behrianus*
										0.770	0.009	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.501	0.009	505616 Cotton Sneezeweed *Centipeda nidiformis*
17-HZc	Patch	muf_0816	Depleted	0	no	0.600	0.003	0.003	0.790	0.800	0.003	10050 Baillon's Crake *Porzana pusilla palustris*
										0.770	0.003	502287 Wavy Marshwort *Nymphoides crenata*
										0.770	0.003	503101 Stiff Groundsel *Senecio behrianus*
										0.770	0.003	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.770	0.003	505616 Cotton Sneezeweed *Centipeda nidiformis*

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Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
18-HZc	Patch	muf_0816	Depleted	0	no	0.600	0.022	0.022	0.820	0.775	0.024	10050 Baillon's Crake *Porzana pusilla palustris*
										0.680	0.022	502287 Wavy Marshwort *Nymphoides crenata*
										0.680	0.022	503101 Stiff Groundsel *Senecio behrianus*
										0.680	0.022	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.680	0.022	505616 Cotton Sneezeweed *Centipeda nidiformis*
18-HZd	Patch	muf_0295	Vulnerable	0	no	0.570	0.010	0.010	0.681	0.740	0.010	10050 Baillon's Crake *Porzana pusilla palustris*
										0.008	0.009	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.601	0.009	502287 Wavy Marshwort *Nymphoides crenata*
										0.601	0.009	503101 Stiff Groundsel *Senecio behrianus*
										0.601	0.009	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
19-HZd	Patch	muf_0295	Vulnerable	0	no	0.570	0.366	0.366	0.638	0.746	0.365	10050 Baillon's Crake *Porzana pusilla palustris*
										0.304	0.333	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.619	0.338	502287 Wavy Marshwort *Nymphoides crenata*
										0.619	0.338	503101 Stiff Groundsel *Senecio behrianus*
										0.619	0.338	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.049	0.351	505616 Cotton Sneezeweed *Centipeda nidiformis*
9-HZh	Patch	muf_0295	Vulnerable	0	no	0.640	0.711	0.711	0.858	0.795	0.816	10050 Baillon's Crake *Porzana pusilla palustris*

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.424	0.752	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.745	0.794	502287 Wavy Marshwort *Nymphoides crenata*
										0.745	0.794	503101 Stiff Groundsel *Senecio behrianus*
										0.745	0.794	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.175	0.819	505616 Cotton Sneezeweed *Centipeda nidiformis*
10-HZh	Patch	muf_0295	Vulnerable	0	no	0.640	0.309	0.309	0.764	0.799	0.355	10050 Baillon's Crake *Porzana pusilla palustris*
										0.269	0.331	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.742	0.344	502287 Wavy Marshwort *Nymphoides crenata*
										0.291	0.345	503101 Stiff Groundsel *Senecio behrianus*
										0.742	0.344	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.202	0.347	505616 Cotton Sneezeweed *Centipeda nidiformis*
10-HZe2	Patch	muf_0816	Depleted	0	no	0.580	0.012	0.012	0.770	0.770	0.012	10050 Baillon's Crake *Porzana pusilla palustris*
										0.610	0.011	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.660	0.011	502287 Wavy Marshwort *Nymphoides crenata*
										0.660	0.011	503101 Stiff Groundsel *Senecio behrianus*
										0.660	0.011	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
12-HZk	Patch	muf_0295	Vulnerable	0	no	0.580	0.076	0.076	0.706	0.801	0.080	10050 Baillon's Crake *Porzana pusilla palustris*

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.766	0.078	502287 Wavy Marshwort *Nymphoides crenata*
										0.766	0.078	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
11-HZk	Patch	muf_0295	Vulnerable	0	no	0.580	0.045	0.045	0.740	0.792	0.047	10050 Baillon's Crake *Porzana pusilla palustris*
										0.640	0.043	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.763	0.046	502287 Wavy Marshwort *Nymphoides crenata*
										0.763	0.046	503101 Stiff Groundsel *Senecio behrianus*
										0.763	0.046	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
12-HZl	Patch	muf_0295	Vulnerable	0	no	0.470	0.099	0.099	0.738	0.804	0.084	10050 Baillon's Crake *Porzana pusilla palustris*
										0.047	0.077	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.780	0.083	502287 Wavy Marshwort *Nymphoides crenata*
										0.157	0.083	503101 Stiff Groundsel *Senecio behrianus*
										0.780	0.083	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
5-HZm	Patch	muf_0816	Depleted	0	no	0.520	0.319	0.319	0.884	0.826	0.303	10050 Baillon's Crake *Porzana pusilla palustris*
										0.450	0.285	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.809	0.300	502287 Wavy Marshwort *Nymphoides crenata*
										0.809	0.300	503101 Stiff Groundsel *Senecio behrianus*
										0.809	0.300	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
										0.525	0.301	505616 Cotton Sneezeweed *Centipeda nidiformis*
6-HZq	Patch	muf_0814	Depleted	0	no	0.610	0.069	0.069	0.927	0.840	0.077	10050 Baillon's Crake *Porzana pusilla palustris*
										0.730	0.073	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.837	0.077	502287 Wavy Marshwort *Nymphoides crenata*
										0.837	0.077	503101 Stiff Groundsel *Senecio behrianus*
										0.837	0.077	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
7-HZo	Patch	muf_0945	Depleted	0	no	0.720	0.128	0.128	0.828	0.824	0.168	10050 Baillon's Crake *Porzana pusilla palustris*
										0.272	0.156	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.792	0.166	502287 Wavy Marshwort *Nymphoides crenata*
										0.792	0.166	503101 Stiff Groundsel *Senecio behrianus*
										0.792	0.166	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.782	0.166	505616 Cotton Sneezeweed *Centipeda nidiformis*
26-HZr	Patch	muf_0816	Depleted	0	no	0.750	0.462	0.462	0.881	0.835	0.637	10050 Baillon's Crake *Porzana pusilla palustris*
										0.423	0.594	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.815	0.629	502287 Wavy Marshwort *Nymphoides crenata*
										0.815	0.629	503101 Stiff Groundsel *Senecio behrianus*
										0.814	0.629	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
										0.289	0.634	505616 Cotton Sneezeweed *Centipeda nidiformis*
27-HZr	Patch	muf_0816	Depleted	0	no	0.750	0.050	0.050	0.830	0.840	0.069	10050 Baillon's Crake *Porzana pusilla palustris*
										0.732	0.065	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.832	0.069	502287 Wavy Marshwort *Nymphoides crenata*
										0.832	0.069	503101 Stiff Groundsel *Senecio behrianus*
										0.832	0.069	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.064	0.069	505616 Cotton Sneezeweed *Centipeda nidiformis*
28-HZr	Patch	muf_0816	Depleted	0	no	0.750	0.213	0.213	0.856	0.839	0.293	10050 Baillon's Crake *Porzana pusilla palustris*
										0.629	0.275	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.838	0.293	502287 Wavy Marshwort *Nymphoides crenata*
										0.838	0.293	503101 Stiff Groundsel *Senecio behrianus*
										0.583	0.293	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.785	0.293	505616 Cotton Sneezeweed *Centipeda nidiformis*
1-HZt	Patch	muf_0816	Depleted	0	no	0.760	0.001	0.001	0.810	0.838	0.002	10050 Baillon's Crake *Porzana pusilla palustris*
										0.828	0.002	502287 Wavy Marshwort *Nymphoides crenata*
										0.664	0.002	503101 Stiff Groundsel *Senecio behrianus*
										0.828	0.002	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*

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Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
2-HZw	Patch	muf_0816	Depleted	0	no	0.720	0.044	0.044	0.861	0.840	0.058	10050 Baillon's Crake *Porzana pusilla palustris*
										0.830	0.058	502287 Wavy Marshwort *Nymphoides crenata*
										0.830	0.058	503101 Stiff Groundsel *Senecio behrianus*
										0.830	0.058	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
19-HZx	Patch	muf_0814	Depleted	0	no	0.760	0.038	0.038	0.930	0.840	0.053	10050 Baillon's Crake *Porzana pusilla palustris*
										0.830	0.053	502287 Wavy Marshwort *Nymphoides crenata*
										0.830	0.053	503101 Stiff Groundsel *Senecio behrianus*
										0.830	0.053	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
4-HZy	Patch	muf_0810	Depleted	0	no	0.740	0.011	0.011	0.810	0.840	0.015	10050 Baillon's Crake *Porzana pusilla palustris*
										0.830	0.015	502287 Wavy Marshwort *Nymphoides crenata*
										0.830	0.015	503101 Stiff Groundsel *Senecio behrianus*
										0.830	0.015	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
25-HZr	Patch	muf_0816	Depleted	0	no	0.750	0.386	0.386	0.922	0.835	0.532	10050 Baillon's Crake *Porzana pusilla palustris*
										0.739	0.504	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.833	0.531	502287 Wavy Marshwort *Nymphoides crenata*
										0.833	0.531	503101 Stiff Groundsel *Senecio behrianus*
										0.778	0.531	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.568	0.532	505616 Cotton Sneezeweed *Centipeda nidiformis*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
27-HZb1	Patch	muf_0816	Depleted	0	no	0.840	0.023	0.023	0.810	0.790	0.034	10050 Baillon's Crake *Porzana pusilla palustris*
										1.000	0.038	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										1.000	0.038	528544 Silver Perch *Bidyanus bidyanus*
										1.000	0.038	528545 Freshwater Catfish *Tandanus tandanus*
										0.750	0.033	502287 Wavy Marshwort *Nymphoides crenata*
										0.750	0.033	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.750	0.033	505616 Cotton Sneezeweed *Centipeda nidiformis*
28-HZb1	Patch	muf_0816	Depleted	0	no	0.840	0.004	0.004	0.620	0.670	0.006	10050 Baillon's Crake *Porzana pusilla palustris*
										0.420	0.005	502287 Wavy Marshwort *Nymphoides crenata*
										0.420	0.005	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
29-HZb1	Patch	muf_0816	Depleted	0	no	0.840	0.000	0.000	0.810	0.810	0.000	10050 Baillon's Crake *Porzana pusilla palustris*
										1.000	0.000	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										1.000	0.000	528544 Silver Perch *Bidyanus bidyanus*
										1.000	0.000	528545 Freshwater Catfish *Tandanus tandanus*
										0.760	0.000	502287 Wavy Marshwort *Nymphoides crenata*
										0.760	0.000	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
28-HZg1	Patch	muf_0295	Vulnerable	0	no	0.620	0.001	0.001	1.000	0.790	0.002	10050 Baillon's Crake *Porzana pusilla palustris*

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
										0.800	0.002	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
29-HZg1	Patch	muf_0295	Vulnerable	0	no	0.620	0.421	0.421	0.805	0.774	0.464	10050 Baillon's Crake *Porzana pusilla palustris*
										0.452	0.444	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.509	0.456	502287 Wavy Marshwort *Nymphoides crenata*
										0.706	0.446	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
21-HZm1	Patch	muf_0295	Vulnerable	0	no	0.580	0.199	0.199	0.753	0.788	0.207	10050 Baillon's Crake *Porzana pusilla palustris*
										0.526	0.195	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.761	0.203	502287 Wavy Marshwort *Nymphoides crenata*
										0.440	0.203	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
22-HZm1	Patch	muf_0295	Vulnerable	0	no	0.580	0.110	0.110	0.720	0.729	0.110	10050 Baillon's Crake *Porzana pusilla palustris*
										0.047	0.109	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.478	0.094	502287 Wavy Marshwort *Nymphoides crenata*
										0.478	0.094	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
22-HZn1	Patch	muf_0295	Vulnerable	0	no	0.500	0.449	0.449	0.701	0.762	0.395	10050 Baillon's Crake *Porzana pusilla palustris*
										0.351	0.370	10019 Red-chested Button-quail *Turnix pyrrhothorax*

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Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.346	0.449	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.691	0.379	502287 Wavy Marshwort *Nymphoides crenata*
										0.190	0.390	503101 Stiff Groundsel *Senecio behrianus*
										0.675	0.381	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
23-HZn1	Patch	muf_0295	Vulnerable	0	no	0.500	0.137	0.137	0.757	0.798	0.124	10050 Baillon's Crake *Porzana pusilla palustris*
										0.654	0.121	10019 Red-chested Button-quail *Turnix pyrrhothorax*
										0.708	0.117	502287 Wavy Marshwort *Nymphoides crenata*
										0.159	0.125	503101 Stiff Groundsel *Senecio behrianus*
										0.708	0.117	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
23-HZq1	Patch	muf_0295	Vulnerable	0	no	0.670	0.405	0.405	0.829	0.829	0.496	10050 Baillon's Crake *Porzana pusilla palustris*
										0.353	0.542	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.353	0.542	528544 Silver Perch *Bidyanus bidyanus*
										0.353	0.542	528545 Freshwater Catfish *Tandanus tandanus*
										0.802	0.488	502287 Wavy Marshwort *Nymphoides crenata*
										0.372	0.490	503101 Stiff Groundsel *Senecio behrianus*
										0.802	0.488	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.230	0.488	505616 Cotton Sneezeweed *Centipeda nidiformis*
24-HZr1	Patch	muf_0295	Vulnerable	0	no	0.530	0.797	0.797	0.783	0.816	0.767	10050 Baillon's Crake *Porzana pusilla palustris*

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
										0.199	0.845	4774 Murray-Darling Rainbowfish *Melanotaenia fluviatilis*
										0.833	0.845	528544 Silver Perch *Bidyanus bidyanus*
										0.199	0.845	528545 Freshwater Catfish *Tandanus tandanus*
										0.166	0.746	502287 Wavy Marshwort *Nymphoides crenata*
										0.598	0.721	503101 Stiff Groundsel *Senecio behrianus*
										0.692	0.715	505068 Fuzzy New Holland Daisy *Vittadinia cuneata var. hirsuta*
										0.361	0.709	505616 Cotton Sneezeweed *Centipeda nidiformis*

Appendix 2: Information about impacts to rare or threatened species' habitats on site

This table lists all rare or threatened species' habitats mapped at the site.

Species common name	Species scientific name	Species number	Conservation status	Group	Habitat impacted	% habitat value affected
Baillon's Crake	*Porzana pusilla palustris*	10050	Vulnerable	Dispersed	Top ranking map	0.0219
Wavy Marshwort	*Nymphoides crenata*	502287	Vulnerable	Dispersed	Habitat importance map	0.0134
Fuzzy New Holland Daisy	*Vittadinia cuneata var. hirsuta*	505068	Rare	Dispersed	Habitat importance map	0.0095
Freshwater Catfish	*Tandanus tandanus*	528545	Endangered	Dispersed	Habitat importance map	0.0075
Cotton Sneezeweed	*Centipeda nidiformis*	505616	Rare	Dispersed	Habitat importance map	0.0073
Stiff Groundsel	*Senecio behrianus*	503101	Endangered	Dispersed	Habitat importance map	0.0072
Murray-Darling Rainbowfish	*Melanotaenia fluviatilis*	4774	Vulnerable	Dispersed	Habitat importance map	0.0070
Red-chested Button-quail	*Turnix pyrrhothorax*	10019	Vulnerable	Dispersed	Habitat importance map	0.0061
Silver Perch	*Bidyanus bidyanus*	528544	Vulnerable	Dispersed	Habitat importance map	0.0060
Murray Cod	*Maccullochella peelii*	4871	Vulnerable	Dispersed	Habitat importance map	0.0047
Swamp Buttercup	*Ranunculus undosus*	502915	Vulnerable	Dispersed	Habitat importance map	0.0042
Australian Painted Snipe	*Rostratula australis*	10170	Critically endangered	Dispersed	Habitat importance map	0.0039
Spotted Emu-bush	*Eremophila maculata subsp. maculata*	501204	Rare	Dispersed	Habitat importance map	0.0037
Northern Sandalwood	*Santalum lanceolatum*	503005	Endangered	Dispersed	Habitat importance map	0.0037
Pale Flax-lily	*Dianella sp. aff. longifolia (Riverina)*	507399	Vulnerable	Dispersed	Habitat importance map	0.0036
Squat Picris	*Picris squarrosa*	504827	Rare	Dispersed	Habitat importance map	0.0036
Australian Little Bittern	*Ixobrychus dubius*	10195	Endangered	Dispersed	Habitat importance map	0.0035
Australasian Bittern	*Botaurus poiciloptilus*	10197	Endangered	Dispersed	Habitat importance map	0.0035

Spreading Emu-bush	*Eremophila divaricata subsp. divaricata*	501200	Rare	Dispersed	Habitat importance map	0.0034
Intermediate Egret	*Ardea intermedia*	10186	Endangered	Dispersed	Habitat importance map	0.0033
Riverina Bitter-cress	*Cardamine moirensis*	505032	Rare	Dispersed	Habitat importance map	0.0033
Southern Pygmy Perch (Murray-Darling lineage)	*Nannoperca australis (Murray-Darling lineage)*	903231	Vulnerable	Dispersed	Habitat importance map	0.0033
Blue Burr-daisy	*Calotis cuneifolia*	500594	Rare	Dispersed	Habitat importance map	0.0032
Eastern Great Egret	*Ardea modesta*	10187	Vulnerable	Dispersed	Habitat importance map	0.0032
Flat Spike-sedge	*Eleocharis plana*	501144	Vulnerable	Dispersed	Habitat importance map	0.0031
Red Swainson-pea	*Swainsona plagiotropis*	503324	Endangered	Dispersed	Habitat importance map	0.0030
Scaly Mantle	*Eriochlamys squamata*	505661	Vulnerable	Dispersed	Habitat importance map	0.0029
Broad-shelled Turtle	*Chelodina expansa*	5133	Endangered	Dispersed	Habitat importance map	0.0028
Growling Grass Frog	*Litoria raniformis*	13207	Endangered	Dispersed	Habitat importance map	0.0028
Carpet Python	*Morelia spilota metcalfei*	62969	Endangered	Dispersed	Habitat importance map	0.0027
Baillon's Crake	*Porzana pusilla palustris*	10050	Vulnerable	Dispersed	Habitat importance map	0.0027
Little Egret	*Egretta garzetta nigripes*	10185	Endangered	Dispersed	Habitat importance map	0.0026
Musk Duck	*Biziura lobata*	10217	Vulnerable	Dispersed	Habitat importance map	0.0025
Twin-leaf Bedstraw	*Asperula gemella*	500280	Rare	Dispersed	Habitat importance map	0.0024
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	10226	Vulnerable	Dispersed	Habitat importance map	0.0024
Superb Parrot	*Polytelis swainsonii*	10277	Endangered	Dispersed	Habitat importance map	0.0023
Hardhead	*Aythya australis*	10215	Vulnerable	Dispersed	Habitat importance map	0.0023
Murray Hardyhead	*Craterocephalus fluviatilis*	4784	Critically endangered	Dispersed	Habitat importance map	0.0022
Freckled Duck	*Stictonetta naevosa*	10214	Endangered	Dispersed	Habitat importance map	0.0020
Australasian Shoveler	*Anas rhynchotis*	10212	Vulnerable	Dispersed	Habitat importance map	0.0020
Deane's Wattle	*Acacia deanei subsp. paucijuga*	504201	Rare	Dispersed	Habitat importance map	0.0019

Three-wing Bluebush	*Maireana triptera*	502115	Rare	Dispersed	Habitat importance map	0.0019
Dwarf Bitter-cress	*Rorippa eustylis*	502944	Rare	Dispersed	Habitat importance map	0.0019
Cane Grass	*Eragrostis australasica*	501184	Vulnerable	Dispersed	Habitat importance map	0.0018
Lewin's Rail	*Lewinia pectoralis pectoralis*	10045	Vulnerable	Dispersed	Habitat importance map	0.0018
Blue-billed Duck	*Oxyura australis*	10216	Endangered	Dispersed	Habitat importance map	0.0018
Bush Stone-curlew	*Burhinus grallarius*	10174	Endangered	Dispersed	Habitat importance map	0.0017
Umbrella Grass	*Digitaria divaricatissima var. divaricatissima*	501045	Vulnerable	Dispersed	Habitat importance map	0.0017
Smooth Minuria	*Minuria integerrima*	502201	Rare	Dispersed	Habitat importance map	0.0017
Long Eryngium	*Eryngium paludosum*	501238	Vulnerable	Dispersed	Habitat importance map	0.0017
Spiny Lignum	*Duma horrida subsp. horrida*	502230	Rare	Dispersed	Habitat importance map	0.0014
Winged Peppercress	*Lepidium monoplocoides*	501905	Endangered	Dispersed	Habitat importance map	0.0014
Branching Groundsel	*Senecio cunninghamii var. cunninghamii*	503104	Rare	Dispersed	Habitat importance map	0.0012
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	10443	Endangered	Dispersed	Habitat importance map	0.0011
Brolga	*Grus rubicunda*	10177	Vulnerable	Dispersed	Habitat importance map	0.0010
Barking Owl	*Ninox connivens connivens*	10246	Endangered	Dispersed	Habitat importance map	0.0009
Bearded Dragon	*Pogona barbata*	12177	Vulnerable	Dispersed	Habitat importance map	0.0008
Floodplain Fireweed	*Senecio campylocarpus*	507136	Rare	Dispersed	Habitat importance map	0.0008
Dwarf Brooklime	*Gratiola pumilo*	503753	Rare	Dispersed	Habitat importance map	0.0008
Waterbush	*Myoporum montanum*	502240	Rare	Dispersed	Habitat importance map	0.0007
Mallee Annual-bluebell	*Wahlenbergia tumidifructa*	504060	Rare	Dispersed	Habitat importance map	0.0006
Squirrel Glider	*Petaurus norfolcensis*	11137	Endangered	Dispersed	Habitat importance map	0.0006
Buloke Mistletoe	*Amyema linophylla subsp. orientalis*	500217	Vulnerable	Dispersed	Habitat importance map	0.0006
Growling Grass Frog	*Litoria raniformis*	13207	Endangered	Dispersed	Top ranking map	0.0006

Spear-grass	*Austrostipa trichophylla*	504512	Rare	Dispersed	Habitat importance map	0.0005
Black-tailed Godwit	*Limosa limosa*	528553	Vulnerable	Dispersed	Habitat importance map	0.0005
Black Falcon	*Falco subniger*	10238	Vulnerable	Dispersed	Habitat importance map	0.0004
Square-tailed Kite	*Lophoictinia isura*	10230	Vulnerable	Dispersed	Habitat importance map	0.0003
Lace Monitor	*Varanus varius*	12283	Endangered	Dispersed	Habitat importance map	0.0003
Buloke	*Allocasuarina luehmannii*	500678	Endangered	Dispersed	Habitat importance map	0.0003
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*	10220	Vulnerable	Dispersed	Habitat importance map	0.0002
Slender Darling-pea	*Swainsona murrayana*	503321	Endangered	Dispersed	Habitat importance map	0.0002
Grey Falcon	*Falco hypoleucos*	10236	Endangered	Dispersed	Habitat importance map	0.0002
Port Lincoln Snake	*Parasuta spectabilis*	12813	Vulnerable	Dispersed	Habitat importance map	0.0002
Umbrella Wattle	*Acacia oswaldii*	500070	Vulnerable	Dispersed	Habitat importance map	0.0001
White-throated Needletail	*Hirundapus caudacutus*	10334	Vulnerable	Dispersed	Habitat importance map	0.0001
Frosted Goosefoot	*Chenopodium desertorum subsp. desertorum*	504380	Rare	Dispersed	Habitat importance map	0.0001
Common Greenshank	*Tringa nebularia*	10158	Vulnerable	Dispersed	Habitat importance map	0.0000
Brown Toadlet	*Pseudophryne bibronii*	13117	Endangered	Dispersed	Habitat importance map	0.0000

Habitat group

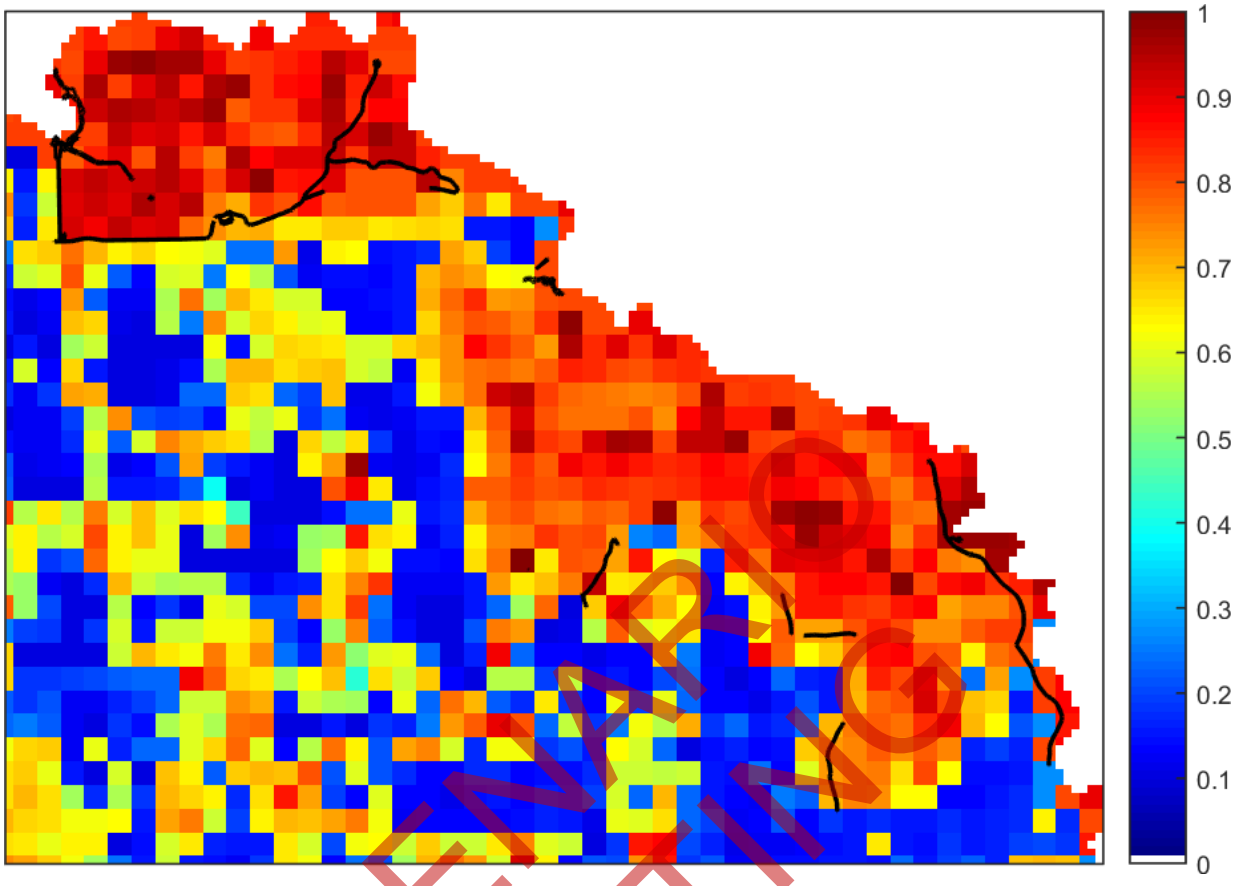
- Highly localised habitat means there is 2000 hectares or less mapped habitat for the species
- Dispersed habitat means there is more than 2000 hectares of mapped habitat for the species

Habitat impacted

- Habitat importance maps are the maps defined in the Guidelines that include all the mapped habitat for a rare or threatened species
- Top ranking maps are the maps defined in the Guidelines that depict the important areas of a dispersed species habitat, developed from the highest habitat importance scores in dispersed species habitat maps and selected VBA records
- Selected VBA record is an area in Victoria that represents a large population, roosting or breeding site etc.

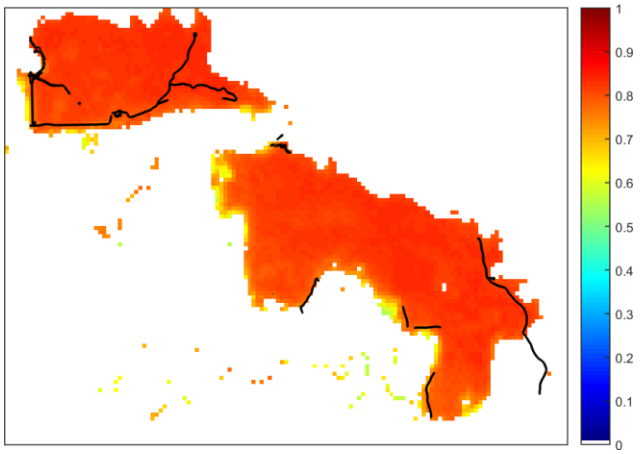
Appendix 3 – Images of mapped native vegetation

2. Strategic biodiversity values map

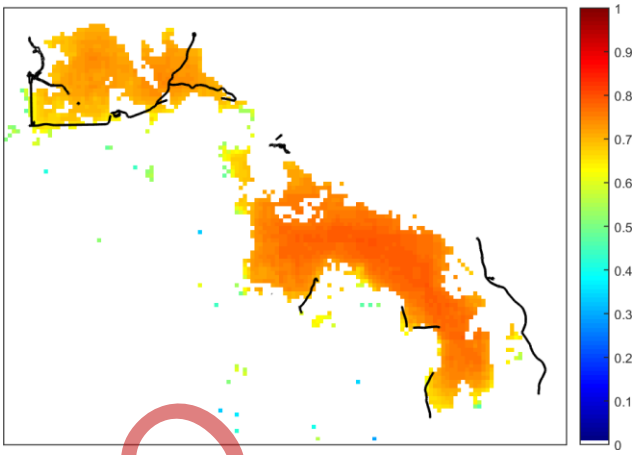


3. Habitat importance maps

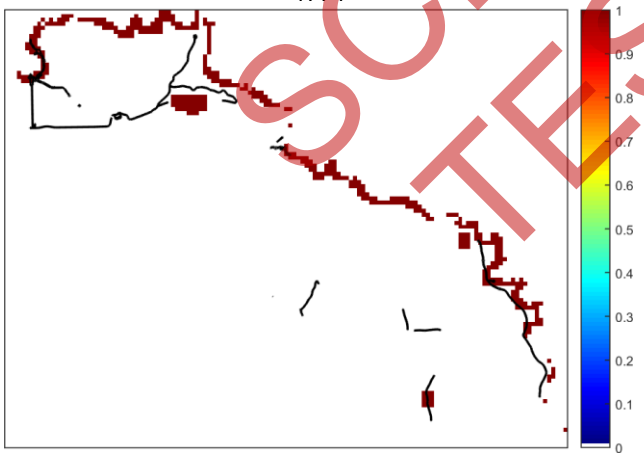
Baillon's Crake
Porzana pusilla palustris
10050



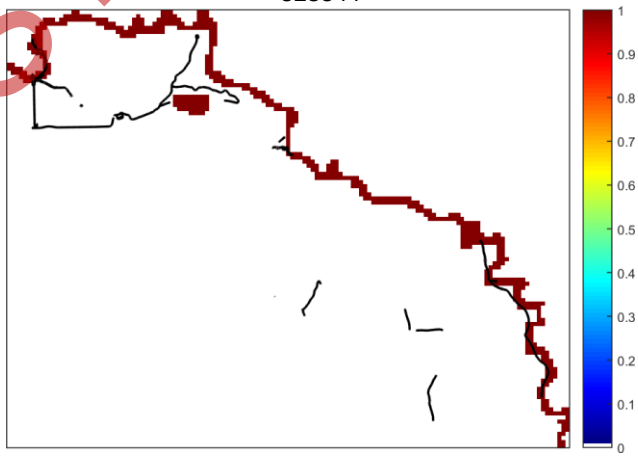
Red-chested Button-quail
Turnix pyrrhothorax
10019



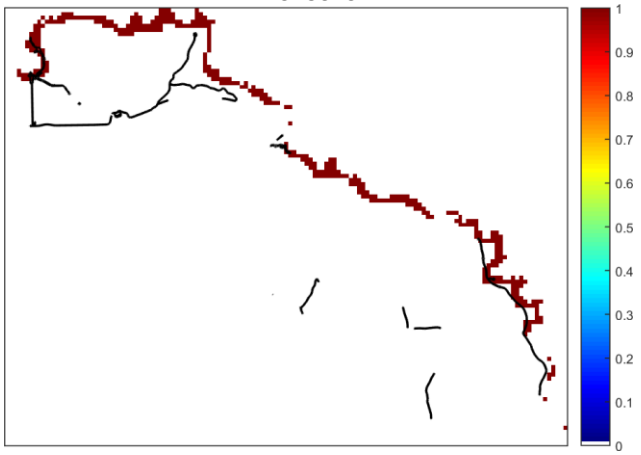
Murray-Darling Rainbowfish
Melanotaenia fluviatilis
4774



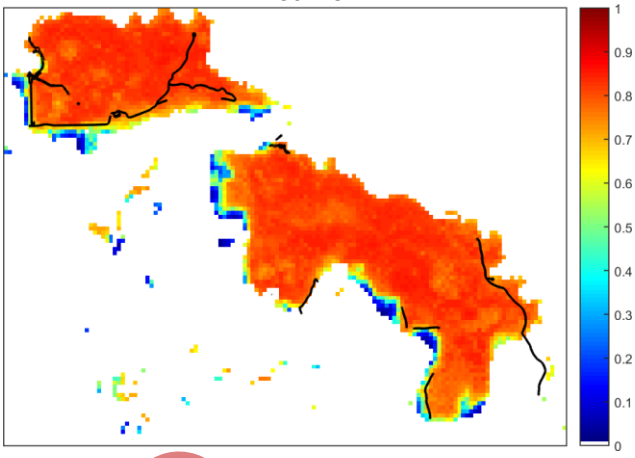
Silver Perch
Bidyanus bidyanus
528544



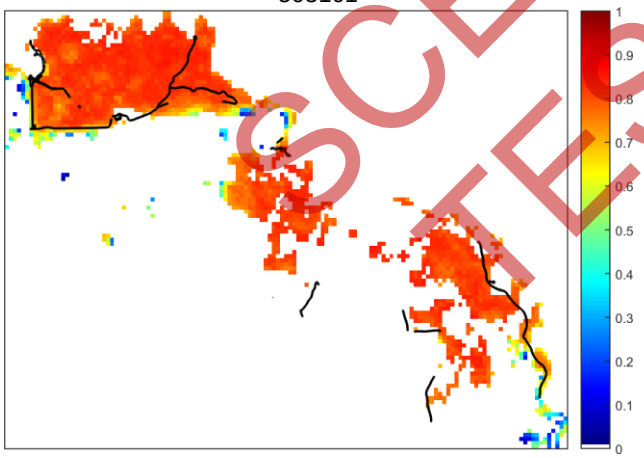
Freshwater Catfish
Tandanus tandanus
528545



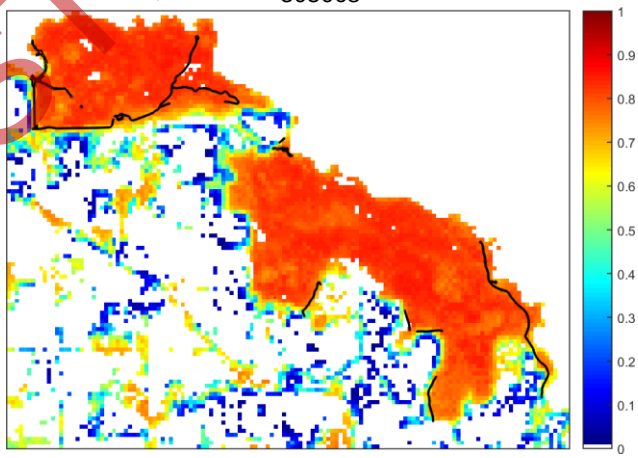
Wavy Marshwort
Nymphoides crenata
502287



Stiff Groundsel
Senecio behrianus
503101



Fuzzy New Holland Daisy
Vittadinia cuneata var. hirsuta
505068



Cotton Sneezeweed
Centipeda nidiformis
505616