seen, likely due to limited visibility, and the pair was not resighted during subsequent surveys in October or November 2025 by Nature Advisory personnel. No additional Brolgas were detected within the assessment area during the 2025 breeding season. Sightings are shown in Figure 9-4 and Figure 7-1.

To date, only a single survey has been completed during the 2026 breeding season (July). During this survey, 70 wetlands were assessed, including all known breeding wetlands and a representative sample of potential breeding wetlands. No Brolgas were observed.

### *9.3.4. Brolga flight behaviour*

Two Brolga flights were observed by EHP at Hird Swamp during breeding surveys in September 2025. Both of these flights were well below RSA, within 300 m flight at 15 m height and the other 900 m at 12 m height. The species was observed several times during BUS surveys, with all observations of Brolgas in flight being estimated at or below RSA height, with the highest flight estimated at 25 m above ground level.

Several observations of Brolga (26) were made during the Autumn 2026 BUS, 12 during formal survey and 14 incidentally. All observations were within 2 km of survey point B03, and the maximum number of Brolga counted was two birds. It is therefore quite likely that all 26 observations were of the same two individual Brolga around B03 during that BUS, which would be consistent with community consultation regarding the limited Brolga activity in the area. None of the Brolga observations were at wetlands, with the nearest wetlands being around 500 m from where some of the observations were made.

Work by Nature Advisory over the last 15 years at wind farms in Victoria showed that of the 67 observed flights (Figure 9-3) the majority of flights by breeding Brolga were below 40 m, though there were a few observations above 60 m (3 % of all flights).

Veltheim et al. used GPS-tracking data to determine movement patterns of breeding Brolga pairs (Veltheim et al. 2019). This was based on the location of fledged chicks, with the assumption that they were accompanied by adult birds. The satellite records were made every six hours from midnight (4 points per 24 hours). Data showed that Brolga remained relatively close to Breeding Wetlands, with 95% of observations less than 1.4 km from roost sites. This suggests that breeding Brolga primarily make local flights. Accordingly, the buffer requirements outlined in the Handbook (DEECA 2025c), these are designed to ensure these local movement corridors remain free of turbines near Breeding Wetlands.

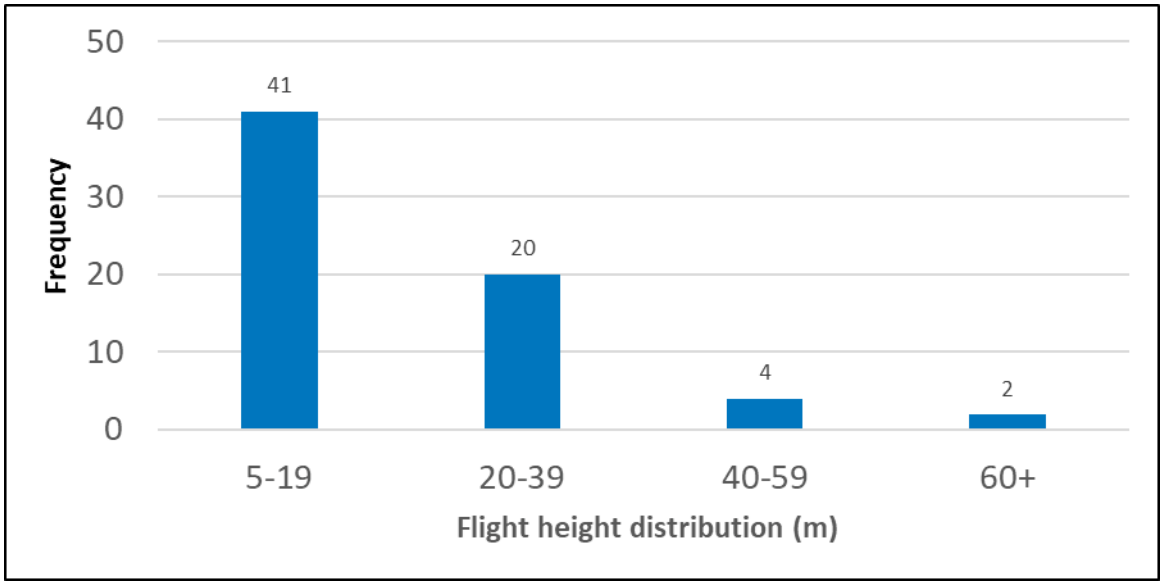



**Figure 9-3: Flight height distribution of Brolga flights from Breeding Wetlands across Victorian wind farms (*N*= 67; Nature Advisory *unpublished data*).**

### *9.3.5. Wetland assessments*

Wetlands identified within the assessment area included 6 BBHSM, 1069 VWI, and 16 unmapped wetlands (see full list in Appendix 15).

*Refining wetland boundaries*

According to the *Handbook*, if site surveys or hydrological analysis indicate that the modelled wetland boundary is incorrect, the wetland boundary can be realigned. In February 2026, DCE undertook an analysis of potentially suitable breeding wetlands to realign wetland boundaries to remove obvious areas of cropping (delineated by fields modified to have berms constructed to direct water for flood irrigation) and areas unable to pond water during typical conditions (DCE 2026c, 2026a). These reports addressed areas within the Project Area, particularly those in proximity to proposed turbine locations. Consequently, not all boundaries of wetlands within 5 km have been updated. Following these reports, the following wetlands were found to have functional boundaries different to that were mapped in the BBHSM/VWI:

- *BBHSM 12* – this mapped area was found to contain 6 separate areas that may function as individual wetlands, with the connecting streams unlikely to function as part of the wetland, but rather as connections between.
- *BBHSM 8330* – this mapped area was found to contain 5 separate areas that may function as individual wetlands, with the connecting stream unlikely to function as a wetland but rather as a connection between the various wetlands.
- *BBHSM 8831* – this mapped area was found to contain 7 separate areas that may function as individual wetlands, with the connecting stream unlikely to function as a wetland but rather as a connection between the various wetlands.
- *VWI 45406* – this mapped area was found to contain 3 separate areas that may function as individual wetlands.

- *VWI 45407* – this mapped area was found to contain 11 separate areas that may function as individual wetlands.
- *VWI 45408* – this mapped area was found to contain 3 separate areas that may function as individual wetlands.

Resulting from the hydrological determination of wetland boundaries, 1,116 individual wetlands/waterbodies were identified within the 5 km assessment area (Figure 9-4). A complete summary of the wetland analysis, including decisions regarding suitability against the Handbook's criteria are provided in Appendix 15.

### *Unsuitable wetlands*

Following evaluation against the criteria of the Handbook (DEECA 2025c), 1,049 wetlands were determined to be unsuitable for Brolga breeding (see full details in Appendix 15):

- Wetlands that did not meet the criteria to define a potential breeding wetland or require a buffer (Table 9 and 11 of the Handbook):
    - Nine did not meet 120 days inundation requirements (Criterion 9.2)
    - 52 did not provide sufficient emergent vegetation for nest building (Criterion 9.3)
    - Three did not meet both inundation and emergent vegetation requirements (Criteria 9.2 and 9.3)
    - 465 did not meet the size requirements of at least 0.1 ha (Criterion 11.2)
    - 514 were saline waterbodies or farm dams that did not have known breeding records (Criterion 11.3)
    - Six were not capable of holding water or functioning as wetlands (Criterion 11.4) and/or were incorrectly identified as a wetland (Criterion 11.5)

### *Potential breeding wetlands*

Assessments found 63 wetlands qualified as potential breeding wetlands under the Handbook:

- 22 met all requirements for a potential breeding wetland (Criteria 11.1-5)
- 41 were conservatively determined to be potential breeding wetlands, owing to a lack of evidence for their exclusion. The majority of these wetlands are outside of the project area and considered as potential breeding wetlands as a precautionary measure:
    - 28 were inconclusive for inundation requirements (Criterion 9.2)
    - Five are yet to be assessed for emergent vegetation (Criterion 9.3); and
    - Eight were lacking evidence for exclusion under both inundation (Criterion 9.2) and emergent vegetation (Criterion 9.3)

Wetlands that were inconclusive for inundation requirements were those identified by DCE as having filling regimes that are linked to water levels of watercourses, many of which have human-managed flow regimes (DCE 2026d). As a precaution, these wetlands were also considered potentially to meet the inundation criteria.

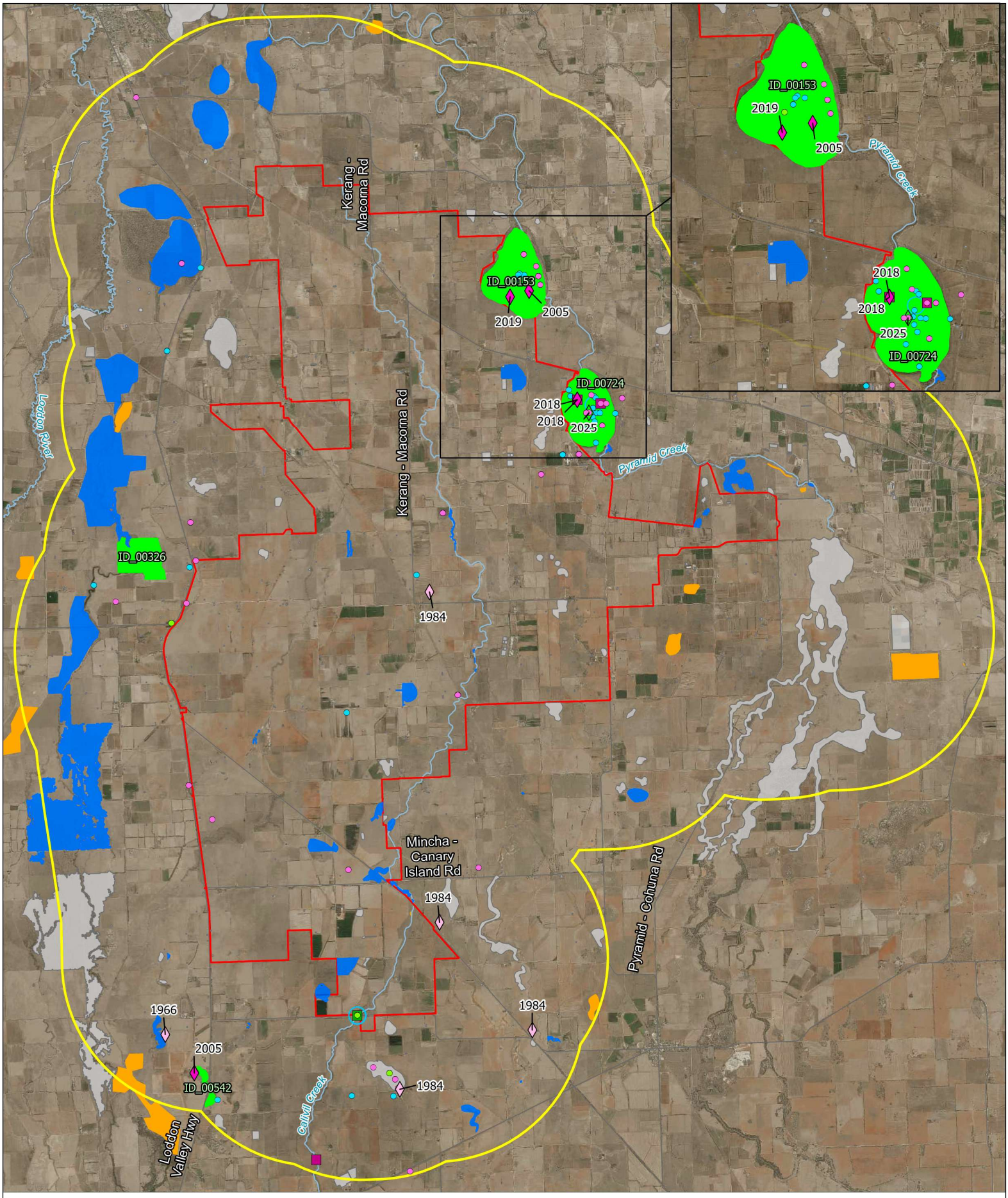
Wetlands that were not assessed for emergent vegetation were those that were generally not within proximity to turbines, shown as desktop-only assessments in Figure 9-4. Wetlands without these

lines of evidence were included on a conservative basis as they did not have strong evidence demonstrating their prevailing unsuitable conditions as outlined in the Handbook.

*Breeding wetlands*

Four wetlands met the Handbook definition of Brolga Breeding Wetlands (Figure 9-4).

- **Johnson Swamp Wildlife Reserve/ Wetland 153** (BBHSM 8, VWI 45222) – A large swamp area (~411 ha) with dense mid-layer vegetation (>1m) that reduces suitability in parts of the site. Conditions may vary between years, providing suitable breeding habitat for Brolgas in some years and not others. Fringing vegetation occurs along an inundated creek line (Pyramid Creek). Breeding records exist from 2005 and 2019, along with multiple non-breeding observations from other years. Community consultation has shown that landholders have observed recent and regular presence of the species, with breeding attempts reported by NCCMA over the last 10 years.
- **Hird Swamp Wildlife Reserve/ Wetland 724** (BBHSM 13, VWI 45231) – A large (~345 ha), densely vegetated swamp with suitable wetland vegetation, though much of it exceeds 1 m in height, and scattered stag trees throughout the site. Creek lines (Pyramid Creek) were inundated during surveys with fringing vegetation and sections of emergent vegetation <1 m. Brolgas were observed during EHP surveys in September 2025 to be nesting, though subsequent visits by both EHP and NA failed to locate the pair or nest. Existing records show breeding attempts in 2018, with NCCMA reporting several other breeding events over the last 10 years. Landholders have reported numerous sightings at and within 100 m of Hird Swamp.
- **Wetland 542** (VWI 42677) - a moderate-sized (~26 ha) wetland with two sections of open water with apparent emergent vegetation visible on aerial imagery, though it was not present when visited in October/November 2025, likely owing to the wetland not holding water at the time. Other parts of the wetland have a dense growth of trees and shrubs that are likely to make these sections unsuitable for breeding brolga. No Brolga were observed during breeding surveys in October/November 2025, however, the wetland was dry at the time. Information within the VBA reports breeding in 2005.
- **Bannagher Creek/ Wetland 326** (BBHSM 12, VWI 43232) - a large wetland complex (~178 ha) west of the Project Area, with open water and emergent vegetation, connected via the Bannagher Creek to several nearby wetlands. The wetland has areas of dense woodland and treed vegetation bordering the open water that may become inundated during floods. No Brolga have been observed here and no records in the databases. However, the landholder has indicated that Brolgas have regularly nested in the wetland in the last 30 years, with the most recent nesting observation approximately two years ago.




## Figure 9-4: Brolga records and potential breeding habitat suitability

**Project No**: 24129.09 **Project location**: Macorna Wind Farm, VIC **Date**: 27/07/2026

- Project Area
- Brolga assessment area (5km)
- Road

***Potential Brolga breeding wetland***

- Breeding wetland
- Potential breeding wetland, Field Assessed
- Potential breeding wetland, Desktop Assessed
- Not requiring buffering

**VBA**

***Breeding record (labelled by year of record)***

- <= 20 years
- > 20 years

***Other observations***

- Flocking >= 10 birds
- Brolga observation

**Ebird**

***Breeding record***

- <= 20 years

***Other observations***

- Flocking >= 10 birds
- Brolga observation

***ALA***

- Flocking >= 10 birds
- Brolga observation

N

Kilometers

0 2 4

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### 9.3.6. Wetland buffer application

As outlined in the Handbook guidance, buffers were applied to all wetlands that met the breeding and potential breeding wetlands criteria .

*Brolga Breeding Wetland buffers*

The analysis identified four breeding wetlands within the 5 km assessment area. Buffering was applied as per the Handbook and incorporated a clustering of those breeding and potential breeding wetlands within 2 km of the breeding buffers, where each was provided with a 600 m foraging buffer, a movement corridor linking these clustered wetlands as measured from the widest extent in straight lines, a 300 m disturbance buffer, plus a buffer for the turbine blade length (90 m). This resulted in three clustered breeding buffers (Figure 9-5).

- *Hird-Johnson Swamp Cluster* – this is a large cluster incorporating two breeding wetlands (153 and 724) and three potential breeding wetlands (55, 97, 1091). It is located in the north-east of the site. This forms part of the BBHSM 8 and 13 wetlands as identified within DEECA's Brolga modelling.
- *Wetland 542 Cluster* – this is a cluster of wetlands outside the Project Area to the south-west, which incorporates the breeding wetland (542) with two potential breeding wetlands (397 and 193). This breeding wetland is not within DEECA's Brolga modelling, but was identified as a wetland within the VWI.
- *Bannagher Creek Cluster* – this is a large cluster of wetlands outside the Project Area to the west, which incorporates one breeding wetland (326) with three potential breeding wetlands (594, 909, and 1021). This forms part of the BBHSM 12 wetland as identified within DEECA's Brolga modelling.

**Turbine overlaps**

No turbines overlap with any breeding buffer. The proponent has taken all means to avoid turbines and their blades from overlapping any of the breeding wetland buffers.

**Other infrastructure overlaps**

It is possible that some developments such as underground cables and creation/upgrading of tracks associated with the wind farm are permissible under 4.2.3 of the Handbook, provided it meets the guidance of implementing measures to minimise disturbance, habitat loss, and meet engineering standards. Impacts from construction footprints, however, are not permissible under the Handbook and, if not able to be microsited, will require a compensation plan (DEECA 2025c).

- *Hird-Johnson Swamp Cluster – entrance point, new/upgraded track, and part of turbine hardstand (T20)*. This wetland cluster was confirmed to support Brolga breeding in 2025, and did not meet any of the criteria for exclusion outlined in Table 10 of the Handbook (Appendix 15). Overlaps will likely be **permissible in part** as per conditions within 4.2.3 of the Handbook. The overlap of the entrance point and new/upgraded track is likely to be permissible. The overlap from the hardstand of T20, however, is likely to be not permissible under the guidelines. The proponent is committed to micrositing this turbine to avoid intersection or omitting the turbine if micro-siting is not possible. A reorientation of the turbine hardstand would also remove this overlap.

### *Potential Brolga Breeding Wetland buffers*

Numerous potential breeding wetlands were identified within the 5 km assessment area. Buffering was applied as per the Handbook, which incorporated a 300 m disturbance buffer, plus a buffer for blade length (90 m; Figure 9-5).

Note that 41 of these buffers are applied conservatively, as some of these wetlands have not yet been assessed through site or hydrological assessments. These wetlands are largely outside of the Project Area (see "desktop assessed wetlands" in Figure 9-4) and their inclusion is a precautionary approach to capture potential uncertainties. Several may be deemed unsuitable for Brolga breeding during forthcoming surveys.

Several potential breeding wetland buffers currently overlap with the proposed development footprint of MAWF (Figure 9-5), but following further planned wetland habitat assessment at the appropriate time as prescribed by the Handbook (July 2026), it is anticipated that not all of these may qualify for buffering under the Handbook's criteria. The Proponent has committed to undertaking design measures to avoid several buffers. Further layout revisions will be made to avoid turbine placement within areas of potential breeding wetlands buffers. Compensation measures will be required should infrastructure be placed within these buffers.

#### Turbine overlaps

Three turbines within the current design overlap with potential breeding wetland buffers (Figure 9-5). While some of this infrastructure may be permissible via 4.3.2 of the Handbook (e.g. tracks and cables), turbine overlaps are unlikely to be permitted under the Handbook. If micro-siting these turbines outside of the buffers is not possible, a compensation plan will be required as per the Handbook (DEECA 2025c).

- *Wetland 962 – T37+T50 and associated infrastructure*. This wetland is mapped under the VWI layer (45412). It is of sufficient size (~27 ha), has sufficient emergent vegetation, and ≥120 d inundation (Appendix 15). As such, it meets all criteria within Table 9 outlined in the Handbook (DEECA 2025c). However, it is considered unlikely to be used by Brolga for breeding due to the elevated human disturbance in the area. Regardless, under the guidance, this wetland must be considered as a potential breeding wetland. Overlaps with the buffer include blade swing, new and upgraded tracks, underground cables, entrance points, and the hardstand. Overlaps will likely be **permissible in part** as per conditions within 4.2.3 of the Handbook. The tracks, entrance points, and underground cables will likely be permissible. The overlap from the hardstand and blade-swing from T37 and T50, however, is unlikely to be afforded an exemption under the guidelines. If micro-siting these turbines outside of the buffer is not possible, the Proponents have committed to their omission from the development.
- *Wetlands 1079, 1080, 1081, 1082 – T111 and associated infrastructure.* These wetlands are mapped as a single wetland under the BBHSM (8331) and did not meet any exclusion criteria within Table 11 of the Handbook (Appendix 15). As such, they are considered potential breeding wetlands. Overlaps with the buffer include blade swing, new and upgraded tracks, underground cables, entrance points, and the hardstand. Overlaps will likely be **permissible in part** as per conditions within 4.2.3 of the Handbook. The tracks, entrance points, and underground cables will likely be permissible. The overlap from the hardstand and blade-swing from T111, however, is unlikely to be afforded an exemption under the guidelines. If micro-siting T111 outside of the buffer is not possible, a compensation plan will be required.

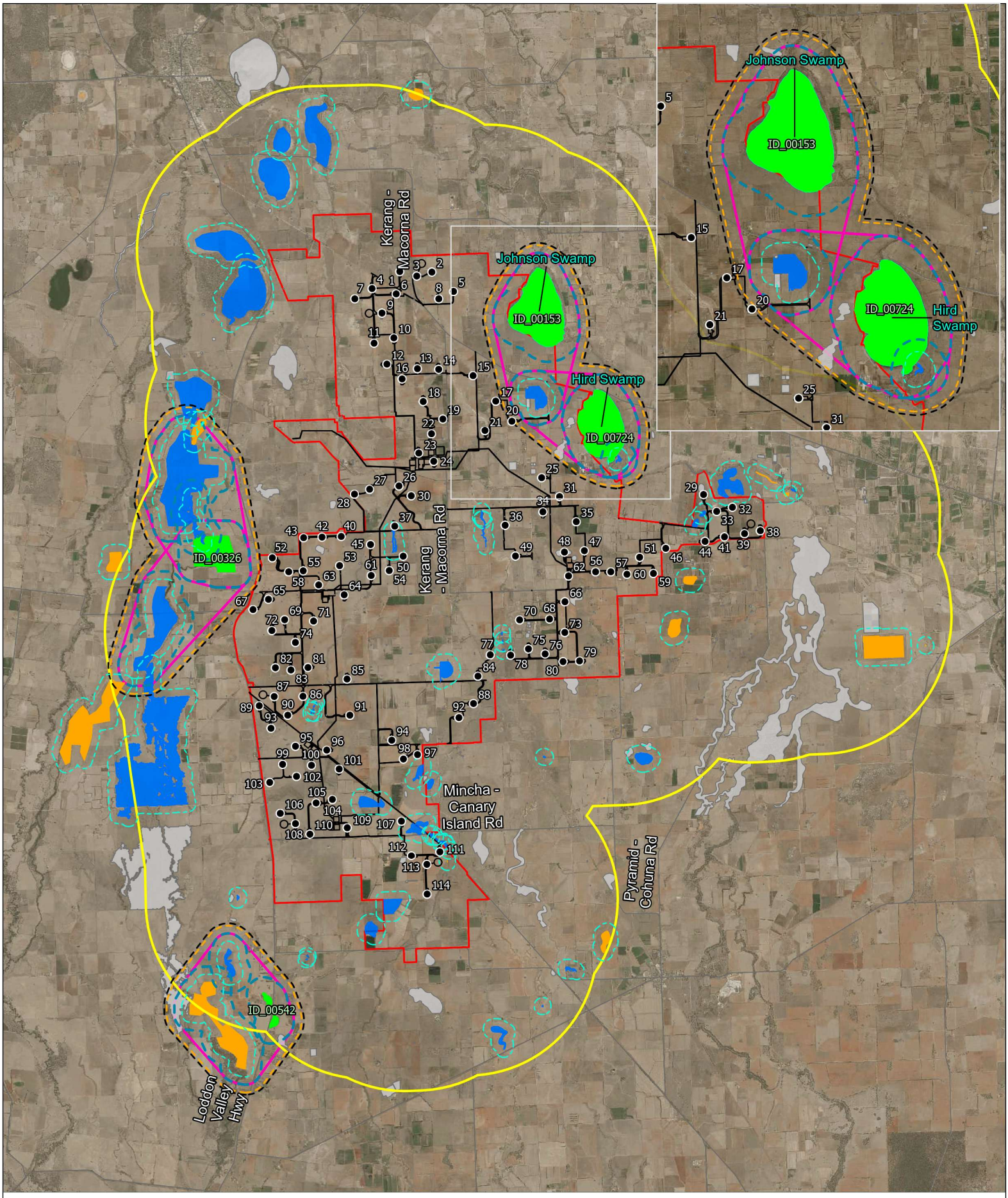
- *Wetland 1076 – T78 and associated infrastructure*. This wetland is mapped within a wetland under the BBHSM (8330) and did not meet any exclusion criteria within Table 11 of the Handbook (Appendix 15). As such, it is considered a potential breeding wetland. Overlaps with the buffer include blade swing, new and upgraded tracks, underground cables, entrance points, and construction footprints. Overlaps will likely be **permissible in part** as per conditions within 4.2.3 of the Handbook. The tracks, entrance points, and underground cables will likely be permissible. The overlap from the hardstand and blade-swing from T78, however, is unlikely to be afforded an exemption under the guidelines. The Proponents have committed to micrositing T78 further from the buffer. A reorientation of the turbine hardstand will resolve this conflict.

**Other infrastructure overlaps**

Eight potential breeding wetland buffers have overlaps with various Project-related infrastructure. It is possible that five of these developments are permissible under 4.2.3 of the Handbook, provided it meets the guidance of implementing measures to minimise disturbance, habitat loss, and meet engineering standards (DEECA 2025c). Impacts to three from construction footprints, however, would not be permissible under the Handbook and, if not able to be microsited, will require a compensation plan (DEECA 2025c).

- *Wetland 1083 – construction footprint associated with Metmast 1*. This wetland is mapped as a part of a single wetland under the BBHSM (8331) and did not meet any exclusion criteria within Table 11 of the Handbook (Appendix 15). As such, it is considered a potential breeding wetland. Overlaps with the buffer include the construction footprint for Metmast 1. This type of activity is **not permissible** under the Handbook. We note that the orientation of the guy wires of the met mast may result in no construction impact overlaps with the potential breeding wetland buffer. This will be revised in future design.
- Wetland 1101 – new/upgraded tracks, underground cables and hardstand for T33. This wetland is mapped under the VWI layer (45407), and was determined to be independent from other sections of the mapped wetland (DCE 2026d). It is of sufficient size (~2.7 ha), has sufficient emergent vegetation, but the inundation duration was not able to be confirmed by hydrological analysis (Appendix 15). As such, it is considered precautionary to meet all criteria within Table 9 outlined in the Handbook (DEECA 2025c). Further observations of water levels will be taken over the 2026 breeding season to ascertain its validity for inclusion. Overlaps will likely be permissible in part as per conditions within 4.2.3 of the Handbook. The tracks and underground cables will likely be permissible. The overlap from the hardstand of T33, however, is unlikely to be afforded an exemption under the guidelines. The proponents have committed to a reorientation of the hardstand to avoid impacts.
- Wetland 1102 – upgraded track and underground cables. This wetland is mapped under the VWI layer (45407), and was determined to be independent from other sections of the mapped wetland (DCE 2026d). It is of sufficient size (~4.8 ha), has sufficient emergent vegetation, but the inundation duration was not able to be confirmed by hydrological analysis (Appendix 15). As such, it is considered precautionary to meet all criteria within Table 9 outlined in the Handbook (DEECA 2025c). Further observations of water levels will be taken over the 2026 breeding season to ascertain its validity for inclusion. The track upgrades and underground cables will likely be **permissible** as per conditions within 4.2.3 of the Handbook.

- *Wetland 1070 – upgraded tracks.* This wetland is mapped as a part of a single wetland under the BBHSM (8330) and did not meet any exclusion criteria within Table 11 of the Handbook (Appendix 15). As such, it is considered a potential breeding wetland. The track upgrades to its north will likely be **permissible** as per conditions within 4.2.3 of the Handbook.
- *Wetland 500 – upgraded tracks and underground cables.* This wetland is mapped within VWI (45209). It is of sufficient size (~40 ha), has sufficient emergent vegetation, but the inundation duration was not able to be confirmed by hydrological analysis (Appendix 15). Further observations of water levels will be taken over the 2026 breeding season to ascertain its validity for inclusion. The track upgrades along Campbells Road will likely be **permissible** as per conditions within 4.2.3 of the Handbook.
- *Wetland 433 – upgraded tracks and underground cables.* This wetland is mapped within VWI (45209). It is of sufficient size (~40 ha), has sufficient emergent vegetation, but the inundation duration was not able to be confirmed by hydrological analysis (Appendix 15). Further observations of water levels will be taken over the 2026 breeding season to ascertain its validity for inclusion. The track upgrades and underground cables along Mitiamo-Kerang Road, Herdmans Road, Godwards Road, and internal tracks will likely be **permissible** as per conditions within 4.2.3 of the Handbook.
- *Wetland 129 – new/upgraded roads, entrance ways, underground cables, and the hardstand for T107.* This wetland is mapped within VWI (44870). It is of sufficient size (~75 ha), has sufficient emergent vegetation, but the inundation duration was not able to be confirmed by hydrological analysis (Appendix 15). Further observations of water levels will be taken over the 2026 breeding season to ascertain its validity for inclusion. Overlaps will likely be **permissible in part** as per conditions within 4.2.3 of the Handbook. The tracks and underground cables along Mincha-Canary Island Road, Mitiamo-Kerang Road, and internal tracks will likely be permissible. The overlap from the hardstand of T107, however, is unlikely to be afforded an exemption under the guidelines. A reorientation of the turbine hardstand will avoid this conflict.
- *Wetland 1077, 1078 – upgraded roads and entrance ways*. These wetlands are mapped as a parts of a single wetland under the BBHSM (8331) and did not meet any exclusion criteria within Table 11 of the Handbook (Appendix 15). As such, they are considered potential breeding wetlands. The track upgrade and entrance point along Mitiamo-Kerang Road will likely be **permissible** as per conditions within 4.2.3 of the Handbook.




# Figure 9-5.1. Brolga buffer map

**Project No**: 24129.09 **Project location**: Macorna Wind Farm, VIC **Date**: 27/07/2026

- Project Area
- Brolga assessment area (5km)
- Construction footprint
- Turbine
- Road
- Turbine buffer - 90m
- Homerange
- Wetland buffer - 600m
- Potenital breeding wetland buffer - 300m
- Disturbance Buffer - 300m
- Turbine blade buffer - 90m

**Potential Brolga breeding wetland**

- Breeding wetland
- Potential breeding wetland, Field Assessed
- Potential breeding wetland, Desktop Assessed
- Not requiring buffering

N

Kilometers

0 5

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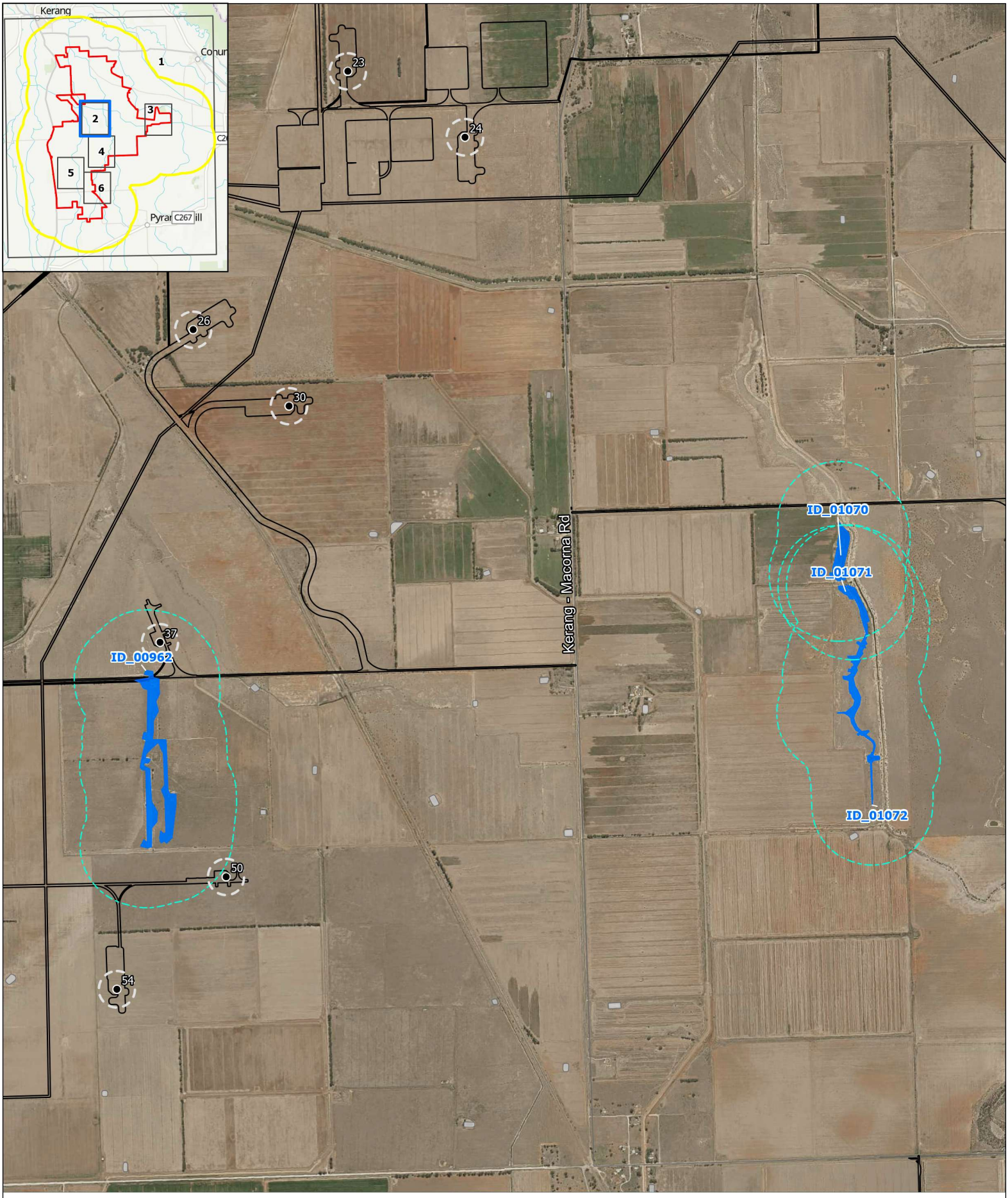


# Figure 9-5.2. Brolga buffer map

**Project No**: 24129.09 **Project location**: Macorna Wind Farm, VIC **Date**: 27/07/2026

- Project Area
- Brolga assessment area (5km)
- Construction footprint
- Turbine
- Road
- Turbine buffer - 90m
- Potenital breeding wetland buffer - 300m

**Potential Brolga breeding wetland**

- Potential breeding wetland, Field Assessed
- Not requiring buffering

N

Meters

0 500

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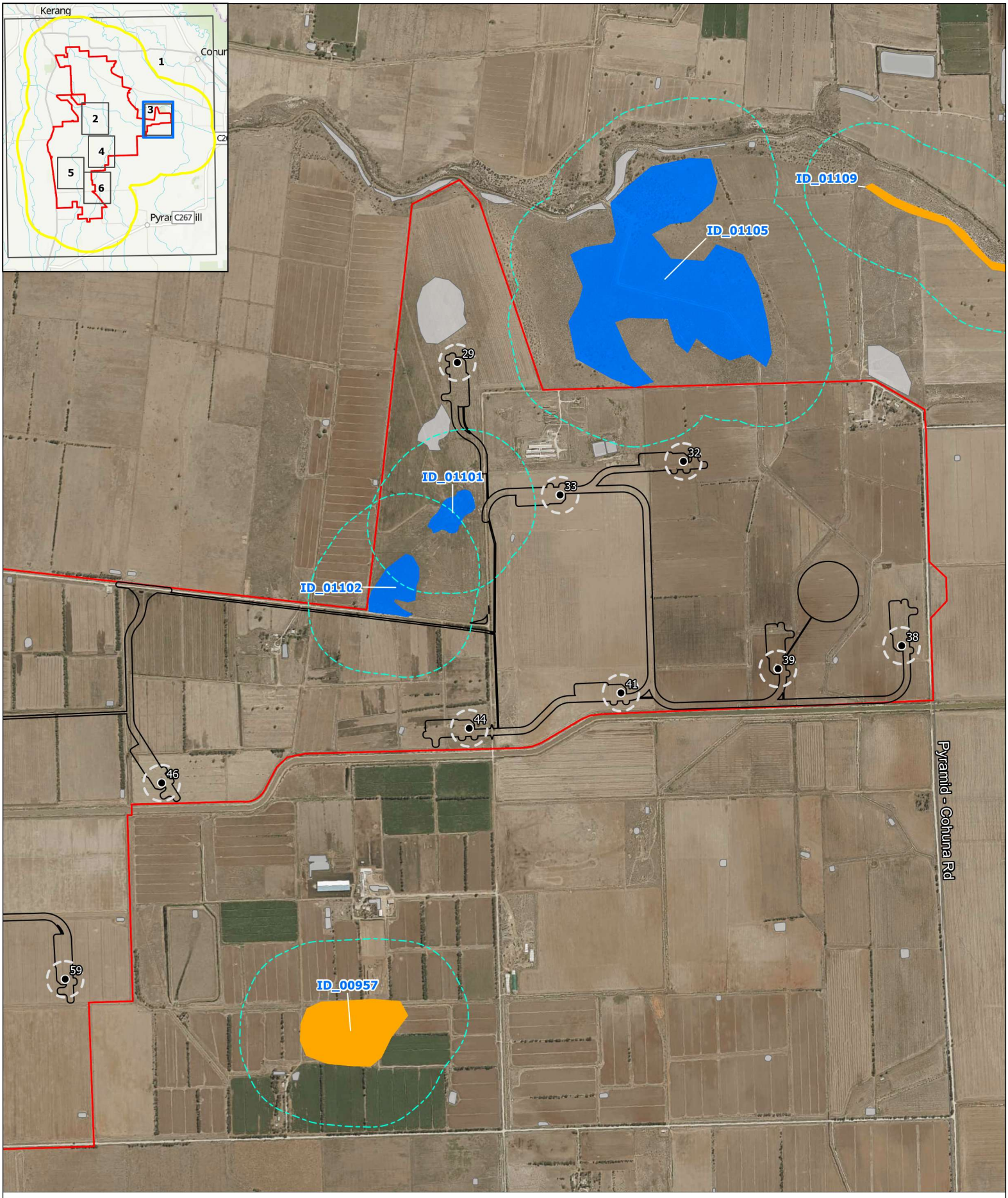


# Figure 9-5.3. Brolga buffer map

**Project No**: 24129.09 **Project location**: Macorna Wind Farm, VIC **Date**: 27/07/2026

- Project Area
- Brolga assessment area (5km)
- Construction footprint
- Turbine
- Road
- Turbine buffer - 90m
- Potenital breeding wetland buffer - 300m
- Disturbance Buffer - 300m
- Turbine blade buffer - 90m

**Potential Brolga breeding wetland**

- Potential breeding wetland, Field Assessed
- Potential breeding wetland, Desktop Assessed
- Not requiring buffering

N

Meters

0 500

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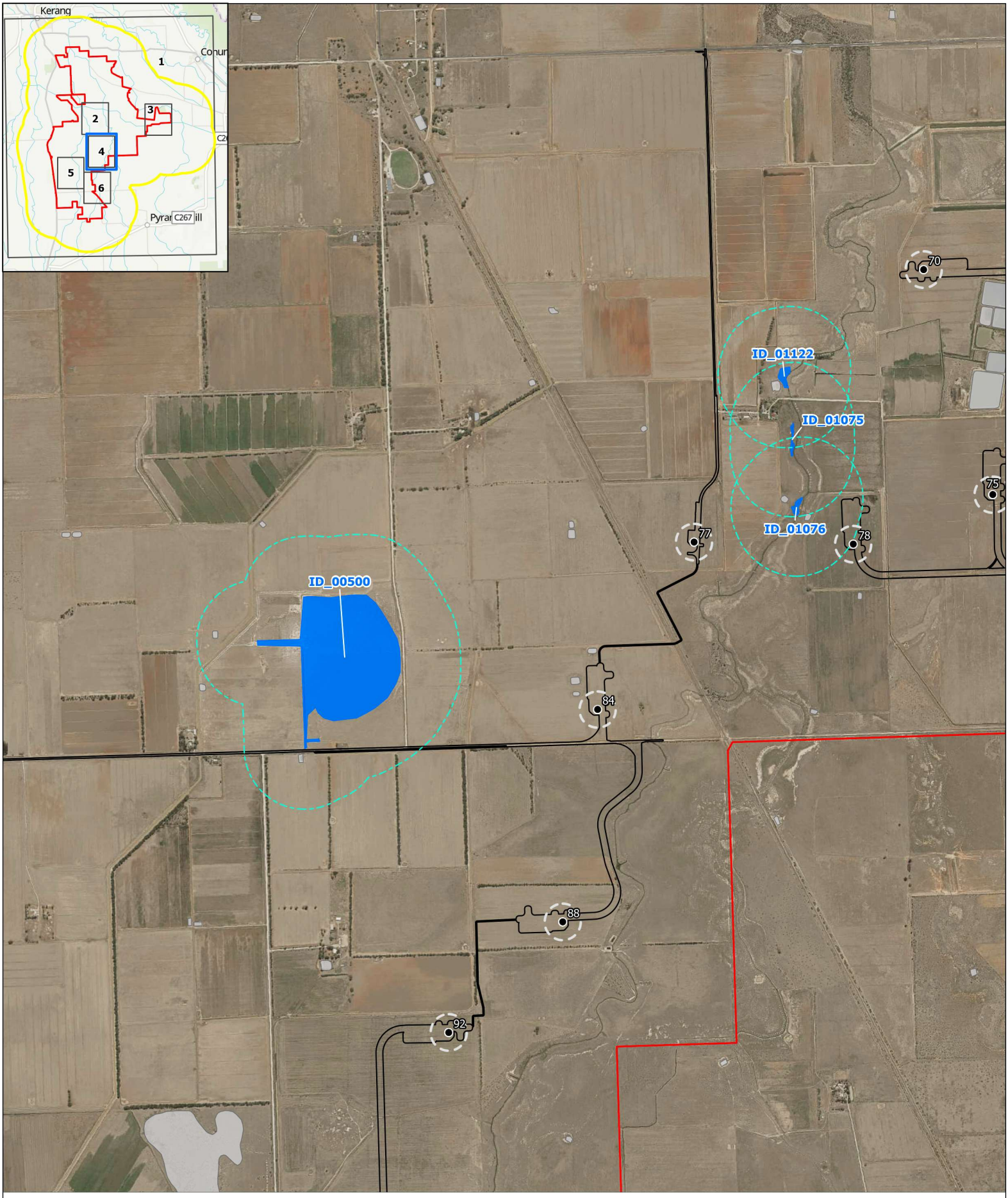


# Figure 9-5.4. Brolga buffer map

**Project No**: 24129.09 **Project location**: Macorna Wind Farm, VIC **Date**: 27/07/2026

- Project Area
- Brolga assessment area (5km)
- Construction footprint
- Turbine
- Road
- Turbine buffer - 90m
- Potenital breeding wetland buffer - 300m

**Potential Brolga breeding wetland**

- Potential breeding wetland, Field Assessed
- Not requiring buffering

N

Meters

0 500

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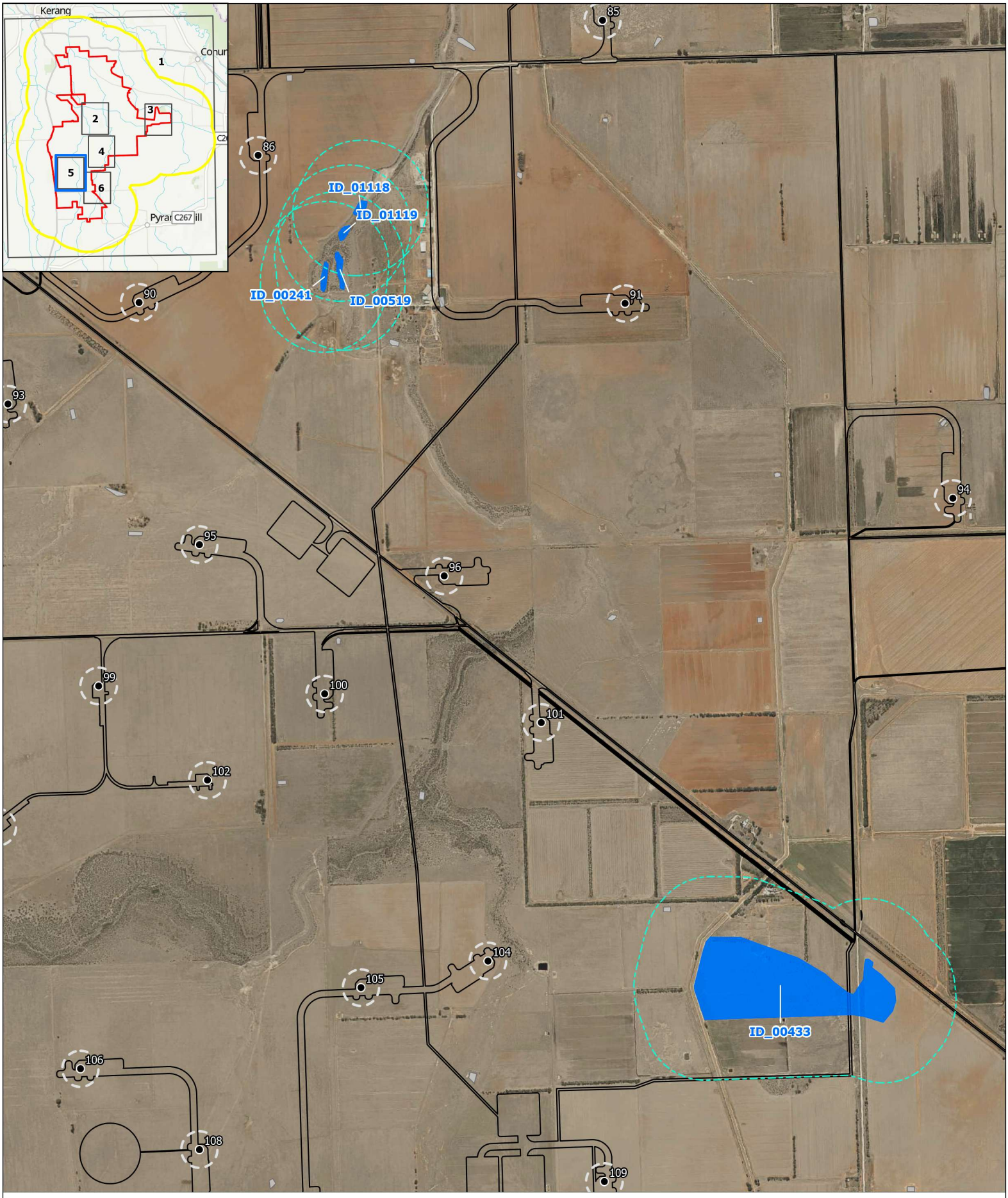


# Figure 9-5.5. Brolga buffer map

**Project No**: 24129.09 **Project location**: Macorna Wind Farm, VIC **Date**: 27/07/2026

- Project Area
- Brolga assessment area (5km)
- Construction footprint
- Turbine
- Road
- Turbine buffer - 90m
- Potenital breeding wetland buffer - 300m

**Potential Brolga breeding wetland**

- Potential breeding wetland, Field Assessed
- Not requiring buffering

N

Meters

0 500

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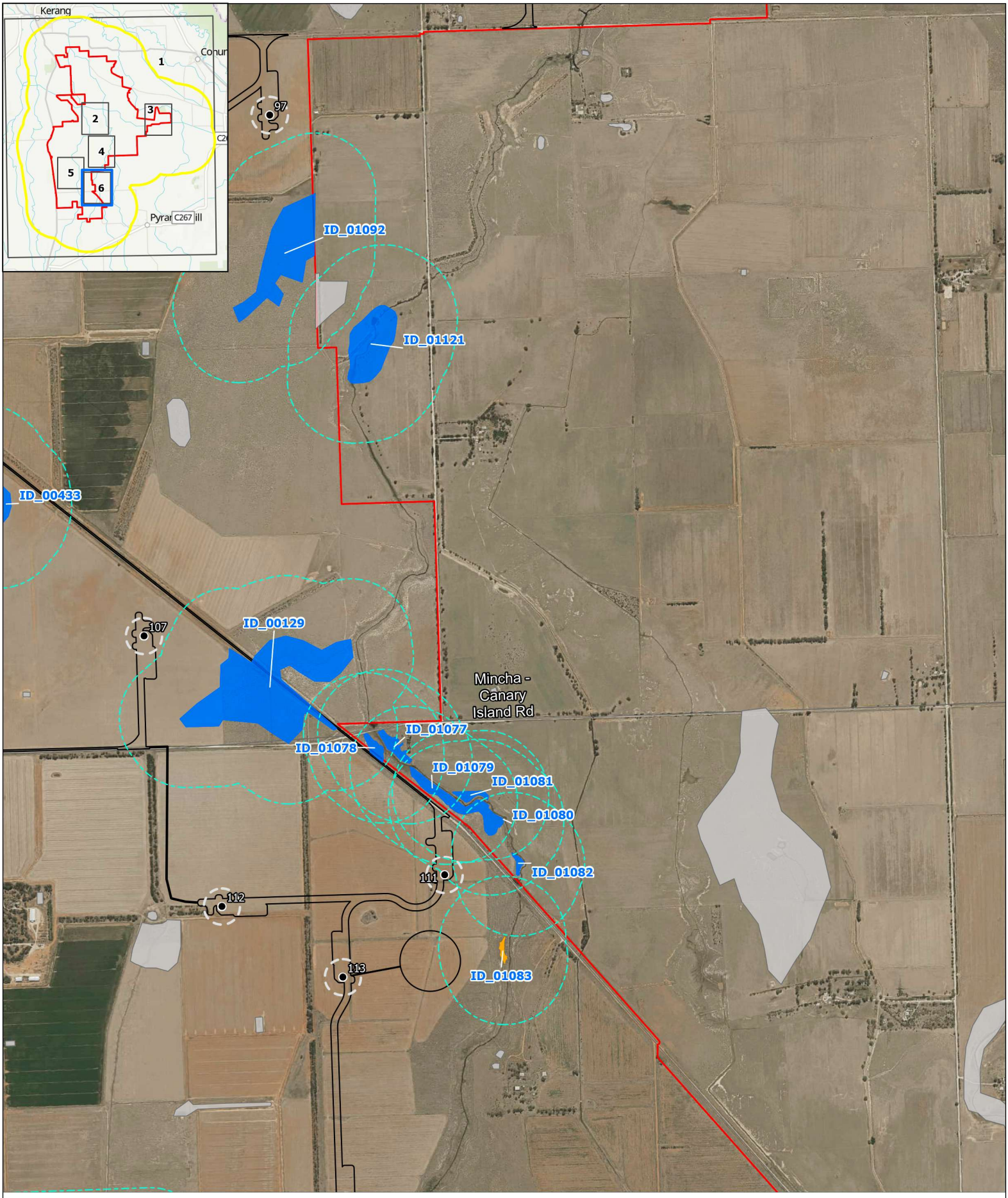


# Figure 9-5.6. Brolga buffer map

**Project No**: 24129.09 **Project location**: Macorna Wind Farm, VIC **Date**: 27/07/2026

- Project Area
- Brolga assessment area (5km)
- Construction footprint
- Turbine
- Road
- Turbine buffer - 90m
- Potenital breeding wetland buffer - 300m

**Potential Brolga breeding wetland**

- Potential breeding wetland, Field Assessed
- Potential breeding wetland, Desktop Assessed
- Not requiring buffering

N

Meters

0 500

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## 9.4. Conclusions

### *9.4.1. Summary of findings*

Brolgas were found to utilise a range of wetlands surrounding but not within the Project Area; however, evidence indicates that breeding activity within the area is relatively limited. Field surveys have found a limited number of detections, which is consistent with community consultation regarding Brolga activity in the area, and a lower number of existing database records. Additional targeted breeding and flocking surveys are planned for 2026-2027 to provide further information on Brolga use of the Project Area and surrounding landscape.

No mapped flocking sites were identified within 5 km of any proposed turbines. Historical records show a few locations where groups of 10 or more individuals were observed, but these have not been recorded during subsequent years or over several months. Hence, these sites do not qualify as flocking sites according to the Handbook. No specific flocking surveys have been undertaken, but shorebird surveys visited all important wetlands within 10 km of the project site during the flocking season and did not record any flocking activity by Brolga. It is concluded that there is minimal risk to important flocking sites.

Brolga habitat and breeding assessments identified 1,114 wetlands, with most of these wetlands (1,049) unsuitable for Brolga breeding as per the criteria within the Handbook. Several wetlands were subject to altered boundaries following hydrological investigation as per the process outlined in the Handbook. Two of these were BBHSM-mapped wetlands (8330 and 8331), which were determined to represent several smaller functional wetlands rather than a single large area in the model.

Within the assessment area, four breeding wetlands were identified, forming three breeding wetland clusters (Figure 9-5). One of these, the Hird–Johnson Swamp breeding cluster, partially overlaps the Project Area, with some infrastructure associated with T20 that is likely to be prohibited under the Handbook. The other two breeding wetland clusters, Bannagher Creek (Wetland 326) and Wetland 542, are outside of the Project Area to the west and south-west, respectively, and do not overlap with any Project infrastructure.

A total of 63 potential breeding wetlands were identified. The majority (41) of these wetlands have been classed as potential breeding wetlands in a precautionary approach. This precautionary approach was used in accordance with the Handbook guidelines, where available evidence was insufficient to confidently confirm or exclude their suitability. Further targeted field assessment will provide refinement of these outcomes and potentially reduce the number and extent of some potential breeding wetland buffers.

Eleven of the identified Potential Breeding Wetlands currently overlap with elements of the proposed MAWF layout. The majority of these overlaps are likely to be permissible under 4.2.3 of the Handbook, provided appropriate measures are put in place to minimise disturbance, habitat loss, and meet engineering standards (DEECA 2025c). Several impacts, however, likely to require compensation if further avoidance is not undertaken. The Proponents have committed to undertaking additional efforts to avoid these areas, particularly where overlap involves turbine locations to comply with the Handbook. This approach is consistent with the mitigation hierarchy and prioritises avoidance and micro-siting before consideration of management or compensatory measures. The process for addressing potential impacts to these wetlands includes:

Further expert review and refinement of existing hydrological assessments for these wetlands to confirm whether they are potential breeding or breeding wetlands;

- Ongoing field observation of wetlands to resolve inconclusive inundation durations. These observations will provide information on areas where the limitations of hydrological modelling (DCE 2026d) have not allowed for conclusive results on inundation durations.
- Further micrositing of infrastructure to avoid Breeding and Potential Breeding Wetland buffers; and
- Where avoidance is not possible, management measures will be implemented within the overlapping construction footprint or, as a last resort, compensatory measures will be applied for turbines intersecting buffer areas. Any required compensation measures will be subject to further discussion and agreement with DEECA.

### 9.4.2. Potential impact pathways

The Handbook (DEECA 2025c) lists both direct and indirect pathways to impact the species, including cumulative impacts.

*Direct impacts*

Direct impacts for Brolga at wind energy facilities are related to:

- Mortality resulting from collision with turbines or powerlines

Wind energy facilities are recognised as having the potential to impact Brolga (DEECA 2025c). While little information is available on their risk of collision with turbines, they are known to collide with powerlines (Herring 2005; Goldstraw and Du Guesclin 1991). Prior studies suggest some level of avoidance, with Brolga observed flying directly under operating turbines (Wood 2014, 2017). However, and importantly, even a small number of mortalities can pose a significant risk to the Brolga due to their slow generational time and small, declining population (DEECA 2025c).

There has only been a single case of a potential Brolga collision at a wind farm, from October 2022, when a carcass search team at the operational Dundonnell wind farm (approximately 224 km south-west of MAWF) found a Brolga carcass near a turbine (Biosis 2023).

*Indirect impacts*

The utilisation of the Project Area by birds may be impacted through:

- Reduction of habitat through loss or degradation,
- Disturbance of roosting/foraging birds from construction activities, and
- Barrier effects.

There is evidence that Brolga are susceptible to disturbance, often selecting habitat away from areas of human activity (Veltheim et al. 2019). Rows of turbines may also create a movement barrier. Brolga avoiding turbines travel greater distances and expend more energy (Drewitt and Langston 2006). Layout, orientation and spacing of wind turbines are important factors to reduce barrier effects. Occasional gaps between turbine clusters may be appropriate to facilitate the movement of Brolga from high-density breeding areas to flocking sites (DSE 2012).

The Brolga can be susceptible to disturbance from frequent human activities, such as during construction (Veltheim et al. 2019). Construction activities, including forming/upgrading tracks,

erecting turbines, increased traffic and activities at the quarry, have the potential to impact nearby Brolga.

*Cumulative Impacts*

The cumulative effects of wind farms may impact Brolga through a combination of the above-mentioned direct and indirect pathways. These include, but are not limited to:

- Collision with turbines and powerlines across their range,
- Displacement or disturbance across their range, and
- Barrier effects, where wind farms may create landscape-scale barriers to seasonal or local flight pathways.

It is possible that, cumulatively, Victorian wind farms could lead to an increased risk of collision, as individual Brolgas moving across the landscape could potentially encounter several of these facilities. This may be particularly pertinent to the Brolga during the non-breeding season, where they undertake flights up to 100 km as they move between seasonal habitats (I. Veltheim, *pers. comm.*). Current turbine collision evidence appears to suggest that cumulative impacts attributable to turbine strike is not occurring.

### 9.4.3. Assessment of potential impacts

*Collision mortality*

While collision risk models (CRMs) are commonly applied to assess potential turbine impacts for some bird species, their application to Brolgas is highly uncertain. These models typically rely on assumptions about flight behaviour, habitat use, and avoidance rates, all of which are poorly understood or unknown parameters for Brolgas. As a result, any CRM-derived outcome for collision probability and mortality estimates is an unreliable indicator of actual impacts, particularly given that only a single carcass has ever been documented.

The scarcity of empirical evidence translates into collision probabilities and mortality estimates for Brolgas at wind farms that are neither robust nor reliable. However, given the single documented carcass, observed tolerance of breeding Brolgas to turbine structures, and avoidance of key breeding and flocking habitats at wind farms, cumulative impacts are still expected to be low. Further, buffers have been applied to Breeding and Potential Breeding Wetlands to minimise the potential impacts if they are used by Brolga. Local and cumulative contributions of impacts at MAWF are therefore expected to remain low, provided that the mitigation hierarchy is properly applied.

*Habitat loss, disturbance and barrier effects*

Construction activities have the potential to disturb breeding Brolgas through increased human presence at wetlands where the recommended 300 m breeding disturbance buffer cannot be achieved. The risk of disturbance could be effectively mitigated by micrositing infrastructure outside of buffers, or by avoiding construction activities within or adjacent to these wetlands during the Brolga breeding season. Where micro-siting or seasonal avoidance are not feasible, minimisation of disturbance may be achievable through monitoring of nearby wetlands, with adaptive management measures (e.g. temporary exclusion zones, cessation of high-disturbance works, or modification of construction activities) implemented if Brolgas are detected within the vicinity of works.

Operational disturbance and barrier effects are unlikely, as Brolgas have been observed nesting as close as ~100 m from operating turbines (Wood 2014, 2017), reflecting the species' tolerance to turbine structures, likely because these installations are not associated with intense or frequent human activity once operational (Veltheim et al. 2019).

No wetlands will be lost by the project, and the hydrological assessment concluded that there will be no substantial or measurable degradation in the hydrological regimes, including the volume, timing, duration, or frequency of surface water flows (DCE 2026b). Similarly, water quality was concluded as having no substantial or measurable changes resulting from the project (DCE 2026b).

*Cumulative impacts*

The Handbook states that cumulative impacts must be considered along with these direct and indirect pathways. Cumulative impacts were investigated by reviewing all wind energy projects that are operational, approved, or under construction within 35 km of the Project Area. Three other wind farms have progressed within the vicinity of MAWF and are currently being assessed (Table 13-3). It is assumed that these wind farms will follow similar rigorous investigations to this project, and that appropriate Breeding and Potential Breeding buffers have been applied. For this reason, an increased risk of Brolga collision is not anticipated through cumulative impacts.

### *9.4.4. Recommended application of mitigation hierarchy*

The Handbook (DEECA 2025c) defines the need to apply the mitigation hierarchy to manage impacts on Brolga. The following avoidance measures are the first step in the mitigation hierarchy and have been developed based on comprehensive information derived from field assessments and desktop studies, and in compliance with the Handbook's guidance and requirements.

*Collision mortality*

Collision risk to Brolga can be mitigated through a combination of avoidance, minimisation, and adaptive management measures. Many of these measures have already been effectively incorporated into the project design. In particular, the siting of the wind farm outside key flocking areas, the micrositing of turbines away from suitable breeding wetland habitats, and the reduction in both the total number of turbines and the extent of overhead transmission lines collectively serve to reduce collision risk. Further avoidance and/or minimisation is possible through micrositing and design alterations, to which the Proponent has committed.

Mitigation of collision may also be reduced through the adoption of a minimum rotor swept area (RSA) clearance of at least 40 m. This approach is informed by over 15 years of monitoring data collected by Natural Resources Australia in Victoria, which indicates that increasing RSA clearance reduces the likelihood of Brolga flights occurring within the collision risk heights. The MAWF design currently exceeds this recommendation, with a minimum RSA of 60 m.

Where overhead transmission lines cannot be avoided, these should be fitted with appropriate bird diverters or line markers to increase visibility and further reduce collision risk. This measure is consistent with established guidance and recommended mitigation measures outlined in relevant industry and Handbook guidelines.

In addition, it is recommended that a Bat and Avifauna Management (BAM) Plan be developed and implemented in consultation with regulators. The BAM Plan should include a targeted monitoring program and clearly defined adaptive management triggers and responses, with the objective of identifying and responding to any impacts on Brolga in a timely and effective manner.

### *Habitat loss and disturbance*

The proposed MAWF has been strategically sited outside both mapped and unmapped Brolga flocking areas, thereby avoiding impacts on these habitats considered critical for the species. This represents a key application of the avoidance principle within the mitigation hierarchy. The project design has also been refined to reduce the overall number of proposed turbines, from 133 to 114. These reductions directly contribute to minimising the extent and intensity of potential impacts on Brolga and other species.

Further impact minimisation has already been achieved through micrositing of turbines, with several turbines relocated away from suitable wetland habitats identified to support Brolga breeding and foraging. The project has also substantially reduced the extent of overhead transmission infrastructure, with the majority of lines placed underground. This design approach reduces both disturbance and collision risk associated with above-ground infrastructure. Collectively, these measures demonstrate a strong commitment to avoidance and minimisation and are expected to significantly reduce the likelihood and magnitude of impacts to Brolga. The Proponent has committed to undertaking further micrositing and design alterations to further avoid and minimise impacts to buffered wetlands.

To further reduce potential impacts during the construction phase, it is recommended that works in areas where potential breeding wetlands cannot be avoided, that construction activities be scheduled outside the Brolga breeding season (July to December), where practicable. Where this is not feasible, Brolga monitoring at wetlands near construction activities should be undertaken. If Brolga are identified within 300 m of construction activities, adaptive management measures should be implemented, such as the establishment of exclusion buffers, modification of works, or temporary cessation of activities until disturbance risks are acceptably reduced.

### *Compensation requirements*

Appendix 2 of the Handbook states that under the mitigation hierarchy, if residual impacts remain after mitigation, compensation can be required (DEECA 2025c). The current layout does not provide buffering to all wetlands, and so will trigger the compensation for residual impacts. However, the Proponent is committed to further design and micrositing processes to avoid and/or minimise these impacts once the wetland assessment and Brolga surveys are completed. If all buffers to known breeding or potential breeding wetlands cannot be applied, compensation would be required, and a Brolga Compensation Plan prepared in consultation with DEECA. Details of matters to be addressed in the plan are outlined below. This does not exempt the requirement to further mitigate residual impacts through processes such as the BAM Plan, which would prioritise impact-triggered, effective responses in line with the mitigation hierarchy.

The nature and extent of compensatory measures are determined by the criteria outlined in the Handbook:

- Number of Potential Breeding Wetlands not buffered by a 300 m disturbance buffer,
- Size of the Wetlands not buffered, and
- Proximity and connectivity of the wetlands to other shallow vegetated wetlands.

The purpose of Brolga compensation is to protect and enhance habitat to enhance breeding success at breeding sites. This can be achieved in two ways:

- **Direct compensation** – overarching and management objectives aimed at restoration and protection of wetlands to directly benefit Brolga and their breeding habitat. These objectives could be achieved through on-ground actions carried out either directly by the proponents or by engaging a third party.
- **Indirect compensation** – delivering, either directly or by funding a third party, research or education outcomes and/or programs that are designed to indirectly benefit Brolga. For example, helping to address key knowledge gaps in behaviour, fecundity, habitat and other matters that are essential to ensuring its long-term survival.

The Handbook (DEECA 2025c) identifies a range of measures that may be implemented to offset potential impacts, including:

a) Restoration of the natural flooding regime of wetlands by closing drains;

b) Increasing the inundation frequency of Brolga Breeding Wetlands through artificial flooding;

c) Creating new potential breeding habitat by damming or modifying existing wetlands or dams;

d) Management of wetland vegetation condition through controlled grazing (or stock removal) to improve suitability as a breeding site;

e) Addition of nesting material to potential breeding wetlands to facilitate nest building; or

f) Fox control at breeding sites.

All of the above measures *"must be accompanied by active management to reduce predation during breeding, such as fox control measures"* (the *Handbook*, p. 43).

Further compensation actions may be required if construction and operational monitoring determines mortalities and/or significant disturbance to Brolga (DEECA 2025c).

Post-construction and operational monitoring will be undertaken as part of any compensation option. This will allow for adaptive improvement of the measures over time and enable demonstration of the effectiveness of the plan. Finalisation and implementation of such compensatory plans should be undertaken in consultation with and to the satisfaction of DEECA, ensuring that potential and residual impacts are addressed in a manner commensurate with the ecological risk posed by the project.

### *9.4.5. Conclusions and further investigations*

There are no breeding wetlands within the Project Area and no mapped flocking sites within a 5 km radius of the Project Area. Most historic observations of groups of 10 or more Brolga are more than 5km from proposed turbines. A small number of breeding wetlands have been identified within the Brolga assessment area. Potential impacts to Brolga associated with the construction and operation of the proposed MAWF are expected to be avoided through the application of buffers around confirmed and potential breeding wetlands. Further design refinement and micrositing will be undertaken by the Proponents to avoid areas where infrastructure currently encroaches into potential breeding wetland buffers. Compensatory measures will be proposed as a last resort in accordance with the mitigation hierarchy, to compensate for any residual risk should potential breeding wetland buffers be encroached.

No mapped or inferred flocking sites occur within 5 km of the development. As such, significant impacts to Brolga are not anticipated, particularly in relation to habitat loss, disturbance, or collision

risk with turbines. These results will be further validated through planned flocking surveys in 2026/27.

The application of the additionally recommended mitigation measures, including overhead line marking, BAM Plan, and Compensation Plan (if required), will further address impacts to Brolga.

Further investigations planned for 2026/27 include additional field surveys to identify breeding events and flocking sites. These surveys will be completed to meet survey effort guidance, confirm the current Brolga buffer overlaps, and confirm the lack of flocking sites within 5 km.

# 10. Migratory shorebird studies

This section presents the pre-construction baseline data on the utilisation of the search region by migratory shorebirds, including a desktop review of shorebird records and field surveys. Migratory shorebird studies were undertaken by Ecology and Heritage Partners (2024 – 2025) and Nature Advisory (2025 – 2026).

## 10.1. Background information

### *10.1.1. Description and Ecology*

Migratory shorebirds are a functional group of waterbirds that undertake long-distance seasonal movements between breeding and non-breeding areas, typically using coastal and inland wetlands as key foraging and roosting habitats. There are 37 listed migratory shorebirds that visit Australia (Higgins and Davies 1996; DEE 2017). Most of these species breed in the northern hemisphere (particularly Arctic and sub-Arctic regions) and migrate annually along the East Asian–Australasian Flyway (EAAF) to spend the austral summer in Australian wetlands, estuaries and shorelines. The exception is the Double-banded Plover, which is a winter visitor to Australia, spending the austral summer in New Zealand (Higgins and Davies 1996). None of these migratory shorebirds are breeding visitors (Higgins and Davies 1996; DEE 2017)

Ecologically, migratory shorebirds are a group that is generally defined by shared habitat use (intertidal mudflats, saltmarshes, beaches and shallow wetlands), foraging strategies (probing or gleaning in soft substrates), and migratory behaviour rather than strict taxonomy, and includes families such as sandpipers, plovers, godwits, knots and curlews. Many species are recognised under international agreements (e.g. JAMBA, CAMBA, ROKAMBA) and national legislation due to their conservation significance and reliance on a network of stopover and non-breeding habitats (DEE 2017).

Australia holds a geographically and ecologically significant position for migratory shorebirds within the East Asian–Australasian Flyway, EAAF (DEE 2017). The EAAF extends from Siberia and Alaska, through eastern and south-eastern Asia and across the Pacific Ocean and islands, reaching as far south as Australia and New Zealand (Figure 10-1).

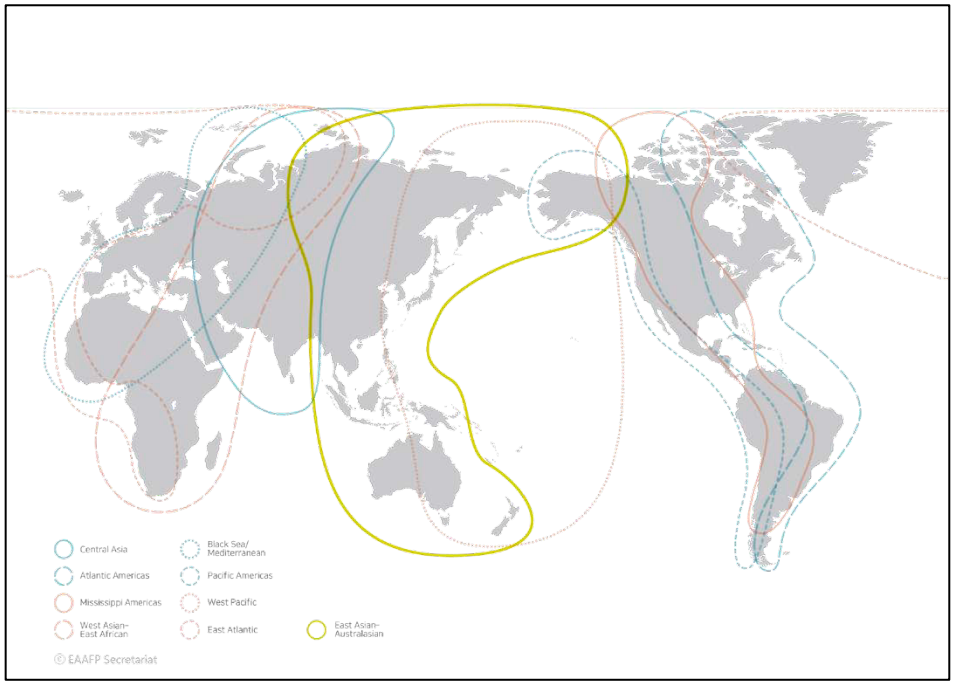



**Figure 10-1: East Asian-Australasian Flyway (EAAF), shown in solid yellow (EAAFP 2025)**

### *10.1.2. Habitat in Australia*

When in Australia, these birds disperse widely across a range of habitats, including coastal and intertidal areas, to inland wetlands, lakes and other water bodies (Higgins and Davies 1996; Driessen et al. 2025). Foraging habitat tends to be open, flat, and partially inundated habitats (e.g. shallow edges of wetlands, mudflats, saltpans, etc.) for all species (Higgins and Davies 1996). Roosting habitat includes areas of low cover, where fields of view allow increased predator detection (Higgins and Davies 1996; Geering et al. 2007). The notable exception is the Latham's Snipe, which, being a nocturnal species, tends to roost hidden in dense vegetation during the day, emerging to open areas to forage at night (Higgins and Davies 1996; Geering et al. 2007).

Australian habitats provide essential resources that allow adult shorebirds to replenish their energy reserves ahead of their return migrations to northern hemisphere breeding grounds (Rogers et al. 2015). Migratory shorebirds must maintain a positive energy balance to recover from their migratory journey, to replace worn feathers through moulting, and to accumulate fat stores necessary for the next migration (Geering et al. 2007; Higgins and Davies 1996). The balance between time spent feeding and resting, as well as the distance between foraging sites and safe roosting locations, plays a critical role in meeting these energy demands, as does the richness and availability of food supplies (DEE 2017; Geering et al. 2007; Driessen et al. 2025).

The proposed site of the Macorna Wind Farm is a semi-arid region of northern Victoria, with average annual rainfall of 372.8 mm recorded at the nearby Kerang township (BOM 2026). Migratory shorebirds in this area are entirely reliant on fresh to semi-saline wetlands, which, in many instances, are ephemeral swamps that may only provide foraging habitat after rainfall events or when inundated due to human-managed flows.

### *Importance of Kerang Wetlands Ramsar site*

The Kerang Wetlands Ramsar site, which includes 23 lakes, marshes and swamps, is an internationally recognised wetland system (DEPI 2013; DELWP 2019). The Ramsar site is situated around the township of Kerang, with two of those wetlands in the southernmost portion of the Ramsar site, Hird and Johnson Swamps, being within 3 km of the northeast extent of the Project Area (Figure 10-2). These two swamps are actively managed through environmental water allocations designed to promote and maintain their ecological values (DSEWPaC 2011). The remainder of the wetlands that make up the Kerang Wetlands Ramsar site are to the north and northwest of the proposed site, with the next nearest wetland in that direction (Fosters Swamp) being just over 8 km away. The recognition of this network of wetlands as a Ramsar site was in part a result of the migratory shorebirds that use them. Several other wetlands in the area are not included in the Ramsar site but may also be used by migratory shorebirds, with the nearest being Tragowel Swamp (~3.3 km west), Kow Swamp (~9.2 km southeast) and Lake Murphy (~10 km west).

The Kerang Wetlands Ramsar site is known to support nationally significant numbers of three species of migratory shorebirds, though these records are at least 26 km from the Project Area (Table 10-1). These shorebird populations have contributed to the Kerang Wetlands Ramsar site being included in the *Australian National Directory of Important Migratory Shorebird Habitat* (Driessen et al. 2025). Nature Advisory was able to locate records of a further 14 species, with records going back to 1990.

A complete list of the 37 migratory shorebird species that regularly visit Australia and their national and international threshold numbers can be found in Appendix 19.

**Table 10-1: Species of migratory shorebirds recorded at nationally significant abundance levels at the Kerang Wetlands (Driessen et al. 2025).**

| Species | Status (FFG/ EPBC) | Season | Year | Wetland | Threshold of importance (International/ National) | Peak count |
|---|---|---|---|---|---|---|
| **Sharp-tailed Sandpiper** | (- /Vu, Mig) | Summer | 2016 | Lake Cullen (26 km NW of site) | 1,300 / 130 | 850 (Nationally significant) |
| **Curlew Sandpiper** | (Cr /Cr, Mig) | Summer | 2015 | Lake Tutchewop (38 km NW of site) | 1,200 / 120 | 133 (Nationally significant) |
| **Double-banded Plover** | (- /Mig) | Winter | 2014 | Lake Cullen 26 km NW of site) | 250 / 25 | 40 (Nationally significant) |

**NOTES**: Vu: Vulnerable, En: Endangered, Cr: Critically Endangered, Mig: Migratory

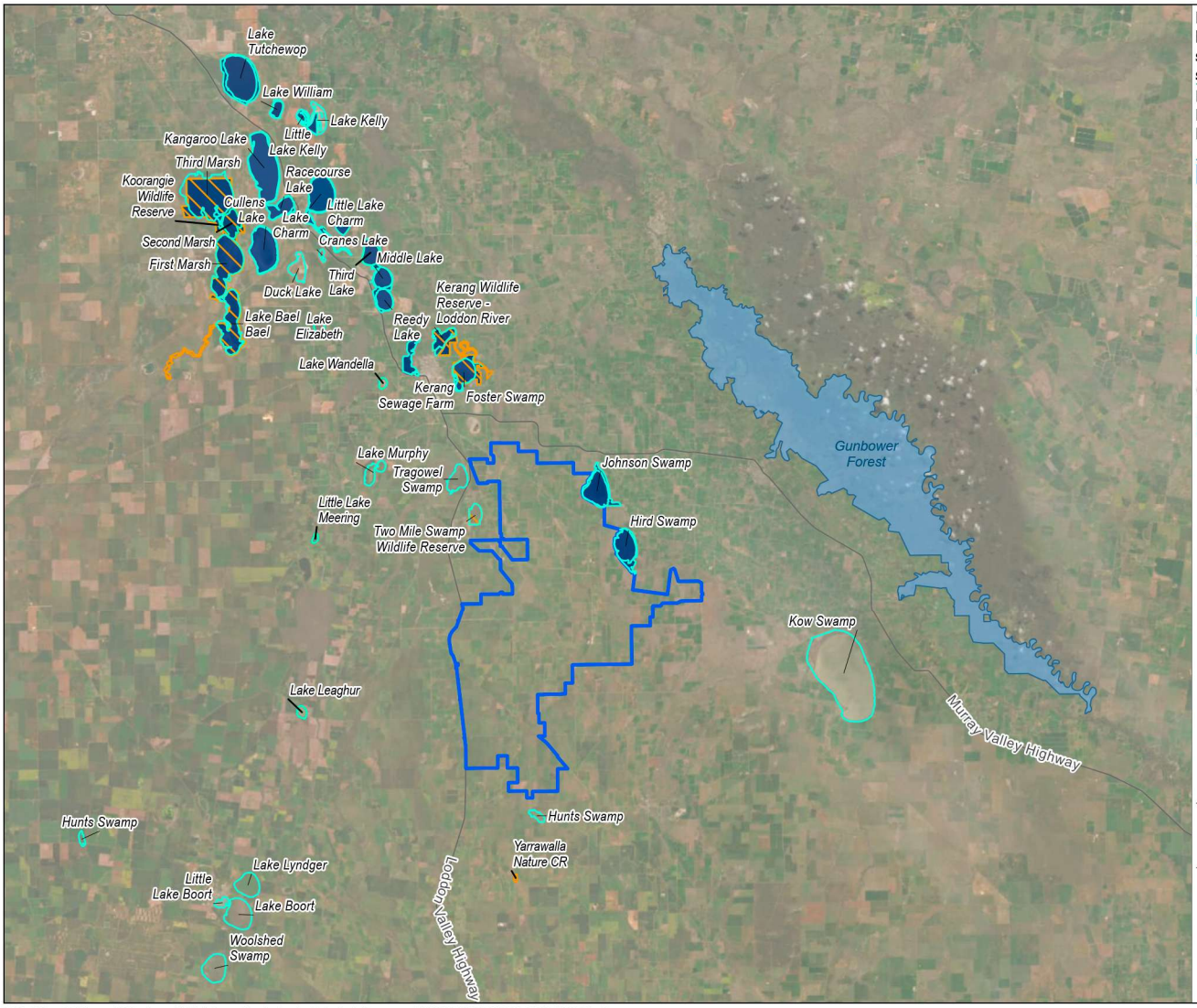



**Figure 10-2: Macorna WF boundary and wetlands surveyed for migratory shorebirds**

**Project No**: 24129.09
**Project**: Macorna Wind Farm, VIC
**Date**: 23/07/2026

- Project Area
- Major roads
- Reserves

**Wetlands surveyed for migratory shorebirds**

- Surveyed wetland
- Surveyed wetland in Kerang Wetlands Ramsar site

**Other wetlands**

- Gunbower Forest (Ramsar wetland)

N

Kilometers
0 5 10

GDA2020 Vicgrid

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

### 10.1.3. Threats

Migratory shorebirds face a range of threats both within the flyway and whilst in Australia, with steep declines in population numbers for many species detected over recent decades (Clemens et al. 2016). The primary threat to this group of birds is coastal development at staging grounds along their migratory route and at foraging areas within their overwintering range (both in Australia and other areas). Increasing human activity along coastlines and loss of coastal habitat have reduced foraging opportunities, making it increasingly difficult for shorebirds to make their migrations (Melville et al. 2016).

Within Australia, other threats include disturbance by human activity, predation by introduced predators, pollution of wetland habitat, destruction or removal of shorebird habitat, as well as climate change, which is altering coastal ecosystems, reducing wetland quality and availability, and increasing the frequency of extreme weather events and sea-level rise (Clemens et al. 2016). The rapid development of wind energy in Australia in the last decade has also brought on increased risk of turbine collision as well as barrier effects that may hamper or extend local or migratory movements made whilst shorebirds are in Australia (Reid et al. 2023).

### 10.1.4. Legislative protection

EPBC Act Policy Statement 3.21 *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DEE 2017), provides guidelines for managing impacts to the 37 species listed as migratory under the EPBC Act. The guidelines note that several migratory shorebirds are listed as threatened under the EPBC Act and are subject to additional significant impact criteria.

The guidelines state that the EPBC Act is the key mechanism for meeting Australia's obligations and responsibilities under a number of international agreements, including:

- The *Convention on Conservation of Migratory Species of Wild Animals* (also known as CMS or the Bonn Convention)
- Bilateral agreements for the conservation of migratory birds between the Government of Australia and the Government of Japan (JAMBA), the Government of China (CAMBA) and the Government of the Republic of Korea (ROKAMBA), and
- The *Convention on Wetlands of International Importance* (also known as the Ramsar Convention).

EPBC Act Policy Statement 3.21 provides guidance on the identification of 'important habitat' for migratory shorebirds. Under the EPBC Act, 'important habitat' is a key concept for migratory species to ensure that sites necessary for the ongoing survival of the 37 species are appropriately managed.

According to EPBC Act Policy Statement 3.21, wetland habitat should be considered *internationally important* if it regularly supports:

- 1 per cent of the individuals in a population of one species or subspecies of waterbird; or
- A total abundance of at least 20,000 waterbirds.

Or *nationally important* if it regularly supports:

- 0.1 per cent of the flyway population of a single species of migratory shorebird; or
- 2,000 migratory shorebirds; or

- 18 Latham's Snipe; or
- 15 migratory shorebird species.

Population estimates of migratory shorebirds for the calculation of nationally and internationally important populations are provided in *Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species* (van Swinderen et al. 2025) and provided in (Table 10-1).

Further information and conservation advice can be found in the following publications:

- Wildlife Conservation Plan for Migratory Shorebirds (Department of the Environment 2015)
- Australian National Directory of Important Migratory Shorebird Habitat (Driessen et al. 2025)
- Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment 2013).
- The conservation advice documents for each of the listed migratory shorebird species considered in this assessment (where available).

## 10.2. Methodology

### *10.2.1. Sources of existing information*

Database searches for existing records of migratory shorebirds were undertaken within 10 km of the Project Area on the 22nd of October 2025. Only species that had records from within the last 30 years were considered, as if a migratory species has not been recorded in the last 30 years it is considered as likely either extinct in the area or an extremely rare visitor/vagrant. The following sources of information were reviewed to collate existing information:

- Victorian Biodiversity Atlas, VBA (DEECA 2026e);
- *NatureKit* (DEECA 2026a);
- BirdLife Australia shorebird database (BirdLife Australia 2025);
- Atlas of Living Australia, ALA (ALA 2026);
- eBird database (Cornell Lab of Ornithology 2026);
- Existing reports and data:
    - Surveys reported in *Migratory Shorebird Surveys for the proposed Macorna Wind Farm, Macorna, Victoria* (Ecology and Heritage Partners 2025) – included as field assessments as it was for the same project and intent.
    - Shorebird records from Rakali Ecological Consulting (2021, 2022; 2023, 2024, 2025), which included records from across the Ramsar site.

### *10.2.2. Field assessments*

#### *Shorebird counts*

Migratory shorebird surveys were undertaken by both EHP and Nature Advisory from November 2024 and concluded in June 2026 (Table 10-2). Surveys involved a combination of point counts and transect surveys at suitable shorebird habitat, including both the Kerang Wetlands Ramsar Site and other nearby suitable habitats (Figure 10-2).

During each survey, a trained observer used binoculars and a telescope to identify all bird species present at the surveyed wetlands. Data collected followed the outlined requirements within the Commonwealth guidance (DEE 2017):

- Shorebird statistics – total abundance, species richness, species abundance,
- Shorebird behaviour – activity (roosting/foraging), foraging location,
- Survey conditions – date, time, and weather conditions,
- Habitat characteristics – substrate characteristics, hydrological conditions, and presence of suitable foraging/roosting habitat.

Survey timing was used as per guidance on non-tidal areas (DEE 2017), including being undertaken during periods when migratory shorebirds are most likely to be present, including the main non-breeding season to capture peak population numbers and, where relevant, the northern hemisphere breeding season to detect non-breeding immature individuals and the Double-banded Plover. Timing was informed by local knowledge to account for regional variation in migration patterns. Surveys were conducted under suitable habitat and weather conditions, targeting exposed, minimally vegetated shorelines with appropriate water levels, and avoiding periods of high rainfall, strong winds, or disturbance that could influence bird presence or behaviour.

### *Survey effort*

Migratory shorebird habitat was surveyed in the 2024/25 summer (3 surveys completed), 2025/26 summer (4 surveys completed) and one winter survey in 2026. This effort generally aligns with that required by the Commonwealth guidance (DEE 2017). Due to the ephemeral nature of most wetlands in the region, the number of sites surveyed differed between survey periods (Table 10-2).

**Table 10-2: The survey dates and effort of migratory shorebirds surveys conducted for MAWF.**

| Survey Period (Consultancy) | Dates | Season | Sites (#) | Surveys (#) | Survey effort (h) |
|---|---|---|---|---|---|
| **1 (EHP)** | 12 – 15 November 2024 | Summer | 5 | *undisclosed* | *undisclosed* |
| **2 (EHP)** | 10 – 13 December 2024 | Summer | 20 | *undisclosed* | *undisclosed* |
| **3 (EHP)** | 14 – 17 January 2025 | Summer | 13 | *undisclosed* | *undisclosed* |
| **4 (NA)** | 2 – 5 December 2025 | Summer | 28 | 37 | 14.8 |
| **5 (NA)** | 13 – 16 January 2026 | Summer | 33 | 43 | 17.2 |
| **6 (NA)** | 10 – 13 February 2026 | Summer | 15 | 20 | 6.0 |
| **7 (NA)** | 24 – 27 February 2026 | Summer | 34 | 51 | 13.1 |
| **8 (NA)** | 9 – 12 June 2026 | Winter | 35 | 46 | 8.8 |
| **TOTAL** | | | **38 sites** | **197+ surveys** | **59.9+ hrs** |

**NOTE**: The search region for migratory shorebird habitat was increased from a 10 km radius to a 35 km radius after survey period one, in response to the limited amount of shorebird habitat found in that initial survey period.

### *Location of survey sites*

Survey sites were located at potentially suitable wetlands and waterbodies up to 35 km from the study area (Figure 10-2). Not all sites were visited during every survey or were given an equal survey effort due to local conditions and accessibility. At the beginning of each survey, an assessment of migratory shorebird habitat was undertaken to determine the locations required for surveys, with the ensuing survey then only occurring at sites with suitable habitat. A list of the sites that were visited during each survey period is provided in Table 10-3 and a map of the sites is provided in Figure 10-2.

**Table 10-3: Migratory shorebird survey locations and number of site visits.**

| Site | Survey period | | | | | | | | Total visits |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Cranes Lake | | x | | 1 | 1 | | 2 | 2 | 5 |
| Duck Lake | | x | | 1 | 1 | | 1 | 1 | 5 |
| First Marsh | | | | 1 | 1 | | 1 | 1 | 4 |
| **Hird Swamp*** | x | x | x | 1 | 1 | 2 | 2 | 1 | 10 |
| Hunts Swamp | | | | | | 1 | 1 | 1 | 3 |
| **Johnson Swamp*** | x | x | x | 1 | 1 | | 1 | 1 | 7 |
| Kangaroo Lake* | | x | | 1 | 2 | 1 | 2 | 1 | 8 |
| **Foster Swamp and associated wastewater treatment plant** | | | | 2 | 1 | 2 | 2 | 2 | 9 |
| Kerang Wildlife Reserve - Loddon River* | | | x | 1 | | | | | 2 |
| Koorangie Wildlife Reserve* | | x | | | | | | | 1 |
| **Kow Swamp** | x | x | x | 2 | 1 | 1 | 2 | 1 | 10 |
| Lake Bael Bael* | | x | | 2 | 1 | | 1 | 1 | 6 |
| Lake Boort | | | x | 1 | 1 | | 1 | 1 | 5 |
| Lake Charm* | | x | | 2 | 2 | 1 | 2 | 1 | 9 |
| Lake Cullen* | | x | x | 1 | 1 | | 2 | 2 | 8 |
| Lake Elizabeth | | | | | 2 | 2 | 2 | 2 | 8 |
| Lake Kelly* | | x | | 2 | 1 | | 1 | 2 | 7 |
| Lake Leaghur | | | | | 1 | 1 | 2 | 1 | 4 |

| Site | Survey period | | | | | | | | Total visits |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Lake Lyndger | | | x | 1 | 1 | | 1 | 1 | 5 |
| **Lake Murphy** | x | x | x | 1 | 1 | | 1 | 2 | 8 |
| Lake Tutchewop* | | x | x | 2 | 1 | | 2 | 2 | 9 |
| Lake Wandella | | | | | 1 | | 1 | 2 | 4 |
| Lake William* | | x | | 2 | 1 | | 1 | 2 | 7 |
| Little Lake (Meering) | | | x | 1 | 2 | | | | 4 |
| Little Lake Boort | | | x | 1 | 2 | 1 | 2 | 1 | 8 |
| Little Lake Charm* | | x | | 1 | 2 | 1 | 2 | 1 | 8 |
| Little Lake Kelly* | | | | 2 | 1 | | 1 | 2 | 6 |
| Little Lake Meran | | | | | 2 | 2 | 2 | 1 | 7 |
| Middle Lake* | | x | | 1 | 2 | 1 | 2 | 1 | 8 |
| Racecourse Lake* | | x | | 1 | 2 | 1 | 2 | 1 | 8 |
| Reedy Lake* | | x | | 1 | 1 | | | | 3 |
| Second Marsh | | | | | 1 | | 1 | 1 | 3 |
| Third Lake* | | x | | | 1 | | 1 | **1** | **4** |
| Third Marsh* | | | | 1 | 1 | | 1 | **1** | **4** |
| **Tragowel Swamp** | x | x | x | 1 | 1 | | 1 | **1** | **7** |
| Two Mile Swamp Wildlife Reserve | | | | | | 1 | 1 | **1** | **3** |
| Woolshed Swamp | | | x | 2 | 2 | 1 | 1 | 1 | 8 |
| Yarrawalla Nature Conservation Reserve | | | | | | | 1 | 1 | 2 |

**NOTE:** Wetlands with a * are part of the Kerang Wetlands Ramsar site (DEPI 2013). An 'x' is used where the number of site visits is not known for a survey. A blank cell means that the site was not surveyed in that survey period. Site names in bold are within 10 km of the Project Area.

### *Incidental observations*

In addition to observations made during formalised surveys, incidental observations of all listed species that were observed whilst performing surveys were recorded.

### 10.2.3. Climate/Rainfall

In the semi-arid climate of the study area, the suitability of wetland habitat for shorebirds is often influenced by the amount of water present, which is most often a result of the amount of rainfall received (with the exception of wetlands that are artificially maintained, e.g. Hird and Johnson Swamps). To determine if the shorebird data presented in this report had shorebird counts from both wetter and drier years, the total annual rainfall for Kerang township, the nearest town with rainfall data to the study area, was accessed from the Bureau of Meteorology website (BOM 2026). The total annual rainfall for each year with shorebird records from field surveys performed by NA, EHP and Rakali Ecology Consulting was analysed to determine how much rain fell in each year relative to the mean rainfall and rainfall deciles. This analysis was undertaken to verify whether field surveys were undertaken during both dry and wet years.

### 10.2.4. Habitat suitability assessment

During shorebird surveys, the habitat suitability of wetlands for migratory shorebirds was classified into one of three categories, marginal, potential, or known. Potential shorebird habitat was classified into one of these three categories in the field by assessing if the site showed the characteristics known to support foraging and roosting migratory shorebirds. Key indicators included water depths, margins, exposed flats, vegetation structure, and steep/hardness of edges, and extent of human disturbance (Higgins and Davies 1996). A wetland was classified as:

- *Good* – Site displayed all or most key habitat indicators for waders such as shallow water margins, exposed mud or sand flats, sparsely vegetated shorelines, gently sloping edges, and areas with minimal disturbance. Considerations for snipe also included presence and density of low vegetation in which they are known to roost. The site may host large flocks of migratory shorebirds when conditions are appropriate, during most years.
- *Potential* – Site displayed some key habitat indicators such as shallow water margins, exposed mud or sand flats, sparsely vegetated shorelines, gently sloping edges, dense and low vegetation roosting snipe, and areas with minimal disturbance. The site may host small numbers of migratory shorebirds when conditions are appropriate, during some years.
- *Marginal* – Site displayed few or no key habitat indicators such as shallow water margins, exposed mud or sand flats, sparsely vegetated shorelines, gently sloping edges, and areas with minimal disturbance. The site is unlikely to host migratory shorebirds.

Temporary or fluctuating wetlands, saline lakes, wastewater ponds, and floodplain depressions were considered particularly suitable where water levels created accessible feeding substrates and open sightlines preferred by shorebirds (Geering et al. 2007; Higgins and Davies 1996). Assessments of sites that were dry at the time of survey attempted to incorporate an assessment of the suitability of the habitat for shorebirds if water was present, whilst noting that the wetland does not always hold water. Sites with recent records or observations of shorebirds during field surveys were another indicator used to determine the suitability of habitat for shorebirds.

As well as wading shorebirds, a consideration of habitat suitability for the Latham's Snipe was also made at each site, using the same habitat classifications. Latham's Snipe prefer more densely vegetated but equally shallow-margined wetlands, in contrast to the open flats preferred by the wading shorebirds (Higgins and Davies 1996).

### *10.2.5. Hydrology*

A hydrological assessment was undertaken by Dalton Consulting Engineers in January 2026 (DCE 2026b). This report addressed the potential for the MAWF to alter hydrological regimes and water quality that could affect the downstream Kerang Wetlands Ramsar Site. The results of this study are discussed with reference to impacts on habitat for migratory shorebirds.

#### *Limitations*

At the time of both EHP's and Nature Advisory's field assessments, many of the surveyed wetlands were dry, providing little habitat. During wetter years, it is likely that more habitat exists within the area than observed during these surveys. However, historical data covers some observations from years that had higher rainfall (Rakali Ecological Consulting 2021, 2022, 2023, 2024, 2025).

Not all wetlands were accessible for all survey periods because of permissions, safety around access, or visibility issues. For example, EHP reported (EHP 2025c) that Fosters Swamp and the Kerang Waste Water Treatment Plant were not accessible during any of their surveys (survey periods 1 – 3), but they were accessible in subsequent Nature Advisory surveys.

To date, surveys have been timed to capture the summer period when most shorebird species are within Australia. Consequently, the results presented here only address the summer species. The Double-banded Plover, however, is only present during the winter months. Data from Birdlife Australia (BirdLife Australia 2025) were accessed to address this species, with an additional winter survey planned in 2026.

## 10.3. Results

### *10.3.1. Existing information*

Database searches of shorebird records within a 10 km radius around the Project Area contained records for 18 species of migratory shorebirds, mapped in Figure 10-3 and summarised in Table 10-5. A complete list of database records can be found in Appendix 20.

Historical records within 10 km of the study area had six nationally significant counts of one species, the Sharp-tailed Sandpiper (i.e. more than 130 birds), though many records gave no count of the birds observed (Table 10-4). Records with no counts were omitted from this analysis. A nationally significant count of a Sharp-tailed Sandpiper is 130 birds (Driessen et al. 2025).

**Table 10-4: Nationally significant counts of Sharp-tailed Sandpipers found in historical records from within 10 km of the Project Area.**

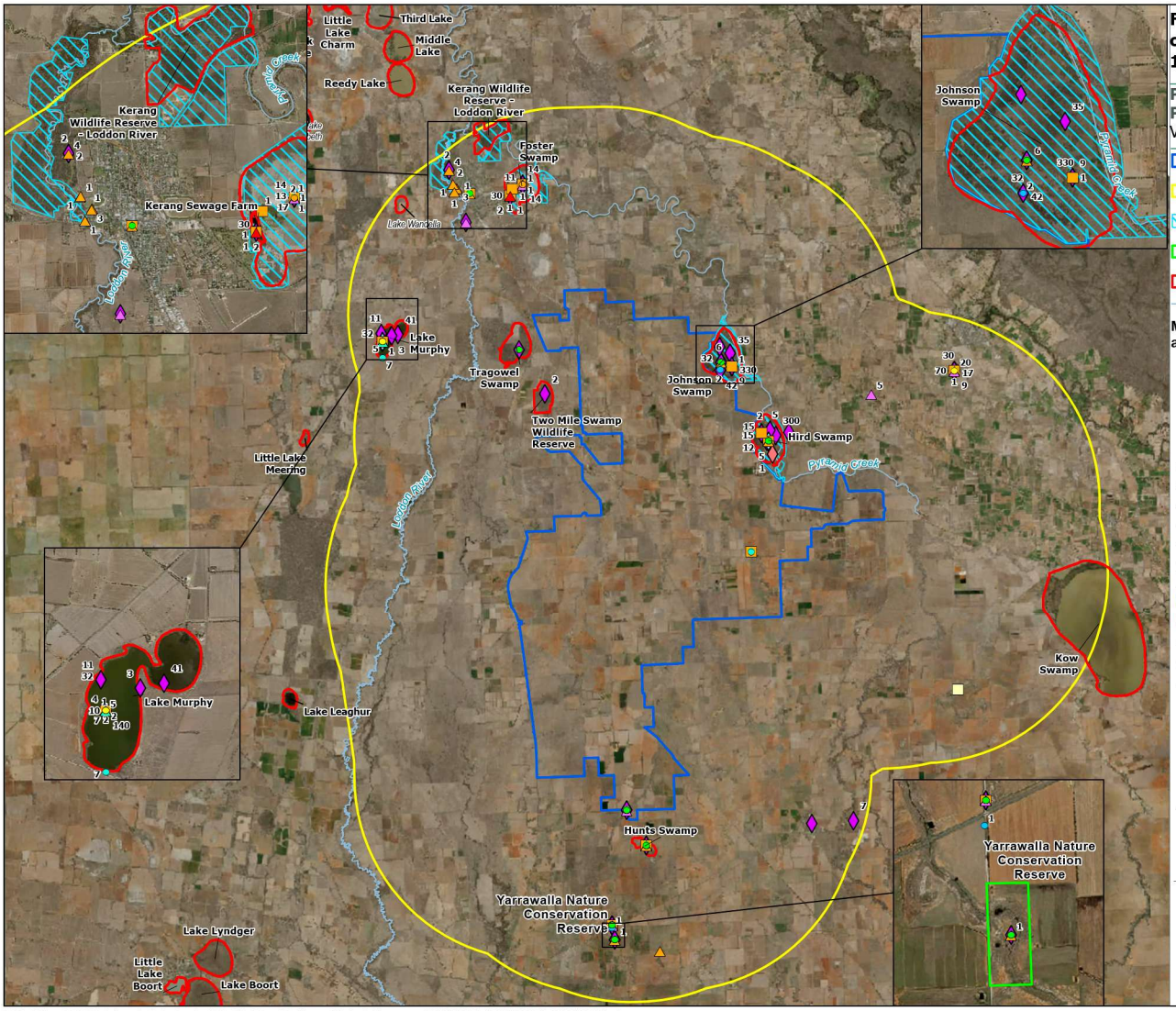
| Species | Wetland | Year | Count |
|---|---|---|---|
| **Sharp-tailed Sandpiper** | Hird Swamp* | 2002 | 300 |
| | Hird Swamp* | 2005 | 200 |
| | Johnson Swamp* | 2006 | 330 |
| | Lake Murphy | 2006 | 140 |
| | Lake Murphy | 2019 | 250 |

**NOTE:** * denotes wetlands within the Kerang Wetlands Ramsar Site.

### *Hydrological impacts to the Kerang Wetlands Ramsar Site*

A hydrological assessment (DCE 2026b) was undertaken to assess whether there will be impacts on the hydrological regimes and water quality of wetlands close to the proposed site of the MAWF. This includes the nearby Hird and Johnson Swamp Wildlife Reserves, part of the Kerang Wetlands Ramsar site (DSEWPaC 2011; Driessen et al. 2025). The proposed layout includes a 2000 m turbine-free buffer around these two swamps to protect the ecological integrity from potential impacts associated with the construction and operation of the wind farm. All other wetlands within the Ramsar site are more than 8 km away.

The assessment concluded that there will be no substantial or measurable change in the hydrological regimes, including the volume, timing, duration, or frequency of surface water flows (DCE 2026b). Similarly, water quality was concluded as having no substantial or measurable changes resulting from the project (DCE 2026b). The management of stormwater, sedimentation and erosion during construction and operation will further reduce the potential for impacts on the adjacent Ramsar wetlands.




# Figure 10-3: Historical records of migratory shorebirds within 10 km of the Macorna WF

**Project No**: 24129.09
**Project location**: Macorna Wind Farm, VIC

- Project Area
- Search region (10km buffer of study area)
- Kerang Ramsar Wetlands
- Yarrawalla Nature Conservation Reserve
- Surveyed wetland
- Waterway

**Migratory shorebird record - VBA, ebird and Birdlife Australia**

- Bar-tailed Godwit
- Black-tailed Godwit
- Common Greenshank
- Curlew Sandpiper
- Double-banded Plover
- Latham's Snipe
- Little Stint
- Long-toed Stint
- Marsh Sandpiper
- Pacific Golden-Plover
- Pectoral Sandpiper
- Red-necked Phalarope
- Red-necked Stint
- Ruddy Turnstone
- Ruff
- Sharp-tailed Sandpiper
- Wood Sandpiper

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Kilometers
0 3 6 9

GDA2020 MGA Zone 55

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**Table 10-5: Existing observations of migratory shorebirds within 10km radius of the MAWF site from 1996 – 2025.**

| Common Name | Scientific name | EPBC | FFG | Source | Number of observations[4] | Date of last observation |
|---|---|---|---|---|---|---|
| Sharp-tailed Sandpiper | *Calidris acuminata* | Vu, Mig | - | eBird, PMST, VBA, REC, Birdata | 194 | 27/12/2024 |
| Red-necked Stint | *Calidris ruficollis* | Mig | - | eBird, PMST, VBA, REC, Birdata | 95 | 9/11/2024 |
| Common Greenshank | *Tringa nebularia* | En, Mig | En | eBird, PMST, VBA, REC | 85 | Summer 2024/25 |
| Marsh Sandpiper | *Tringa stagnatilis* | Mig | En | eBird, PMST, VBA, REC | 78 | 25/11/2003 |
| Double-banded Plover | *Charadrius bicinctus* | Migratory Mig | - | eBird, PMST, VBA, REC, Birdata | 41 | 15/8/2024 |
| Wood Sandpiper | *Tringa glareola* | Mig | En | eBird, VBA, REC | 34 | 21/01/2021 |
| Latham's Snipe | *Gallinago hardwickii* | Vu, Mig | - | eBird, PMST, VBA, REC | 25 | Summer 2022/23 |
| Curlew Sandpiper | *Calidris ferruginea* | Cr, Mig | Cr | eBird, PMST, VBA, REC, Birdata | 24 | 2/12/2025 |
| Pectoral Sandpiper | *Calidris melanotos* | Mig | - | eBird, PMST, VBA, REC | 12 | 26/4/2024 |
| Long-toed Stint | *Calidris subminuta* | Mig | - | eBird, VBA, REC | 10 | 24/04/2006 |
| Pacific Golden Plover | *Pluvialis fulva* | Mig | Vu | eBird, VBA, REC | 8 | Summer 20243/24 |

[4] Each observation could include multiple individuals of birds.

| Common Name | Scientific name | EPBC | FFG | Source | Number of observations[4] | Date of last observation |
|---|---|---|---|---|---|---|
| Black-tailed Godwit | *Limosa limosa* | En, Mig | Cr | eBird | 8 | 22/04/2006 |
| Ruff | *Calidris pugnax* | Mig | - | eBird, PMST, VBA | 7 | 4/04/2006 |
| Little Stint | *Calidris minuta* | Mig | - | eBird, VBA | 4 | 24/04/2006 |
| Ruddy Turnstone | *Arenaria interpres* | Vu, Mig | En | eBird, VBA, REC | 2 | 6/9/1997 |
| Bar-tailed Godwit | *Limosa lapponica* | En, Mig | Vu | eBird | 1 | 6/1/2012 |
| Red-necked Phalarope | *Phalaropus lobatus* | Mig | - | eBird | 1 | 15/02/1999 |

### *10.3.2. Field assessments*

*Shorebird counts*

The results of the migratory shorebird surveys conducted by Nature Advisory, EHP and Rakali Ecological Consulting are presented in Table 10-6 and Table 10-8. A complete list of field survey records can be found in Appendix 20. 314 of the 9,184 shorebird observations counted in these field surveys were within 10 km of the Project Area, representing 3.4 % of the total birds counted. Of those 314 shorebird observations, only eight were within 8 km of the Project Area, all of which were observed at Hird Swamp, indicating very limited utilisation of areas in closer proximity to the development footprint.

Ten migratory shorebird species were observed within 10 km of the project site, mostly in low numbers (Table 10-6). Of the shorebirds observed within 10 km, the Sharp-tailed Sandpiper was the only species observed in nationally important numbers (>130 birds), on one occasion at Kerang-Foster Swamp & Wastewater Treatment Plant (over 8 km from Project Site) in 2023/24 by Rakali Ecological Consulting.

**Table 10-6: Results of the migratory shorebird surveys performed by NA, EHP and Rakali Ecological Consultants within 10 km of the MAWF site.**

| Survey period | REC | | | | REC/EHP | NA | |
|---|---|---|---|---|---|---|---|
| | 20/21 | 21/22 | 22/23 | 23/24 | 24/25 | 25/26 | Winter 2026 |
| **Hird Swamp Wildlife Reserve** | | | | | | | |
| Marsh Sandpiper | - | - | - | - | - | 1 | - |
| Sharp-tailed Sandpiper | 5 | - | - | - | - | - | - |
| Wood Sandpiper | 2 | - | - | - | - | - | - |
| **Kerang - Foster Swamp & Wastewater Treatment Plant** | | | | | | | |
| Common Greenshank | - | - | - | 2 | - | - | - |
| Common Sandpiper | - | - | - | 1 | - | - | - |
| Double-banded Plover | - | - | - | 7 | - | - | - |
| Pacific Golden Plover | - | - | - | 1 | - | - | - |
| Pectoral Sandpiper | - | - | - | 1 | - | - | - |
| Red-necked Stint | - | - | 46 | 6 | - | 1 | - |
| Sharp-tailed Sandpiper | - | - | 13 | **226** | - | - | - |
| **Kerang Wildlife Reserve - Loddon River** | | | | | | | |
| Latham's Snipe | - | - | 1 | - | - | - | - |

**NOTES**: Data presented is the maximum count. Bold numbers indicate a nationally significant count of that shorebird species.

Most Ramsar wetlands are located beyond 10km from the project site. Results of migratory shorebird surveys between 2020 and 2026 confirm higher numbers of shorebird counts at lakes more than 20km away from the project site, such as Lake Bael Bael, Lake Cullen and Lake Tutchewop (Table 10-7).

**Table 10-7: Results of the migratory shorebird surveys performed by NA, EHP and Rakali Ecological Consultants more than 10 km from the MAWF site.**

| Season | 20/21 | 21/22 | 22/23 | 23/24 | 24/25 | 25/26 | Winter 2026 |
|---|---|---|---|---|---|---|---|
| **Lake Bael Bael** | | | | | | | |
| Common Greenshank | - | 1 | - | - | - | - | |
| Red-necked Stint | - | - | - | - | - | 170 | |
| Sharp-tailed Sandpiper | - | - | - | - | - | 1 | |
| **Lake Cullen** | | | | | | | |
| Common Greenshank | 3 | - | - | - | 5 | - | |
| Curlew Sandpiper | 8 | 2 | - | - | 5 | - | |
| Marsh Sandpiper | 3 | 4 | - | - | 1 | - | |
| Pacific Golden Plover | - | - | - | - | 5 | - | |
| Pectoral Sandpiper | - | - | - | - | 1 | - | |
| Red-necked Stint | 526 | - | - | - | 180 | - | |
| Ruddy Turnstone | - | - | - | - | 1 | - | |
| Sharp-tailed Sandpiper | **2,020** | **395** | - | - | **572** | - | |
| **Lake Elizabeth** | | | | | | | |
| Common Greenshank | - | - | - | - | - | 2 | |
| Curlew Sandpiper | - | - | - | - | - | 1 | |
| Red-necked Stint | - | - | - | - | - | 37 | |
| **Lake Kelly** | | | | | | | |
| Curlew Sandpiper | - | - | 4 | 2 | - | - | |
| Double-banded Plover | - | - | - | 9 | - | - | |
| Pacific Golden Plover | - | - | 20 | - | - | - | |
| Red-necked Stint | - | - | 4 | 61 | - | - | |
| **Lake Tutchewop** | | | | | | | |
| Curlew Sandpiper | - | - | - | 3 | 13 | 1 | |
| Double-banded Plover | | | | | | | **50** |
| Long-toed Stint | - | - | - | - | 3 | - | |
| Pectoral Sandpiper | - | - | - | 1 | 2 | - | |
| Red-necked Stint | - | - | 26 | 64 | **1,061** | 110 | 134 |
| Sharp-tailed Sandpiper | - | - | 2 | 30 | **1,200** | 5 | |
| **Middle Lake** | | | | | | | |
| Sharp-tailed Sandpiper | - | - | - | 11 | - | - | |
| **Second Marsh** | | | | | | | |
| Marsh Sandpiper | - | - | - | 1 | - | - | |
| **Third Lake** | | | | | | | |
| Marsh Sandpiper | - | - | - | 1 | - | - | |
| Sharp-tailed Sandpiper | - | - | - | 58 | - | - | |
| **Third Marsh** | | | | | | | |
| Marsh Sandpiper | - | - | - | 1 | - | - | |

**NOTE:** Data presented is the maximum count. Bold numbers indicate a nationally significant count of that shorebird species, whilst grey cells indicate an internationally significant count.

*Habitat suitability assessment*

For wading migratory shorebirds (all shorebirds but the Latham's Snipe), six of the 37 assessed wetlands were classified as 'good', meaning the habitat was of the quality that might attract large flocks of shorebirds, whilst 17 were assessed as 'marginal', as they were unlikely to provide habitat for shorebirds. A further 14 were assessed as potential, meaning the habitat was likely to provide habitat for small groups of shorebirds in some years.

Of the assessed wetlands within 10 km of the Project Area:

- One 'good' habitat for wading shorebirds:
    - Foster Swamp and associated wastewater treatment plant
- Four 'potential' habitats for wading shorebirds:
    - Hird Swamp, Johnson Swamp*, Hunts Swamp, Two Mile Swamp Wildlife Reserve, and Yarrawalla Nature Conservation Reserve.
- Five 'marginal' habitats for wading shorebirds:
    - Kerang Wildlife Reserve - Loddon River, Kow Swamp, Lake Murphy, Lake Wandella and Tragowel Swamp.

Almost all assessed sites were assessed as at least potential habitat for the Latham's Snipe, with many densely vegetated wetlands or wetland margins across the sites. However, Latham's Snipe are generally found in lower densities, so it is unlikely that many Snipes will be found at any one wetland. Therefore, most sites were assessed as potential.

The complete results of the habitat suitability assessment for every wetland are detailed in Appendix 21.

### *10.3.3. Climate/Rainfall analysis*

Total annual rainfall and decile annual rainfall for the Kerang township are presented in Table 10-8.

Decile rainfall is a number from 1 to 10, with one representing the lowest 10 % (<10th percentile) of all annual rainfalls recorded and ten representing the highest 10 % (>90th percentile) of all rainfalls recorded.

Results show that there was above-average annual rainfall in four of the six years in which shorebird surveys by NA, EHP and Rakali Ecological Consulting were undertaken, with 2022 being in the highest percentile of rainfall. Results of the shorebird surveys conducted by these three parties therefore represent a broad spectrum of rainfall conditions, including very wet years when shorebird utilisation of the region is likely altered, providing a robust basis for assessment.

**Table 10-8: Total annual rainfall and decile rainfall recorded in the township of Kerang (approximately 10 km NW of the Project Area) in millimetres.**

| Year | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | Mean | 2026 (up to 31 July) |
|---|---|---|---|---|---|---|---|---|
| **Rainfall (mm)** | 426.6 | 288.6 | 583.5 | 432.1 | 403.2 | 270.7 | 388.8 | 316.8 |
| **Decile** | 7 | 3 | 10 | 8 | 7 | 2 | 5 | 9 |
| **Surveys performed by** | REC | REC | REC | REC | REC, EHP | EHP, NA | - | NA |

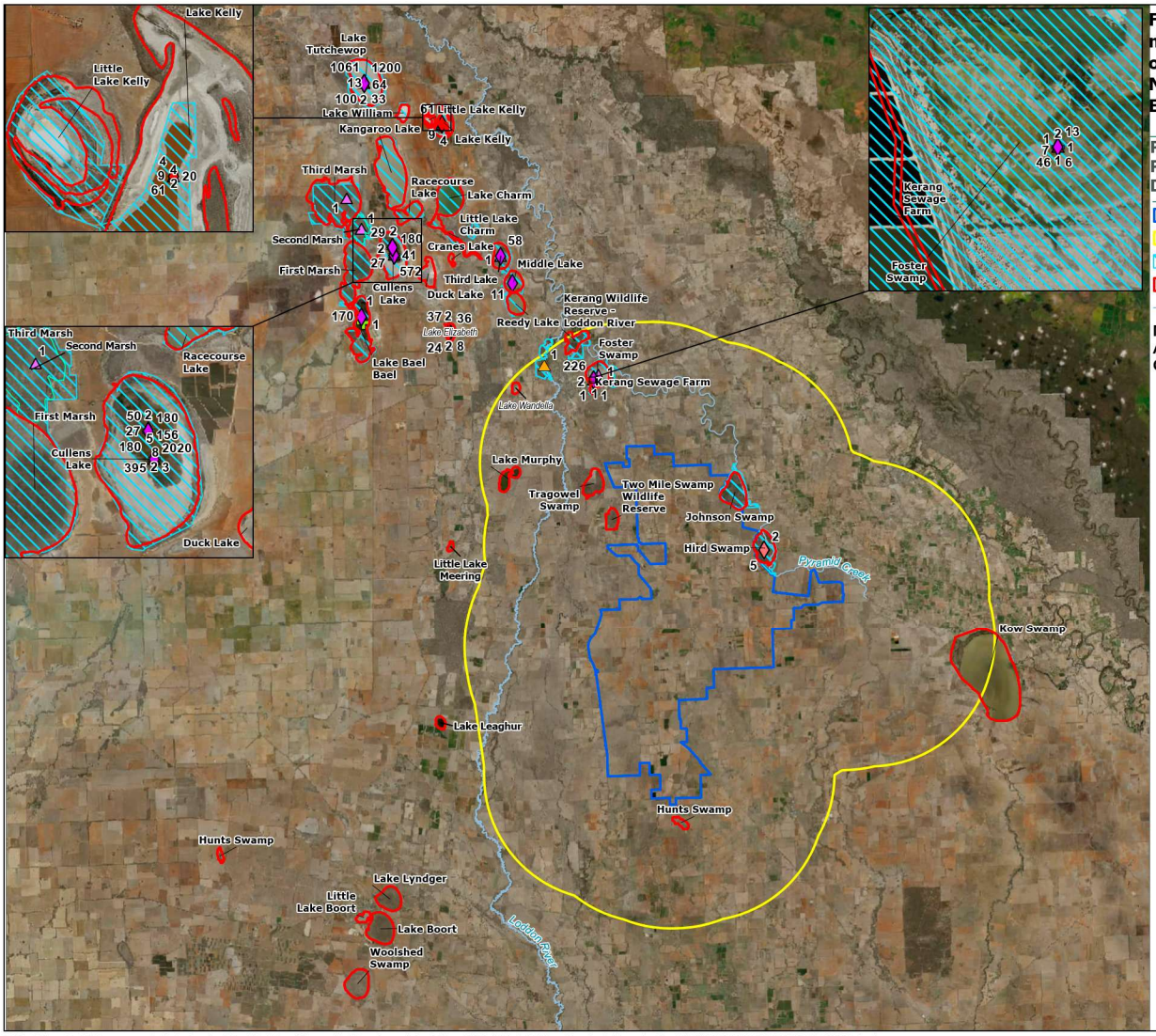


**Figure 10-4. Field survey records of migratory shorebirds within 10 km of Macorna Wind Farm. Source, Nature Advisory, EHP, Rakali Ecological Consulting.**

**Project No**: 24129.09
**Project location**: Macorna Wind Farm, VIC
**Date**: 30/07/2026

- Project Area
- 10 km buffer of Project Area
- Kerang Ramsar Wetlands
- Surveyed wetland
- Waterway

**Migratory shorebird record - Nature Advisory, EHP, Rakali Ecological Consulting**

- Common Greenshank
- Common Sandpiper
- Double-banded Plover
- Latham's Snipe
- Marsh Sandpiper
- Pacific Golden Plover
- Pectoral Sandpiper
- Red-necked Stint
- Sharp-tailed Sandpiper
- Wood Sandpiper

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Kilometers
0 3 6 9 12 15 18
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## 10.4. Conclusions and recommendations

### *10.4.1. Summary of findings*

The field surveys and examination of historical data provided in this assessment indicate that whilst there are large numbers of migratory shorebirds using wetland habitat across the Kerang Wetlands Ramsar site, there are comparably few shorebirds using the wetlands in closest proximity to the Project Area (Figure 10-3 and Figure 10-4). Of the shorebird surveys completed by Nature Advisory, EHP and Rakali Ecological Consulting over six years and across the 37 wetlands including the entire Kerang Wetlands Ramsar site, 3.5 % of the shorebirds counted were within 10 km of the proposed MAWF.

Of the shorebirds counted during field surveys within 10 km of the Project Area (Figure 10-4), the majority were counted at Foster Swamp and the associated wastewater plant, which is approximately 8 km to the northwest of the wind farm boundary. Excluding Foster Swamp and the wastewater plant, only 8 birds in total were counted within 8 km of the Project Area during surveys by EHP, NA, and Rakali Ecological Consulting, all of which were counted at Hird Swamp (Figure 10-4). These counts indicate that there has been very little use of the wetlands within 8 km of the Project Area since at least 2021, even though four out of the six years (2020–2024) have had above-average rainfall.

Database records are more difficult to interpret due to the fact that records were not collected using a standardised methodology. From 1996–2026, there were 561 records of migratory shorebirds recorded within 10 km of the study area on either the VBA, eBird, or Birdlife Australia's Shorebird Program, at an average of 16 records per year. Of those records, 159 were recorded within 6 km of the Project Area, all of which are at Hird and Johnson Swamps, at an average of around 5 records per year. However, closer inspection of the data indicates that there are likely duplications amongst the eBird data, where the same wetland can be surveyed multiple times on the same day or month. For example, there were 16 eBird checklists submitted at Lake Murphy in the first four months of 2006, likely in response to the presence of rare shorebirds such as the Long-toed Stint and Little Stint that were recorded during that time. Multiple checklists at the same site over a short period of time likely result in the same shorebirds being counted multiple times, inflating the number of records.

Both the database records and field surveys indicate that there is, at a minimum, intermittent use of a number of the wetlands within 10 km of the Project Area, including Hunts, Hird and Johnson Swamps, which are within 3-4 km of the Project Area. Hird and Johnson Swamps combined have had shorebirds recorded during 16 of the 30 years for which records existed, with three instances where nationally significant counts of Sharp-tailed Sandpipers were recorded, in 2002, 2005, and 2006. Hunts Swamp has several historical records, without counts, from the 1990s, with only two records since 2000 (Latham Snipe in 2008 and Common Greenshank in 2000). No migratory shorebirds were identified at Hunts Swamp during surveys for the present Project. Other database records within the Project Area are from the 1990s and do not appear to be associated with any existing habitat; no information is provided on the spatial accuracy of these records, and they are considered to be either inaccurate or very rare sightings. No shorebirds were recorded in the next nearest major wetlands of Tragowel Swamp and Kow Swamp.

### *10.4.2. Potential impact pathways*

The impact pathways affecting migratory shorebirds can be broadly categorised into two groups: construction impacts and operational impacts.

*Construction impacts*

The utilisation of the Project Area by birds may be impacted by construction through (DEE 2017):

- Reduction of habitat through loss or degradation, and
- Disturbance of roosting/foraging birds from construction activities.

These impacts would only be expected if construction is occurring near suitable habitat for these species. As the Project Area does not contain any habitat of importance to migratory shorebirds and a 2km buffer is applied to Johnson and Hird Swamps to the east, these impacts are considered unlikely to occur.

*Operational impacts*

The utilisation of the Project Area by migratory shorebirds may be impacted by the operation of wind farms through (DEE 2017):

- Direct mortality from collision with turbines, transmission lines, and other infrastructure; and
- Barrier effects from birds diverting around turbines.

Direct mortality is a higher risk for species and species groups known to fly at rotor swept area (RSA) height. This may include all species of migratory shorebird, though little is known about their short-distance flight behaviour when moving between nearby wetlands. None of the four species of migratory shorebird that have been observed in nationally or internationally significant numbers within the Kerang Wetlands Ramsar (the Curlew Sandpiper, Sharp-tailed Sandpiper, Red-necked Stint or Double-banded Plover) are considered Species of Concern in *The Handbook for the Development of Renewable Energy in Victoria* (DEECA 2025).

Barrier effects are difficult to assess, and data on their prevalence within Australia, as caused by wind farms, is limited. Barrier effects can be assumed to be most likely if turbines are placed between wetlands of suitable habitat, as birds may divert their flights around the wind farm when traversing between adjacent wetlands and waterbodies.

### *10.4.3. Assessment of potential impacts*

The primary potential impact pathway of MAWF on migratory shorebirds is likely to be collision mortality, as no shorebird habitat will be impacted by the wind farm's construction. The local movements of shorebirds whilst they are in Australia are not well understood, but it can be assumed with a reasonable level of certainty that the majority of local movements made by shorebirds will most often be from one wetland to another, likely taking the shortest route, and likely as a result of pursuing new foraging opportunities, or commuting from roost sites to foraging sites, and therefore, possibly involve twice daily movements (Watts et al. 2021). As a result of a lack of observations or other data on the movements of shorebirds in the vicinity of the proposed Macorna Wind Farm, movement corridors of shorebirds have to be inferred, but a commensurate level of caution will be applied in this inference.

The largest and highest-quality proportion of wetland habitats within 35 km of the Project Area are to the northwest and west. Shorebirds using the most suitable and highly-used wetlands are unlikely to fly over the Project Area, as direct flightlines between those wetlands do not intersect with the Project Area. The exceptions are Johnson and Hird Swamps, which are situated to the east of the site. None of these wetlands were found to be frequently used, with Hird and Johnson having only smaller numbers in recent years. Hunts Swamp, situated to the south, has no shorebird records within the last 18 years.

Other major wetlands near the Project Area, Kow and Tragowel Swamp, have no records of shorebirds and both are considered to only provide marginal habitat.

There are historical records of migratory shorebirds using wetlands within proximity to the Project Area, with a nationally important number of Sharp-tailed Sandpipers reported at Hird Swamp in 2006. However, all surveys by this project and Rakali Ecological Consulting, between 2021 and 2026, recorded only eight shorebird observations (all at Hird Swamp). No shorebirds were observed at Johnson Swamps, with the wetland only having intermittent records in existing databases, despite the identification of potential habitat. This suggests Johnson Swamp may be less favoured, or only used under certain conditions. Similarly, Hunts Swamp provided potential habitat in the south but had few records, all of which were over 18 years ago. Given the limited records and the buffers provided in the design (2km for Hird and Johnson; 4 km for Hunts), it would be considered infrequent/unlikely (in particular for Hunts Swamp) that flights will cross turbine areas. More likely is that migratory shorebirds move between the higher-quality and high-usage areas to the northwest, well outside the Project Area. As a result, direct flightlines across the Project Area are considered unlikely.

Given the limited number of shorebirds within 8 km of the Project Area, and therefore the limited frequency of movements between wetlands, the likelihood of turbine collision is considered likely to be low. Similarly, any barrier effects are expected to be minor and localised, and unlikely to disrupt broader movement patterns across the Kerang Wetlands system.

The potential for significant impacts to migratory shorebirds is expected to be low given the 2 km buffer from Hird Swamp embedded in the layout design and the context of the low frequency of shorebird records over the past 6 years from the immediate vicinity of the Project Area. This buffer, in combination with the Project's broader avoidance of other wetland habitats, aims to ensure that construction and operation are unlikely to result in significant impacts on migratory shorebirds. Overall, the operational impacts to migratory shorebirds are not expected to cause significant effects at a local, regional or Ramsar site scale.

The residual risk of the occasional collision cannot be excluded and will be managed through appropriate management plans and adaptive mitigation measures (Section 10.4.4).

### *10.4.4. Recommended application of mitigation hierarchy*

This section outlines the key impact pathways and provides recommendations for the application of the mitigation hierarchy to reduce the potential significance of potential impacts.

#### *Habitat degradation*

Habitat degradation has been entirely avoided through the siting of turbines and other infrastructure a minimum of 2 km away from migratory shorebird wetland habitat. Changed hydrology as a result of the construction and operation of the wind farm can have downstream effects, but a hydrological assessment concluded that there will be no substantial or measurable change in the hydrological regimes, including the volume, timing, duration, or frequency of surface water flows (DCE 2026b). Similarly, water quality was concluded as having no substantial or measurable changes resulting from the project (DCE 2026b).

#### *Collision with turbines and barrier effects*

The risk of turbine collision on migratory shorebirds will be at least partially avoided through the placement of turbines as far from wetland habitat as practicable. The 2 km turbine-free area around

Hird and Johnson Swamps is likely to reduce interactions between migratory shorebirds and turbine blades. The closest turbine to habitat at Hunts Swamp is approximately 4 km away. The distances between the habitat and turbines will improve the probability that migratory shorebirds will reach a flight altitude above that of the turbine blades, or avoid the turbines altogether.

Corridors between wetland habitats have been excluded from turbine placement where practicable. Migratory shorebirds are known to make local movements between wetland habitats for reasons such as changing conditions, exploiting different resources, or moving between foraging and roosting sites. It is assumed that migratory shorebirds travel in a direct line between habitats, taking the shortest possible route, as it would reduce the energy costs of these movements and help to maintain the positive energy balance required for migratory flights. In this context, no turbines have been proposed between or within 2 km of the closest shorebird habitat at Hird and Johnson Swamps.

A small proportion of the proposed turbines are located within potential flight lines between areas of shorebird habitat near the Project Area, with between Hird and Johnson Swamps and other major wetlands to the northwest. However, Hird and Johnson Swamps represent the closest habitats that may support shorebirds under favourable conditions, and both have demonstrated only low and intermittent use. Since 2021, just eight migratory shorebirds have been recorded across these two wetlands. This limited utilisation reduces the likelihood of regular flight movements between these areas, and therefore, decreases the risk of turbine collisions.

Potential barrier effects may arise if turbines are between key habitats. There are a small number of turbines positioned between Hird and Kow Swamps, and between Johnsons and Tragowel/Two Mile Swamps. In these instances, shorebirds may deviate slightly around turbines to the east or north, respectively. However, we note that Kow, Two Mile and Tragowel Swamps have been assessed as providing only marginal shorebird habitat, with no shorebirds observed during surveys and very few shorebirds in existing databases at Tragowel and Two Mile (none at Kow Swamp). As such, the likelihood of flights between these wetlands, and thus impacts to shorebirds from either collision or barrier effects, is considered low.

Residual risks of turbine collision will be addressed through the development of a Bat and Avifauna Management (BAM) Plan. The BAM Plan will be informed by local information on utilisation and agreed to in consultation with the regulator. The contents of BAM Plans are outlined in the Handbook (DEECA 2025d). The aim of these plans includes:

- Minimise the impacts from the MAWF on threatened fauna listed under the Commonwealth EPBC Act and/or the FFG Act;
- Post-construction monitoring to understand how migratory shorebird (and other listed fauna) use of the site changes in response to wind farm construction and operation;
- Monitoring for the timely identification of turbine collisions and the timely collection and analysis of data;
- Responsive updates to, and regular validation of, the impact assessment framework for migratory shorebirds (and other listed fauna regularly recorded within the Project Area), using monitoring data to support a robust adaptive management approach to reducing impacts, where possible; and

- Where applicable, the development and implementation of tangible, on-ground management actions to promote a long-term collision risk reduction on migratory shorebirds and other listed threatened and migratory bird and bat species.

#### *10.4.5. Conclusions and further investigations*

Impacts to migratory shorebirds from the construction and operation of the proposed MAWF have been largely avoided through the placement of turbines a minimum of 2 km away from major wetland habitat (Hird and Johnson Swamps, forming part of the Kerang Wetlands site). This design response completely avoids impacts to shorebird habitat and reduces the risk of turbine collision and barrier effects.

A low residual risk for turbine collision and barrier effects exists for shorebirds that may use Hird Swamp, as this swamp are the closest to the Project Area with direct flight lines from some other major wetlands to the northwest (Tragowel Swamp) and southeast (Kow Swamp) intersecting with the Project Site. However, this risk is considered low, as both the collision risk and barrier effect regarding Hird Swamp are limited by the fact that the wetland is only intermittently used by shorebirds, with just 8 birds recorded there since 2021 and no nationally significant count of a shorebird species since 2006. In addition, no shorebirds were recorded at Tragowel and Kow Swamps. The 2 km buffer from Hird Swamp provides a substantial separation distance between turbine infrastructure and the nearest areas of recorded shorebird activity. This has the effect of further reducing the likelihood of interaction.

Residual risk to shorebirds at the proposed MAWF can be further reduced through the implementation of a BAM Plan, which will provide for the ongoing monitoring of shorebirds during construction and part of the operation of the wind farm, and monitor for shorebirds. The BAM Plan will also include clearly defined trigger thresholds and adaptive management responses, enabling additional mitigation measures to be implemented if required.

Overall, given the limited utilisation of nearby wetlands, the avoidance of key habitats through the layout design, and the implementation of adaptive management measures in a BAM Plan, impacts to migratory shorebirds are expected to be low and unlikely to result in significant effects at a local, regional or Ramsar site scale.

# 11. Plains-wanderer

This section assesses the potential implications of the Project on Plains-wanderer (*Pedionomus torquatus*), which is listed as *Critically Endangered* under the EPBC and FFG Acts. Specifically, this section addresses the following:

- A review of scientific literature and statutory documents relating to Plains-wanderer,
- A review of existing information regarding nearby Plains-wanderer records, modelled habitat, and modelled suitable EVCs, including the VBA, NatureKit and eBird,
- A review of existing ecological reporting and data, including detailed botanical data derived from Habitat Hectare scoring, to derive an understanding of grassland microhabitat structures present. This informs the habitat assessment in relation to the Plains-wanderer,
- Mapping of potential habitat areas to avoid/buffer to minimise likelihood of impacts, and
- Risk assessment and outline of impact pathways if impacts cannot be avoided, and legislative implications of such impacts.

## 11.1. Background information

### *11.1.1. Description*

The Plains-wanderer is a small, ground-dwelling bird of Australian semi-arid grasslands. It resembles a button-quail but can be distinguished by its longer legs, longer, narrower bill, longer neck and characteristically erect 'alert' posture (see Plate 11-1). It measures 15–19 cm in length and has a wingspan of 28–36 cm. The average female mass (57–95 g) is slightly greater than that of males (39–78 g) (Marchant and Higgins 1993; Menkhorst et al. 2017). Plains-wanderers are camouflaged and exhibit sexual dimorphism in their adult plumage: females are distinguished by a rufous breast and black collar with white spots, while males have plainer light-brown plumage. Both sexes exhibit a buff to white belly with small brown crescents.

The call is a repeated, low, resonant "*oo*", heard mainly at dawn and dusk during spring (Menkhorst et al. 2017). This species is mainly active during the day and at twilight; however, it is very cryptic and seldom seen during the daytime. As plains-wanderers are difficult to spot during daytime, most sightings are made by spotlighting roosting birds at night (Menkhorst et al. 2017).

**Plate 11-1: Plans-wanderer, female (left) and male (right) (source: Michael Sebastian).**

### *11.1.2. Habitat*

The Plains-wanderer typically occurs in sparsely vegetated native grassland. They prefer grassland with 50 % bare ground and 10 % litter, with the remainder consisting of herbs and grasses < 5 cm tall and some widely spaced plants of up to 30 cm tall (DoE 2016). Grass tussocks spaced 20–30 cm apart are considered ideal (Parker and Oliver 2006). Occasionally, the species ventures into other low-grassland and agricultural habitats, such as crop stubble, but it cannot persist in an agricultural landscape (Garnett and Baker 2020). Furthermore, Plains-wanderers tend to avoid areas with high exotic herb and litter cover (Nugent et al. 2022).

Whilst sparsely vegetated native grassland on red soils is considered ideal, this habitat is mainly favoured for roosting (Nugent et al. 2022). In contrast, areas of denser native vegetation with higher grass and lichen cover, which are often associated with grey and mosaic soils, are preferred for foraging (Nugent et al. 2022). Plains-wanderers also occur in low, sparse chenopod shrubland (DoE 2016).

### *11.1.3. Distribution and threats*

Once common across the sparsely vegetated grasslands of south-western Victoria, south-eastern South Australia and eastern New South Wales (NSW), the Plains-wanderer's current distribution is limited to north-central Victoria, the Riverine Plain of NSW and south-western Queensland (Figure 11-1) (Garnett and Baker 2020). The distribution and population size declined rapidly following the modification and clearance of lowland native grasslands. These declines are continuing and have been especially severe in recent years. Several reasons have been proposed for these declines. The main threats can be summarised as follows (Garnett and Baker 2020; DoE 2016).

- Habitat loss, both as a direct result of converting grassland into cropland and as an indirect consequence of habitat fragmentation;

- Inappropriate grazing in terms of overgrazing that reduces grass cover and height, especially during drought, and insufficient grazing that allows excessive grass cover;
- The small population size decreases genetic diversity and the likelihood that chance events may significantly impact the population;
- Predation by feral species, such as European foxes (*Vulpes vulpes*) and domestic cats (*Felis catus*), as well as native birds of prey such as the Spotted Harrier (*Circus assimilis*);
- Pesticides such as Fenitrothion can kill Plains-wanderers directly or have indirect impacts via accumulation in the food chain;
- Planting and recruitment of trees in or near native grasslands, as Plains-wanderers avoid trees to avoid predation;
- Habitat disturbance by invasive herbivores such as rabbits (*Oryctolagus cuniculus*).
- Lack of appropriate burning regimes; and
- Increased likelihood of high-intensity and large-scale fires due to reduced rainfall and more frequent heatwaves, both of which are driven by climate change, and inappropriate burning regimes.

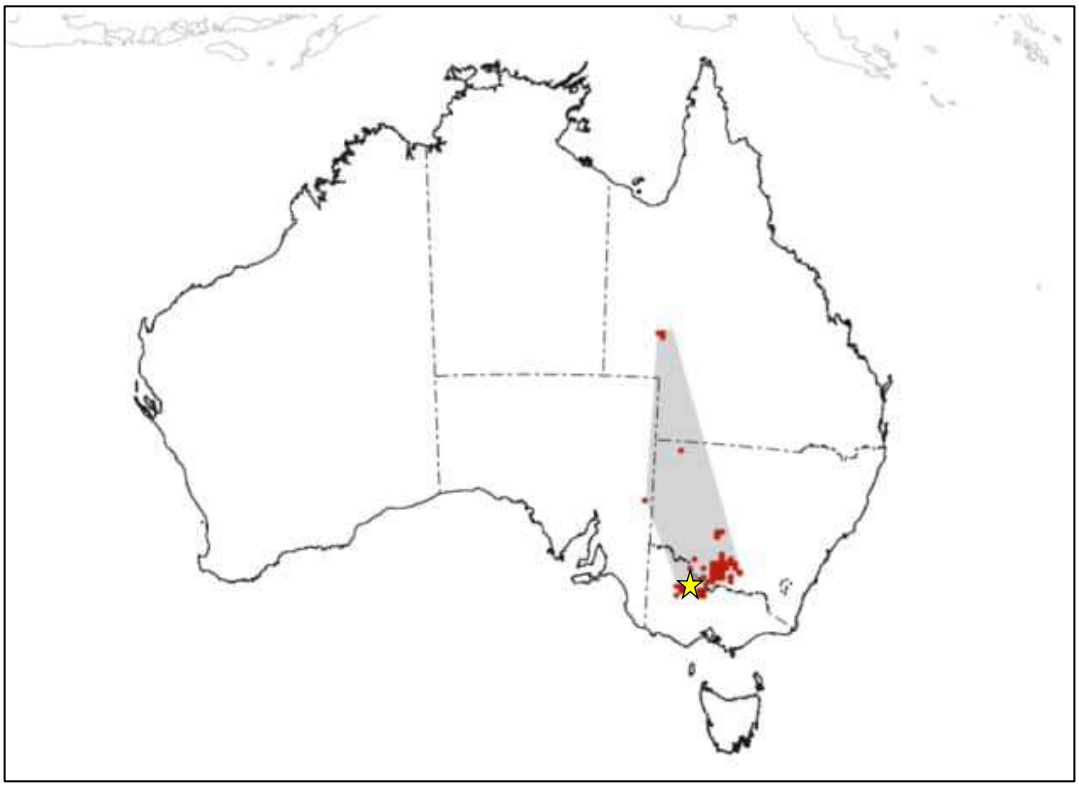

**Figure 11-1: Distribution of Plains-wanderer as sourced from *The Action Plan for Australian Birds 2020* (Garnett and Baker 2020).**

**NOTE:** Red points represent records of the species, and grey shading represents the estimated range. The yellow star is the approximate location of the MAWF.

#### *11.1.4. Legislative protection*

**Victoria**: Listed as Critically Endangered under the FFG Act.

**Commonwealth**: Listed as Critically Endangered under the EPBC Act.

### 11.2. Methodology

#### *11.2.1. Sources of existing information*

Database searches for existing records of Plains-wanderers were undertaken on the 2nd of February 2026, within 10 km of the study area. The following sources of information were reviewed to collate existing information:

- Victorian Biodiversity Atlas, VBA (DEECA 2026e);
- *NatureKit* (DEECA 2026a);
- Birdata database (BirdLife Australia 2025);
- Atlas of Living Australia, ALA (ALA 2026);
- eBird database (Cornell Lab of Ornithology 2026); and
- Habitat Management and Conservation of the Critically Endangered Plains-wanderer on the Northern Plains of Victoria (Nugent et al. 2022).

In addition, discussions about the project and suitable habitat areas were held on 24 March 2026 with the Northern Central CMA and Dr D. Nugent, an ecological expert regarding Plains-wanderer.

#### *11.2.2. Desktop assessment*

Potentially suitable habitat for the Plains-wanderer was preliminarily assessed using DEECA's Habitat Distribution Models (HDM) and Habitat Importance Model (HIM) (DEECA 2026a).

The availability of suitable habitat was further refined using the DEECA-modelled EVCs (DEECA 2026a), in conjunction with data collected from detailed vegetation surveys (see discussion on Habitat Hectare scoring in Section 5). EVCs corresponding to suitable habitats included:

- Plains Grassland (EVC 132), and
- Chenopod Grassland (EVC 829).

The Plains-wanderer requires tussock grassland with 20-50 % of the bare ground (Nugent et al. 2022; DoE 2016). This information can be roughly derived from Habitat Hectare data, as the amount of bare ground in habitat zones (HZ). The Habitat Hectare scoring system does not explicitly define habitat suitability for Plains-wanderer, as the bare ground cover classes used in vegetation quality assessment (<5 %, 5–40 %, 40–60 %, >60 %) do not align precisely with the species' preferred range of 20–50 % bare ground. To address this mismatch, a precautionary, likelihood-based approach was adopted rather than assuming definitive suitability.

Specifically, grassland EVCs with 5–60 % bare ground were considered to have a higher likelihood of providing suitable habitat, acknowledging that not all areas within this range will meet the species' requirements, but may have a higher chance under most conditions. This approach is considered appropriate for a high-level assessment conducted under an assumed presence scenario.

As such, the following definition of habitat was applied:

- *Likely Suitable* – suitable EVC with vegetation survey showing 5-60 % of bare ground;
- *Potentially Suitable* – suitable modelled EVC without vegetation survey; and
- *Unsuitable* – unsuitable EVC (e.g. woodland) or suitable EVC with vegetation survey showing <5 % or >60 % bare ground.

*Connectivity and patch loss*

The impact of habitat loss and fragmentation was assessed at the habitat patch scale using GIS-based spatial analysis. Areas of potentially suitable and likely suitable Plains-wanderer habitat were delineated into habitat patches by combining habitat polygons separated by less than 400 m, reflecting the current understanding of typical dispersal distance for the species (DoE 2016; Marchant and Higgins 1993).

The area of each habitat patch was calculated and assessed against for removals under the Project Footprint. The amount of habitat removed from each patch and the resulting post-impact patch size were then quantified. Habitat patches were deemed 'lost' if the minimum breeding patch size of 18 ha was not maintained (DoE 2016; Marchant and Higgins 1993).

To assess Project-related fragmentation, habitat patches were re-evaluated following the application of the Project Footprint to determine whether habitat removal increased the separation between remaining habitat areas to greater than 400 m, thereby creating new discrete habitat patches.

#### *11.2.3. Limitations*

The HDM, HIM, modelled EVC (DEECA 2026a) and detailed Habitat Hectare scoring systems (Section 5), do not neatly define habitat suitability for the Plains-wanderer. The existing HDM/HIM modelling is coarse (75 m resolution) and does not capture the heterogeneity of bare ground, a key aspect of suitability for the Plains-wanderer. Similarly, the Habitat Hectare scoring system does not capture the specific 20-50 % bare ground required for the species, but rather uses broader buckets (e.g., <5 %, 5–40 %, 40-60 % and >60 %). Using Habitat Hectare scoring in conjunction with DEECA's modelling provides a conservative estimate of habitat suitability for desktop assessments, which is considered appropriate under the assumption of the species presence.

Areas assessed as structurally unsuitable at the time of Habitat Hectare scoring may become suitable under different climatic conditions, such as in drier or wetter years than when the assessment was undertaken. Similarly, areas that are currently bare may increase in coverage with wetter periods. Consequently, areas not currently classified as suitable or unsuitable (but which lack features that would permanently preclude the species, e.g. recent ploughing) may provide suitable or unsuitable habitat under alternative environmental conditions. The current assessment provides a snapshot at the time of assessment.

### 11.3. Results

#### *11.3.1. Existing information*

A review of existing Plains-wanderer records within the Search Region was undertaken on 29 December, 2025. Four records were retrieved from the databases (Figure 11-5) with two of the records being from more than 100 years ago, and one from over 50 years ago:

- One record within the Project Area:

- Undisclosed number in the north of the Project Area in 1905 (VBA ID: 822728)

- Three records within 10 km of the Project Area:
  - 3 individuals near Pyramid Hill (Southeast of the Project Area) in 2019 (VBA ID: 1972243)
  - 1 individual near Leaghur State Park (West of the Project Area) in 1974 (VBA ID: 493926)
  - Undisclosed number near The Bannacher (West of the Project Area) in 1912 (VBA ID: 822727)

There is no existing information on the presence of habitat within the Project Area, owing to a lack of study effort (D. Nugent and NCCMA *personal communications*). The DEECA-modelled habitat (HDM and HIM) for this species covered much of the Project Area, with the highest-quality habitat generally concentrated in the south and low-quality habitat in much of the northern and central part of the Project Area (Figure 11-3 and Figure 11-4). The modelled habitat was distributed in relatively well-connected patches of native grassland.

Strongholds exist for the species ~16 km to the south-east (Patho Plains Grassland) and ~20 km to the north-west (Lower Avoca Grasslands; Figure 11-2). Local authorities and species experts advise that it is possible that birds dispersing between these two strongholds could stopover at the MAWF if/where habitat exists.

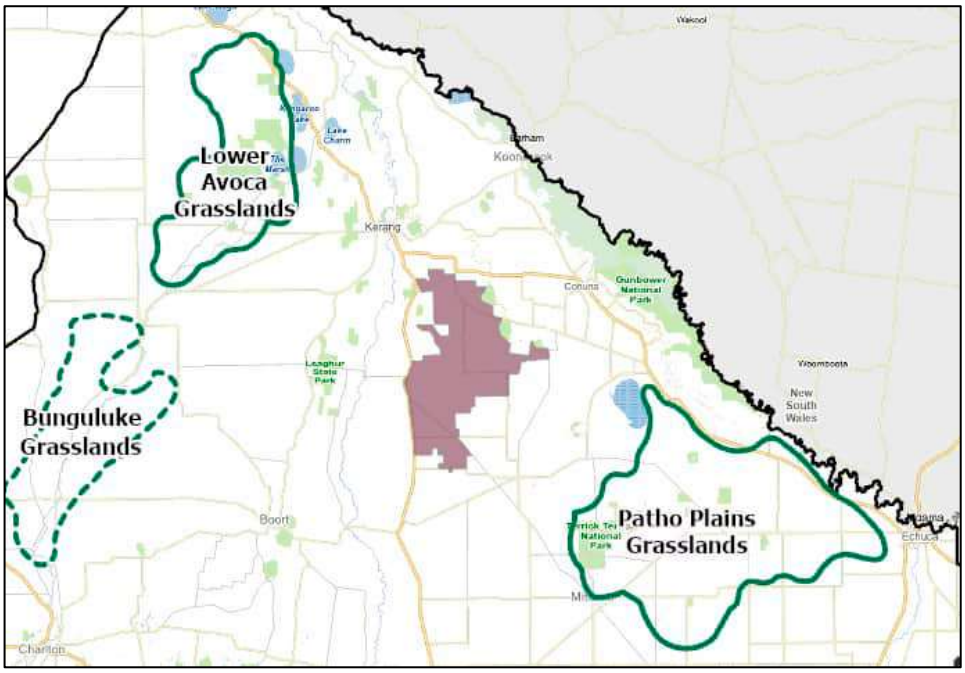


**Figure 11-2: Identified strongholds for the Plains-wanderer as provided by NCCMA on the 19th of March 2026.**

**NOTE**: MAWF is represented by the solid brown polygon.

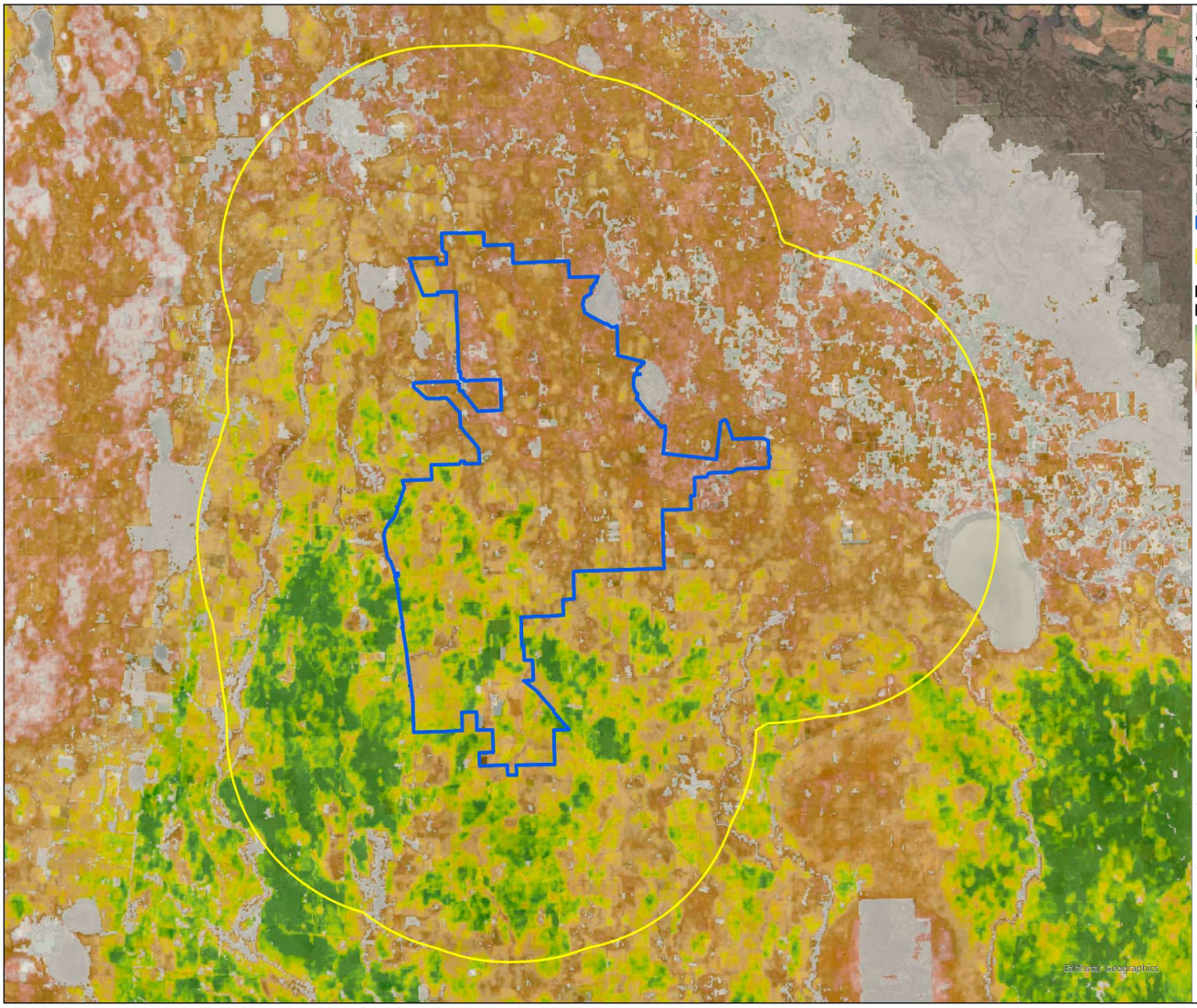


**Figure 11-3: Plains-wanderer Habitat Distribution Model (HDM) for the Macorna Wind Farm and surrounding area**

**Project No**: 24129.07
**Project location**: Macorna Wind Farm, VIC
**Date**: 14/04/2026

Project Area

Search region - 10 km buffer

**Plains-wanderer Habitat Distribution Model (HDM)**

High suitability

Low suitability

Note: transparent white of the Habitat Distribution Model has a value of 0, no suitability

N

Kilometers

0 2.5 5 7.5 10

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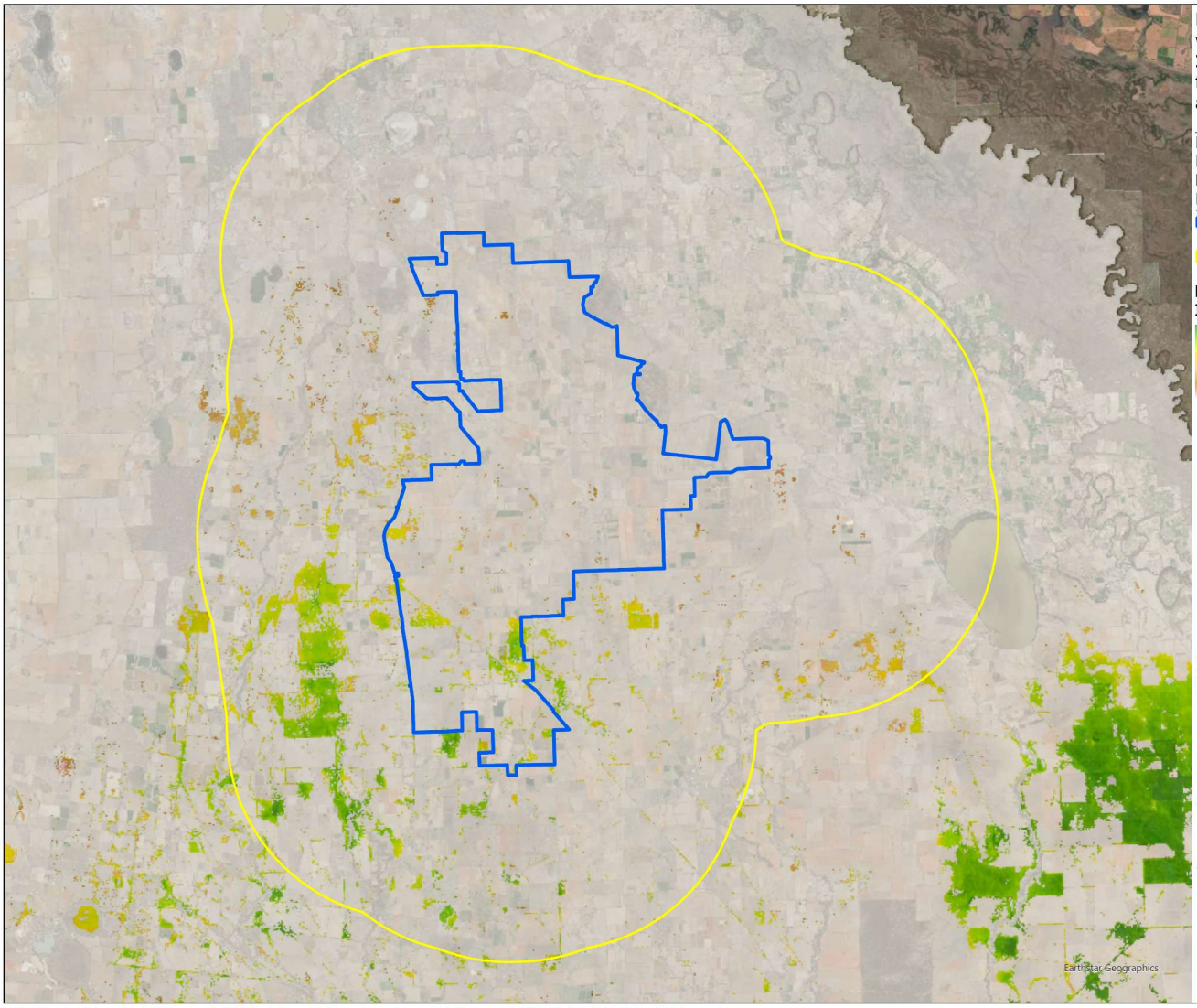


**Figure 11-4: Plains-wanderer Habitat Importance Model (HIM) for the Macorna Wind Farm and surrounding area**

**Project No**: 24129.07
**Project location**: Macorna Wind Farm, VIC
**Date**: 14/04/2026

Project Area

Search region - 10 km buffer

**Plains-wanderer Habitat Importace Model (HIM)**

High importance

Low importance

Note: transparent white of the Habitat Importance Model has a value of 0, no importance

N

Kilometers

0 5 10

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### *11.3.2. Habitat suitability*

At the regional scale, the majority of habitat is concentrated in key areas, including several kilometres away to the south-east (Patho Plains Grassland stronghold) and further again to the north-west (Lower Avoca Grasslands stronghold) (Figure 11-2). Within closer proximity, there are some small extents of modelled habitat occurring to the south-west, along the Loddon River and its associated plains (Figure 11-3; Figure 11-4). Regionally, DEECA's species modelling (Figure 11-3; Figure 11-4) suggests the largest and highest-quality habitat is outside of the Project Area.

Investigating the modelled location of grasslands indicated that potentially suitable habitat may be widespread across the Project Area. However, refinement using detailed Habitat Hectare assessments substantially reduced this extent, with most patches of grassland EVC being well outside of the species requirements for bare ground, even using the precautionary approach adopted here (see methods; Section 11.2). Field vegetation surveys ultimately identified 1,101.984 ha of 'likely suitable' habitat in the Project Area, comprising 221 grassland areas. A further 12,579.218 ha were modelled as 'potentially suitable' within the broader search region (Figure 11-5).

The majority of the proposed development footprint avoids suitable habitat, with 164.954 ha (81.92 %) of all impacted areas (including native and non-native vegetation) located within areas assessed as unsuitable for the Plains-wanderer. Through avoidance in the design phase, the Project has avoided 97.4 % of all habitats identified as 'likely suitable', with an impact expected to be 28.846 ha (2.6 %) of the total identified within the Project Area. In addition, most (99.94 %) of the 'potentially suitable' habitat has been avoided, with 7.549 ha to be affected. The mapping of 'likely suitable' and 'potentially suitable' habitats represents a conservative estimate of habitat suitability for this species. We note that this assessment provides a snapshot, with the extent of habitat possible to increase/decrease with environmental conditions and land use.

**Table 11-1: Habitat availability for the Plains-wanderer at the Project Area.**

| Habitat suitability | Total area within search region† | Impact area (% of total habitat type) |
|---|---|---|
| *Unsuitable* | 20,406.706 ha | 164.954 ha (0.81 %) |
| *Potentially Suitable* | 12,579.218 ha | 7.549 ha (0.06 %) |
| *Likely Suitable* | 1,108.031 ha | 28.846 ha (2.60 %) |

**NOTES:** † Search region is the area within 10 km of the Project Area.