Arrow Energy -

Request for Information Response DXP 4

Version	1.0
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1 Application Details

The amendment application for a site-specific environmental authority was received by the administering authority on 28 February 2025.

The application reference number is: A-EA-AMD-100829511

Land description: PL238, PL258, PL252, PL198, PL230 and PL260.

2 Information Request

2.1 Sensitive Receptor

Issue:

1. A property located approximately 2 km from the proposed Lynwood Field Compression Station (Lynwood FCS) does not appear to be referenced in the noise or air modelling assessment reports or Supporting Information Report (SIR), please refer to Figure 1. The approximate coordinates are E 315416 N 6956908. During a meeting between DETSI and Arrow on 12/05/2025, Arrow advised that the company may own the property. Based on the information provided to date, the department is unclear about the property's current use and whether it is a sensitive receptor—such as a residence or commercial activity—under the Environmental Protection (Noise) Policy 2019.

Figure 1 – Sensitive receptor to east of FCS (QGlobe)

Information requested:

a. Please provide a description of the property (including current use) and confirm in writing reasoning as to why Arrow do not believe this to be a sensitive receptor. If the property is classed as a sensitive receptor, please update your air and noise modelling to include the property and update your supporting information to discuss the results.

Arrow Response

This property is owned by Arrow Land Holdings Pty Ltd (40DY363) and is not classed as a sensitive receptor as the property is unoccupied. As such, no updates to the air and noise modelling are required.

2.2 Environmentally Relevant Activities

Issue:

1. Following review of the application, we have identified that 0.44 ha of endangered remnant RE 11.4.3 and 0.50 ha of endangered regrowth RE 11.3.1 will be impacted by the project. As these impacts are considered significant impacts to Category B environmentally sensitive areas (ESAs), the environmentally relevant activity (ERA) Schedule 3-03 ‘a petroleum activity that is likely to have a significant impact on a category A or B environmentally sensitive area’ is triggered which we require be added to the environmental authority.

Information required:

a. Please confirm your agreement to the addition of ERA Schedule 3-03 to your environmental authority (EA) EPPG00972513 or provide justification as to why you believe this activity does not apply to the environmental authority (EA).

Arrow Response

For clarity (and further discussed in Section 2.9 and Appendix F), this amendment application does not impact RE 11.4.3 and impacts a reduced area (0.21 ha) of regrowth RE 11.3.1.

Arrow agrees to the inclusion of ERA Schedule 3-03 into the Environmental Authority. This will address the inconsistency in the EA conditions and the authorised PEMs table which coincides with the period in which there was an update to the Environmental Protection Regulations (2008 and 2019). Specifically, the condition in Schedule D Table 2 that allows for 0 ha impact on Cat B ESA; yet Schedule Table 3 PEMS, authorises a 5 ha impact to Endangered Regional Ecosystem (ERE) vegetation.

2.3 Noise Modelling

Issue:

1. Referring to the Operational Noise Assessment Report (ONAR), cl. 4.4.1 Pg. 23, the noise modelling assessment applies a reduction of 8.7 dB to the assessment based on an Arrow 'flare noise study'. However, limited information has been provided as to how this figure has been derived, whether it allowed for varying weather conditions and whether it applies to one design or supplier of flare fence.
2. Referring to the ONAR, cl. 4.5 Pg. 27, it is noted that flaring at a flow rate of 87 MMscfd and 116 MMscfd may result in noise limits being exceed at up to three or five sensitive receptors under adverse weather conditions, respectively. It is unclear, however, what the number and duration of such events would be and what, if any, additional control or mitigation measures have been considered to prevent these exceedances.

Information required:

Item	Information Requested	Arrow Response	Relevant Documents
2.3a	Provide brief details on how the 8.7 dB reduction figure has been derived. Specifically, please confirm if the flare noise study, on which the reduction was based, considered adverse weather events comparable to those modelled and whether the study and reduction was based on the design of the flare fence that will be used here.	The 8.7 dB reduction figure was derived by Acoustics specialist SLR using the '*Q12551A-C01 Rev 0 Flare Noise Study*' comparing a vertical flare design and a multipoint ground flare design (MPGF) with a wind fence. Arrow confirms that the design of the flare fence is consistent with the proposed design. Adverse weather conditions were used in the study consistent with the noise impact assessment.	Appendix A: Q12551A-C01 Rev 0 Flare Noise Study
2.3b	Provide an estimate of the number and duration of the events that may result in exceedances of the noise limits at sensitive receptors LFCS-1 to LFCS-5.	The worst-case probability of an exceedance occurring (sensitive receptor LFCS-1) is less than 1 hour/year, as estimated based on: - Frequency of adverse meteorological conditions (atmospheric conditions class F) for meteorological year 2023 (refer to Table 9 and Figure 13 of the SLR Air Quality report) of 28% - A conservative probability of occurrence of a flaring event of 87 MMscfd and above of 0.2% - Wind direction frequency for wind blowing from the FCS facility towards sensitive receptor LFCS-1 of 15% (as per 2023 meteorological data from Figure 11 of SLR's AQ report).	
2.3c	Provide details of any additional control measures or mitigations that have been considered to prevent exceedances at	The MPGF design reduces noise levels to As Low as Reasonably Practical (ALARP).	

	LFCS-1 to LFCS-5 due to the flaring and why they have not been adopted.	As Arrow's facilities become more interconnected (through the Surat Gas Project), more opportunities have been available to divert gas and minimise flaring due to compression outages. In addition, Arrow has increased well turndown ability and improved responses through the Central Control Room, which is also reducing the rate of flaring across Arrow assets. Flaring during scheduled events, such as annual maintenance activities can be scheduled to occur during the day and gas flow is minimised to reduce gas loss (maximum flare rates do not occur on a scheduled basis).	

2.4 Lynwood Field Compression Station (FCS)

Issue:

1. The supplied spatial data and Figure 4-1 of the SIR appears to show the location of the ground flare package in different locations approximately 200 m apart, refer to Figures 2 and 3 below. It is unclear which is the correct location and whether this has been correctly used in the air and noise emissions assessment.
2. For the proposed Lynwood FCS, it is unclear if an indirect assessment for visual/noise impact on biodiversity matters has been undertaken in relation to the activity including the multi-point ground flare (MPGF).
3. It is unclear if the assessment of impacts referred to in cl. 4.7.3 of the SIR is reflective of the location of the proposed Lynwood FCS and associated MPGF. The flare facility is located approx. 350m from the nearest road being Boundary Road. However, cl. 4.7.3 refers to Retreat Road and a clearance of 2.4km. It also refers to a proposed warehouse facility which is not mentioned anywhere else in the report.

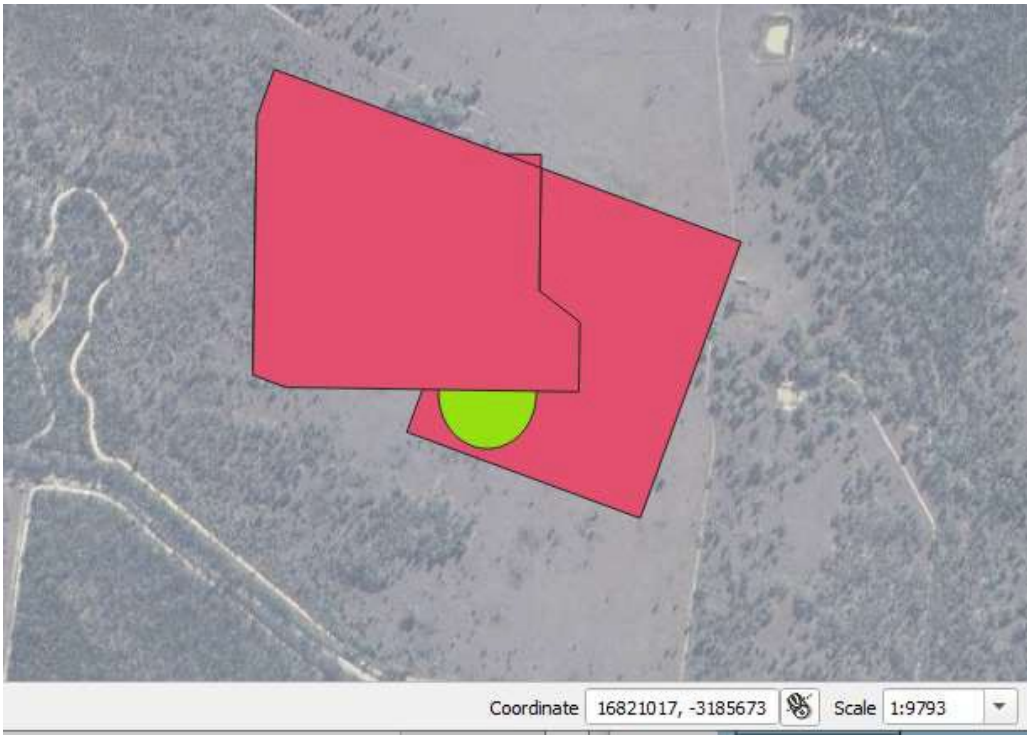

Figure 2 – View of supplied spatial data – flare package shown in green (Arrow)

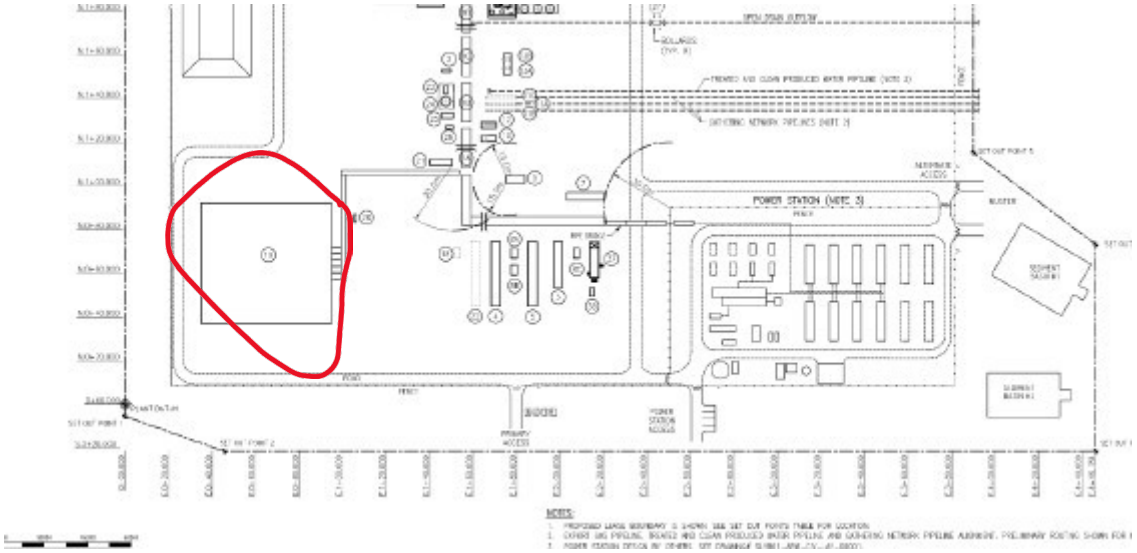

Figure 3 – Extract from SIR Figure 4-1. Flare package highlighted in red (Arrow)

Information required

Item	Information Requested	Arrow Response	Relevant Documents
2.4a	Please confirm the location of the MPGF and that this location has been used in the noise and air modelling assessments.	The location of the MPGF is correct in SIR Figure 4-1 (Figure 3 above). The noise and air modelling assessments have been undertaken based on this location. This can be seen in Table 13 of the Air Quality Impact Assessment, and Table 10 of the Operational Noise Assessment.	Supporting Information Report Appendix C (Lynwood FCS Air Assessment) and Appendix D (Lynwood FCS Noise Assessment)
2.4b	If necessary, please update the DXP 4 EA Disturbance Spatial Data to show the correct location of the ground flare package.	The DXP 4 EA Disturbance Spatial Data has been updated to reflect the correct location of the ground flare package.	Attachment 1: DXP 4 EA Disturbance Spatial Data 202506
2.4c	Undertake an indirect impact assessment for biodiversity matters, including prescribed environmental matters (PEMs) which should include the impacts of the visual and acoustic pollution from the proposed Lynwood FCS plant including for flaring events.	Arrow selected a MPGF over a vertical or horizontal sonic tip flare as it mitigates both noise and light impact, when compared with other options. The Central Control Room has the ability to remotely turn down wells in the instance of upset conditions which result in flaring. This minimises the duration and intensity of flaring events. Flaring during scheduled events, such as annual maintenance activities can be scheduled to occur during the day and gas flow is minimised to reduce gas loss (maximum flare rates do not occur on a scheduled basis).	

		Flare analysis of similar facilities forecasts an annual average of eight flare events per year, including planned events, which would generally occur during daylight hours. Based on the above, noting that scheduled maintenance would result in flaring during the day, there is unlikely to be an indirect impact from the MPGF on visual amenity or acoustic pollution to biodiversity. This would also be the case of unplanned flaring events during the day. Based on the infrequency of unplanned flaring events (e.g. plant trip or safety event), indirect impacts on biodiversity matters to visual amenity and acoustic pollution would be difficult to assess in any robust manner as they would be very unlikely to manifest.	
2.4d	Please review and confirm that the description in cl. 4.7.3 is correct, otherwise update and resubmit the assessment citing the correct location and features.	The description in 4.7.3 is incorrect. The flare facility is located approx. 230m from the nearest road being Boundary Road. Should a warehouse be constructed it would be within the disturbance allocated to the FCS in DXP 4 EA Disturbance Spatial Data. An updated section 4.7 has been provided in conjunction with this RFI response (Appendix B). The correct flare facility location was used in the noise and air modelling assessments and is available in the spatial data provided (Attachment 1).	Appendix B: Updated Section 4.7

2.5 Power Station

Issue:

1. The submitted application is seeking authorisation for the proposed Lynwood FCS which will incorporate a power station to supply the proposed FCS. However, a review of the spatial data submitted indicates two separate power stations and two 'powerplants' located on or near the site of the proposed Lynwood FCS, refer to Figure 4 below. As the application only refers to one power station and a review of the plan in Figure 4-1 of the SIR does not appear to reflect these four items of infrastructure, it is unclear where the proposed power station associated with the Lynwood FCS will be located and if authorisation for an additional power station is required.

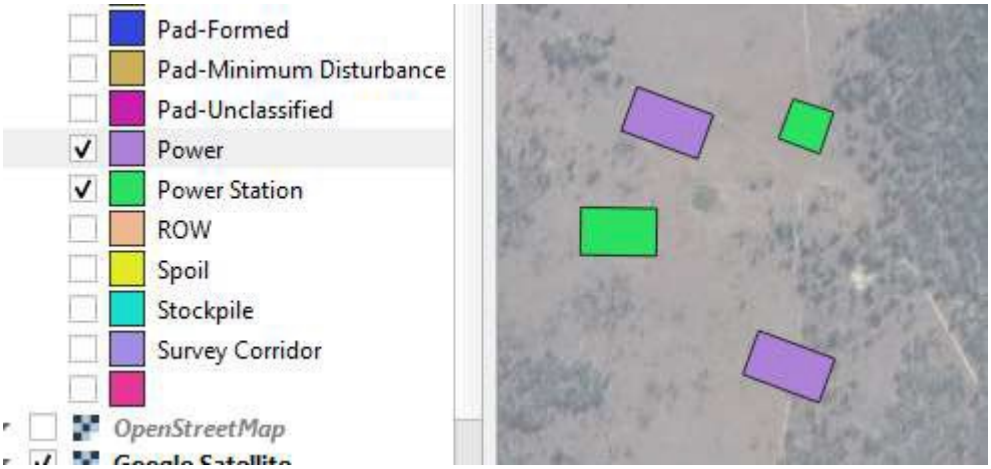

Figure 4 – Extract from spatial data showing power related infrastructure adjacent to Lynwood FCS (Arrow)

Information required:

Item	Information Requested	Arrow Response	Relevant Documents
2.5a	Confirm the location of the power station associated with the Lynwood FCS and that this location has been used in the air and noise modelling assessments.	The location of the power station associated with the Lynwood FCS is correct in SIR Figure 4-1 (Figure 3 on page 8 of this Response). The noise and air modelling assessments have been undertaken based on this location. This can be seen on page 8 of the Air Quality Impact Assessment, and Table 10 of the Operational Noise Assessment.	Supporting Information Report Appendix C (Lynwood FCS Air Assessment) and Appendix D (Lynwood FCS Noise Assessment)
2.5b	Please advise whether you are seeking authorisation for disturbance associated with any additional power stations and an update to Schedule A, Table 1.	The only power station subject to this amendment is that which is associated with the Lynwood FCS. It forms part of the Central Gas Processing Facility line item in Schedule A, Table 1. The disturbance required for the	

		power station is included in the 23 ha proposed to be included in the authorised activity table. No further additional petroleum activities require an update.	
2.5c	If necessary, update the DXP 4 EA Disturbance Spatial Data to reflect the location of the proposed power station(s).	The DXP 4 EA Disturbance Spatial Data has been updated to include only the correct location of the Lynwood FCS power station.	Attachment 1: DXP 4 EA Disturbance Spatial Data 202506

2.6 Distinct matter area groupings

Issue:

1. In table 7 of the supplied Significant Residual Impacts to PEMs report, a list of distinct matter area (DMA) groupings has been provided, however, there is limited detail provided that justifies the grouping of the different species. Further information to support the grouping of species within the same regional ecosystem is required to support the calculation of PEM impact areas and costs in any future Notice of Election (NoE).

Information required:

a. The DMA groupings must be supported by information that demonstrates that the habitat characteristics are the same and the habitat management practices for one species are appropriate for the other species in that DMA. Consideration must be made to the DMA principles, according to the Queensland Environmental Offsets Policy, as provided below:

The following principles provide guidance on when separate DMAs must be used:

- there should be one only regional ecosystem per DMA
- wetlands must be in separate DMAs to non-wetland areas
- koala habitat in SEQ (see section 4.3.10) must be treated as a separate DMA to other matters impacted
- impacts to *protected areas* are treated as a separate DMA to the other matters impacted
- species that have very specific habitat requirements (such as rocks for rock wallabies and certain endangered plant species or caves for certain bat species) must be in separate DMAs
- species of fauna not covered above must be in separate DMAs where any of the following are true:
  - the species do not occupy the same regional ecosystem; or
  - the species do not respond to the same management actions.
- matters imposed by Queensland Government agencies must be in separate DMAs from matters imposed by local governments.

Arrow Response

Arrow has updated the DMA groupings section in the Significant Residual Impact (SRI) assessment (Appendix D) to provide further detail that justifies the grouping of the different species.

2.7 Likelihood of occurrence assessment and Significant Residual Impact assessment

Issue:

1. The likelihood of occurrence assessment for PEMs, as found in Appendix E - Surat Gas Project Terrestrial Ecological Report, dates from 2017. Given the age of the assessment and recent survey works in the areas under consideration, an updated assessment is required to ensure the assessment on biodiversity matters is based on current information relevant to DXP area.

Information required:

Item	Information Requested	Arrow Response	Relevant Documents
2.7a	Ensure a summary is provided that identifies the scope of survey efforts undertaken across the DXP area. This should include dates, hours taken, survey types and mapping.	This survey effort summary is provided in Appendix C.	Appendix C: : Survey Effort Summary
2.7b	Provide an updated likelihood of occurrence assessment for all potentially occurring PEMs within the DXP Area. Ensure this assessment incorporates the data found during on-ground surveys.	EcoSmart (2023) provides an updated likelihood of occurrence assessment for the whole of the SGP. The Significant Residual Impact (SRI) assessment (Appendix D) provides a contemporaneous likelihood of occurrence assessment within the DXP Area.	Appendix D: Significant Residual Impact (SRI) Assessment Appendix E: EcoSmart Likelihood of Occurrence Assessment (2023)
2.7c	Quantify all PEMs that are possible or likely to occur within the proposed project impact areas and provide a significant residual impact (SRI) assessment for all these PEMs.	Arrow has provided an updated Significant Residual Impact (SRI) assessment (Appendix D) in conjunction with this RFI response. This SRI is based on an updated footprint which has been refined as it has progressed through the design process. This SRI quantifies and assesses all PEMs that are possible or likely to occur within the proposed project impact areas.	Appendix D: Significant Residual Impact (SRI) Assessment

2.8 Prescribed environmental matters table – Schedule D, Table 3 – Significant residual impacts to prescribed environmental matters

Issue:

1. It is unclear from the proposed amended Schedule D, Table 3 – 'Significant residual impacts to prescribed environmental matters' table what the cumulative 'maximum extent of impacts' will be as compared to the disturbance area offset under the previously approved and proposed NoE approvals. This information will need to be recorded in the PEMs table to demonstrate how much of the maximum extent of impact has been drawn down to date.
2. The Queensland Environmental Offsets Policy states:

   When an amendment to an existing authority is proposed (for example an amendment application for an existing environmental authority or development approval), the significant residual impact assessment relates to the cumulative impacts of the entire project - i.e. impacts proposed in both the existing authority and any additional impacts proposed in the amendment.

   The DXP amendment application should demonstrate that all impacts to PEMs, regardless of SRI, have been considered.

Information required:

a. Provide the total disturbed area for each PEM matter for the previously approved and proposed NoE approvals, i.e. Stages 1 A-E and Stage 1F. This should be added to a revised Schedule D, Table 3 – Significant residual impacts to prescribed environmental matters table which should also record the cumulative authorised impact for each matter. The following is a suggested format:

Prescribed environmental matter	Location of impact	Significant residual impact and offset required	Total maximum extent of impact (ha)	Stage 1 A-E area impact (ha)	Stage 1 F area impact (ha)
REGULATED VEGETATION					
Endangered regional ecosystem					
RE 11.3.1	PL238, PL258, PL252, PL198, PL230, PL260	Yes (MNES)	0.06	0.06	0
RE 11.3.21		TBD	3	0	0
Of concern regional ecosystem (not within an urban area)					
RE 11.3.2	PL238, PL258, PL252, PL198, PL230, PL260	Yes	16	0.08	1.95
RE 11.3.4		Yes	15	0.37	0
RE 11.3.17		Yes	15	0.35	0
Regional ecosystems (not within an urban area) that intersect a wetland on the vegetation management wetlands map					
RE 11.3.4	PL238, PL258,	TBD	1	0	0

RE 11.3.27	PL252, PL198, PL230, PL260	TBD	2	0	0
Regional ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse on the vegetation management watercourse map					
RE 11.3.2	PL238, PL258, PL252, PL198, PL230, PL260	Yes	0.86	0	0.08
RE 11.3.14		Yes	0.20	0	0.20
RE 11.3.4		Yes	4.28	0.19	0
RE 11.3.18		Yes	2.57	0	0.30
RE 11.3.25		Yes	12.86	0.31	0
RE 11.4.12		TBD	0.86	0	0
RE 11.5.1		Yes	4.28	0.4	0.17
RE 11.7.4		Yes	0.43	0	0.01
RE 11.7.7		Yes	0.86	0.09	0
Essential habitat (not in an urban area) for endangered wildlife					
Phascolarctos cinereus	PL238, PL258, PL252, PL198, PL230, PL260	Yes	7.65	7.65	0
Hemiaspis damelii		Yes	6	1.54	0
Essential habitat (not in an urban area) for vulnerable wildlife					
Calyptorhynchus lathami	PL238, PL258, PL252, PL198, PL230, PL260	TBD	1	0	0
Jalmenus eubulus		TBD	0.5	0	0
CONNECTIVITY AREAS					
Connectivity area that is a Regional Ecosystem (not in urban area)	PL238, PL258, PL252, PL198, PL230, PL260	Yes	32.54	N/A	32.54
WETLANDS AND WATERCOURSES					
A wetland of high ecological significance shown on the Map of referable wetlands	PL238, PL258, PL252, PL198, PL230, PL260	No SRI	2.12	0.45	0.26
PROTECTED WILDLIFE HABITAT					
An area shown as a high risk area on the flora survey trigger map that contains plants that are endangered or vulnerable wildlife					
Picris barbarorum	PL238, PL258, PL252, PL198, PL230, PL260	TBD	2.5	0	0
Solanum papaverifolium		TBD	3	0	0
Habitat for an animal that is vulnerable wildlife					
Acanthophis antarcticus	PL238, PL258, PL252, PL198, PL230, PL260	Yes	317	37.4	35.12
Calyptorhynchus lathami		Yes	94	6.7	17.46
Furina dunmalli		Yes (MNES)	70.07	39.29	30.78

Grantiella picta		Yes	0.62	0.4	0.22
Nyctophilus corbeni		Yes (MNES)	55.98	23.12	32.86
Petaurus australis		Yes	26.49	0	26.49
Petauroides volans		Yes	29.87	1.1	28.77
Stagonopleura guttata		Yes	35.12	0	35.12
Jalmenus eubulus		Yes	17	0.4	0
Habitat for an animal that is endangered wildlife					
Hemiaspis damelii	PL238, PL258, PL252, PL198, PL230, PL260	Yes	219	4.22	8.42
Phascolarctos cinereus		Yes	95.21	21.69	73.52
Adclarkia cameroni		Yes	6.1	0	6.1
Habitat for an animal that is Special Least Concern wildlife					
Tachyglossus aculeatus	PL238, PL258, PL252, PL198, PL230, PL260	No SRI	57	0	0.3
FISH HABITAT AREAS					
Waterway providing for fish passage Fish passage (not in an urban area)	PL238, PL258, PL252, PL198, PL230, PL260	No SRI	6	0	0.20 (no SRI)

b. Undertake an assessment of all PEMs that have been impacted to date by approvals authorised since the commencement of the *Environmental Offsets Act 2014*. Quantify these impacts in the relevant columns of the template provided against item a) above.

Arrow Response

These impacts have been provided in the relevant columns in item a. above.

c. Ensure a SRI assessment is provided for all PEMs identified as cumulatively impacted by the project to date, including the proposed activities.

Arrow Response

An updated SRI assessment has been provided in Appendix D of this RFI response and has taken into consideration cumulative assessment where it can be appropriately applied (i.e. this is assessed on a case by case basis and cannot be blanket applied to all scenarios as it would be retrospectively applying contemporaneous rules to previously assessed scenarios).

2.9 Category B ESA/Regulated vegetation for endangered regional ecosystems (RE)

Issue:

1. The Significant Residual Impacts to Prescribed Environmental Matters report and the SIR confirm that 0.44 ha of endangered RE 11.3.1 and 0.5 ha of RE 11.4.3 will be impacted by the project. This is considered impact to Category B ESAs. Although some locations have been identified in the SIR, it is unclear where the impacts to these REs will occur and how they have been determined. Further, these impacts to Category B ESAs, have not been identified in full in the proposed changes to condition Biodiversity 8B and Schedule D, Table 4 as an authorised disturbance to an ESA.

Information required:

Item	Information Requested	Arrow Response	Relevant Documents
2.9a	Update the proposed changes to Schedule D, Table 4 to include the disturbance associated with RE 11.4.3.	Arrow has provided an updated SRI Assessment in conjunction with this RFI response. This was developed based on a refined scope, which has resulted in an updated disturbance footprint. This updated disturbance footprint does not impact RE 11.4.3, and impacts a reduced area (0.21 ha) of regrowth RE 11.3.1 (Table 5 of Appendix D: Significant Residual Impact (SRI) Assessment). No changes are required to Schedule D, Table 4 to include RE 11.4.3 disturbance.	Appendix D: Significant Residual Impact (SRI) Assessment
2.9b	Provide a breakdown of the areas of impact that comprise the 0.44 ha of endangered RE 11.3.1 and 0.5 ha of RE 11.4.3. Provide justification as to why they are impacted and identify the relevant locations and activity types.	The updated disturbance footprint does not impact RE 11.4.3 and impacts 0.21 ha RE 11.3.1 Regrowth. A breakdown of impacts to regrowth RE 11.3.1 has been provided in Appendix F.	Appendix F: Breakdown of Impacts to RE 11.3.1 Regrowth

Arrow Further Information:

Arrow has provided an updated SRI Assessment in conjunction with this RFI response. This was developed based on a refined scope, which has resulted in an updated disturbance footprint. The updated disturbance footprint has been provided in Attachment 1. There is one additional despite needed in the proposed changes to condition Biodiversity 8B and Schedule D, Table 4, the details of which are in Table 2-1. In line with Appendix F, one despite is to be removed from the table (Right of Way (SLS_PAD_WP369)).

Table 2-1 Addition to Schedule D, Table 4

Location	Infrastructure ID	Image	Details and Justification	Ecological Impact	Area (ha)
PL198	Cat C ESA (Protected Wildlife Habitat) Borrow Pit and Access Track		Expansion of existing gravel pit to recover material for tracks, pads and roads. Arrow plan to extend the disturbance area to the South-West as indicated. During previous geotechnical investigation this area was determined as being superior for recovery of gravel material as well as being the most practical extension to the quarry from a construction perspective, considering terrain and accessibility.	5.17 ha cleared (PWH PPZ) 2.67 ha RE 11.7.4 (PWH) See Appendix D (SRI Report) for assessment of PEMS.	7.84 ha

2.10 Wilkin Road disturbance to RE11.5.1 Regrowth

Issue:

1. The upgrade to Wilkin Road in PL258 will result in the impacts to 1.3 ha of regrowth vegetation. It is unclear what measures have been taken to avoid or reduce this impact or justification provided as to why they are unavoidable. It is unclear from the information provided if existing disturbance or infrastructure has an impact on the proposed location of the road upgrade.

Information request:

a. Provide justification as to why the impacts to 1.3 ha of regrowth vegetation are unavoidable.

Wilkin Road is an existing two-lane unsealed gravel road with a formation varying between 4.2m and 6.7m between Cecil Plains Moonie Road and Boundary Road. In alignment with the Institute of Public Works Engineering Australasia Queensland (IPWEAQ) Lower Order Road Design Guidelines for a Minor Road, the proposed upgrade incorporates shape correction and widening to achieve the necessary width. This would improve road safety for all road users (Arrow and public).

Establishing a suitable “clear zone” from the edge of the proposed traffic lanes on either side of the road is also required. This has been designed based on a preliminary risk evaluation of the roadside hazards for various scenarios, following the process outlined in the Australian Guide to Road Design (AGRD) Part 6: Roadside Design, Safety and Barriers. Clearing is generally required to the western side of Wilkin Road as the current road formation is located close to the eastern property boundary. There will be re-alignment of the road required, especially coming up to the intersection with Boundary Road where the existing road is currently located in private property on the south-east corner of the intersection.

2.11 Battery Energy Storage System

Issue:

1. In cl 4.2.3 of the SIR, Arrow states a Battery Energy Storage System (BESS) may be constructed within the compound of the proposed Lynwood FCS to provide immediate power reserves to the plant prior to the back-up generators coming online. Further, Arrow may construct a 20 MW solar farm to support the operation and reduce GHG impacts which would be subject to a separate planning approval under the Queensland Planning Act 2014. The issue of the BESS and solar farm was discussed during the meeting on 12/5/2025 and in a subsequent conversation, however, the department remains unclear about the construction timing of the BESS and solar farm and the proposed approval processes.

Information request:

It is understood that a separate planning approval for the solar farm will be sought, but the department would like to confirm:

- What separate approval Arrow will be seeking for the BESS;
- That the facility will solely be used for the purposes of supplying energy to the resource activity and will not be used for off-site infrastructure.
- The potential environmental risks associated with the BESS, including land disturbance and any emissions to air, noise or water, and the proposed measures to manage these impacts;
- Whether Arrow proposes to include the BESS within the scope of the current environmental authority application or intends to seek assessment under a separate regulatory process.

Arrow Response

- Arrow is not seeking any separate approval for the authorisation of the BESS. The BESS is considered an authorised activity under the EA and is part of the FCS facility and within the compound making up the energy system required to power and operate the FCS. I.e. The BESS would supplement the Gas Engine. With changing technologies and initiatives to reduce greenhouse gas emissions, as well as providing opportunities to reduce maintenance and operational costs, technology such as BESS will continue to be rolled out to replace aging or out of date technologies.
- The intention of the BESS is purely for Arrow's consumption within the FCS for resource activities at present.
- Environmental Risk of the BESS has been considered as part of the EA amendment application supporting material.
    - Land disturbance of the BESS is within the footprint of the FCS and has been considered within the application material.
    - There are no water impacts proposed relating to the construction or operation of the BESS outside of the needs required for the construction of the FCS i.e. dust suppression.

- There are no air impacts from the BESS as there are no air emissions produced or released.
- The noise impacts from the BESS were considered in the noise assessment (Table 9 and Table 10 of the Supporting Information Report Appendix D (Lynwood FCS Noise Assessment)), which determined that the facility can operate in compliance within the existing noise conditions within EPPG00972513.
- Arrow's intent is that the BESS is approved within the scope of the current environmental authority application, noting it is part of the FCS equipment. Arrow does not intend to seek assessment under a separate regulatory process.

Appendix A: Q12551A-C01 Flare Noise Study

In this study we use FlareSIM Version 5.2, an industrial flare simulation tool, to investigate noise emission from vertical flares and multipoint ground flares of 100 MMscfd and 175 MMscfd design capacities. The following aspects are addressed:

- Variation of flare sound power with flaring rate,
- Sound pressure level in the near-field of the flares, and
- Measures for achieving flare noise attenuation.

1. Flare Design Details and Environmental Conditions

The flares are sized based on datasheets and other specifications contained in Arrow Energy's EFI 103816. Relevant design details of the vertical flares and multipoint ground flares (MPGF's) are tabulated below.

Table 1 – Design Details of Vertical Flares

Flare Code	VF-100	VF-175
Design Capacity	100 MMscfd	175 MMscfd
Flare Gas Compositions	As per EFI 103816	As per EFI 103816
Flare Tip Diameter	DN500	DN650
Overall Flare Height	21m	40m
Sterile Radius	60m	60m
Radiation at Sterile Boundary	4.73 kW/m2	4.73 kW/m2
Location of 1.58 kW/m2 Radiation	161m from stack	208 from stack

Table 2 – Design Details of Multipoint Ground Flares (MPGF's)

Flare Code	MPGF-100	MPGF-175
Design Capacity	100 MMscfd	175 MMscfd
Flare Gas Compositions	As per EFI 103816	As per EFI 103816
Wind Fence Dimensions: L x W x H	50m x 50m x 14m	61m x 53m x 14m
Total Number of Burners	26	46
Number of Burner Stages	3	3
Burner Staging Design	Stage 1: 3 burners Stage 2: 9 burners Stage 3: 14 burners	Stage 1: 5 burners Stage 2: 15 burners Stage 3: 26 burners

Flare noise emission is simulated based on the following environmental conditions:

- Temperature = 13°C
- Humidity = 86%
- Pasquil-Gifford-Turner (PGT) Atmospheric Stability Class = F
- Wind speed = 2 m/s (from source to receptor)
- Terrain type = Rural (open grassland)

2. Flare Sound Power

Sound Power of the Vertical Flares

For the flares considered, flare sound power is directly related to total heat release of the flare gas and is independent of flare tip diameter. This is because flare noises are predominantly due to flare gas combustion, and contribution of jet noise is negligibly small. Therefore, as far as flare sound power is concerned, we do not need to differentiate between flare tip size, i.e., DN500 or DN650.

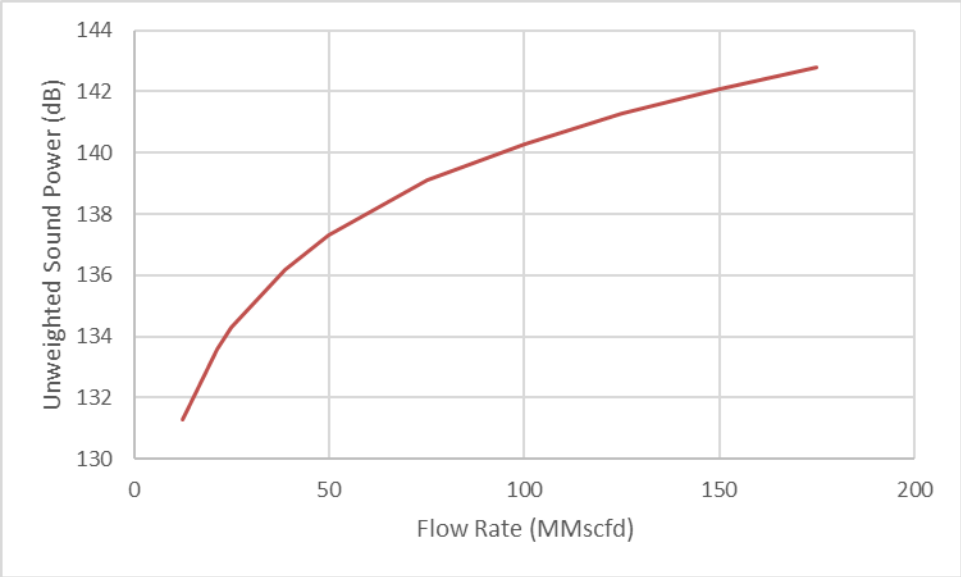

Fig. 1: Variation of Flare Sound Power with Flaring Rate

Variation of flare sound power with flaring rate is shown in Fig. 1. We have found that as flaring rate is reduced from 175 MMscfd to 12.5 MMscfd, the flare sound power decreases from 142.8 dB to 131.3 dB.

Octave bands of flare sound power for various flaring rates of interest are presented in Appendix 1.

Sound Power of the Multipoint Ground Flares (MPGF's)

In MPGF's, flare gas is combusted in multiple burners rather than a single flare tip. Taking MPGF-175 for example, forty-six (46) burners are used and the burners are arranged in three stages. When the MPGF-175 flare is operated at its design capacity, gas flow through each of its 46 burners will be approximately 3.8 MMscfd.

Table 3 – Sound Power of a Single Burner Operated at 3.8 MMscfd Flaring Rate

Hz	31.25	62.5	125	250	500	1000	2000	4000	8000	16000
dB	116.4	121.4	120.4	118.5	114.1	112.3	107.7	103.5	100.9	97.7

Total Sound Power: 126.18 dB

Table 3 shows sound power of a single burner operated at 3.8 MMscfd flaring rate. Calculation shows that combining the sound power of 46 burners each flaring at 3.8 MMscfd gives 143 dB, which is approximately the same sound power of a single vertical flare operated at 175 MMscfd flaring rate (referring to Appendix 1).

Similarly, we note that total sound power of the MPGF-100 flaring at its design capacity with 26 burners approximately equals that of a single vertical flare operated at 100 MMscfd flaring rate.

The above results suggest that, for a given flaring rate, we expect the same total sound power whether the gas is flared in a MPGF or in a vertical flare.

3. Sound Pressure Level in the Near-Field of the Flares

Vertical Flares

Fig. 2 shows sound pressure level in the near-field of flare VP-100 operated at 21.2 MMscfd flaring rate. We note the following variations:

- 86.7 dBA at flare base,
- 78.7 dBA at 50 m,
- 73.8 dBA at 100 m,
- 71.3 dBA at 150 m, and
- 69.9 dBA at 200 m.

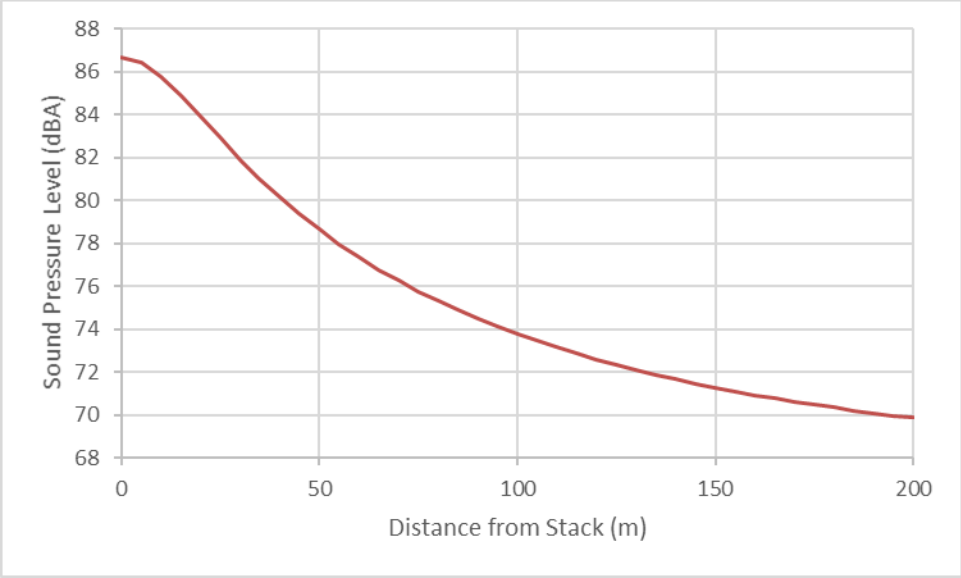

Fig. 2: Flare Sound Pressure Level near Vertical Flare of 100 MMscfd Design Capacity. Flaring Rate: 21.2 MMscfd

In Fig. 3 we present sound pressure results in the near-field of flare VP-175 operated at 38.6 MMscfd flaring rate. The following sound pressure variations are noted:

- 83.7 dBA at flare base,
- 79.7 dBA at 50 m,
- 75.5 dBA at 100 m,
- 72.9 dBA at 150 m, and
- 71.2 dBA at 200 m.

Detailed results of sound pressure levels for VP-100 and VP-175 flares over a wide range of flaring rates are presented in Appendix 2 and Appendix 3.

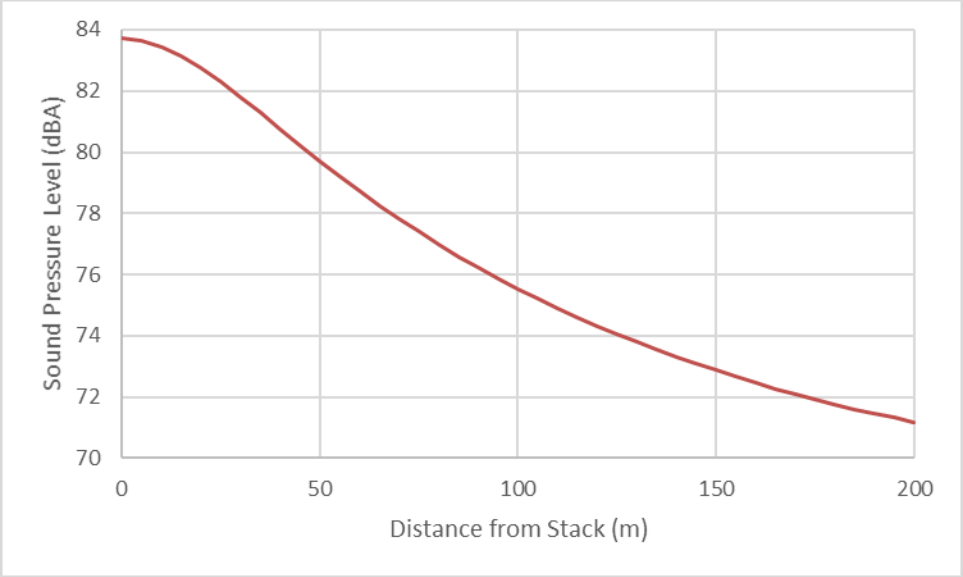

Fig. 3: Flare Sound Pressure Level near Vertical Flare of 175 MMscfd Design Capacity. Flaring Rate: 38.6 MMscfd

Multipoint Ground Flares (MPGF's)

We have looked at the following cases for sound pressure level in the near-field of the MPGF's:

- MPGF-100 flaring at 21.2 MMscfd, and
- MPGF-175 flaring at 38.6 MMscfd

In both cases, both of the Stage 1 and Stage 2 burners are operational.

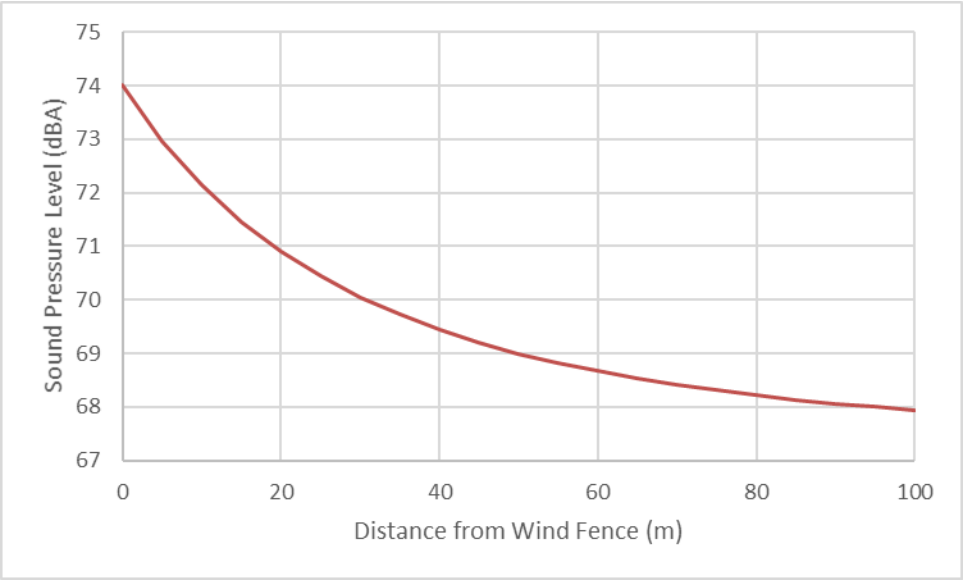

Fig. 4: Flare Sound Pressure Level near MPGF of 100 MMscfd Design Capacity. Flaring Rate: 21.2 MMscfd

Fig. 4 shows sound pressure level in the near-field of flare MPGF-100 at 21.2 MMscfd flaring rate. We note the following sound pressure variations:

- 74.0 dBA at the wind fence,
- 69.0 dBA at 50 m outside the wind fence, and
- 67.9 dBA at 100 m outside the wind fence.

Sound pressure results in the near-field of flare MPGF-175 at 38.6 MMscfd flaring rate are shown in Fig. 5. The following sound pressure levels are noted:

- 74.6 dBA at the wind fence,
- 69.7 dBA at 50 m outside the wind fence, and
- 68.4 dBA at 100 m outside the wind fence.

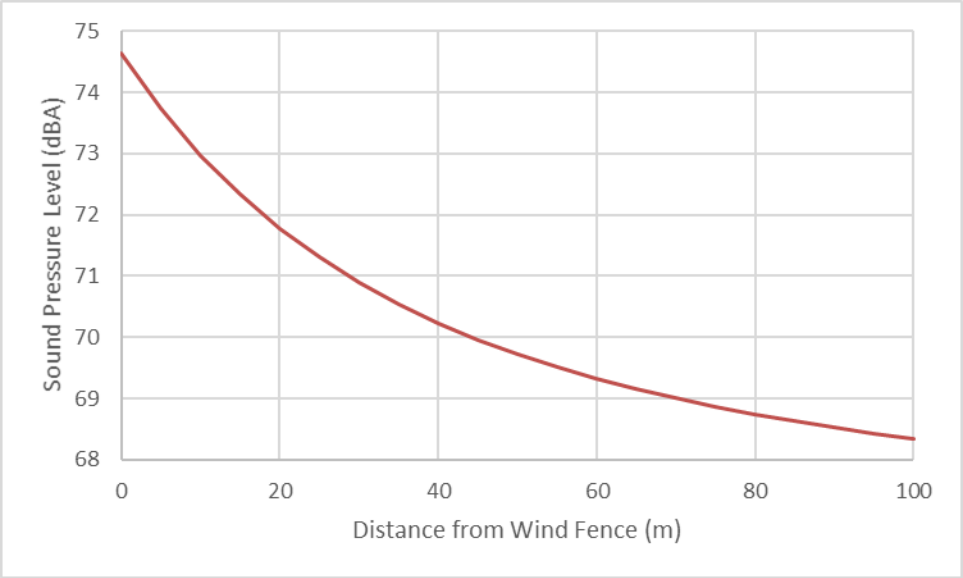

Fig. 5: Flare Sound Pressure Level near MPGF of 175 MMscfd Design Capacity. Flaring Rate: 38.6 MMscfd

4. Discussion on Measures for Achieving Flare Noise Attenuation

Vertical Flares

We address the following question in this section: Can we reduce SPL by over-sizing the vertical flares, such as increasing flare tip diameter and flare height?

(a) Over-sizing of flare through use of a larger flare tip

In Fig. 6 and Fig. 7 we compare predicted flare sound power at 100 MMscfd flaring rate using DN500 and DN1050 flare tips. We note that while jet noise decreases from 111.5 dB for a DN500 tip to 62.9 dB for a DN1050 tip, the total sound power remains 140.3 dB in both cases. Reasons for this are:

1) Combustion noises are the same for the flare tips of different size, and
2) Compared to combustion noise, jet noise contributes little towards the total flare noise.

Therefore, increasing flare tip diameter will not help to reduce flare noise.

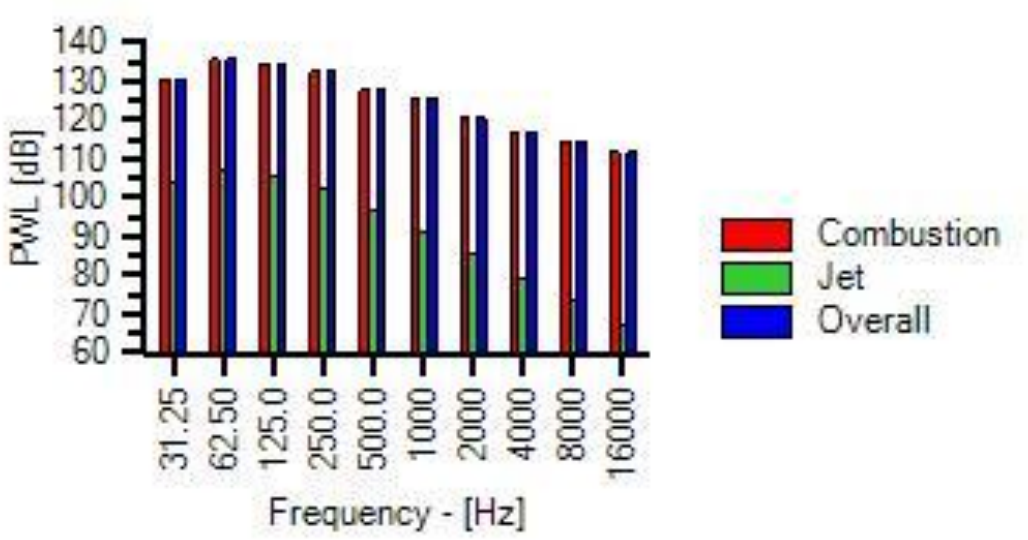

Fig 6: Sound Power of DN500 Tip Flaring at 100 MMscfd
Total Jet Noise: 111.5 dB
Total Combustion Noise: 140.3 dB
Total Noise: 140.3 dB

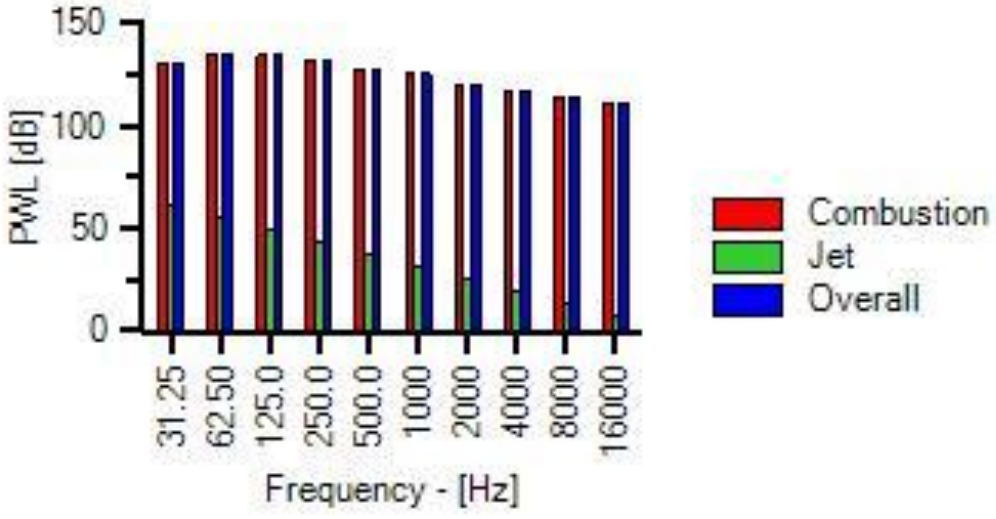

Fig 7: Sound Power of DN1050 Tip Flaring at 100 MMscfd
Total Jet Noise: 62.9
Total Combustion Noise: 140.3
Total Noise: 140.3 dB

(b) Over-sizing of flare through use of a larger flare height

A comparison of sound pressure level at 100 MMscfd flaring rate for two different flare heights is shown in Fig. 8. We note the following changes in sound pressure level caused by increase in flare height from 21m to 42m:

- 6 dBA reduction at flare base (from 93.4 dBA to 87.4 dBA),
- 1.6 dBA reduction at 50 m (from 85.1 dBA to 83.5 dBA),
- 0.5 dBA reduction at 100 m (from 79.7 dBA to 79.2 dBA),
- 0.2 dBA reduction at 150 m (from 76.4 dBA to 76.2 dBA), and
- 0.1 dBA reduction at 100 m (from 74.2 dBA to 74.1 dBA).

The above results indicate that noise reduction due to increasing flare height diminishes with increasing distance from the flare. This is because the impact of flare height on the distance between flare tip and receptor decreases as the receptor is further away from the flare.

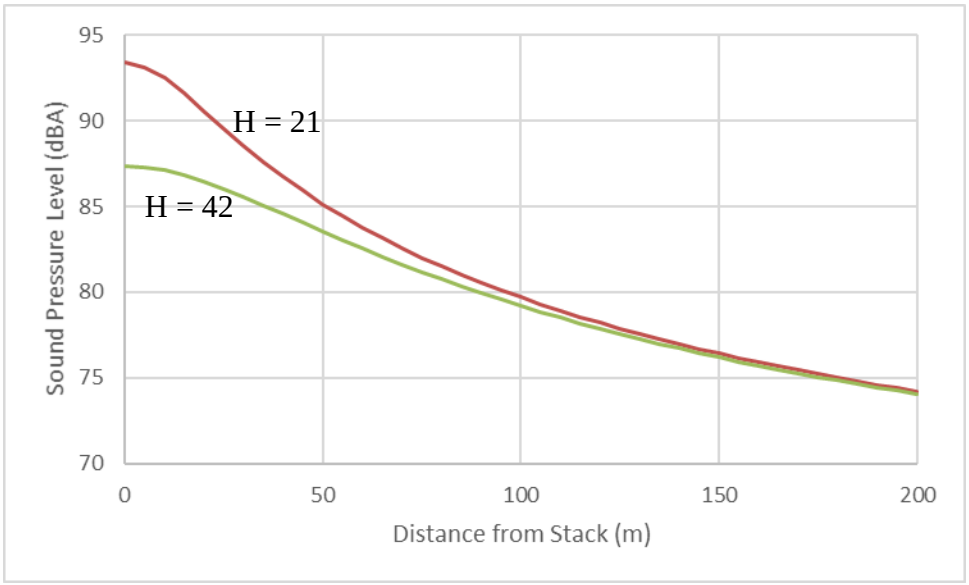

Fig 8: Effect of Flare Height on Sound Pressure Level. Gas Flow Rate: 100 MMscfd

Multipoint Ground Flares

In this section we discuss whether it is practical to reduce sound pressure level surrounding the MPGF's by changing (1) burner design, and (2) wind fence design. For ease of discussion, it is useful to note some main features of the MPGF's as shown in Appendix 4.

(1) Burner design

To reduce noise emission from flare burners, the burner design will need to incorporate mufflers / silencers close to the flame zone. Due to very large heat release and large flame volume, it is impractical to install such mufflers / silencers at the burner tips. So far, little progress has been achieved in flare noise attenuation by changing flare burner design.

Even for aeroplane engines where the heat release is significantly lower than the MPGF's, despite millions of dollars invested in the research and development of low-noise engines, noise problems near large airports remain a serious issue.

(2) Wind fence design

Wind fences for the MPGF's are always designed to maximize air in-flow to ensure high combustion efficiency and smokeless flaring. Therefore, modification to wind fence design must not cause restriction to the supply of combustion air.

It may be possible to reduce sound pressure level by (a) changing air passage angle and air passage length, and (2) using noise-absorbing materials surrounding the air passages at the wind fence. These changes will be rather expensive, and their effectiveness in flare noise attenuation has yet to be rigorously tested.

Horizontal Flares

(a) Horizontal flares with wind fence

Horizontal flares with wind fence can be considered as a simplified version of MPGF's. Noise performance of a horizontal flare with wind fence is expected to be not as good as a MPGF due to possibility of flame rising above the wind fence under unfavourable environmental conditions.

(b) Horizontal flares without wind fence

Horizontal flares without wind fence are similar to pit flares; their noise performance is expected to be similar to that of vertical flares. Since flare tip of a horizontal flare is closer to the ground, we expect sound pressure level in the near-field of a horizontal flare to be higher than that of a vertical flare.

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Appendix B: Updated Section 4.7

4.7 Community and Visual Amenity

4.7.1 Applicable legislation

The following legislation, policy and guidelines are relevant to identifying values and mitigating and managing impacts on community and visual amenity from the Project.

- *Planning Act 2016* (Qld): This act establishes an efficient, effective, transparent, integrated, coordinated, and accountable system of land use planning, development, assessment, and related matters that facilitates the achievement of ecological sustainability.
- *Toowoomba Regional Planning Scheme (2012)*: This planning scheme has been prepared and updated in accordance with the *Planning Act 2016* as a framework for managing development in a way that advances the purpose of the *Planning Act 2016*.
- *Material Change of Use Performance Criteria Codes:* These are applicable to the requirements set out in the planning schemes within the Western Downs Regional Council which might specify height restrictions, lighting nuisance and performance criteria dependant on the zoning.

4.7.2 Description on Environmental Values

The proposed Lynwood FCS is located in the Darling Downs Region, within the Toowoomba Regional Council (TRC). The area is a rural area predominantly comprised of cattle, wheat, and other grain activities. The geography is dominated by pastures, crop lands, roads, bush, ridges, and creeks.

As presented in the SGPEIS, the visual baseline is described in terms of views from selected representative viewpoints, which correspond to the location of residents, settlements, work places, recreational features, recognised vantage points, tourist trails, and roads.

The description of environmental values from a community perspective and landscape characteristic for the Project are provided in **Table 4-23**.

Table 4-23 Environmental Values – Community and Landscape

Environmental Values	Description
Land use	• The land use pattern for the Project area is predominantly rural with a focus on pastoral and agricultural activities as well as areas of remnant vegetation. • Most of the land within the Project area is 'freehold land' held by agricultural/pastoral families, infrastructure or pastoral companies, or State Government entities. • There is a cotton processing facility (cotton gin) located approximately 6 km to the southeast of the proposed Lynwood FCS, on Cecil Plains Moonie Road. • The proposed Project area does not contain any areas zoned for urban development. Farming homesteads and associated farming infrastructure and/or dwellings are present.
Stakeholders, sensitive receptors, and commercial places	• The closest towns to the Project Area are Springvale and Cecil Plains, lying within close proximity to the proposed project activities. • Commercial stakeholders include existing gas fields, as well as agricultural activity.

Environmental Values	Description
	• Other stakeholders include the Toowoomba Downs Regional Council (TRC), and other State and Government departments. • Modern day communities have evolved from agricultural settlements established in the 1800s and retain a rural and agricultural character. • Community values include relative proximity to services, relaxed lifestyle, safe and family-friendly community, and the rural outlook with open space and opportunity recreation.
Landscape[6]	• Topography throughout the project area is typically flat to gently undulating, with some low hills, jump-ups, and excised river/creek banks. • Land use across the tenement and the broader surrounds is predominantly based upon agriculture, including pastoral holdings used for grazing. • Sparsely settled character, with small towns and property homesteads and cottages. • Generally comprises a strong sense of remoteness away from major roads.

4.7.3 Assessment of environmental impacts and proposed management practices

Construction

There will be some localised impacts on visual amenity on local roads due to increased traffic movements and vehicle movements above normal traffic volumes for local rural roads during daylight hours during construction. During night-time vehicle movements would be reduced and impacts temporary in nature. While Arrow Energy own the land where the FCS is being proposed, as well as surrounding properties to the North, East, and South, landholders and property owners traversing Boundary Road may notice an increase in traffic movements and vehicles from above the expected number of vehicle movements on rural roads.

An assessment of the impact of proposed infrastructure as part of the EA amendment has been determined as low given the siting of infrastructure is located on Arrow Energy's own property. All sensitive receptors are located at least 3 kilometres (km) from the proposed FCS and power station facilities.

The proposed height of the wall around the MPGF, the existing vegetation within the verge and fenceline varying from sparse to dense with tree heights of 3m to 15m, and a speed limit of 60km/h would make visibility of the facility some 230m from the road very localised to sections along Boundary Road. This impact would be limited to local landholders given the location of the proposed site away from main roads and highways.

Operation

During operation, a MPGF will be used to manage distressed gas. Potential visual impacts from the MPGF can include the MPGF components, such as burners, a radiation shield (staggered fence panels) around the flare, pipe connections, a slug catcher for removing water in gas lines, a cyclone separator to remove solids/fines in gas lines, and the MPGF itself. The MPGF is expected to feature a 16.7 m radiation fence surrounding the flare in order to minimise radiation impacts, and to reduce visibility of the flare flame. A typical MPGF fence is shown in **Figure 4-7**.

[6]Source: SGPEIS Chapter 18 Landscape and Visual Amenity

Figure 4-7 Indicative Multi-Point Ground Flare radiation fence

The flare facility is located approx. 230m from the nearest road being Boundary Road. In the event of flaring during the day at the FCS through the MPGF, impacts would be considered low and visual impacts impeded and hidden behind the radiation wall.

At night, impacts from lighting around the facilities and the FCS would be noticeable with visible night glow due to little to no other sources of light in a rural environment. However, facility lighting can be directed down and shielded to reduce light spill into the surrounding environment. Given the distance from the nearest sensitive receptors and that landholders would likely be inside during the night, impacts from lighting at the proposed infrastructure is unlikely to impact on the visual amenity or would be considered temporary from vehicles travelling on Boundary Road.

In the event of flaring during the night at the FCS through the MPGF, impacts would be considered low**.** Whilst there will be a noticeable night glow from the flare due to no other light sources in the rural environment at night which would have the likelihood to be seen much further afield due to the likely intensity of the flare, the frequency of which flaring would occur under normal operating conditions is low. As noted in previous sections the frequency of planned flaring could be once or twice a year, however the intention is to minimise flaring as much as possible and may occur during upset or abnormal operating conditions. Similar to lighting around the facility, if flaring was to occur at night, landholders at nearby sensitive receptors would likely be inside their residences or asleep.

There will be some localised impacts on visual amenity on local roads due to increased traffic movements and vehicle movements above normal traffic volumes for local rural roads during daylight hours. During night-time vehicle movements would be reduced and impacts temporary in nature.

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Appendix C: Survey Effort Summary

Dalby Expansion Project (DXP) - EA (EPPG00972513)

Field-based Ecological Survey summary

1. Survey summary

Ecological surveys have been conducted on petroleum leases across Arrow's Surat Gas Project (SGP), between 2009 and January 2025. Three major assessments were carried out for the broader SGP before the Dalby Expansion Project (DXP) footprint was targeted with ground-truthing surveys. These include the SGP EIS Aquatic and Terrestrial Ecology Impact Assessment (EIS), Supplementary SGP EIS Aquatic and Terrestrial Impact Assessment (SREIS), and 2017 SGP Terrestrial Ecological Assessment Report (EAR). Assessments prior to the DXP ground-truthing surveys (EIS, SREIS and EAR) have provided a baseline understanding across the study area. These prior assessments generally spent more time in areas with higher potential for biodiversity. The DXP is only a small sub-section of the broader SGP; located in an area of exceptionally high agricultural intensity. Therefore, the survey effort required to understand the ecological constraints in the DXP was much lower than the more vegetated sections of the SGP.

More recent contemporary ground-truthing surveys in the DXP have allowed Arrow to create larger scale mapping to more finely assess impacts on ecological values in context with the higher level SGP surveys.

Survey efforts is outlined in Table 1, below.

Table 1 Survey effort undertaken for DXP

Survey name	Survey scope	Survey effort*	Conducted by
SGP EIS – Terrestrial Ecology Impact Assessment	- Vegetation mapping assessments - Flora and Fauna habitat assessments - Fauna searches - informal flora searches	Across broader SGP: - 21 October to 4 December 2009 (29 days); and - 4 to 9 May 2010 (six days).	3D Environmental & EcoSmart Ecology (2011).
GP EIS – Aquatic Ecology Impact Assessment	Full aquatic assessment	- November 2009; and - May 2010	Aquateco Consulting Pty Ltd (2011).
SGP Supplementary EIS - Terrestrial Ecology Assessment	- Vegetation mapping assessments - BioCondition assessments - Flora and Fauna habitat assessments - targeted fauna surveys - informal flora searches	Across broader SGP: - 9 to 10 February 2013 (two days); - 18 to 26 February 2013 (nine days); - 1 to 3 March 2013 (three days); and - 18 to 22 March 2013 (five days).	3D Environmental, EcoSmart Ecology (2013).
SGP Supplementary EIS - Aquatic Ecology Assessment	Full aquatic assessment	- March 2013; and - May 2013.	AMEC (2013)
SGP Terrestrial Ecological Assessment Report	- Vegetation mapping and assessments - fauna and flora habitat assessments - targeted fauna surveys - informal flora searches	Across broader SGP: - 29 August to 2 September 2016 (5 days); - 12 to 23 September 2016; - 18 to 28 October 2016; - 6 to 18 February 2017; and - 7 to 16 March 2017.	EcoSmart Ecology, (2017).
SGP Off-tenement Terrestrial Ecological Assessment Report	- Vegetation mapping and assessments - fauna and flora habitat assessments - targeted fauna surveys - informal flora searches	- March 2018 - March 2019	EcoSmart Ecology (2017).
DXP ground-truthing surveys	Regional ecosystem (RE) validation, fauna surveys and habitat assessments. Surveys included: - Quaternary; - Secondary; - Koala SAT sites; and - informal threatened flora and fauna searches.	Previous assessments within: - December 2011; - March 2015; - August 2016; - April 2017; - January, April, and August 2018; - July and November 2020; - February 2021; - May to September 2021; and - March and November 2022. Contemporary Assessments: - December 2023 to October 2024.	Arrow Energy (including contractors)

- - dates and number of days given where stated in a report.

2. Survey aims and methodology

The following summary of surveys has been synthesised from the associated ecological reports:

- EIS - SGP Terrestrial Ecology Impact Assessment (3D Environmental & EcoSmart Ecology 2011).
- SREIS - SGP Supplementary Terrestrial Ecology Assessment (3D Environmental & EcoSmart Ecology 2013).
- EAR - SGP Terrestrial Ecological Assessment Report (3D Environmental 2017).

SGP Off-tenement Terrestrial Ecological Assessments have not been considered in this summary as they are not located in the vicinity of the DXP.

2.1 SGP EIS – Terrestrial Ecology Impact Assessment

Terrestrial ecological values were assessed across petroleum leases and pipelines proposed or underway at the time of the study. To satisfy the EIS terms of reference, a study was completed consisting of a desktop review, field survey, and post field analysis. Analysis placed terrestrial ecological values into a significance assessment framework to perform an impact assessment against proposed project activities. The results were then extrapolated across the 860,000 ha EIS project development area (PDA) and appropriate mitigation measures provided.

The literature review results, including an aerial imagery analysis, informed site selection of remnant and non-remnant vegetation for targeted field surveys. Surveys were then completed in parallel taking 29 days between 21 October and 4 December 2009 with an additional six days between 4 – 9 May 2010. Vegetation mapping consisted of a total 399 sites; 74 secondary, six tertiary, and 319 quaternary. 40 of which were located within 1km of the DXP disturbance footprint (10 secondary, 1 tertiary and 29 quaternary). RE mapping was then plotted at a scale of 1:50,000 for the SGP including EPBC listed Threatened Ecological Communities (TECs).

Habitat assessments for fauna were taken in conjunction with each flora site. Habitat features were recorded and searches (e.g. active searches for reptiles under logs and rocks) were conducted for threatened species. Secondary signs of threatened species were also observed such as Koala scat or scratches.

2.2 SGP EIS – Aquatic Ecology Impact Assessment

Following an rigorous review of data across the study area, which includes the PDA and sections of the surrounding catchments, 73 potential aquatic ecosystem sampling sites were identified. This number was reduced to 11 following field reconnaissance and further assessment of physical and ecological factors. The data from each site is considered representative of the aquatic ecological function across the study area. Field surveys at each site included:

- Physico-chemical water quality;
- Sediment sampling and analysis;
- Fish and macroinvertebrate surveys;
- Aquatic vegetation audits; and
- Rapid assessments for geomorphological processes and riparian health.

2.3 SGP SREIS - Supplementary Terrestrial Ecology Assessment

As development of the SGP went forward, Arrow established improved knowledge of the Surat gas resource. This resulted in the decrease in Arrow tenement, cutting the PDA to 610,000 ha, and a reduction in total wells to be built. Additional infrastructure, such as gas processing facilities, were built into the Project description. Additional key concerns raised by government departments were:

- EIS had no site-specific assessments for infrastructure and facilities;
- No estimated disturbance area for habitats;
- Vegetation corridors not sufficiently defined in EIS;
- Additional information needed on potential impacts to MNES matters.

Subsequently, The SREIS was requested to validate the impact assessment completed in the EIS and to assess against the changes to the SGP PDA. Five survey locations were targeted made up of:

- four central gas processing facilities (CGPF 2, 7, 8 and 9); and
- Temporary Works Accommodation Facility (TWAF).

Flora surveys were conducted over 17 days, in three separate field mobilisations:

- 18 – 26 February 2013 (nine days);
- 1 – 3 March 2013 (three days); and
- 18 – 22 March 2013 (five days).

Flora surveys were completed using the same methodology as the EIS using secondary, tertiary and quaternary sites to map vegetation. Additional surveys were completed, including BioCondition sites, assessments within riparian areas, and flora species assessments. See Table 2 for a summary of flora survey effort.

Table 2 SREIS terrestrial flora survey effort

Survey area	Survey type				Total sites
	BioCondition	Secondary	Tertiary	Quaternary	
2	15	1	2	19	**37**
7	0	3	0	8	**11**
8	0	5	1	5	**11**
9	13	3	0	17	**33**
TWAF	0	2	0	4	**6**
Total sites+	**28***	**14 (5)**	**3 (1)**	**53 (6)**	**98 (12)**

- * - four sites completed in riparian areas.
- + - sites within 1 km of the DXP disturbance footprint.

Additional flora survey effort includes approximately 14 hours of threatened flora species searches (30 minutes meanders, at each BioCondition site, in a 100 m radius).

Fauna survey effort consisted of a pilot study survey between 9 – 10 February and a baseline survey mobilisation between 20 – 28 February. The pilot was focused on a visual assessment to inform site selection for the baseline survey. Fauna surveys methods did not provide a concise survey effort for some assessments, so estimates have been made off the available information. See Table 3 for a summary of fauna survey effort.

Table 3 SREIS terrestrial fauna survey effort

Method	Site quantity	Site duration	Total	
Trap sites (Pitfall + funnel)	10	3 days	**Trap nights/days**	**30**
Harp traps	6	6 days		**36**
Anabat	5	6 days		**30**
Camera traps (white-flash)	2	4 days		**8**

Diurnal bird survey		20 (repeated twice at each trap site)	20 minutes+	**Person hours**	**6.6**
Spotlighting (vehicle + foot)	**Survey area 2**	3	2.5 hours x 6 Ecologists		**45**
	Survey area 9	3	4.5 hours x 3 Ecologists		**40.5**
Observation site*		15	-	**Sites**	**15**
Habitat assessment		18	-		**18**

- * - observation sites included active searches, spotlighting and habitat assessments; however, the methodology in the SREIS does not specify survey effort.
- + - the SREIS methodology section indicates a 20 minute duration minimum for diurnal bird surveys. It is likely survey effort exceeds the total.

A total of 12 flora surveys and 13 habitat assessments were completed within 1 km of the DXP footprint consisting of 5 secondary, 1 tertiary, and 6 quaternary surveys.

2.4 SREIS - SGP Aquatic Ecological Assessment Report

Similar to the terrestrial ecological SREIS, changes to the Project scope and gaps flagged by government departments triggered re-assessment. Surveys focused on five proposed infrastructure locations; four CGPF and the TWAF. Sites were chosen for survey based on the following:

- Within a waterway located in, or in close proximity to, the PDA;
- Has aquatic values representative of the locale;
- Allowed for further characterisation of aquatic ecosystem values (as required in the Project Terms of Reference);
- Situated in public land or private property in which landholder access was permitted; and
- Quickly accessible.

A total of 21 survey sites were completed as follows:

- One in Commoron Creek – Weir River Catchment;
- Three in Bottle Tree Creek – Dogwood Creek Catchment;
- Five in Dogwood Creek – Dogwood Creek Catchment;
- Seven in The Condamine River – Condamine River Catchment;
- Two in Crawlers Creek – Condamine River Catchment; and
- Two in unnamed waterways in the Wilkie Creek Catchment.

Assessments undertaken included:

- Water Quality;
- Aquatic habitat assessments (AusRIVAS);
- Macrophyte surveys;
- Macroinvertebrate surveys; and
- Fish, Turtle and other vertebrate species surveys.

Three sites located in the Condamine River did not have Fish, Turtle and other vertebrate surveys completed. The three unnamed waterways in the Wilkie Creek Catchment only had ‘qualitative visual surveys’ completed.

2.5 EAR - SGP Terrestrial Ecological Assessment Report

Terrestrial ecology surveys were conducted, as a condition of the SGP EIS approval, across a 202,915 ha study area. The condition was set by the Federal Government in which additional flora and fauna assessments were to be performed in accordance with State and Federally approved survey guidelines.

Subsequently, Arrow contracted EcoSmart Ecology and 3D Environmental to undertake surveys, across the SGP, aimed at:

- Completing detailed seasonal terrestrial ecological surveys sampling the range of habitats within the SGP study area and targeting likely threatened species to satisfy State and Federal survey guidelines. Surveys considered:
    - ESAs;
    - Wetland and watercourses with a focus on HES wetlands;
    - 'Endangered' and 'Of Concern' regional ecosystems;
    - Essential Habitat;
    - Areas of high connectivity;
    - Protected plants high-risk areas; and
    - Core Habitat identified in SREIS for EPBC listed species.
- Validating and improving existing RE and HES wetland mapping; and
- Refining Core Habitat mapping for State and Federally listed threatened species.

Seasonal wet and dry season surveys were undertaken between:

- Pilot survey: 29 August – 2 September 2016 (five days);
- Dry season surveys:
    - Flora: 12 – 23 September 2016 (12 days); and
    - Fauna: 18 – 28 October 2016 (11 days).
- Wet season surveys:
    - Flora: 6 – 18 February 2017 (13 days); and
    - Fauna: 7 – 16 March 2017 (10 days).

Flora surveys were undertaken with a triage of precedence which included:

- Remnant vegetation;
- 'Endangered' or 'Of Concern' vegetation;
- Potential Threatened Ecological Communities (TECs);
- Proximity to prior records of threatened flora and fauna (including protected plant trigger mapping);
- Higher quality habitat quantified by structure and contiguity across large areas; and
- Gaps from previous EIS and SREIS studies.

Table 4 summarises the flora survey effort.

Table 4 EAR terrestrial flora survey effort

Survey	Dry season	Wet season	Total sites*
Secondary	58	47	**105**
Tertiary	1	0	**1**
Quaternary	837	682	**1,519 (38)**
Total			**1,625**

* - sites within 1 km of the DXP disturbance footprint.

Fauna surveys prioritised areas of broadly vegetated areas. This included tenement in:

- Kumbarilla State Forest, east of Cecil Plains;
- Dalby State Forest, east of Kogan;
- Forested areas east, south and west of Miles; and
- Binkey State Forest.

Table 5 outlines the fauna survey effort.

Table 5 EAR terrestrial fauna survey effort

Method	Unit	Survey Period			Total
		Dry season	Wet season	Follow up	
Pitfall	**Trap nights**	640	636		**1,276**
Funnel		960	954		**1,914**
Elliot		1600	1590		**3,190**
Harp		86	78		**164**
Anabat		36	33		**69 (4+)**
Camera traps (white-flash)		186	186	24	**396 (+64 black-flash)**
Active search	**Person hours**	56.25	64	5	**125.25**
Detailed bird survey		40	40		**80**
Opportunistic bird survey		8	13	5	**26**
Foot spotlight		71.75	68		**139.75**
Vehicle spotlight		9.58	17.5		**27.08**
Traverse (fauna)		160	160	18	**338**
Traverse (flora surveys and other)		Hours traversing the SGP study area.			**700**
Koala SAT	**Sites**	60	43	8	**111**
Glossy Black-cockatoo ort search		8	3		**11**

- \+ - individual ANABATs are generally required to be left out for no less than 4 nights for target species; however, some species may require longer deployment. As there is one ANABAT site within 1 km of the DXP disturbance footprint, it is assumed that at least 4 trap nights were completed at that location. Deployment duration is not mentioned in the report methodology.

38 Quaternary sites and one Anabat site (4+ nights of deployment) were completed within one kilometre of the disturbance footprint. Given the size of the study area, the high intense agricultural use in the DXP locale, and aforementioned survey priorities; the survey effort is considered sufficient for its original purpose. This has provided Arrow with a good baseline for the more detailed DXP ground-truthing surveys.

3.1 DXP ground-truthing surveys

With the intention of obtaining contemporary data prior to the approval of construction, Arrow have undertaken a significant number of ground-truthing surveys across the DXP. Prior to 2023 (2011 to 2022), 168 Secondary and 52 Quaternary surveys (approximately 176.5 hours of survey effort) were completed within 300 m of the disturbance footprint. This historical data has allowed arrow to build a robust understanding of the key ecological constraints in the disturbance footprint. Contemporary surveys between January 2023 to December 2024 have assessed a large portion of the DXP disturbance footprint, providing accurate ground-truthed information to inform the approvals process. Assessments were completed within the disturbance footprint and the surrounding 300 m to account for ESA protection zones.

See Table 6 for a summary of the 2023 – 2024 survey effort.

Table 6 2023 – 2024 Contemporary ground-truthing survey effort

Assessment	Assessment description	Site quantity			Approximate effort (hours)
		Disturbance footprint	300 m from disturbance footprint	Total sites	
Secondary	Secondary sites are intended for detailed classification of REs and can take up to one hour depending on a variety of factors such as the complexity of the site and the level of disturbance present. Data collected includes a complete structural assessment, an inventory of species, percentage cover and abundance of species (Neldner *et al.* 2024). Additionally, Arrow incorporates information on species habitat (i.e. habitat assessments) through assessments including site physiography, fauna habitat features, micro-habitat features and fauna signs within the ecologically stratified unit (ESU).	28	74	**102**	**102 hours (1 hour per site)**
Quaternary	Quaternary sites are intended to be rapid assessments, no longer than a couple of minutes (Neldner *et al.* 2024). Arrow undertakes these surveys to accompany Secondary sites when mapping broader areas of an ESU. Therefore, Quaternary sites will include additional information such as height, stratum and cover to demonstrate equivalence between the more detailed Secondary sites. Basic habitat information is recorded at these sites (e.g. presence of gilgai or presence of hollow-bearing trees).	83	126	**209**	**35 hours (10 minutes per site)**
Koala surveys	Koala surveys were conducted in areas of remnant and regrowth vegetation with Koala habitat trees present. Floristics are recorded alongside a SAT search where any evidence of Koala is recorded.	2	20	**22**	**7.5 hours (20 minutes per site)**
Total		**113**	**220**	**333**	**186.5**

As the DXP disturbance footprint avoids any protected plants high-risk trigger mapping, no formal threatened flora meanders were completed. Informal threatened flora searches were performed as Ecologists meandered the disturbance footprint on foot. No Threatened flora species were observed within the disturbance footprint.

Appendix D: Significant Residual Impact (SRI) Assessment

Report

Safe Work. Strong Business.

Surat Gas Project – DXP4

Significant Residual Impacts to Prescribed Environmental Matters
EPPG00972513

Version	*4.0*
Released	*20/06/2025*
Document Status	*Final*
Security Classification	*Routine*

Please see document administration section for more information

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Table of Contents

Figures

Tables

1. Introduction

Arrow Energy Pty Ltd (Arrow) is planning to construct the remaining parts of The Dalby Expansion Project (DXP4), hereafter the project, as a component of our Surat Gas Project (SGP). This part of the SGP (Stage 1f) comprises a series of well pads, coal seam gas pipelines, water pipelines, Field Compressor Station (FCS) and infrastructure required to transfer coal seam gas and produced water. The key details for the current report are outlined in Table 1.

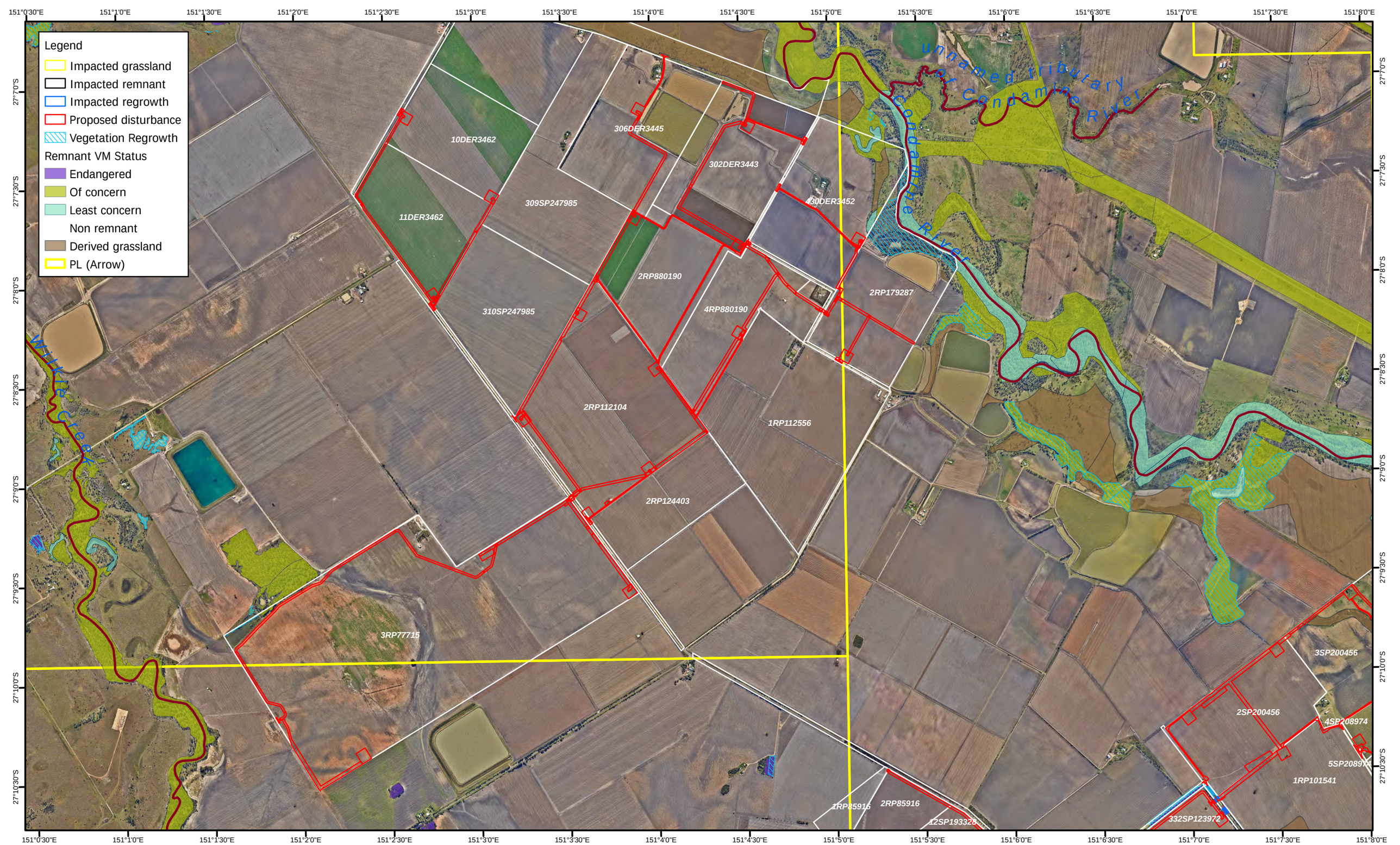
Table 1 Project details

	Key project details
Project Name	Dalby Expansion Project (DXP4)
Petroleum Lease	PLs 238, 258, 252, 198, 230, 260
Environmental Authority	EPPG00972513
Appropriately Qualified Person and Contact	Dr Paul Finn, Principal Ecologist paul.finn@arrowenergy.com.au

The relevant Environmental Authority (EA) for the project is the Dalby Expansion Project (DXP) EPPG00972513. This report addresses relevant EA conditions for the above-mentioned project, by providing a significant residual impact (SRI) assessment on Prescribed Environmental Matters (PEMs) to determine the project's environmental offset requirements under the *Environmental Offsets Act 2014* (EO Act). The DXP EA is currently dated 5 February 2025, however Arrow has an amendment being assessed which if approved will allow the estimated impacts to PEMs from this project. This SRI assessment report has been provided with the EA amendment approval so that it may be assessed in conjunction with the EA amendment decision.

The project is located on petroleum lease (PL) 238, 258, 252, 198, 230 and 260 in the Southern Brigalow Belt Bioregion. The project has a total disturbance footprint of approximately 636.71 ha, and is predominantly located in pre-disturbed, cleared land. The total area of remnant, regrowth and derived grassland vegetation to be cleared is approximately 192.85 ha (Table 2).

The location of the project is shown in Figure 1.



Rev	Date	Revision Description	Dsg	Drfd	Eng	QA	App
B	18/06/25	Revised DXP4	TS	XX	XX	XX	PF
A	28/01/25	First issue	TS	XX	XX	XX	PF

Source:
Arrow Energy Limited, Geosciences Australia
Qld Gov.

Status: IFU

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Scale @ A3: 1:31,000

0 0.25 0.5 1 km

Coordinate System: GDA2020 MGA Zone 56

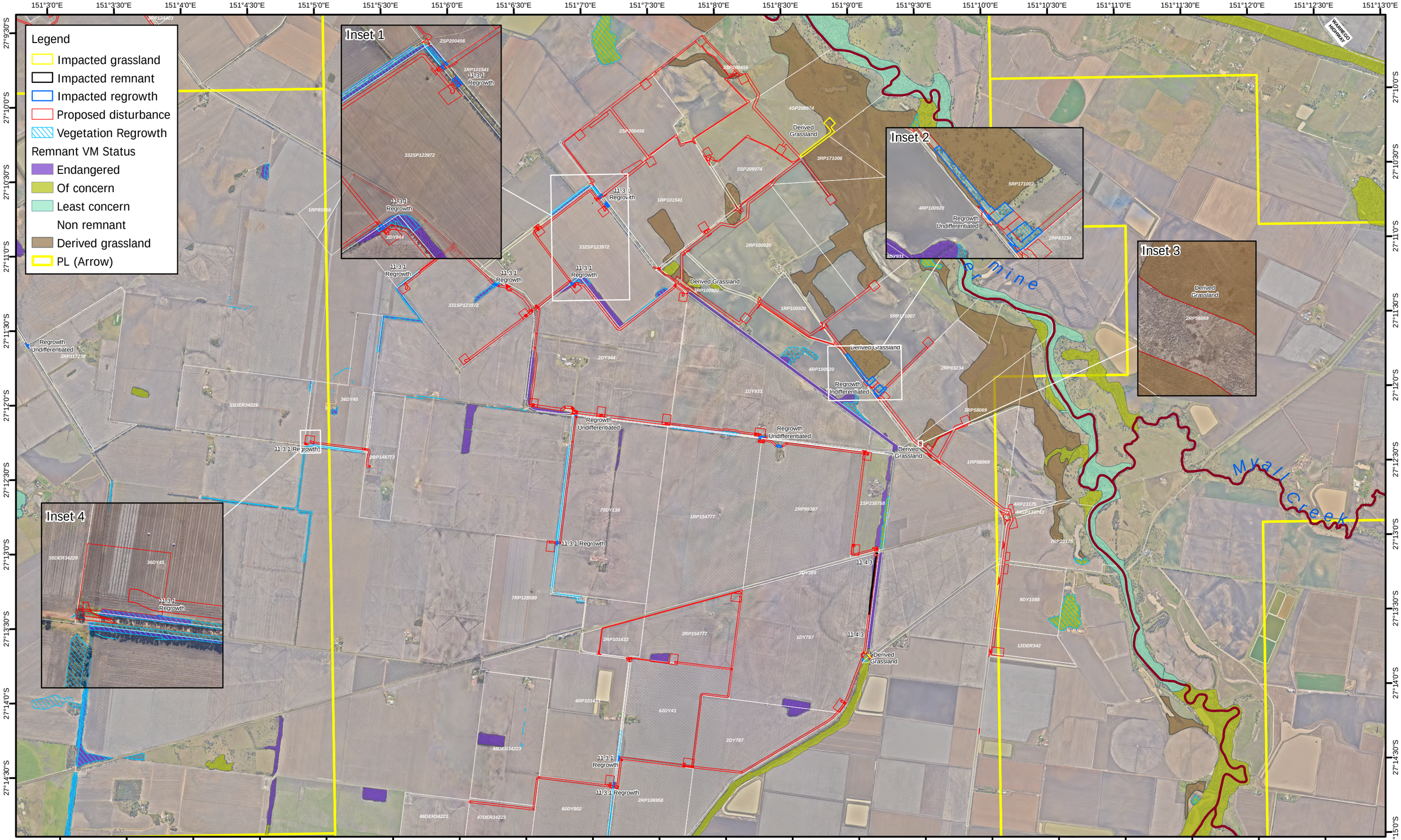
Figure 1a
Daandine East
location along with that
of ground-verified remnant
and regrowth vegetation

Uncontrolled (B)

Document: R:\GIS\Geomatics_Team\WORK_REQUESTS\Environment\210222_RITM0277984_MSES_PF\Output\DXP4\DaandineEast_LocationVegv2.aprx

NOT FOR CONSTRUCTION

Print Date: 19/06/2025



Rev	Date	Revision Description	Dsg	Drfd	Eng	QA	App
B	18/06/25	Revised DXP4	TS	XX	XX	XX	PF
A	28/01/25	First issue	TS	XX	XX	XX	PF

Source:
Arrow Energy Limited, Geosciences Australia
Qld Gov.

Status: IFU

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Scale @ A3: 1:42,000

0 0.25 0.5 1 km

Coordinate System: GDA2020 MGA Zone 56

Figure 1b
Daandine Nandi Rd & Duleen Kupunn Part 3
location along with that
of ground-verified remnant
and regrowth vegetation

Uncontrolled (B)

Document: R:\GIS\Geomatics_Team\WORK_REQUESTS\Environment\210222_RITM0277984_MSES_PF\Output\DXP4\DaandineNandiRd_DuleenKupunnPart3_LocationVegv2.aprx

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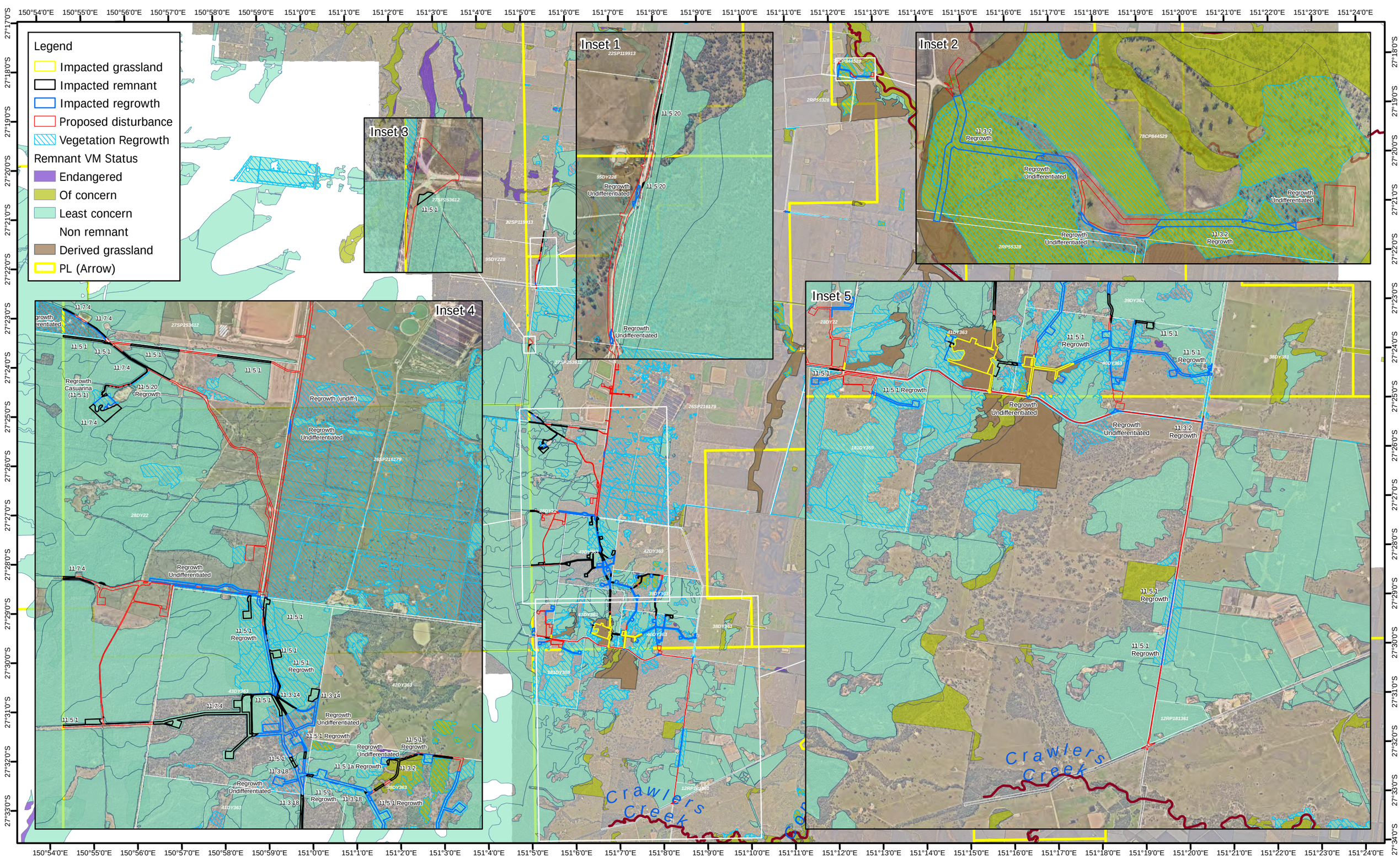
Print Date: 19/06/2025



Rev	Date	Revision Description	Dsg	Drftd	Eng	QA	Appr
B	18/06/25	Revised DXP4	TS	XX	XX	XX	PF
A	28/01/25	First issue	TS	XX	XX	XX	PF

Source:
Arrow Energy Limited, Geosciences Australia
Qld Gov.

Status: IFU

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Scale @ A3: 1:127,000

0 1 2 4 km

Coordinate System: GDA2020 MGA Zone 56

Figure 1c
Nandi Springvale Part 1 and Road Scopes
location along with that
of ground-verified remnant
and regrowth vegetation

Uncontrolled (B)

Document: R:\GIS\Geomatics_Team\WORK_REQUESTS\Environment\210222_RITM0277984_MSES_PF\Output\DXP4\NandiSpringvalePart 1_RoadScopesv2.aprx

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Legend
- Impacted grassland
- Impacted remnant
- Impacted regrowth
- Proposed disturbance
- Vegetation Regrowth

Remnant VM Status
- Endangered
- Of concern
- Least concern
- Non remnant
- Derived grassland
- HES wetlands
- PL (Arrow)

Inset 1
Regrowth Casuarina (11.5.1)
11.5.1
11.5.20
11.5.20
11.5.20
11.5.1
27SP253612

Inset 2
955SP128667
Derived Grassland

Inset 3
1212DER34118
11.3.2 Regrowth
Regrowth Undifferentiated
26SP216179
Regrowth Undifferentiated
Regrowth Undifferentiated
1035DER3490

Inset 4
1057DER3487
1DER3492
11.3.2 Regrowth
11.3.2 Regrowth
Derived Grassland
2SP242069
Derived Grassland
3RP88749

2RP111930
955SP128667
1212DER34118
2RP36714
370DER3450
371DER3450
26SP216179
1035DER3490
424DER3451
1057DER3487
1DER3492
2SP242069
30DY1060
3RP88749
32DY562
28DY32
43DY383
42DY383
39DY383
Condamine River

151°3'30"E 151°4'0"E 151°4'30"E 151°5'0"E 151°5'30"E 151°6'0"E 151°6'30"E 151°7'0"E 151°7'30"E 151°8'0"E 151°8'30"E 151°9'0"E 151°9'30"E 151°10'0"E 151°10'30"E 151°11'0"E 151°11'30"E 151°12'0"E 151°12'30"E 151°13'0"E 151°13'30"E 151°14'0"E 151°14'30"E 151°15'0"E 151°15'30"E 151°16'0"E 151°16'30"E

27°21'30"S 27°22'0"S 27°22'30"S 27°23'0"S 27°23'30"S 27°24'0"S 27°24'30"S 27°25'0"S 27°25'30"S 27°26'0"S 27°26'30"S 27°27'0"S 27°27'30"S 27°28'0"S 27°28'30"S

Rev	Date	Revision Description	Dsg	Drfd	Eng	QA	Appr
B	18/06/25	Revised DXP4 layout	TS	XX	XX	XX	PF
A	28/01/25	First issue	TS	XX	XX	XX	PF

Source:
Arrow Energy Limited, Geosciences Australia
Qld Gov.

Status: IFU

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Scale @ A3: 1:55,000

0 0.25 0.5 1 km

Coordinate System: GDA2020 MGA Zone 56

Figure 1d
Grassdale Rd P2, Grassdale Rd Sth, Tipton
location along with that
of ground-verified remnant
and regrowth vegetation

Uncontrolled (B)

Document: R:\GIS\Geomatics_Team\WORK_REQUESTS\Environment\210222_RITM0277984_MSES_PF\Output\DXP4\GrassdaleRd_P2_GrassdaleRd_Sth_Tiptonv2.aprx

NOT FOR CONSTRUCTION

Print Date: 20/06/2025

Table 2 Ground-verified vegetation communities and cleared areas impacted by the project with Road scope sections condensed

Vegetation Community	Area (ha)											
	Boundary Road Part 1	Daandine East	Daandine Nandi Rd	Duleen Kupunn Part 3	Grassdale Rd P2	Grassdale Rd Sth	Lynwood FCS	Nandi Springvale Part 1	Tetris 1	Tipton CGPF Phase 1	Road Scope*	Total
RE 11.3.1 Regrowth			0.04	0.16								**0.21**
RE 11.3.2 Remnant	1.95											**1.95**
RE 11.3.2 Regrowth						0.92		2.83			0.20	**3.94**
RE 11.3.14 Remnant	2.27											**2.27**
RE 11.3.18 Remnant	2.79						1.52				0.09	**4.41**
RE 11.3.26 Remnant	0.12											**0.12**
RE 11.5.1 Remnant	4.47								3.52	0.82	0.12	**8.93**
RE 11.5.1 Regrowth	26.68						6.19			0.68	0.49	**34.04**
RE 11.5.1a Regrowth	0.17											**0.17**
RE 11.5.20 Remnant										0.18	0.01	**0.19**
RE 11.5.20 Regrowth									0.001	0.04		**0.04**
RE 11.7.4 Remnant	10.06								6.38		0.81	**17.25**
Regrowth undifferentiated Land zone 3	4.99			0.12				0.38		0.17	0.29	**5.94**
Regrowth undifferentiated Land zone 5	45.90									0.31	0.11	**46.31**
Derived grassland	9.28		18.03		11.89	5.28	22.36			0.24	0	**67.08**
Cleared	44.75	76.68	69.29	92.14	17.08	83.56	0.004	3.27	4.65	18.74	32.24	**443.96**
Total	**153.42**	**76.68**	**87.26**	**92.42**	**28.97**	**89.76**	**30.08**	**6.47**	**14.55**	**21.18**	**35.90**	**636.71**

* Road Scope are further grouped in this table and expanded in Table 3

Table 3 Expanded summary of Road scope ground-verified vegetation communities and cleared areas impacted

Vegetation Community	Area (ha)					
	Road Scope - Boundary Road	Road Scope - Broadwater Road - Stage 1 - 70kph	Road Scope - Broadwater Road - Stage 2 - 110kph	Road Scope - Hennings Connection Road	Road Scope - Lynwood to Tipton	Road Scope - Wilkin Road
RE 11.3.1 Regrowth						
RE 11.3.2 Remnant						
RE 11.3.2 Regrowth				0.07		0.13
RE 11.3.14 Remnant						
RE 11.3.18 Remnant					0.09	
RE 11.3.26 Remnant						
RE 11.5.1 Remnant					0.12	
RE 11.5.1 Regrowth					0.49	
RE 11.5.1a Regrowth						
RE 11.5.20 Remnant		0.01				
RE 11.5.20 Regrowth						
RE 11.7.4 Remnant					0.81	
Regrowth undifferentiated Land zone 3		0.16	0.13			
Regrowth undifferentiated Land zone 5					0.11	
Derived grassland						
Cleared	5.28	3.76	1.27	0.26	4.21	17.45

2. Purpose

There are several requirements of EA EPPG00972513 relating to managing environmental offsets for the proposed activities to be undertaken.

2.1 Surat Gas Project development

The subject of this SRI is to support the amendment to the DXP EA which includes:

- Wells, access tracks, and supporting infrastructure.
- Water and gas gathering.
- Local Infrastructure, including laydowns, spoil stockpiles, and Extra Work Areas.
- Lynwood Field Compression Station (FCS) and associated infrastructure (dams, power station, laydowns, flare).

2.2 Surat Gas Project EPBC Act Approval

The areas of the SGP that are located on Arrow PL tenements, of which the project is a part, is approved under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval (EPBC 2010/5344). As an approval condition, the SGP Stage 1 Offset Strategy (EPBC Act Offset Strategy) was prepared by Arrow to address the offset requirements for Stage 1 of the SGP. The strategy was approved by The Department of Agriculture, Water and the Environment (DAWE) on 7 July 2019. This EPBC Act approval for Stage 1 incorporates impacts from infrastructure located on all PLs in the DXP EA and as such addresses the offsets from any impacts to all relevant Matters of National Environmental Significance (MNES) on these tenures.

MNES and MSES where they are substantially the same matter

On many occasions, remnant and high-value regrowth vegetation listed as PEMs or Matters of State Environmental Significance (MSES) also provide habitat for species listed as MNES. In these situations, the Federal approval takes precedent and therefore offsets provided for MNES also satisfies the requirement for State offsets.

All MNES species identified in the project (Table 4), are the same matters as those assessed and approved under the EPBC Act SGP Stage 1 Offset Strategy.

While the EPBC Act Offset Strategy area shown in the figures (5.4a and 5.5a) does not cover the entire area of the SGP Stage 1 project footprint, the offset strategy foresees that infrastructure location changes would occur and addresses this with the inclusion of the following statement in section 1:

> '*Figure 1.1 shows an indicative location of the Stage 1 activities in relation to the project. The locations shown are subject to change as the project progresses through the detailed design phase and Arrow shareholder and joint venture partner approval processes*.'

The offset strategy also notes that whilst specific locations may change, the principles and strategies for securing offsets that are presented in the EPBC Act Stage 1 Offset Strategy will be implemented.

3. Methods

3.1 Identifying Prescribed Environmental Matters (PEMs)

The project's disturbance footprint (Figure 1) has been used to identify areas that may have a SRI on PEMs as defined in the EO Act. The presence/absence of each matter was determined in accordance with the 'Method for mapping matters of state environmental significance' (DESI, 2024).

Detailed and seasonal ecological assessment over 2024 including supplementary reports (Ecosmart Ecology and 3D Environmental, 2017, 2018, 2019 and 2021) was undertaken for the SGP area which provided ground-verified data on PEMs that are regulated vegetation, protected wildlife habitat and connectivity areas. This assessment included:

- detailed, seasonal terrestrial ecological surveys across the full range of habitats occurring within the SGP area.
- validating and refining Regional Ecosystem (RE) mapping for the project.
- refining mapping for 'core habitat known' and 'core habitat possible' for all relevant species identified under the EPBC Act and *Nature Conservation Act 1992* (NC Act).

This ground-verified data was used to cross-check government supplied mapping data on PEMs that are regulated vegetation, protected wildlife habitat and connectivity areas. Government supplied mapping data was relied upon to identify the following PEMs:

- Wetlands and watercourses.
- Designated precincts in strategic environmental areas.
- Protected areas.
- Highly protected zones of State marine parks.
- Fish habitat areas.
- Waterway providing for fish passage.
- Marine plants.
- Legally secured offset areas.

Additionally, the government's Landscape Fragmentation and Connectivity (LFC) Tool was used to assess potential impacts on connectivity areas using ground-verified data.

Conclusions drawn on the presence/absence of PEMs are provided in Section 5 (Table 4), which covers all PEMs listed in the DXP EA and whether or not they were identified within impact areas. Further detailed assessment is provided in Sections 4.2.1 to 4.2.9 for those PEMs that were identified from mapping sources and potentially impacted by the project.

3.2 Significant residual impact (SRI) assessment

The following documents have been used to assess whether the project will have a SRI on PEMs:

- *Environmental Offset Act 2014* (EO Act).
- *Environmental Offset Regulation 2014* (EO Regulation).
- Queensland Environmental Offsets Policy (Version 1.17) (DETSI, 2025).
- Queensland Environmental Offsets Policy Significant Residual Impact Guideline (DEHP, 2014).

- Method for mapping matters of state environmental significance (Version 7) (DESI, 2024).
- Surat Gas Project – Threatened Species Mapping Rules Review Report (Ecosmart Ecology and 3D Environmental, 2023).

4. Results

4.1 Assessment of PEMs for Potential SRI

Table 4 includes an analysis and estimated significant residual impact against all of the PEMs listed in the DXP EA. It identifies nine (9) PEMs that warrant further assessment to establish the presence or absence of a significant residual impact. These being:

1) Regulated vegetation – Endangered regional ecosystem.
2) Regulated vegetation – Of Concern regional ecosystem.
3) Regulated vegetation – regional ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse.
4) Regulated vegetation – essential habitat (not in an urban area) for Critically Endangered, Endangered or Vulnerable wildlife.
5) Connectivity Areas – connectivity area that is a Regional Ecosystem (not in urban area).
6) Wetlands and watercourses – a wetland of high ecological significance.
7) Protected wildlife habitat – habitat for animals that are Critically Endangered, Endangered or Vulnerable wildlife.
8) Protected wildlife habitat – habitat for an animal that is Special Least Concern wildlife.
9) Waterway providing for fish passage – fish passage (not in an urban area).

Table 4 Analysis of all Prescribed Environmental Matters (PEMs) and whether or not they have the potential for a Significant Residual Impact (SRI)

Item	PEM	Potential for SRI	Details
1	Regulated vegetation – Endangered regional ecosystems.	Yes	0.21 ha of ground-verified Endangered regrowth RE 11.3.1 will also be cleared, however as regrowth this is not regulated vegetation so will not be considered further as part of this PEM but will be included in protected wildlife habitat. These vegetation polygons are co-located with habitat for Koala, Glossy Black-cockatoo, Brigalow Woodland Snail, Painted Honeyeater, and Dunmall's Snake (Table 5). The SRI assessment of this PEM in Section 4.2.1.
2	Regulated vegetation – Of Concern regional ecosystems.	Yes	1.95 ha of ground-verified Of Concern remnant RE 11.3.2 will be cleared on at Boundary Road Pt. 1 on Lot on Plan 39DY363. 3.94 ha of ground-verified Of Concern regrowth RE 11.3.2 will also be cleared, however as regrowth this is not regulated vegetation so will not be considered further as part of this PEM but will be included in protected wildlife habitat. Thes vegetation polygons are co-located with (Table 5): • RE within the defined distance of a watercourse, noted in item 4.

Item	PEM	Potential for SRI	Details
			• Habitat for Koala, Diamond Firetail, Death Adder, Brigalow Woodland Snail, and Grey Snake, noted in item 14. • Waterways providing for fish passage, noted in item 19. The SRI assessment of this PEM in Section 4.2.2.
3	Regulated vegetation – Regional ecosystems (not within an urban area) that intersect a wetland on the vegetation management wetlands map.	No	Not located within the disturbance footprint of the current project.
4	Regulated vegetation – Regional ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse on the vegetation management watercourse map.	Yes	1.44 ha of ground-verified regional ecosystems, including: • 0.08 ha of remnant RE 11.3.2 • 0.27 ha of regrowth RE 11.3.2 • 0.20 ha of remnant RE 11.3.14 • 0.30 ha of remnant RE 11.3.18 • 0.17 ha of remnant RE 11.5.1 • 0.41 ha of regrowth RE 11.5.1 • 0.01 ha of remnant RE 11.7.4 Although some regrowth vegetation is mapped within the defined distance, regrowth is not regulated vegetation so will not be considered further as part of this PEM but will be included in protected wildlife habitat. These vegetation polygons are located adjacent to tributaries of Wilkie Creek, The Condamine River, and Broadwater Gully (all stream orders one or two). These vegetation polygons are co-located with (Table 4): • An Of Concern Regional Ecosystem, noted in item 2. • Habitat for the Koala, Grey Snake, Death Adder, Corben's Long-eared Bat, Dunmall's Snake, Greater Glider, and Brigalow Woodland Snail, noted in item 5 and 14. • Habitat for the Short-beaked Echidna, noted in item 15. • Waterways providing for fish passage, noted in item 19. The SRI assessment of this PEM is presented in Section 4.2.3.

Item	PEM	Potential for SRI	Details
5	Regulated vegetation – Essential habitat (not in an urban area) for Endangered or Vulnerable wildlife.	Yes	0.03 ha for Koala (*Phascolarctos cinereus)* (Endangered under the NC and EPBC Act), of regrowth RE 11.3.2 at the following location: • 0.03 ha at Grassdale Road Sth (2SP242069, Miss Jurgs Road reserve, and Percy Jurgs Road Cook Road Miss Jurgs Road reserve). Although mapped as Essential Habitat, as regrowth this is not regulated vegetation so will not be considered further as part of this PEM but will be included in protected wildlife habitat.
6	Connectivity Areas – Connectivity area that is a regional ecosystem (not in urban area)	Yes	The project has a significant impact on connectivity areas, with a total RVM Cat B clearing of 32.54 ha. The results of the assessment are: • Significance test one (reduction in core remnant vegetation at the local scale): The percent change of core habitat at the local scale post impact for the project is 0.31%. The local impact threshold for this project is 10%. The project does not have a significant impact on connectivity in significance test one. • Significance test two (change from core to non-core remnant at the site scale): the number of core remnant areas occurring on the site is reduced from eight (8) before impact to seven (7) post impact. The project does have a significant impact on connectivity in significance test two. The SRI assessment of this PEM is presented in Section 4.2.5.
7	Wetlands and watercourses – A wetland in a wetland protection area shown on the Map of referable wetlands (HES wetlands in GBR)	No	Not located within the disturbance footprint of the current project.
8	Wetlands and watercourses – A wetland of high ecological significance shown on the Map of referable wetlands	No	0.26 ha of wetland (0.22 ha of cleared land and 0.04 ha of cultivated land) associated with a tributary of Wilkies Creek, including: • Daandine Nandi Road: 0.04 ha (3SP200456). • Grassdale Road South: 0.22 ha (26SP216179). These vegetation polygons are co-located with a level three waterway providing for fish passage (a tributary of Wilkie Creek) and noted in item 19 (Table 4). The SRI assessment of this PEM is presented in Section 4.2.6.

Item	PEM	Potential for SRI	Details
9	Wetlands and watercourses – A wetland or watercourse in high ecological value waters	No	Not located within the disturbance footprint of the current project.
10	Designated precinct in a strategic environmental area	No	Not located within the disturbance footprint of the current project.
11	Protected wildlife habitat – An area shown as a high-risk area on the flora survey trigger map that contains plants that are Endangered or Vulnerable.	No	Not located within the disturbance footprint of the current project.
12	Protected wildlife habitat – An area that is not shown as a high risk area on the flora survey trigger map, to the extent the area contains plants that are critically Endangered, Endangered or Vulnerable.	No	Not located within the disturbance footprint of the current project.
13	Protected wildlife habitat – A koala habitat area as determined by the chief executive on the koala conservation plan map.	No	Not located within the disturbance footprint of the current project.

14	Protected wildlife habitat – Habitat for an animal that is Endangered or Vulnerable.	Yes	A total of 76.45 ha of ground-verified remnant and regrowth vegetation will be cleared (includes 0.21 ha of Brigalow TEC (MNES)), including (ranked from largest to smallest area; **species listed under the NC Act only are bolded**): • 73.52 ha for Koala (*Phascolarctos cinereus*) (Endangered under the NC Act and EPBC Act). • **35.12 ha for Common Death Adder (*Acanthophis antarcticus*) (Vulnerable under the NC Act).** • 35.12 ha for Diamond Firetail (*Stagonopleura guttata*) (Vulnerable under the NC Act and EPBC Act). • 32.86 ha for Corben's Long-eared Bat[1] (*Nyctophilus corbeni*) (Vulnerable under both the NC Act and EPBC Act). • 30.78 ha for Dunmall's Snake[1] (*Furina dunmalli*) (Vulnerable under the NC Act and EPBC Act). • 28.77 ha for Greater Glider (*Petauroides volans (southern and central populations)*) (Endangered under the NC Act and EPBC Act). • 26.49 ha for Yellow-bellied Glider (*Petaurus australis australis*) (Vulnerable under the NC Act and EPBC Act). • 17.46 ha for Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*) (Vulnerable under the NC Act and EPBC Act). • 8.42 ha for Grey Snake (*Hemiaspis damelii*) (Endangered under the NC Act and EPBC Act). • 6.10 ha for Brigalow Woodland Snail (*Adclarkia cameroni*) (Endangered under the NC Act and EPBC Act). • 0.22 ha for Painted Honeyeater (*Grantiella picta*) (Vulnerable under the NC Act and EPBC Act). This vegetation is present over the following properties: • Boundary Rd Pt. 1: 182DY359, 26SP216179, 27SP253612, 28DY22, 38DY361, 39DY363, 40DY363, 41DY363, 43DY363, and Boundary Road reserve. • Daandine Nandi Rd: 2RP100920, 3RP100920, 3RP171006, 3SP200456, 4RP100920, 4SP208974, 5RP208974, Greenbank Access Road, and Hereward Road reserve. • Duleen Kupunn Pt. 3: 12SP193328, 1DY787, 1RP85916, 2DY944, 2RP148773, 2RP85916, 2RP99387, 332SP123972, 36DY45, 4RP101433, 55DER34229, 60DY802,

Item	PEM	Potential for SRI	Details
			62DY43, ASP194566 and Daandine Nandi Road, Greenbank Access Road reserve, and Kupunn Road, Moonie Highway and unnamed road reserve. • Grassdale Rd Pt. 2: 2RP36714, 370DER3450, 955SP128667, and an unnamed road adjacent to the Condamine River reserve. • Grassdale Rd Sth: 26SP216179, 2SP242069, 424DER3451, 30DY1060, 32DY562, 3RP88749, Grassdale Road reserve, Miss Jurgs Road reserve, Percy Jurgs Road reserve, and Cook Road reserve. • Lynwood FCS: 41DY363. • Nandi Springvale Rd Pt. 1: 1RL7745, 78CP844529, and an unnamed gazetted temporarily closed road reserve. • Road Scopes: ○ Boundary Rd: Boundary Road reserve and Wilkin Road reserve. ○ Broadwater Rd Stage 1: Broadwater Road reserve ○ Broadwater Rd Stage 2: 95DY228, and Broadwater Road reserve ○ Hennings Connection Rd: Hennings Road reserve and Hennings Connection Road reserve. ○ Lynwood to Tipton: 27SP253612, 28DY22, 43DY363 and an unnamed road reserve. ○ Wilkin Rd: Wilkin road reserve and Boundary Wilkin Road reserve These vegetation polygons are co-located with (Table 5): • An Endangered RE, noted in item 1. • An Of Concern RE, noted in item 2. • REs within the defined distance of a watercourse, noted in item 4. • Habitat for the Short-beaked Echidna, noted in item 15. • Waterways providing for fish passage, noted in item 19. The SRI assessment of this PEM is presented in Section 4.2.7.

Item	PEM	Potential for SRI	Details
15	Protected wildlife habitat – Habitat for an animal that is Special Least Concern.	Yes	0.30 ha of ground-verified remnant or regrowth vegetation for the Short-beaked Echidna (*Tachyglossus aculeatus*) (Special Least Concern under the NC Act), including: • Boundary Road Pt.1: 0.20 ha (39DY363, 40DY363, 41DY363, 181DY359). • Road Scope – Broadwater Road Stage 1 – 70kph: 0.10 ha (Broadwater Road reserve). These vegetation polygons are co-located with (Table 5): • REs within the defined distance of a watercourse, noted in item 4. • Habitat for the Koala, Diamond Firetail, Death Adder, Corben's Long-eared Bat, Dunmall's Snake, Greater Glider, Yellow-bellied Glider, and Brigalow Woodland Snail, noted in item 14. • Waterways providing for fish passage, noted in item 19. The SRI assessment of this PEM is presented in Section 4.2.8.
16	Protected areas	No	Not located within the disturbance footprint of the current project.
17	Highly protected zones of State marine parks	No	Not located within the disturbance footprint of the current project.
18	Fish habitat area	No	Not located within the disturbance footprint of the current project.

19	Waterway providing for fish passage – Fish passage (not in an urban area)	Yes	0.19 ha including: • Boundary Road Part 1: 0.09 ha within seven tributaries of Wilkie Creek (fish passage levels one and two). These impacted waterways are located adjacent to remnant REs 11.3.2, 11.3.14, and 1.3.18 and regrowth RE 11.5.1 on 28DY22, 39DY363, 41DY363, 43DY363, and 43DY363). • Daandine East: 0.01 ha within one tributary of Wilkie Creek (fish passage level one). This impacted waterway is located adjacent to cleared land on 3RP77715. • Grassdale Road Part 2: 0.02 ha within one tributary of the Condamine River (fish passage level one). This impacted waterway is located adjacent to cleared land on 371DER3450. • Grassdale Road South: 0.01 ha within one tributary of Wilkie Creek (fish passage level two). This impacted waterway is located adjacent to cleared land on 26SP216179. • Nandi Springvale Part 1: 0.01 ha within one tributary of the Condamine River (fish passage level one). This impacted waterway is located adjacent to regrowth RE 11.3.2 on 78CP844529. • Road Scope – Boundary Road: 0.01 ha within one tributary of the Wilkie Creek (fish passage level one). This impacted waterway is located adjacent to cleared land on an unnamed road reserve. • Road Scope – Broadwater Road Stage 1: 0.01 ha within Broadwater Gully (fish passage level two). This impacted waterway is located adjacent to cleared land on 95DY228. • Road Scope – Broadwater Road Stage 2: 0.003 ha within Broadwater Gully (fish passage level two). This impacted waterway is located adjacent to cleared land on 95DY228. • Road Scope – Lynwood to Tipton: 0.02 ha within one tributary of Wilkie Creek (fish passage level two). This impacted waterway is located adjacent to remnant RE 1.3.18 and 11.7.4, cleared land, and undifferentiated regrowth on 27SP253612 and 43DY363. • Road Scope – Wilkin Road: 0.01 ha within one tributary of Wilkie Creek (fish passage level one) and one tributary of Crawlers Creek (fish passage level one). This impacted waterway is located adjacent to remnant RE 11.5.1 and cleared land on Wilkin Road reserve. These vegetation polygons are co-located with (Table 5): • An Of Concern RE, noted in item 2.

Item	PEM	Potential for SRI	Details
			• REs within the defined distance of a watercourse, noted in item 4. • Habitat for the Koala, Diamond Firetail, Death Adder, Corben's Long-eared Bat, Dunmall's Snake, Greater Glider, Yellow-bellied Glider, Glossy Black-cockatoo, and Brigalow Woodland Snail, noted in item 14. • Habitat for the Short-beaked Echidna, noted in item 15. The SRI assessment of this PEM is presented in Section 4.2.9.
20	Marine plants	No	Not located within the disturbance footprint of the current project.
21	Legally secured offset area	No	Not located within the disturbance footprint of the current project.

([1]) Instances where the PEM corresponds to a MNES assessed under EPBC Act Approval (EPBC 2010/5344).

4.2 Assessment of PEMs for Actual SRI

Review of Table 4 shows nine PEMs with a potential for SRI (see Figure 1 for locations). Sections 4.2.1 to 4.2.9 provide a further assessment of these nine matters. Prior to that assessment, Table 5 provides a breakdown of each vegetation community that is impacted by the project and the relevant PEM that is associated with each one.

Table 5 Summary of Impacted Prescribed Environmental Matters (PEMs) including areas (ha), vegetation communities, and co-locations

Vegetation Community	Total area (ha)	Regulated Vegetation				Protected Wildlife Habitat (ha) – Endangered or Vulnerable wildlife											Protected wildlife habitat – Special Least Concern	Protected wetlands	Waterway providing for fish passage (ha)
		RE within the defined distance of defining bank of a watercourse	Endangered Regional Ecosystems*	Of Concern Regional Ecosystems	Essential habitat for Koala	Koala	Grey Snake	Diamond firetail	Death Adder	Corben's Long-eared Bat*	Dunmall's Snake*	Greater Glider	Yellow-bellied Glider	Glossy Black-cockatoo	Brigalow Woodland Snail	Painted honeyeater	Short-beaked Echidna	High ecological significance wetlands	Fish passage (not in an urban area)
RE 11.3.1 Regrowth	0.21		0.21			0.21								0.21	0.21	0.21			
RE 11.3.2 Remnant	1.95	0.08		1.95		1.95	0.28	1.95	1.95						1.95				0.008
RE 11.3.2 Regrowth	3.94	0.27		3.94	0.03	3.94	0.98								3.94				0.01
RE 11.3.14 Remnant	2.27	0.20				2.27	0.67	2.27	2.27	2.27		2.27					0.16		0.012
RE 11.3.18 Remnant	4.41	0.30				4.41	0.44	4.41	4.41	4.41	4.41								0.02
RE 11.3.26 Remnant	0.12					0.12		0.12	0.12			0.12	0.12						
RE 11.5.1 Remnant	8.93	0.17				8.93	0.64	8.93	8.93	8.93	8.93	8.93	8.93				0.04		
RE 11.5.1 Regrowth	34.04	0.41				34.04	2.31												0.02
RE 11.5.1a Regrowth	0.17					0.17													
RE 11.5.20 Remnant	0.19					0.19		0.19	0.19		0.19	0.19	0.19			0.01			
RE 11.5.20 Regrowth	0.04					0.04													
RE 11.7.4 Remnant	17.25	0.01				17.25	0.18	17.25	17.25	17.25	17.25	17.25	17.25	17.25					0.001
Regrowth undifferentiated Land zone 3	5.94						0.24										0.10		
Regrowth undifferentiated Land zone 5	46.31						0.27												
Derived grassland	67.08						2.41												
Cleared land	443.86																	0.26	0.12
Total	**636.71**	**1.44**	**0.21**	**5.89**	**0.03**	**73.52**	**8.42**	**35.12**	**35.12**	**32.86**	**30.78**	**28.77**	**26.49**	**17.46**	**6.10**	**0.22**	**0.30**	**0.26**	**0.19**

* = Instances where the PEM corresponds to a MNES assessed under EPBC Act Approval (EPBC 2010/5344)
^ = The addition of areas in each row of this table may slightly differ from the total area provided because totals have been calculated using the full, not rounded, numbers.

4.2.1 Regulated vegetation – Endangered Regional Ecosystems

Table 4 and Table 5 show that approximately 0.21 ha of Endangered regrowth RE 11.3.1 will be impacted by the Project. However, the vegetation community is consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community (TEC) listed as Endangered under the EPBC Act and as such offsets will be managed under the EPBC Act approval (EPBC 2010/5344).

Please also note that the Queensland Environmental Offsets Policy Significant Residual Impact Guideline (DEHP, 2014) states that regulated vegetation must be a prescribed regional ecosystem which as defined in the EO regulation does not include regrowth (Category C) vegetation.

As shown in Table 4, these RE polygons also provides habitat for listed protected species under both the NC Act and EPBC Act. It is Arrow's consideration that under such circumstances the biodiversity offset associated with this PEM would therefore be managed under the EPBC Act approval (EPBC 2010/5344) and associated SGP Stage 1 Offset Strategy (EPBC Act Offset Strategy).

However, The Department of Environment, Tourism, Science and Innovation (DETSI) considers regulated vegetation – Endangered Regional Ecosystems as a substantially different matter to habitat for protected species. Given the time-critical nature of the approval for this SRI report Arrow will include 0.21 ha in the Notice of Election (NoE) as protected wildlife habitat for applicable species (see Section 4.2.7). It is noted that Arrow will discuss this matter with DETSI to avoid duplication of offset requirements for future SGP projects.

4.2.2 Regulated vegetation – Of Concern Regional Ecosystems

Table 4 and Table 5 show that approximately 1.95 ha of Of Concern remnant RE 11.3.2 and 3.94 ha of Of Concern regrowth RE 11.3.2 will be impacted by the Project. Regional Ecosystem 11.3.2 is listed as 'Regulated Vegetation Of Concern RE' within the DXP EA with sufficient allowable impact areas. The Queensland Environmental Offsets Policy Significant Residual Impact Guideline (DEHP, 2014) states that regulated vegetation must be a prescribed regional ecosystem which as defined in the EO regulation does not include regrowth (Category C) vegetation.

As shown in Table 5, these RE polygons also provide habitat for listed protected species under both the NC Act and EPBC Act. It is Arrow's consideration that under such circumstances the biodiversity offset associated with this PEM would therefore be managed under the EPBC Act approval (EPBC 2010/5344) and associated SGP Stage 1 Offset Strategy (EPBC Act Offset Strategy).

However, DETSI considers regulated vegetation – Of Concern Regional Ecosystems as a substantially different matter to habitat for protected species. Given the time-critical nature of the approval for this SRI report Arrow will include the full 5.89 ha in the NoE as protected wildlife habitat for applicable species (see Section 4.2.7). It is noted that Arrow will discuss this matter with DETSI to avoid duplication of offset requirements for future SGP projects.

Arrow will include a total area of 1.95 ha of remnant RE 11.3.2 within the NoE for biodiversity offset (both under this PEM and for the overlapping protected wildlife habitat as shown in Table 5, see also Section 4.2.7).

4.2.3 Regulated vegetation – Regional Ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse.

Table 4 and Table 5 show that 1.44 ha of seven (7) vegetation communities occur within the defined distance from the defining banks of a relevant watercourse will be impacted by the project. These include:

- 0.08 ha of remnant RE 11.3.2
- 0.27 ha of regrowth RE 11.3.2
- 0.20 ha of remnant RE 11.3.14
- 0.30 ha of remnant RE 11.3.18
- 0.17 ha of remnant RE 11.5.1
- 0.41 ha of regrowth RE 11.5.1
- 0.01 ha of remnant RE 11.7.4

These Regional Ecosystems are listed as 'Regional ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse on the vegetation management watercourse map' within the DXP4 EA with sufficient allowable impact areas.

Regulated vegetation is a prescribed regional ecosystem as defined in the EO Regulation and does not include regrowth vegetation. Therefore Arrow, will only offset the remnant portions of the total area, not including the areas of regrowth RE 11.3.2 and regrowth RE 11.5.1, under this PEM.

As shown in Table 4, these RE polygons also provides habitat for listed protected species under the EPBC Act. It is Arrow's consideration that under such circumstances the biodiversity offset associated with this PEM would therefore be managed under the EPBC Act approval (EPBC 2010/5344) and associated SGP Stage 1 Offset Strategy (EPBC Act Offset Strategy).

However, DETSI considers regulated vegetation within the defined distance from a watercourse as a substantially different matter to habitat for protected species. Given the time-critical nature of the approval for this SRI report Arrow will include 0.76 ha for this PEM in the NoE for this project.

This PEM overlaps with protected wildlife habitat for Endangered and Vulnerable species and Special Least Concern species (possible habitat for Koala, Diamond Firetail, Death Adder, Corben's Long-eared Bat, Dunmall's Snake, Greater Glider, Yellow-bellied Glider, Glossy Black-cockatoo, Brigalow Woodland Snail and Short-beaked Echidna) PEMs under the NoE, as shown in Table 5 (see Sections 4.2.7 and 4.2.8). This PEM also overlaps with Regulated Vegetation – Of Concern Regional Ecosystems under the NoE, as shown in Table 5 (see Section 4.2.2) and Waterways Providing for Fish Passage (see Section 4.2.9).

It is noted that Arrow will discuss this matter with DETSI to avoid duplication of offset requirements for future SGP projects.

4.2.4 Regulated vegetation – essential habitat (not in an urban area) for Endangered and Vulnerable wildlife.

Table 4 and Table 5 show the vegetation impacted by the project located within the State-mapped Essential habitat mapping layer for one (1) Endangered species. This constitutes 0.03 ha within regrowth RE 11.3.2 which is mapped as Essential Habitat for the Koala (*Phascolarctos cinereus*) (Endangered under the NC Act and EPBC Act). Regulated vegetation is a prescribed regional ecosystem as defined in the EO Regulation and does not include regrowth vegetation. The 0.03 ha of mapped Essential Habitat in regrowth RE 11.3.2 is not regulated vegetation but overlaps with protected wildlife habitat for Koala (see Table 5 and Section 4.2.7) and will be offset for Koala under that PEM.

This PEM also overlaps with the following PEMs under the NoE:

- Regulated vegetation - RE within the defined distance from the defining banks of a relevant watercourse, as shown in Table 5 (see Section 3.2.3).
- Protected wildlife habitat for the Koala, Grey Snake, and Brigalow Woodland Snail, as shown in Table 5 (see Section 4.2.7).

4.2.5 Connectivity Areas – connectivity area that is a Regional Ecosystem (not in urban area).

The LFC tool determined a significant impact on connectivity areas (*A significant a change from core to non-core remnant at the site scale is True*). The tool returned a total area of RVM Cat B clearing of 32.54 ha. Arrow will include a total area of 32.54 ha for connectivity areas within the NoE for biodiversity offset.

4.2.6 Wetlands and watercourses – a wetland of high ecological significance.

The Project intercepts 0.26 ha of a Government-mapped high ecological significance (HES) wetland (Long Swamp, Wilkie Creek tributary). Field surveys show this area has been subject to extensive clearing and is highly disturbed and modified (e.g. access tracks, roads and cultivated areas). Where possible, to minimise impacts to mapped wetland areas, the RoW width has been reduced to 20m, with disturbances aligned with this existing infrastructure.

Arrow concludes that the disturbance of a total area of 0.26 ha for Government-mapped HES wetlands on land that has been cleared and is currently highly disturbed will not constitute a SRI and therefore will not be included this area in the NoE for biodiversity offset.

4.2.7 Protected wildlife habitat – habitat for an animal that is Critically Endangered, Endangered or Vulnerable.

Table 4 and Table 5 show there is habitat for eleven (11) Endangered or Vulnerable species to be impacted by the project. In all situations, the specific area of habitat to be impacted for a listed species protected under the NC Act is also habitat to be impacted for a species protected under the EPBC Act. Arrow will further investigate options to avoid this sort of duplication of offset requirements when State matters overlap with Federal matters for the same impact area.

However, given the time-critical nature of the approval for this SRI report, Arrow will include the areas of impacted PEMs for protected wildlife habitat.

Protected wildlife habitat includes 76.45 ha for the Koala, Grey Snake, Diamond Firetail, Death Adder, Corben's Long-eared Bat, Dunmall's Snake, Greater Glider, Yellow-bellied Glider, Glossy Black-cockatoo, Brigalow Woodland Snail and Painted Honeyeater, including:

- 0.21 ha of regrowth RE 11.3.1
- 1.95 ha of remnant RE 11.3.2
- 3.94 ha of regrowth RE 11.3.2
- 2.27 ha of remnant RE 11.3.14
- 4.41 ha of remnant RE 11.3.18
- 0.12 ha of remnant RE 11.3.26
- 8.93 ha of remnant RE 11.5.1
- 34.04 ha of regrowth RE 11.5.1
- 0.17 ha of regrowth RE 11.5.1a
- 0.19 ha of remnant RE 11.5.20
- 0.04 ha of regrowth RE 11.5.20
- 17.25 ha of remnant RE 11.7.4
- 0.24 ha of regrowth undifferentiated land zone 3
- 0.27 ha of regrowth undifferentiated land zone 5
- 2.41 ha of derived grassland

The 0.21 ha of regrowth RE 11.3.1 is possible habitat for Koala, Glossy Black-Cockatoo, Brigalow Woodland Snail, and Painted Honeyeater as shown in Table 5. This vegetation community is consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC listed as Endangered under the EPBC Act and as such offsets will be managed under the EPBC Act approval (EPBC 2010/5344). It is Arrow's consideration that under such circumstances the biodiversity offset associated with this PEM would therefore be managed under the EPBC Act approval (EPBC 2010/5344) and associated SGP Stage 1 Offset Strategy (EPBC Act Offset Strategy). Given the time-critical nature of the approval for this SRI report Arrow will include the full areas of impacted PEMs for protected wildlife habitat. This totals an area of 76.45 ha to be included in the NoE for biodiversity offset for this project (refer to Table 5 for breakdown). It is noted that Arrow will discuss this matter with DETSI to avoid duplication of offset requirements for future SGP projects.

4.2.8 Protected wildlife habitat – habitat for an animal that is Special Least Concern

Table 4 and Table 5 show there is 0.30 ha of habitat for the Short-beaked Echidna, listed as a Special Least Concern species, to be impacted by the project. This habitat is comprised of State-mapped wildlife habitat (Special Least Concern species) and records of sightings during Arrow field work, buffered by one kilometre. Under the SRI Assessment Guideline (DEHP, 2014), an action is likely to have a significant impact on a Special Least Concern (non-migratory) animal wildlife habitat if it is likely that it will result in:

- a long-term decrease in the size of a local population; or
- a reduced extent of occurrence of the species; or
- fragmentation of an existing population; or
- result in genetically distinct populations forming as a result of habitat isolation; or
- disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species.

The Short-beaked Echidna is a widespread and common mammal, occurring throughout all of mainland Australia. They are generalist in their habitat preference, occurring within alpine and cold-temperate areas to deserts and tropical regions. The Short-beaked Echidna appears to have no specific habitat requirements beyond a food supply of ants and termites.

As this species is widespread, highly mobile, non-territorial, and a generalist in habitat preference, the removal of 0.30 ha of potential habitat for the Short-beaked Echidna is not likely to lead to a long-term decrease in the size of a local population, or a reduced extent of occurrence of the species.

The nature of the clearing works for the DXP4 Project and associated infrastructure does not involve broadscale clearing and is instead linear in nature, with vegetation clearing comprising of narrow (<40 meters wide) linear strips, and well pads approximately one ha in size. This type of clearing footprint is not likely to result in fragmentation of an existing population, as the species will move through disturbed and cleared areas such as access tracks, and the nature of the clearing does not create a 'hard' barrier to dispersal (such as a permanent road or large building). Therefore, the proposed action is unlikely to result in fragmentation of populations, or result in genetically distinct populations forming because of habitat isolation

Although no burrows or potential den sites have been specifically recorded within the project area, Arrow's *Species management program for Tampering with Animal Breeding Places* (2023) (SMP) will be implemented prior to and during habitat disturbance. The SMP outlines specific controls and mitigation measures to be implemented if individuals Echidnas, as well as potential or active burrows are found within the clearing area during pre-clearing surveys or clearing works. The Impact Minimisation Hierarchy ensures that avoiding disturbance during breeding season (July – November) is the highest priority in the hierarchy of controls, as well as additional measures including exclusion zones around individuals or burrows, and specific management by an experienced fauna spotter catcher. Therefore, the proposed action is unlikely to result in disruption to ecologically significant locations for the Short-beaked Echidna.

Therefore, it is unlikely that the construction of the pipeline will result in a long-term decrease in the size of a local population or reduce the extent of occurrence of the Short-beaked Echidna and is unlikely to result in population fragmentation or genetically distinct populations of Short-beaked Echidnas. Furthermore, it is unlikely that the construction works will result in a disruption to ecologically significant locations (breeding, feeding or nesting sites).

The results of this SRI assessment conclude that the construction and operation of the pipeline for the project is unlikely to have a significant impact to the Short-beaked Echidna. An SRI for this PEM is not considered likely and therefore this PEM will not be included in the NoE for biodiversity offset for this project.

4.2.9 Waterway providing for fish passage – Fish passage (not in an urban area).

There are fifteen mapped watercourses (Broadwater Gully and unnamed tributaries of Wilkie Creek and Condamine River) intersecting the project footprint, which are categorised by DAF as having 'low' and 'moderate' risks of impact for fish passage.

Waterway barrier works in a fish passage waterway will be undertaken in accordance with the DAF guideline "*Accepted development requirements for operational work that is constructing or raising waterway barrier works*" (DAF, 2018). The purpose of this section is to assess if the proposed pipeline crossing construction will have a SRI relating to the MSES 'Waterway providing for Fish Passage'.

Under the SRI Assessment Guideline (DEHP, 2014), an environmental offset may be required '*for any part of a waterway that provides for passage of fish (other than that part of a waterway within an urban area) if the construction, installation or modification of waterway barrier works carried out under an authority will limit the passage of fish along the waterway*'.

In accordance with DEHP (2014), the construction and operation of the pipeline for the project is not likely to:

- result in the mortality or injury of fish; or
- result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage such as through the depletion of fishes energy reserves, stranding, increased predation risks, entrapment or confined schooling behaviour in fish; or
- reduce the extent, frequency or duration of fish passage previously found at a site; or
- substantially modify, destroy or fragment areas of fish habitat (including, but not limited to in-stream vegetation, snags and woody debris, substrate, bank or riffle formations) necessary for the breeding and/or survival of fish; or
- result in a substantial and measurable change in the hydrological regime of the waterway, for example, a substantial change to the volume, depth, timing, duration and frequency of flows; or
- lead to significant changes in water quality parameters such as temperature, dissolved oxygen, pH and conductivity that provide cues for movement in local fish species.

Except for The Condamine River which will be under bored (HDD - horizontal directional drilling), the focal watercourses are ephemeral in nature. Construction of the pipelines are proposed to be a standard open-cut (trenching) method. This technique is most suited to dry or low flow conditions and involves establishing a stable working platform either side of the watercourse and creating a trench using excavators, or similar. Tie-in points will be located on high ground, away from any water flow. Trench spoil removed from the watercourse will be positioned above the high bank. Welded pipe will be laid in the trench and spoil material returned to the trench. Trench and backfill activities will be undertaken to ensure that the bed and bank materials are stockpiled separately and returned to the trench to match original conditions to the greatest extent possible. Rock protection may be placed over the trench if required, to prevent potential scouring during high water flow conditions.

Pipeline construction will be undertaken outside of the wet season when the watercourses are not expected to be flowing. As such it is very unlikely that fish species will be present during construction. Construction time for watercourse crossing is expected to be approximately 10 days.

Construction methodology will not introduce any chemicals or solvents, alter water chemistry, or change flow regimes. All construction works will be undertaken and completed in accordance with IECA Best Practice Erosion & Sediment Control Guidelines (IECA, 2008). If water is present in the watercourse, erosion and sediment control (ESC) measures such as temporary coffer dams and silt curtains, as determined by a suitably qualified person, will be installed for the duration of instream works. These measures may temporarily restrict passage whilst in place. If required, water quality monitoring (such as, total dissolved solids (TDS), dissolved oxygen, pH, etc.) will be undertaken during instream construction works to ensure ESC measures and construction methodology is effective. Fauna spotter-catchers will regularly monitor the crossing for possible presence of aquatic species including fish. If monitoring has indicated an impact, then works will cease until such time as the issue is resolved in consultation with a suitably qualified person. The ESC measures will be removed once in-stream construction works are completed.

Following construction, the construction trench will be backfilled using spoil to match original conditions. All temporary construction materials and equipment will be removed from the crossing location prior to the onset of the following wet season. No permanent structure or water barrier will be left in-situ that will meaningfully change local hydrology. Following completion of construction activities, the disturbed area will be rehabilitated to reflect the pre-disturbance state and surrounding area.

Therefore, it is very unlikely that the construction of the pipeline will result in the direct mortality or injury of fish or substantially increase risks to fish health and wellbeing through stranding, entrapment, or confined schooling behaviour. The extent, frequency or duration of fish passage is unlikely to be reduced. The construction and operation of the pipeline is unlikely to substantially modify, destroy or fragment areas of fish habitat necessary for the breeding and/or survival of fish. It is also very unlikely to result in a substantial and measurable change in the hydrological regime of the waterway or lead to significant changes in water quality.

The results of this SRI assessment conclude that the construction and operation of the pipeline for the project is very unlikely to have a significant impact to a waterway providing for fish passage and will not limit the passage of fish along the waterway. An SRI for this PEM is not considered likely and therefore this PEM will not be included in the NoE for biodiversity offset for this project.

5. Conclusion

Arrow is yet to investigate options to avoid duplication regarding biodiversity offsets for many overlapping State and Federal matters for the same impact area. This, in combination with the time critical nature of this DXP4 SRI assessment report approval has led Arrow to identify a total of 76.45 ha of vegetation clearing to require an offset under the state processes for the following:

- Regulated vegetation:
    - Of Concern Regional Ecosystems
    - Regional ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse
- Connectivity Areas
- Protected wildlife habitat for the Koala, Grey Snake, Diamond Firetail, Death Adder, Greater Glider, Yellow-bellied Glider, Glossy Black-cockatoo, Brigalow Woodland Snail and Painted Honeyeater.

These PEMs are within the following vegetation communities:

- 0.21 ha of regrowth RE 11.3.1
- 1.95 ha of remnant RE 11.3.2
- 3.94 ha of regrowth RE 11.3.2
- 2.27 ha of remnant RE 11.3.14
- 4.41 ha of remnant RE 11.3.18
- 0.12 ha of remnant RE 11.3.26
- 8.93 ha of remnant RE 11.5.1
- 34.04 ha of regrowth RE 11.5.1
- 0.17 ha of regrowth RE 11.5.1a
- 0.19 ha of remnant RE 11.5.20
- 0.04 ha of regrowth RE 11.5.20
- 17.25 ha of remnant RE 11.7.4
- 0.24 ha of regrowth undifferentiated land zone 3
- 0.27 ha of regrowth undifferentiated land zone 5
- 2.41 ha of derived grassland

Table 6 summarises the authorised SRIs to PEMs as listed in the DXP EA Table 3.

Table 6 Significant Residual Impacts (SRIs) to Prescribed Environmental Matters (PEMs) with the Environmental Authority (EA) Table 3

PEM	Total area (ha) authorised in EA	Total additional area (ha) from DXP4 (SGP Stage 1f)
REGULATED VEGETATION		
Of Concern regional ecosystem		
RE 11.3.2	16	1.95
Regional Ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse on the vegetation management watercourse map		
RE 11.3.2	0.86	0.08
RE 11.3.14	0.20	0.20
RE 11.3.18	2.57	0.30
RE 11.5.1	4.28	0.17
RE 11.7.4	0.43	0.01
CONNECTIVITY AREAS		
Connectivity area that is a Regional Ecosystem (not in urban area)	32.54	32.54
WETLANDS AND WATERCOURSES		
A wetland of high ecological significance shown on the Map of referable wetlands	2.12	0.26 (no SRI)
Waterway providing for fish passage – Fish passage (not in an urban area)	6.0	0.19 (no SRI)
PROTECTED WILDLIFE HABITAT		
Habitat for an animal that is Endangered wildlife		
Adclarkia cameroni	6.10	6.10
Hemiaspis damelii	219	8.42
Phascolarctos cinereus	95.21	73.52
Habitat for an animal that is Vulnerable wildlife		
Acanthophis antarcticus	317	35.12
Calyptorhynchus lathami	94	17.46
Furina dunmalli	70.07	30.78 (MNES)
Grantiella picta	0.62	0.22
Nyctophilus corbeni	55.98	32.86 (MNES)

PEM	Total area (ha) authorised in EA	Total additional area (ha) from DXP4 (SGP Stage 1f)
Petaurus australis australis	26.49	26.49
Petauroides volans	29.87	28.77
Stagonopleura guttata	35.12	35.12
Habitat for an animal that is Special Least Concern wildlife		
Tachyglossus aculeatus	57.0	0.30 (no SRI)

5.1 Distinct Matter Area (DMA) Grouping Justification for Financial Offsets

If this SRI assessment is approved by DETSI a corresponding Notice of Election (NoE) submission will be made as a Financial Offsets Calculation. Table 7 outlines the Distinct Matter Area (DMA) grouping for the financial offset calculation. The purpose of this Section is to provide supporting justification that demonstrates why it is appropriate to group these matters in the same DMA, in relation to their required habitat requirements and rehabilitation management actions.

Appendix 6 of the Queensland Environmental Offsets (EO) Policy (v1.17) (DETSI, 2025) outlines several examples of direct management actions that can achieve a conservation outcome. The implementation of such management actions when applied to rehabilitated areas of the REs applicable to each focal species (Table 5; Ecosmart Ecology and 3D Environmental, 2023) can lead to an improvement in the extent and quality of available habitat for these species. Based on the habitat mapping rules (Ecosmart Ecology and 3D Environmental, 2023), management actions intended to restore disturbed and/or degraded areas of the applicable REs for the focal species will simultaneously result in an improvement in the shelter and foraging habitat for these species.

Species	Description	Corresponding Project REs
Acanthophis antarcticus (Death Adder)	Common Death Adders are present throughout most of Queensland but are rarely observed. When located, they are often associated with large contiguous tracts of vegetation (Wilson & Swan 2020). The species can be present in a broad range of habitat including heath, shrubland, rainforest and open woodland and typically not associated with Grassland environments (Ehmann, 1992; Wilson & Swan, 2020). Within the Brigalow Belt, the Common Death Adder is mostly associated with large contiguous patches of remnant vegetation (Ecosmart Ecology and 3D Environmental, 2023). As a sit-and-wait predator, this species is typically sedentary, burying itself in leaf litter, vegetation or soil where is lies in wait targeting small mammals, lizards and sometimes frogs (Ehmann 1992; Shine *et al.,* 2014). A reduction in available ambush sites and increased exposure to predation in fragmented and disturbed areas, such as the SGP, likely restricts the species to larger tracts of vegetation (Cogger 2000; Reed & Shine 2006). The Common Death Adder is particularly susceptible to poisoning from Cane Toads which are widespread in the SGP (Hagman *et al.* 2009).	Remnant REs 11.3.2, 11.3.14, 11.3.18, 11.3.26, 11.5.1, 11.5.20, and 11.7.4.

Species	Description	Corresponding Project REs
	These factors may explain the lack of abundance in the project area as there are only two spatially reliable records within 50 km of the SGP. One record near Tara in 2021 and a second record near Lake Broadwater in 1984 (Ecosmart Ecology and 3D Environmental, 2023). Based on the above information, the Common Death Adder has a broad range of potential habitat but is highly susceptible to disturbance. Therefore, all REs within or directly adjacent to large tracts of remnant vegetation are considered potential habitat for the species.	
Adclarkia cameroni (Brigalow Woodland Snail)	This species inhabits the southern portion of the Brigalow Belt, and more specifically, within the Condamine River Floodplain between Dalby and Chinchilla. Habitat includes Brigalow and alluvial Eucalypt communities with dense leaf-litter, fallen bark, and other scattered debris such as logs and wood piles accumulated from flooding events. The Brigalow Woodland Snail has limited ability for dispersal, putting it at a higher risk from fragmentation (Ecosmart Ecology and 3D Environmental, 2023). Significant canopy/shrub cover is necessary for survival as it replenishes its food supply which is likely to be lichen, algae, and other detritus (TSSC, 2016). Egg desiccation is a significant threat to land snails and a canopy/shrub layer maintains a relative humidity within the substrate further supported by an increased abundance of litter compared to non-remnant cleared areas (TSSC, 2016). As such, potential habitat correlates with remnant and regrowth Brigalow and alluvial Eucalypt woodland REs with dense tree/shrub cover and a ground layer providing ample scattered woody debris, leaf-litter, wood piles and flood debris.	Remnant or regrowth REs 11.3.1 and 11.3.2.
Calyptorhynchus lathami lathami (Glossy Black-cockatoo)	Inhabits woodlands and forests containing abundant food resources and large hollows for breeding. Therefore, many populations are restricted to remnant vegetation communities surrounded by agricultural land uses (Higgins 1999). The Glossy Black-cockatoo is a dietary specialist, foraging exclusively on *Allocasuarina* and *Casuarina* spp. (Chapman, 2007). This species is never far from waterbodies, which are visited daily by flocks. As a highly mobile species, considerable distance is covered in the search of food. Advanced regrowth vegetation may provide some value as a foraging resource for the species. Records exist where feeding on non-preferred plants in other genera such as *Callitris* and *Banksia* species has occurred; potentially due to periods of poor *Allocasuarina* spp. seed/cone production. Glossy-black Cockatoos are well represented in the broader SGP with a number of reliable records (Ecosmart Ecology and 3D Environmental, 2023). Spatial analysis of Glossy Black-cockatoo records within 50 km of the SGP shows an association with remnant REs containing *Casuarina cristata* (Belah), *Allocasuarina inophloia* (Stringybark She-oak) and *Allocasuarina littoralis* (Black She-oak) (Ecosmart Ecology and 3D Environmental, 2023). Regrowth REs with the possibility of containing larger trees suitable for foraging are also considered potential habitat; for example, where previous clearing activities retained large trees to provide shade for livestock.	Remnant or regrowth REs 11.3.1 and 11.7.4.

Species	Description	Corresponding Project REs
Grantiella picta (Painted Honeyeater)	Painted Honeyeater are a migratory species that inhabit dry open woodlands and forests, preferring large areas of remnant woodland composed of old trees. Mistletoe is a key component of habitat used by the Painted Honeyeater; however, it is not the only resource utilised by the species. The Painted Honeyeater will use its entire habitat matrix as necessary, such as feeding on nectar and taking invertebrates to supplement its diet (Oliver *et al*., 2003). *Amyema quandang* (Grey Mistletoe) is known to have a close link to the breeding behaviour of Painted Honeyeaters and is a common component of RE 11.4.3 as it frequently parasitises *Acacia harpophylla* (Brigalow) (Stanley & Ross 1995; Barea & Watson, 2007). *Amyema cambagei* (Needle-leaved Mistletoe), another important species to the Painted Honeyeater, is also a common component of RE 11.4.3, where it parasitises *Casuarina cristata* (Belah). Grey Mistletoe can be found in higher abundance in fragmented landscapes, especially linear patches of Brigalow, such as that found in and around the project footprint and the wider Surat Gas Project (SGP) (Bowen *et al*., 2009). This suggests a high importance of Brigalow patches for the Painted Honeyeater in fragmented landscapes, providing a food source and connectivity between larger habitats (Bowen *et al*., 2009). Within the SGP, Painted Honeyeater potential habitat consists of both remnant and regrowth Brigalow REs. The species' reliance on Brigalow dominant vegetation communities is mirrored in the analysis of Painted Honeyeater records throughout the entire SGP, undertaken by Ecosmart Ecology and 3D Environmental (2023), where 97% of the 533 records within the bounds of the SGP exist in either non-remnant vegetation, or in vegetation communities where Brigalow is a significant floristic component. This provides a clear picture of the Painted Honeyeater's habitat preference in the SGP.	Remnant or regrowth RE 11.3.1 and 11.5.20 (around Lake Broadwater).
Hemiaspis damelii (Grey Snake)	Occurring in the Brigalow Belt, Grey Snakes inhabit a variety of communities with frog prey habitat, primarily where water accumulates for protracted periods of time. This includes Brigalow (± Belah) and grassland communities on cracking clay soils where the formation of gilgai microrelief and soil cracks are common. Eucalypt forest on alluvial plains (land zone 3), where frequent inundation occurs, will also harbour Grey Snake habitat. Grey Snake has been observed a multitude of times in non-remnant habitats such as derived grassland. (Hobson 2002; Rowland 2012; Covacevich & Wilson 2020; Wilson & Swan 2020; Wilson 2022; Ecosmart Ecology and 3D Environmental, 2023). This suggests a higher reliance on frog prey habitat and microrelief features (i.e. gilgai and soil cracks) as opposed to the dominant vegetation type within a community (Ecosmart Ecology and 3D Environmental, 2023). A desktop mapping review of the Grey Snake was undertaken by Attexo (2024) to address inaccuracies encountered when using broad-scale vegetation mapping to predict potential habitat, as the species is highly dependent on microhabitat features. Grey Snake records in the SGP were assessed against the Queensland wetland mapping, watercourse data, floodplains assessment overlay, land use mapping and Australian Soil Classification mapping. As a result, areas with suitable landform (e.g. alluvial plains, streams, water features) and microhabitat features (i.e. cracking clay soils, dense leaf litter, and coarse woody debris) within close proximity to freshwater wetlands, waterways and other water	Remnant or regrowth REs 11.3.1, 11.3.2, 11.3.14, 11.3.18, 11.5.1, 11.7.4, undifferentiated regrowth and derived grassland where there is proximity to freshwater frog habitat.

Species	Description	Corresponding Project REs
	features are considered potential habitat for the species. Gilgai microrelief can hold water for protracted periods (2-3 months) and is also considered potential habitat. These areas of potential habitat are not restricted to REs and can be found in non-remnant areas, such as derived grassland and undifferentiated regrowth. Areas of significant disturbance, such as access tracks, cropping or cultivation, are not considered habitat for this species.	
Petauroides volans sensu lato (Greater Glider)	Predominately restricted to Eucalypt forests and woodlands. Greater Gliders feed primarily on *Eucalyptus* spp.; however, will also occasionally feed on other species such as *Acacia* or mistletoes (Lindenmayer, 2002; Kavanagh & Wheeler, 2004; Woinarski *et al.*, 2014). This species requires an abundance of large hollows which is linked to greater populations. Selected hollows are typically higher in the canopy and comparatively deeper, with a large internal cavity preferred. Greater Gliders in the southern Brigalow Belt are primarily associated with forests dominated by *Eucalyptus tereticornis, E. moluccana, E. fibrosa* and *Corymbia citriodora, E. crebra* and *E. melanophloia* (Comport et al. 1996; Smith et al. 2007; Eyre et al. 2022). In drier or more open woodlands, an individual's home range can be upwards of 19 ha however, they can also persist in small, fragmented patches (Lindenmayer 2002; Pope et al. 2004; Eyre et al. 2022). This is in line with the spatial analysis of records undertaken by Ecosmart Ecology (2023) noting several observations made in highly fragmented landscapes. Therefore, potential habitat includes remnant REs containing large hollows and feed trees as well as being connected to other remnant vegetation forming a patch large enough to support a home range.	Remnant REs 11.3.14, 11.3.26, 11.5.1, 11.5.20, and 11.7.4.
Petaurus australis australis (Yellow-bellied Glider)	In the northern and central parts of Australia, this species is associated with dry Eucalypt Forest containing smooth and gum-barked trees with high, narrow, and deep hollow. Favouring larger trees (>60 cm dbh), the Yellow-bellied Glider diet consists primarily of tree sap and nectar, which is supplemented with insects (Eyre, 2007; Smith & Russell, 1982; Craig, 1985; Kavanagh, 1987; Goldingay, 1987, 1990; Bilney *et al.,* 2022). The Yellow-bellied Glider is generally restricted to contiguous or nearly contiguous patches of forest with vegetated areas less than 18,000 ha not likely to support a viable population (Goldingay & Possingham, 1995; TSSC, 2022). Individuals have an average home range size between 25 – 85 ha and will regularly change dens, sometimes nightly (Craig, 1985; Goldingay & Kavanagh, 1991; Goldingay & Possingham, 1995). This species is well represented in the Barakula and Gurulmundi State Forests which has connectivity with sections of the SGP north of the Miles township. Records are also present in Braemar State Forest, towards the south of the SGP. Based on this, the species is likely to occur within the SGP but has not been detected (Ecosmart Ecology and 3D Environmental, 2023). Location data within 50 km of the SGP shows most Yellow-bellied Glider records are in vegetation communities dominated by *Corymbia citriodora* (Spotted Gum), a smooth barked species. Known Yellow-bellied Glider tree associations are also identified in the species federal conservation advice (TSSC, 2022). Potential habitat for the species is therefore restricted to remnant REs (with	Remnant REs 11.3.26, 11.5.1, 11.5.20 and 11.7.4.

Species	Description	Corresponding Project REs
	the relevant tree associations) within large, contiguous or near-contiguous areas of vegetation.	
Phascolarctos cinereus (Koala)	Occurs in a diversity of habitats including forest, woodland and semi-arid communities on foothills, plains and in coastal areas. Although it is not a restriction to the Koalas habitat, there is an association with watercourses near the western edge of the species range. Koalas primarily feed on *Eucalyptus* tree species and show dietary preferences based on geographical region and tree species present. In the Brigalow Belt, Koalas have at least 24 species of Eucalyptus upon which they preferentially forage (ANU, 2021). The following have been recorded within the SGP: *Corymbia tessellaris, C. citriodora, Eucalyptus camaldulensis, E. chloroclada, E. coolabah, E. crebra, E. exserta, E. fibrosa, E. melanophloia, E. moluccana, E. ochrophloia, E. populnea, and E. tereticornis*. Across the SGP, this species inhabits all remnant and regrowth REs, except RE 11.9.5 where potential foraging trees do not grow (Ecosmart Ecology and 3D Environmental, 2023). RE 11.9.5 is not present within the project area.	All remnant and regrowth REs.
Stagonopleura guttata (Diamond Firetail)	The Diamond Firetail has a broad range of habitat including cypress forest, Banksia shrubland and Eucalypt woodlands but, are likely unable to persist in fragmented landscapes as vegetation patches greater than 200 ha are needed (Cooney & Watson, 2005; McGuire & Kleindorfer, 2007; Antos, et al. 2008; Hodder, 2019). It is a granivorous species, spending most of its time on the ground feeding on grasses and a modicum of forbs (Read, 1994; Hodder, 2019). Ideal foraging habitat is in areas of low tree density, few fallen logs, and a high percentage of grass cover interspersed with moss, forbs and bare ground (Antos & Bennett, 2006; Antos *et al*., 2008). Understanding the habitat use of this species within the SGP is difficult as accurate publicly available records are scarce and prior survey effort has not located the species. Therefore, all remnant REs within a patch of vegetation greater than 200 ha, except those known for low grass cover, are considered potential habitat for the species.	Remnant REs 11.3.2, 11.3.14, 11.3.18, 11.3.26, 11.5.1, 11.5.20 and 11.7.4.

Table 7 Distinct Matter Area (DMA) Groupings for Financial Offsets Calculation

DMA	Matter no.	Matter Groups	Impact Area (ha)
1.1	1.1.1	Regional Ecosystem 11.3.2 (*Eucalyptus populnea* woodland on alluvial plains (regulated vegetation – remnant RE within defined distance of a watercourse)	**0.08**
	1.1.2	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.1.3	Threatened animals — *Adclarkia cameroni* (Brigalow Woodland Snail)	
	1.1.4	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.1.5	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.1.6	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.2	1.2.1	Regional Ecosystem 11.3.2 (regulated vegetation - Of Concern regional ecosystem)	**0.20**
	1.2.2	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.2.3	Threatened animals — *Adclarkia cameroni* (Brigalow Woodland Snail)	
	1.2.4	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.2.5	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.2.6	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.3	1.3.1	Regional Ecosystem 11.3.2 (regulated vegetation - Of Concern regional ecosystem)	**1.67**
	1.3.2	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.3.3	Threatened animals — *Adclarkia cameroni* (Brigalow Woodland Snail)	
	1.3.4	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.3.5	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.4.	1.4.1	Regional Ecosystem 11.3.14 (*Eucalyptus spp., Angophora spp., Callitris spp.* woodland on alluvial plains) (regulated vegetation – remnant RE within defined distance of a watercourse)	**0.20**
	1.4.2	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.4.3	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.4.4	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.4.5	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.4.6	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.5	1.5.1	Regional Ecosystem 11.3.18 (*Eucalyptus populnea*, *Callitris glaucophylla*, *Allocasuarina luehmannii* shrubby woodland on alluvium) (regulated vegetation – remnant RE within defined distance of a watercourse)	**0.30**
	1.5.2	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.5.3	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.5.4	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.5.5	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.6	1.6.1	Regional Ecosystem 11.5.1 (*Eucalyptus crebra* and/or *E. populnea*, *Callitris glaucophylla*, *Angophora leiocarpa*, *Allocasuarina luehmannii* woodland on Cainozoic sand plains and/or remnant surfaces) (regulated vegetation – remnant RE within defined distance of a watercourse)	**0.17**
	1.6.2	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.6.3	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.6.4	Threatened animals — *Petauroides volans* (Greater Glider)	

	1.6.5	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.6.6	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.6.7	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.7	1.7.1	Regional Ecosystem 11.7.4 (*Eucalyptus decorticans* and/or *Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius* woodland on Cainozoic lateritic duricrust) (regulated vegetation – remnant RE within defined distance of a watercourse)	**0.01**
	1.7.2	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.7.3	Threatened animals— *Calyptorhynchus lathami (*Glossy Black-cockatoo)	
	1.7.4	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.7.5	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.7.6	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.7.7	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.7.8	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.8		Regrowth RE 11.3.1 (non-regulated vegetation)	**0.21**
	1.8.1	Threatened animals — *Adclarkia cameroni* (Brigalow Woodland Snail)	
	1.8.2	Threatened animals— *Calyptorhynchus lathami (*Glossy Black-cockatoo)	
	1.8.3	Threatened animals — *Grantiella picta* (Panited Honeyater)	
	1.8.4	Threatened animals — *Phascolarctos cinereus* (Koala)	
1.9		Regrowth RE 11.3.2 (non-regulated vegetation)	**0.98**
	1.9.1	Threatened animals — *Adclarkia cameroni* (Brigalow Woodland Snail)	
	1.9.2	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.9.3	Threatened animals — *Phascolarctos cinereus* (Koala)	
1.10		Regrowth RE 11.3.2 (non-regulated vegetation)	**2.96**
	1.10.1	Threatened animals — *Adclarkia cameroni* (Brigalow Woodland Snail)	
	1.10.2	Threatened animals — *Phascolarctos cinereus* (Koala)	
1.11		Remnant RE 11.3.14 (non-regulated vegetation)	**0.47**
	1.11.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.11.2	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.11.3	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.11.4	Threatened animals — *Petauroides volans* (Greater Glider)	
1.12		Remnant RE 11.3.14 (non-regulated vegetation)	**1.6**
	11.12.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	11.12.2	Threatened animals — *Phascolarctos cinereus* (Koala)	
	11.12.3	Threatened animals — *Petauroides volans* (Greater Glider)	
1.13		Remnant RE 11.3.18 (non-regulated vegetation)	**0.14**
	1.13.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.13.2	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.13.3	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.13.4	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.14		Remnant RE 11.3.18 (non-regulated vegetation)	**3.96**
	1.14.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.14.2	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.14.3	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	

1.15		Remnant RE 11.3.26 (non-regulated vegetation)	**0.12**
	1.15.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.15.2	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.15.3	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.15.4	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.15.5	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.16		Remnant RE 11.5.1 (non-regulated vegetation)	**0.47**
	1.16.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.16.2	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.16.3	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.16.4	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.16.5	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.16.6	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.17		Remnant RE 11.5.1 (non-regulated vegetation)	**8.29**
	1.17.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.17.2	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.17.3	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.17.4	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.17.5	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.18		Regrowth RE 11.5.1 (non-regulated vegetation)	**2.31**
	1.18.1	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.18.2	Threatened animals — *Phascolarctos cinereus* (Koala)	
1.19		Regrowth RE 11.5.1 (non-regulated vegetation)	**31.9**
	11.19.1	Threatened animals — *Phascolarctos cinereus* (Koala)	
1.20		Remnant RE 11.5.20 (non-regulated vegetation)	**0.01**
	1.20.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.20.2	Threatened animals — Grantiella picta (Panited Honeyater)	
	1.20.3	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.20.4	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.20.5	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.20.6	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.21		Remnant RE 11.5.20 (non-regulated vegetation)	**0.18**
	1.21.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.21.2	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.21.3	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.21.4	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.21.5	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.22		Regrowth RE 11.5.20 (non-regulated vegetation)	**0.04**
	1.22.1	Threatened animals — *Phascolarctos cinereus* (Koala)	
1.23		Remnant RE 11.7.4 (non-regulated vegetation)	**0.17**
	1.23.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.23.2	Threatened animals— *Calyptorhynchus lathami (*Glossy Black-cockatoo)	

	1.23.3	Threatened animals — *Hemiaspis damelii* (Grey Snake)	
	1.23.4	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.23.5	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.23.8	Threatened animals — *Phascolarctos cinereus* (Koala)	
	1.23.9	Threatened animals — *Stagonopleura guttata* (Diamond Firetail)	
1.24		Remnant RE 11.7.4 (non-regulated vegetation)	**17.07**
	1.24.1	Threatened animals — *Acanthophis antarcticus* (Death Adder)	
	1.24.2	Threatened animals— *Calyptorhynchus lathami (*Glossy Black-cockatoo)	
	1.24.3	Threatened animals — *Petauroides volans* (Greater Glider)	
	1.24.4	Threatened animals — *Petaurus australis australis* (Yellow-bellied Glider)	
	1.24.5	Threatened animals — *Phascolarctos cinereus* (Koala)	
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Request for Information Response DXP 4

Appendix E: EcoSmart Likelihood of Occurrence Assessment

THREATENED SPECIES MAPPING RULES REVIEW

Surat Gas Project

PREPARED FOR ARROW ENERGY PTY LTD
September 2023

Surat Gas Project

Threatened species mapping rules review

September 2023

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DOCUMENT CONTROL

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Project Manager:	Mark Sanders
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APPENDICES

1.0 INTRODUCTION

In 2011 3D Environmental (3DE) and EcoSmart Ecology (ESE) prepared a terrestrial ecology impact assessment report for the Surat Gas Project (SGP). This work included inspecting relevant data sources to identify threatened species (flora and fauna specially protected under the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] and *Nature Conservation Act 1992* [NC Act]), which are known within and surrounding the SGP.

'Rules' were created to map habitat for these Matters of National and State Environmental Significance (MNES and MSES) based on GIS data, allowing the prediction of high value habitat. Habitats were classed as 'core' habitat or 'general' habitat. Core habitat areas reflect those REs which are likely to be regularly inhabited by, or of 'high importance' to, the species. Such areas include high amenity habitat which could include important resources such as roosting and nesting sites or food resources. General habitats are 'those REs that may be used less regularly by fauna' (3DE and ESE 2011) and has lower amenity habitat. These definitions roughly match the definitions of 'Core Habitat Possible' and 'General Habitat Possible' in DES (2020), which was not available in 2011 The mapping has been used to calculate offset requirements based on the extent of Core Habitat Known and Core Habitat Possible.

Considerable field work has been completed within and surrounding the SGP area since this work was completed and our local knowledge has increased substantially. In a few cases, this has identified ways in which the mapping rules could be modified and improved for greater accuracy. Such changes are scattered across various survey documents, leading to confusion regarding the most relevant mapping rules. Furthermore, additional MNES and MSES species have been listed under legislation since the work was completed. These additional species have not been previously assessed. A revision of this work is now required, to consolidate previous works, assess new taxa, and review and update the mapping information.

2.0 STUDY METHODOLOGY

2.1 THE SGP AREA

The SGP has a combined extent of 206,594 ha and includes a southern (145,945 ha), central (53,048 ha) and northern area (7,601 ha). The Condamine River forms the eastern boundary of the southern area (Figure 2.1).

A large portion of the central area is covered by remnant vegetation while the northern area has the least amount of remnant vegetation. Available RE mapping (Queensland herbarium v13) across the broader area has been used to identify extensive contiguous or near-contiguous vegetation. Large contiguous patches of remnant vegetation are more likely to contain suitable habitat for patch-size dependant species. The layer 'large tracts remnant veg.shp' (Figure 2.1) has been created to assist in mapping these patch-size dependant species.

2.2 DATA SOURCES

Information on the types of MNES and MSES species which might occur in the SGP area, along with coordinate accurate GIS data (where possible) was gathered from the following sources:

- The EPBC Act Protected Matters Search Tool,
- Australia's Virtual Herbarium (AVH 2023) for vouchered specimen records sourced from a number of Australian Herbarium,
- Wildnet database of voucher plant specimens and fauna and flora observation records,
- The Atlas of Living Australia (ALA) online database (https://www.ala.org.au/),
- EcoSmart Ecology's inhouse database, which includes records from the SGP area gathered while working for Arrow since 2011, and
- Records supplied by Arrow arising from other works such as spotter-catcher activities.

All databases were inspected using a 50 km buffer around the SGP, though for plants a 25 km buffer may have been used to aid the assessment of likelihood. The results were collated, sorted, loaded into ArcGIS for analysis. While possible duplicate records were removed from the database it is undoubtable some remain.

Ground-truthed Regional Ecosystem data was used to determine vegetation types within the SGP area, while mapping from the Queensland Government (v13) was used for areas outside the SGP but within the 50 km buffer (Queensland Government 2023). Other data sources, including Essential Habitat, was also inspected as useful.

2.3 LIKELIHOOD ASSESSMENT

Using the above data, a list of threatened species (as protected under the EPBC or NC Acts) was generated for consideration. The potential of populations of these species occurring within the SGP was assessed based on (i) the location of relevant records, (ii) relevance (i.e., date of records) and (iii) suitability of habitat within the SGP, using the criteria in Table 2.1.

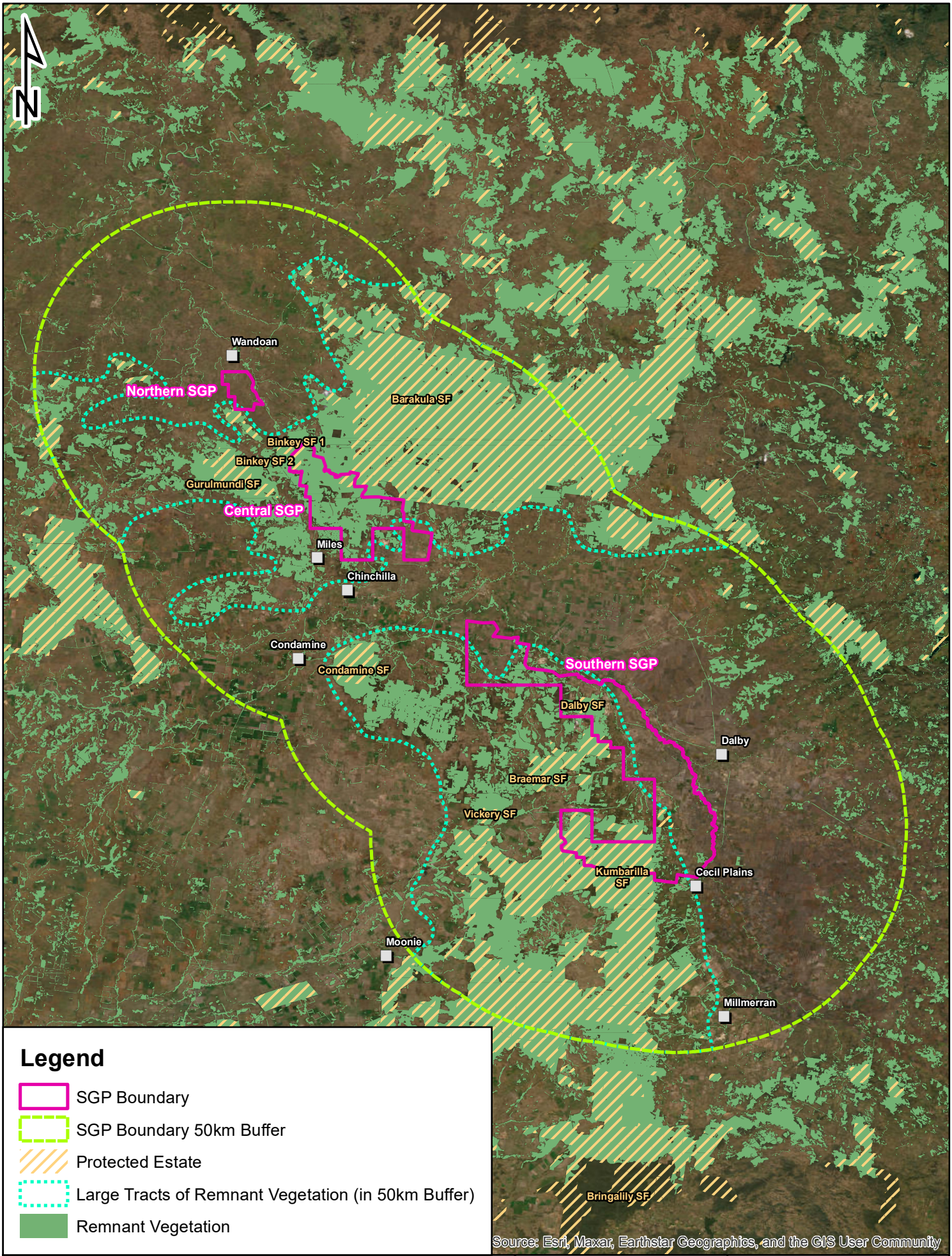


Figure 2.1
The SGP assessment area, remnant vegetation and protected estate

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

A number of species have been recorded from, or could occur at, Lake Broader National Park and will not occur away from this feature. This lake is unique in the local landscape and provides habitat not found elsewhere within the SGP. It is assumed development activities will not affect the lake directly or indirectly and, as such, these species need no further assessment. Special mention is made where a species is restricted to the lake, but they are assessed as 'will not occur' for the broader SGP.

Based on the assessment mapping rules were produced for species known, likely or with the possibility of occurring. Rules for unlikely or transient individuals were not formulated.

Table 2.1. Criteria for assessing the likelihood of populations being present

Likelihood	Criteria	Probability
Known	Recorded within and/or immediately adjacent the SGP area	100%
Likely	Suitable habitat within or immediately adjacent the SGP area; numerous relevant records (< 30 years old and within 20 km)	>80%
Possible	Suitable habitat within or adjacent the SGP; numerous records but records > 20 km away or > 30 years old OR Marginal habitat within the SGP; few, but recent (<30 yrs), records within 20 km of SGP	10-18%
Unlikely	No suitable habitat; few records from desktop assessment and records > 20 km from the SGP	<10%
Will Not Occur (WNO)*	Despite records within 50 km, these species will not occur due to local extinction or the lack of suitable habitat.	0%
Transient	Species highly mobile and known to occasionally appear in areas away from known population centres (usually birds). Species not expected to permanently establish.	N/A

* Some species may occur at Lake Broadwater, which is unique in the landscape and provides habitat not located in the broader SGP.

2.4 Threatened Species Habitat Mapping Rules

An assessment of habitat suitability for individual threatened species (both flora and terrestrial vertebrate fauna) was undertaken to identify areas of 'core' habitat and areas of 'general' habitat. Core habitat areas reflect those REs that are likely to be regularly inhabited by, or of high importance to, the species, while general habitats reflect those REs which may contribute to their broader distribution (DES 2020). Core and general habitat types were determined using the following steps:

1. Refining the threatened species database created in Section 2.1 to include only sightings since 1950 for flora, since 1975 for fauna, and with an accuracy (precision) to within 500 m (DES 2020).
2. Cross-referencing the above sightings against vegetation mapping data (ground-truthed for the SGP and RE mapping v13 for the broader 50 km buffer) to generate a list of REs and Broad Vegetation Groups (BVG) in which each species has been recorded.
3. Extrapolating additional REs based on the types of BVG (1 m) identified in the above step.
4. Cross-referencing the RE list for each species to ensure it includes relevant REs documented as having high value in the Regional Ecosystem Description Database (REDD; Queensland Herbarium 2023).

5. Vetting the resulting RE list generated in the above steps for each species, based on known habitat requirements, to remove erroneous REs.
6. Segregating the REs into core and supplementary categories by comparing the REDD with each species' known habitat requirements.
7. Suggesting any modifications to account for factors that cannot be included in RE descriptions (e.g. species distributions, proximity to highly valuable habitat, patch size etc.).

Consistent with DES (2020), we have designated areas around recent known records (as defined in the first point above) as 'Core Habitat Known'.

Numerous fauna species select habitats based on specific habitat factors which cannot be assigned to individual REs, such as rock outcrops or the presence of water or mistletoe.

2.5 Regional Ecosystems Subject to Assessment

The habitat mapping for this project assessed only REs present within the SGP, as detailed in Table 2.2 below.

Table 2.2. Regional Ecosystems within the SGP and assessed in this work

RE	Description	Extent (ha) in SGP	BVG (1 m)
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	21.51	25a
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	593.55	17a
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	26.83	16 c
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	822.90	16 c
11.3.14	*Eucalyptus spp., Angophora spp., Callitris spp.* woodland on alluvial plains	342.31	18a
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	213.49	25a
11.3.18	*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium	418.39	17a
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	1,448.53	16a
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	3.82	13d
11.3.27a	Vegetation ranges from open water +/- aquatics and emergents such as *Chara spp. Nitella spp., Myriophyllum verrucosum, Nymphaea violacea, Pyrgillus javanicus, Potamogeton crispus, P. tricarinatus, Ottelia ovalifolia, Vallisneria caulescens* and *Nymphoides indica*. A narrow fringing woodland commonly dominated by *E. camaldulensis* or *E. coolabah*	25.36	34a
11.3.27d	*Eucalyptus camaldulensis* and/or *E. tereticornis* woodland. A range of sedges and grasses occur in the ground layer including *Fimbristylis vagans, Myriophyllum striatum, Nitella*	203.49	34a

RE	Description	Extent (ha) in SGP	BVG (1 m)
	pseudoflabellata and *Pseudoraphis* sp. Occurs fringing large lakes.		
11.3.27f	*Eucalyptus coolabah* and/or *E. tereticornis* open woodland to woodland fringing swamps. Occurs on closed depressions on floodplains associated with old drainage courses that are intermittently flooded.	207.11	34d
11.3.27i	*E. tereticornis* woodland to open woodland with sedgeland ground layer. Other tree species such as *E. coolabah* and *E. largiflorens* may be present or locally dominant.	52.0	34d
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains	388.71	25a
11.4.3a	*Melaleuca squamophloia* woodland associated with *Acacia harpophylla* communities on Cainozoic clay plains	56.64	25a
11.5.1	*Eucalyptus crebra* and/or *E. populnea, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains and/or remnant surfaces	35,333.91	18b
11.5.1a	*Eucalyptus populnea* woodland with *Allocasuarina luehmannii* low tree layer. Occurs on flat to gently undulating plains formed from weathered sandstones	350.93	17a
11.5.4	*Eucalyptus chloroclada, Callitris glaucophylla, C. endlicheri, Angophora leiocarpa* woodland on Cainozoic sand plains and/or remnant surfaces	3,242.26	18b
11.5.20	*Eucalyptus moluccana* and/or *E. microcarpa* and/or *E. woollsiana* +/- *E. crebra* woodland on Cainozoic sand plains	5,422.68	13d
11.5.21	*Corymbia bloxsomei* +/- *Callitris glaucophylla* +/- *Eucalyptus crebra* +/- *Angophora leiocarpa* woodland on Cainozoic sand plains and/or remnant surfaces	2,238.88	18a
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	176.41	24a
11.7.4	*Eucalyptus decorticans* and/or *Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius* woodland on Cainozoic lateritic duricrust	12,945.05	12a
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	437.07	29b
11.7.6	*Corymbia citriodora* or *Eucalyptus crebra* woodland on Cainozoic lateritic duricrust	956.16	10a
11.7.7	*Eucalyptus fibrosa subsp. nubilis* +/- *Corymbia spp.* +/- *Eucalyptus spp*. woodland on Cainozoic lateritic duricrust	9,286.21	12a
11.9.2	*Eucalyptus melanophloia* +/- *E. orgadophila* woodland to open woodland on fine-grained sedimentary rocks	46.04	17b
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest to woodland on fine-grained sedimentary rocks	6.50	25a
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	1.53	17a
11.9.10	*Eucalyptus populnea* open forest with a secondary tree layer of *Acacia harpophylla* and sometimes *Casuarina cristata* on fine-grained sedimentary rocks	14.98	25a

2.6 LIMITATIONS

Habitat mapping for this project has assessed only REs present within the SGP (see above). The rules do not supply an exhaustive list of suitable habitats and should only be used for mapping vegetation within the SGP.

Some threatened species are poorly understood and predicting suitable habitats can be difficult. Others are unexplainably scattered throughout the landscape apparently absent from areas suitable habitat while present in others. Fauna can also be highly cryptic and difficult to detect, they can go un-noticed for decades before appearing. This hinders accurately predicting the presence of some species, and therefore potential impacts. Comments on mapping accuracy for each species has been provided as a guide.

3.0 PROBABILITY OF OCCURRENCE ASSESSMENT

3.1 FLORA

There are 30 threatened and near threatened plant species recorded within a 50 km radius of the SGP which have been assessed for their likely occurrence. Of these, 20 are either known or have the possibility to occur (Table 3.1).

Table 3.1. Threatened flora identified in the database searches within 50 km of the SGP

Species	Status		Likelihood in SGP
	NCA	EPBC	
Trees and Shrubs			
Acacia barakulensis Waaje Wattle	Vul		Possible
Acacia curranii Curly Bark Wattle	Vul	Vul	Possible
Acacia handonis Hando 's Wattle	Vul	Vul	Possible
Acacia lauta Tara Wattle	Vul	Vul	Unlikely
Acacia wardellii Thomby Range wattle	NT		Unlikely
Apatophyllum teretifolium Cliff Apatophyllum	NT		Unlikely
Callitris baileyi Bailey's cypress pine	NT		Possible
Calytrix gurulmundensis Gurulmundi Fringe Myrtle	Vul	Vul	Possible
Cadellia pentastylis Ooline	Vul	Vul	Unlikely
Denhamia parviflora Small-leaved Denhamia	Vul	Vul	Unlikely
Eucalyptus argophloia Chinchilla white gum	Vul	Vul	Unlikely
Eucalyptus curtisii Plunkett Mallee	NT		Possible
Eucalyptus pachycalyx subsp. waajensis Pumpkin gum	End		Unlikely
Eucalyptus sideroxylon subsp. improcera Red ironbark	Vul		Unlikely
Eucalyptus virens Shiny-leaved Ironbark	Vul	Vul	Unlikely
Homoranthus decumbens	Vul	End	Unlikely
Homoranthus papillatus	CrE		Unlikely
Melaleuca groveana	NT		Unlikely
Micromyrtus carinata	End		Possible
Micromyrtus patula	End		Unlikely
Philotheca sporadica Kogan Waxflower	NT	Vul	Known
Pomaderris coomingalensis	End		Unlikely
Sophora fraseri	Vul	Vul	Unlikely
Grasses and Sedges			
Cyperus clarus	Vul	-	Unlikely

Species	Status		Likelihood in SGP
	NCA	EPBC	
Digitaria porrecta Finger Panic Grass	NT		Known
Dicanthium queenslandicum	Vul	End	Unlikely
Fimbristylis vagans	End		Known, at least in the past
Homopholis belsonii	End	Vul	Possible
Forbs and Herbs			
Camptacra perdita	End		Unlikely
Clematis fawcettii	Vul	Vul	Unlikely
Cryptandra ciliata	NT		Possible
Cymbonotus maidenii	End		Possible
Leuzea australis	Vul	Vul	Unlikely
Picris barbarorum	Vul		Possible
Picris evae	Vul	Vul	Unlikely
Prostanthera sp. (Dunmore D.M.Gordon 8A)	Vul	Vul	Unlikely
Rutidosis glandulosa	NT		Known
Rutidosis lanata	NT		Possible
Solanum papaverifolium	End		Known
Solanum stenopterum	Vul		Possible
Thesium australe Austral Toadflax	Vul	Vul	Possible
Vincetoxicum forsteri	End	End	Unlikely
Xerothamnella herbacea	End	End	Possible

CrE = Critically Endangered; End = Endangered; Vul = Vulnerable; NT = Near Threatened

3.2 Terrestrial Fauna

A total of 47 threatened fauna species were identified as occurring, or having potential to occur, within 50 km of the SGP. This includes two species identified under the EPBC Protected Matters Search Tool (PMST; DCCEEW 2023a) for which no records were found. The PMST is predictive in nature and can return species which have not been recorded within the search extent.

An analysis of likelihood (Appendix A) indicates 12 species have already been detected within the SGP and a further five are possible. No vertebrates are considered likely, which is not unexpected considering survey effort within the SGP - any species likely to occur have been confirmed as present. This suggests the remaining possible species have a much lower probability of occurring, which is consistent with our assessment. Targeted surveys for the three invertebrates have not been undertaken.

Table 3.2. A summary of the likelihood assessment for threatened terrestrial fauna

GROUP	Likelihood Assessment				
	Known	Possible	Unlikely	Transient	WNO
Invertebrate	3	0	0	0	0
Amphibia	0	0	0	0	3
Reptilia	4	0	2	0	2
Aves	3	3	5	3	6
Mammalia	3	1	2	0	6
Total	*13*	*4*	*9*	*3*	*17*

WNO = Will not occur (but may be restricted to Lake Broadwater)

Profiles and mapping rules for the combined 17 species possible or known from the SGP is provided in Section 5.0. In addition to these species, the Yakka Skink (*Egernia rugosa*), Collared Delma (*Delma torquata*) and Squatter Pigeon (*Geophaps scripta scripta*) were included in Arrows original approval (EPBC 2010/5344). Consideration of records and habitats within the SGP suggest two of these species, the Yakka Skink and Collared Delma, are unlikely to occur while the Squatter Pigeon is possible only as a transient. Populations or areas of important habitat for these species is unlikely and they are not considered further.

Searches also highlighted the possible presence of Hooded Robin and Brown Treecreeper, both of which have a subspecies specially protected under legislation (*Melanodryas cucullata cucullata* and *Climacteris picumnus victoriae* respectively). The SGP is likely within the Brown Treecreeper hybrid zone (Schodde and Mason 1999), suggesting Brown Treecreepers present within the SGP cannot be assigned to subspecies. The boundary between subspecies of Hooded Robin is obscure, with some texts suggesting the southern subspecies extends north into Queensland (Schodde and Mason 1999) while others indicating it is largely restricted to NSW (DCCEEW 2023b). Neither have been confirmed within the SGP and based on all available evidence it seems that the protected subspecies do not occur. They are not considered further in this work.

Table 3.3. Threatened terrestrial vertebrates identified in the database searches within 50 km of the SGP.

CLASS *Scientific Name*	Common Name	EPBC	NCA	No. Rec	Likelihood
INVERTEBRATES					
Adclarkia cameronii	Brigalow Woodland Snail	End	Vul	27	Known
Adclarkia dulacca	Dulacca Woodland Snail	End	End	12	Known
Jalmenus eubulus	Pale Imperial Hairstreak	-	Vul	18	Known
AMPHIBIA					
Adelotus brevis	Tusked Frog	-	Vul	3	WNO
Litoria cooloolensis	Cooloola Tree Frog	-	NT	2	WNO
Mixophyes iteratus	Giant Barred Frog	End	End	1	WNO
REPTILIA					
Acanthophis antarcticus	Common Death Adder	-	Vul	26	Known
Anomalopus mackayi	Five-clawed Worm-skink	Vul	Vul	32	WNO
Delma torquata	Collared Delma	Vul	Vul	0	Unlikely
Egernia rugosa	Yakka Skink	Vul	Vul	5	Unlikely
Furina dunmalli	Dunmall's Snake	Vul	Vul	20	Known
Hemiaspis damelii	Grey Snake	End	End	118	Known
Strophurus taenicauda	Golden-tailed Gecko	-	NT	492	Known
Tympanocryptis condaminensis	Condamine Earless Dragon	End	End	122	WNO
AVES					
Anthochaera phrygia	Regent Honeyeater	CrE	CrE	5	Unlikely
Aphelocephala leucopsis	Southern Whiteface	Vul	Vul	18	Possible
Botaurus poiciloptilus	Australasian Bittern	End	End	16	Unlikely
Calidris ferruginea	Curlew Sandpiper	CrE	CrE	10	WNO (LB)
Calyptorhynchus lathami lathami	Glossy Black Cockatoo	Vul	Vul	293	Known
Erythrotriorchis radiatus	Red Goshawk	End	End	25	Unlikely
Falco hypoleucos	Grey Falcon	Vul	Vul	5	Transient
Geophaps scripta scripta	Squatter Pigeon	Vul	Vul	71	Transient
Grantiella picta	Painted Honeyeater	Vul	Vul	863	Known

CLASS ***Scientific Name***	**Common Name**	**EPBC**	**NCA**	**No. Rec**	**Likelihood**
Hirundapus caudacutus	White-throated Needletail	Vul	Vul	273	Known
Lathamus discolor	Swift Parrot	CrE	End	9	Unlikely
Limosa lapponica baueri	Bar-tailed Godwit	Vul	Vul	10	WNO (LB)
Lophochroa leadbeateri leadbeateri	Major Mitchell's Cockatoo	End	End	15	Transient
Ninox strenua	Powerful Owl	-	Vul	5	Unlikely
Pedionomus torquatus	Plains-wanderer	CrE	CrE	9	WNO
Psephotus pulcherrimus	Paradise Parrot	Ex	Ex	13	WNO
Rostratula australis	Australian Painted Snipe	End	End	24	Possible
Poephila cincta	Black-throated Finch	End	End	2	WNO
Stagonopleura guttata	Diamond Firetail	Vul	Vul	110	Possible
Turnix melanogaster	Black-breasted Button-quail	Vul	Vul	3	WNO
MAMMALIA					
Chalinolobus dwyeri	Large-eared Pied Bat	Vul	Vul	1	WNO
Dasyurus hallucatus	Northern Quoll	End	LC	0	WNO
Dasyurus maculatus maculatus	Spotted-tailed Quoll	End	End	19	Unlikely
Onychogalea frenata	Bridled Nailtail Wallaby	End	End	1	WNO
Petrogale penicillata	Brush-tailed Rock-wallaby	Vul	Vul	2	WNO
Pteropus poliocephalus	Grey-headed Flying-fox	Vul	LC	3	Unlikely
Macroderma gigas	Ghost Bat	Vul	Vul	0	WNO
Nyctophilus corbeni	South-eastern Long-eared Bat	Vul	Vul	25	Known
Petauroides volans (sensu lato)	Greater Glider	End	End	83*	Known
Petaurus australis australis	Yellow-bellied Glider	Vul	Vul	94	Possible
Phascolarctos cinereus	Koala	End	End	735	Known
Pseudomys australis	Plains Rat	Vul	LC	1	WNO

CrE = Critically Endangered; End = Endangered; Vul = Vulnerable; LC = Least Concern; WNO = Will not occur; WNO (LB) = Will not occur across the broader SGP but known specially and only from Lake Broadwater

*Likely duplication of records as *P. armillatus* in Wildnet and *P. volans* in ALA

4.0 POSSIBLE OR KNOWN THREATENED FLORA

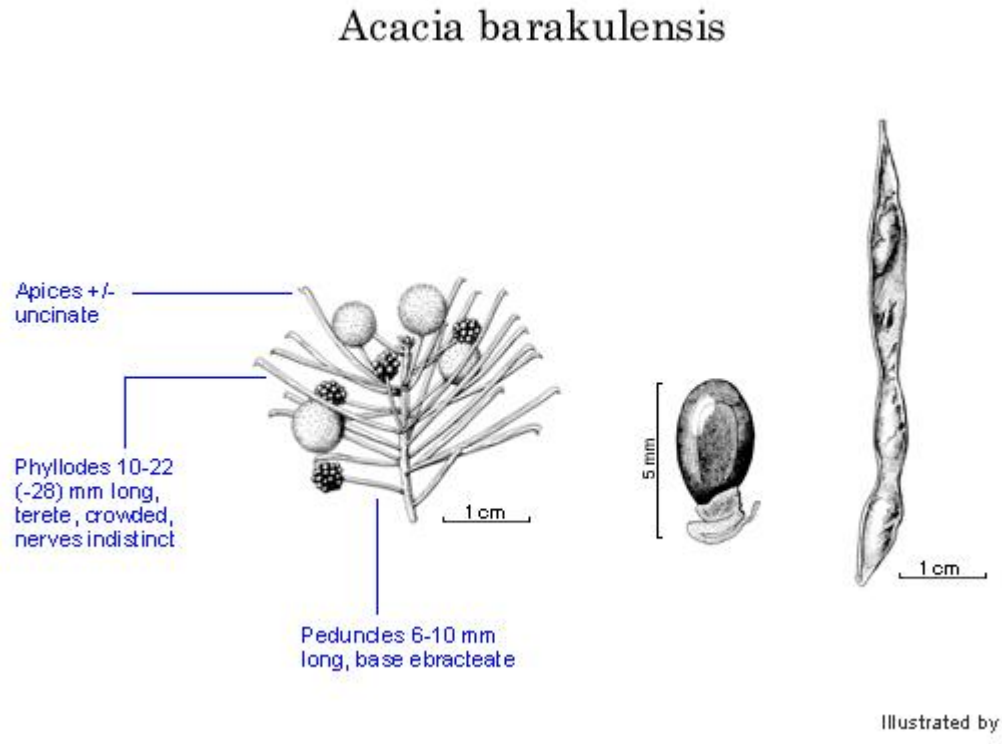
4.1 TREES AND SHRUBS

4.1.1 *Acacia barakulensis* (Waaje Wattle)

Vulnerable (NC Act)

Description

Acacia barakulensis is a small shrub, up to 2 m tall. It is distinguished by its small, terete leaves with an apical hook and round globular flower heads on a long stalk.



Acacia barakulensis diagram from World Wide Wattle

Distribution and Habitat

Waaje Wattle is a local endemic restricted to Barakula State Forest, north of Chinchilla where it grows on sandy soils in eucalypt communities in the Waaje Wildflower Area (Lithgow 1997; Orchard and Wilson 2001; Chinchilla Field Naturalists Club 2017).

HERBRECS specimen records indicate habitat in flat gently undulating plains on the crest of the slope on deep yellow loamy sand soil derived from sandstone or laterite. Vegetation is tall shrubland with *Eucalyptus tenuipes, Corymbia trachyphloia, Calytrix gurulmundensis*, and *Triodia mitchellii* (DES 2022a). Habitat is consistent with RE 11.7.4, 11.7.5, 11.7.6, and 11.7.7. Survey records identified the species in woodland of narrow leaf ironbark (*Eucalyptus crebra*) + smooth barked apple (*Angophora leioclada*) + white cypress pine (*Callitris glaucophylla*) with

a subcanopy of white cypress and bulloak (*Allocasuarina luehmanii*) on old loamy plains (RE 11.5.1, 11.5.4, 11.5.21).

Ecology

Similar to many Acacias, there is a likelihood that *Acacia barakulensis* will respond to disturbance, or populations rejuvenated by fire. Knowledge of the species biology and response to disturbances such as habitat fragmentation, changed fire regimes and edge effects is poorly understood.

Records Relevant to the SGP

Herbrecs identifies five confirmed populations 28 km to the north-east of the SGP area within Barakula State Forest (Figure 4.1). Due to contiguous habitats between this area and the SGP, the species is considered possible to occur.

Rule(s) for Habitat Mapping:

1. The species will only likely occur in the central SGP area.
2. Within the central area of the SGP, REs 11.5.1, 11.5.14, 11.5.21, 11.7.4, 11.7.5, 11.7.6 and 11.7.7 are mapped as 'General Habitat' due to lack of local records.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. Non-remnant and regrowth habitats are mapped as 'Absence Suspected'.

Mapping Confidence

Due to the relatively broad habitat tolerances, mapping of general habitat is considered to be of moderate accuracy.

Legend

Acacia barakulensis

NC Act, EPBC

- Vulnerable, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.1. Spatial distribution of *Acacia barakulensis*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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4.1.2 *Acacia curranii* (Curly-bark Wattle)

Vulnerable EPBC Act (effective Jul 2000)
Vulnerable NC Act

Description

Acacia curranii is a shrub with reddish flaky "minni ritchi" bark. It has long needle like leaves with tiny silky hairs, flowers are clustered in leave axils and the narrow pods have matted hairs.

Curly-bark wattle (*Acacia curranii).* Photograph M. Fagg, Australian National Botanical Gardens

Distribution and Habitat

Acacia curranii has disjunct NSW and Queensland populations. The NSW populations grow on the state's southern western downs. The only known Queensland population occurs in and adjacent to the Gurulmundi State Forest area of the Darling Downs, approximately 65 km north-west of Chinchilla (Pedley 1987; Orchard and Wilson 2001). The Gurulmundi population is restricted to an area of less than 20 km diameter and represents a significant northern population, well separated from the NSW populations.

Plants are known to occur in shrubby heaths, dry sclerophyll forests and semi-arid woodlands where they can occur as widely scattered thickets in very species-rich heathy scrub with emergent eucalypts (Pickard 1995 c, Threatened Species Scientific Committee 2008a). The Gurlumundi population has been reported as growing in dense "groves" (Pedley 1987). Queensland collections of curly-bark wattle, recorded in Herbrecs, mostly occur within areas mapped by the Queensland Herbarium as Regional Ecosystem 11.7.5; shrubland with *Calytrix* spp., *Hakea* spp., *Kunzea* spp., *Micromyrtus* spp., *Acacia* spp., *Melaleuca* spp. and a spinifex grass layer, on natural scalds on deeply weathered sedimentary rocks.

Ecology

The typical life span of curly-bark wattle is unknown, but it is probably similar to many other shrubby *Acacia* species in being a moderately long-lived shrub of 10 to 30 years. It has been recorded flowering during August and September, with pods maturing several months later (Pedley 1987). As a hard-seeded legume, the soil-stored seed reserves of *A. curranii* are likely to be long lived (i.e. > 10 years). The observed abundant regeneration via seedlings after fire

suggests *Acacia curranii* will also germinate seedlings following mechanical disturbance of the topsoil, although repeated soil disturbance would kill the seedlings that germinate after any initial disturbance. The impact of stock grazing is unknown, but damage from grazing by feral goats has been observed (Cohn 1995).

Records Relevant to the SGP

Sixteen records of the species are confirmed in Herbrecs with the nearest population 11 km west of the SGP area with Gurulmundi State Forest (excluding low precision records). An additional two records exist within tenement boundaries 20 km to the north of Miles, from Arrow Energy internal database (Figure 4.2).

Rule(s) for Habitat Mapping:

1. The species will likely only occur in the central SGP area to the north of Miles.
2. In the absence of survey records within the SGP area, RE 11.7.5, 11.7.4, 11.7.7 in the potential area of occurrences have been allocated as 'General Habitat'.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. All other regional ecosystems, regrowth and cleared areas are mapped as 'Absence Suspected'.

Mapping Confidence

High mapping confidence is applied to be species based on the revised mapping boundaries and detailed on-ground assessment.

Legend

Acacia curranii

NC Act, EPBC Act

- Vulnerable, Vulnerable
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.2. Spatial distribution of *Acacia curranii*

Client ARROW ENERGY

0 15 30 45 60
Kilometers

Scale 1:1,050,026 | **Drawn By** DG | **Date** 30-Jul-23 | A4

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4.1.3 *Acacia handonis* (Hando's Wattle)

Vulnerable EPBC Act (effective Jul 2000)
Vulnerable NC Act

Description

Acacia handonis is a small, resinous shrub that grows to 2 m tall. Leaves are tiny, terete with glandular hairs and a slightly hook tip point. Flowers are relatively large heads and pods have a rough surface.

Acacia handonis (Photograph M. Fagg, Australian National Botanical Gardens)

Distribution and Habitat

Hando's wattle has an extremely restricted occurrence, being known only from the Barakula State Forest, approximately 40 km north of Chinchilla (Orchard and Wilson 2001). This population of Hando's wattle was considered to occur in three adjacent areas and was estimated in 1994 to contain around 10 080 individuals over approximately 28 ha (Halford 1995a). The extent of population was considered to have broadened within the Barakula State Forest between the initial collections in 1978 and 1997 (Lithgow 1997).

Hando's wattle has only been collected on rocky ridges and slopes on sandstone-derived geology in eucalypt woodland and open forest (Orchard and Wilson 2001). The vegetation it grows within is a shrubby woodland of *Eucalyptus fibrosa* subsp. *nubila*, *Eucalyptus watsoniana* subsp. *watsoniana, Lysicarpus angustifolius,* and *Allocasuarina inophloia* (Halford 1995a). The descriptions of the habitat from which it has been collected are consistent with the regional ecosystem mapping for its locations. This is, primarily RE 11.7.7: *Eucalyptus fibrosa* subsp.

nubila +/- *Corymbia* spp. +/- *Eucalyptus* spp. on lateritic duricrust. One collection is also recorded in RE 11.7.6: *Corymbia citriodora* or *Eucalyptus crebra* woodland on lateritic duricrust.

Ecology

The life span of Hando's wattle plants in the wild is unknown, but they live for about 10 years in cultivation (Hando 2007). Plants have been collected in flower in July, August and September, and with pods in August, September and November. As a hard-seeded legume, the soil-stored seed reserves of Hando's wattle are likely to be long lived (i.e. > 10 years). The response to fire by Hando's wattle has not been well studied. However, it is suggested that it regenerates well from seed following burning (DNR 2000).

Records Relevant to the SGP

Seventeen records in Herbrecs with the nearest population 35 km east of the SGP within Barakula Sate Forest (Figure 4.3).

Rule(s) for Habitat Mapping:

1. Regional Ecosystems 11.7.4, 11.7.5, 11.7.6, 11.7.7 and 11.5.1 in the Central region of the SGP (North of Miles) should be classed as 'General Habitat' on account of the intensive survey undertaken in the SGP.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Non-remnant and regrowth derived from these habitats are mapped as 'Absence Suspected'.

Mapping Confidence

High mapping confidence is applied to be species based on the revised mapping boundaries and detailed on-ground assessment.

Legend

Acacia handonis

NC Act, EPBC

- Vulnerable, Vulnerable
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.3. Spatial distribution of *Acacia handonis*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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4.1.4 *Callitris baileyi* (Bailey's Cypress pine)

Near Threatened NC Act

Description

Callitris baileyi is a small native pine with rough bark. It's branchlets appear grooved due to the ridged leaves, 2 to 5 mm long. The cone has a point on the upper half of the outer surface.

Callitris baileyi (Photograph Paul Williams)

Distribution and Habitat

In Queensland, Baileys Cypress occurs from the state border to Goomeri in the north and west to the Bunya Mountains. The distribution is predominantly within the Southeast Queensland bioregion extending into the Brigalow Belt near the bioregional boundary (EHP 2017b). The species also occurs in the drier ranges of NSW.

Typical habitat is open woodland with *Eucalyptus exserta*, *E. crebra* and *Callitris glaucophylla* with a mid-dense shrubby understorey typical of RE 11.7.4. (Stanley and Ross 1983) describe its habitat as eucalypt woodland, with ironbark, blue gum and spotted gum on rocky slopes, mountainous areas, in shallow and often clay soils. Bailey's cypress can alson grow along riparian edges.

Ecology

Little is known concerning the ecology of this species. Male and female cones occur on the same tree and fruiting has been recorded all year round. This species is threatened by direct loss as a result of clearing as well as inappropriate fire regimes.

Records Relevant to the SGP

Nearest local record is 2.6 km west of the SGP (40 km north of Miles) in Gurulmundi State Forest (Figure 4.4). The record was collected during SGP EIS studies in 2011.

Rule(s) for Habitat Mapping:

1. Regional Ecosystems 11.7.4, 11.7.5, 11.7.6, 11.7.7 and 11.5.1 in the Central region of the SGP (North of Miles) should be classed as 'General Habitat' on account of the intensive survey undertaken in the SGP.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Non-remnant and regrowth derived from these habitats are mapped as 'Absence Suspected'.

Mapping Confidence

The general nature of habitat for this species makes preferred habitats relatively easy to predict and habitat mapping for the species is considered to have high to moderate confidence.

Legend

Callitris baileyi

NC Act, EPBC Act

- Near Threatened, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.4. Spatial distribution of *Callitris baileyi*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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4.1.5 *Callitrix gurulmundensis* (Gurulmundi Fringe Myrtle)

Vulnerable EPBC Act (effective Jul 2000)
Vulnerable NC Act;

Gurulmundi fringe myrtle (*Calytrix gurulmundensis*). Copyright © Boobook

Distribution and Habitat

The species is endemic to the Gurulmundi and Barakula areas north of Chinchilla (Halford 1996). Gurulmundi fringe myrtle has been recorded growing in patches of shrubland on very shallow soils. Soils are lateritic sandstone ridges, which contain yellow sandy-clay that retains moisture (Williams 1979). Vegetation is predominately eucalypt, acacia, casuarina dense shrublands with spinifex, and spinifex grassland with scattered shrubs. This habitat description is consistent with RE 11.7.5 (shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks). The coordinates of Gurulmundi fringe myrtle collections derived from Herbrecs place them in areas mapped by as RE 11.7.4, 11.7.5, 11.7.6 and 11.7.7.

Ecology

The life span of Gurulmundi fringe myrtle is unknown, but it is likely to live for at least a decade. Flowers have been recorded from June to October (Halford 1996). Plants as small as 15 cm tall have been observed to flower (Williams 1979). Gurulmundi fringe myrtle can be quite common at sites where it grows, being described in several collection labels as abundant or co-dominant at the collection site (AVH 2023).

Records Relevant to the SGP

The nearest local record is 12 km west of the SGP (30 km north of Miles) within Gurulmundi State Forest. A population also exists in Waaje Scientific Reserve 36 km east of Wandoan (Figure 4.5).

Rule(s) for Habitat Mapping:

1. REs 11.5.1, 11.7.4, 11.7.5, 11.7.6 and 11.7.7 in the Gurulmundi area to the north of Chinchilla (-27.75) in the central SGP area should be considered 'General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Other habitats including all regrowth and non-remnant habitats should be assigned to "Absence Suspected

Mapping Confidence

High mapping confidence is applied to be species based on the revised mapping boundaries and detailed on-ground assessment that did not locate any additional populations.

Legend

Calytrix gurulmundensis

NC Act, EPBC

- Vulnerable, Vulnerable
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.5. Spatial distribution of *Calytrix gurulmundensis*

Client ARROW ENERGY

0 15 30 45 60
Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 04-Sep-23 A4

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4.1.6 *Eucalyptus curtisii* (Plunkett Mallee)

Near Threatened NC Act

Description

Eucalyptus curtisii is a multi-stemmed "mallee" small eucalypt tree. The trunk is smooth with bark shedding in curled flakes. Leaves are narrow, flower buds contain four sepal teeth.

Eucalyptus curtisii (Photographs from Euclid)

Distribution and Habitat

The plant is scattered but nowhere common occurring on coastal hinterland to 80 km north and south of Brisbane and inland over 300 km north west to the Dalby and Miles districts (DNR 2000). Occurs in the Burnett, Leichhardt, Moreton and Darling Downs pastoral districts (Bostock and Holland 2016). Conserved in Expedition Range, Robinson Gorge and Isla Gorge National Parks (Brooker and Kleinig 2004).

(DES 2022b) suggests *Eucalyptus curtisii* has two growth forms that occur in different habitats with a shorter shorter mallee associated with shrublands dominanted by banksia in poorly drained lowland sites with a larger growth occurring as scattered individuals on better drained soils in the more open areas of mixed eucalypt forests. The species is most typically associated with lateritised landscapes within regional ecosystems 11.7.4 and 11.7.5. Commonly associated species include *C. trachyphloia, Eucalyptus exserta* and *Callitris endlicheri* and less commonly associated with *E. fibrosa*.

Ecology

Flowering of *Eucalyptus curtisii* has been recorded between the months of September and November, and fruiting occurs throughout the year (Queensland Herbarium, 2012 cited in DES 2022). Response to fire is not documented.

Records Relevant to the SGP

Not known from within the SGP but with numerous records to the west, the nearest being approximately 2. km from the SGP boundary and 35 km north of Miles. There are also a number of records in Kumbarilla State Forest to the south, although all records are well outside the SGP (Figure 4.6).

Rule(s) for Habitat Mapping:

1. Eucalyptus curtisii may occur throughout the entire SGP area.
2. Through the SGP, REs 11.7.2, 11.7.4, 11.7.5, 11.7.6 and 11.7.7 should be classified as 'General Habitat' in recognition of the extensive survey effort undertaken.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. All other REs including regrowth and non-remnant vegetation should be classified as 'Absence Suspected'.

Mapping Confidence

Due to the extensive survey effort and known habitat preferences, mapping of *Eucalyptus curtisii* is attributed as having a high degree of confidence.

Legend

Eucalyptus curtisii

NC Act, EPBC Act

- Near Threatened, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.6. Spatial distribution of *Eucalyptus curtisii*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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4.1.7 *Micromyrtus carinata* (Gurulmundi Heath-myrtle)

Endangered NC Act

Description

Micromyrtus carinata is a 2.5 m tall shrub with pendulous branches. Its tiny leaves overlap and small yellow flowers cluster along the ends of branchlets, the back of petals have a ridged keel (Bean 1997).

Micromyrtus carinata specimen (Image from Atlas of Living Australia)

Distribution and Habitat

Micromyrtus carinata is known only from Gurulmundi State Forest 40 km to the north of Miles with a sub-population located on the Wyona Property 10 km to the north of Miles .

Herbarium records indicate *Micromyrtus carinata* is associated with landscapes formed on lateritised sediments with an upper soil layer of red to yellow sand (DES 2022c). Associated regional ecosystems include inhabits the tops of laterised ridges, on shallow to deep, yellow or red sands. Associated habthitats include heath and shrubland (RE 11.7.5) and low woodland dominated by *Eucalyptus exserta, Corymbia trachyphloia* and *Callitris glaucophylla* (RE 11.7.4).

Ecology

Little is known regarding the ecology of this species. (Bean 1997) suggest it likely flowers at any time in response to rain although fruits and flowers have been collected between May and October (DES 2022c).

Records Relevant to the SGP

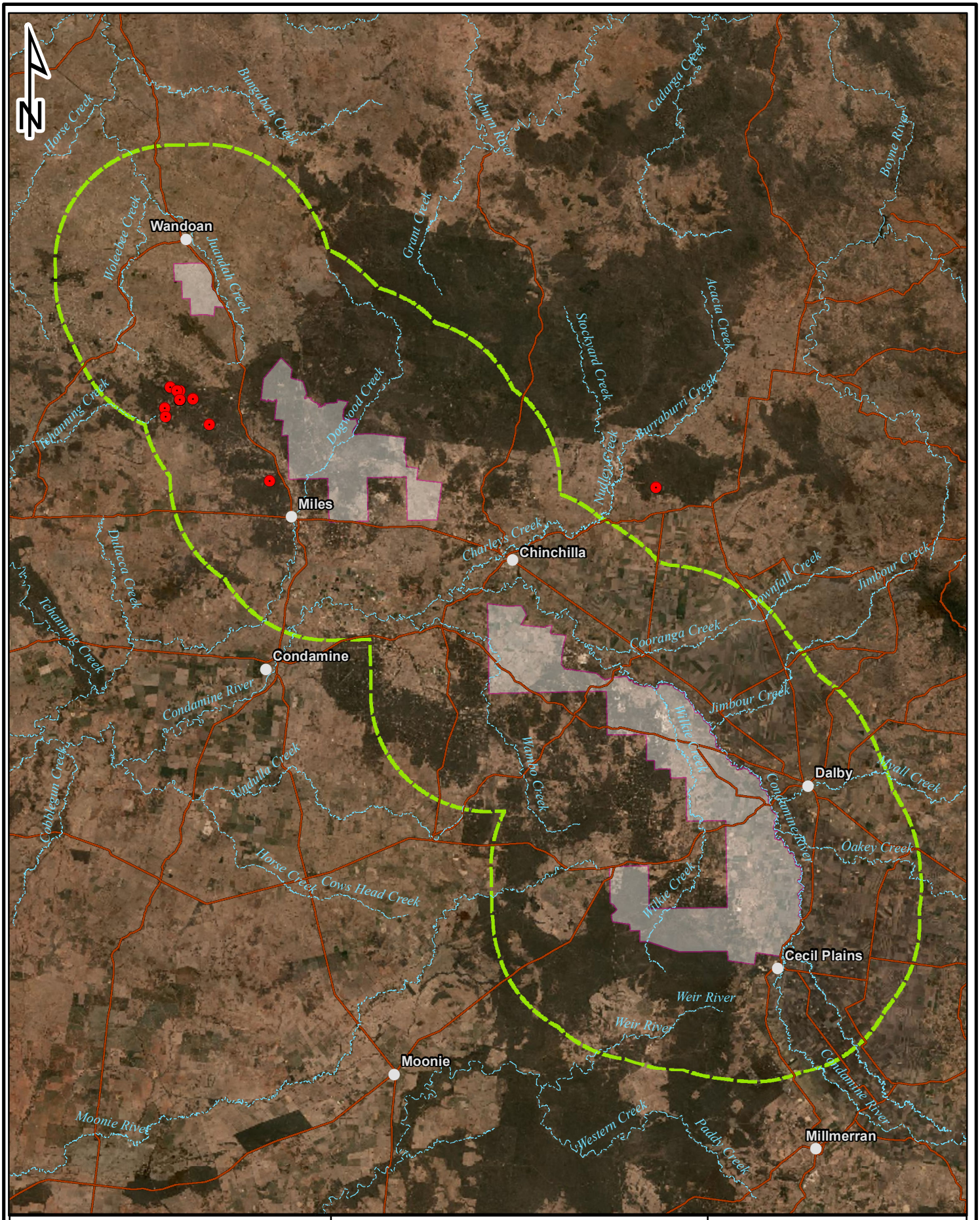
Nearest record is 10 km north-west of Miles and 4 km west of the SGP on the Wyona Property. The major population occurs in Gurulmundi State Forest 12 km west of the SGP (Figure 4.7).

Rule(s) for Habitat Mapping:

1. REs 11.7.4 and 11.7.5 in the Gurulmundi area to the north of Chinchilla (-27.75) in the central SGP area should be considered 'General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Other habitats should be assigned to "Absence Suspected. Non-remnant and regrowth derived from these habitats are mapped as 'Absence Suspected'.

Mapping Confidence

High mapping confidence is applied to be species based on the revised mapping boundaries and detailed on-ground assessment that did not locate any additional populations.



Legend

Micromyrtus carinata

NC Act, EPBC Act

- Endangered, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.7. Spatial distribution of *Micromyrtus carinata*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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4.1.8 *Philotheca sporadica* (Kogan Waxflower)

Near Threatened NC Act

Description

Philotheca sporadica is an attractive small shrub with tiny spherical "club-shaped" leaves and showy white flowers.

Philotheca sporadica (Photograph David Stanton)

Distribution and Habitat

Philotheca sporadica is a local endemic, known only from the Dalby-Kogan district in south-east Queensland. It has been collected over a 25 km distance, from Kumbarilla State Forest south-west of Dalby, to north-west of Kogan (TSSC 2008a; AVH 2023). This species main populations occur within Arrow's lease.

Field surveys indicate Philotheca sporadica occurs almost exclusively within RE 11.7.4 (*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on lateritic duricrust) and RE 11.7.5 with a few individual plants overlapping with RE 11.7.7. The species has a tendency to form dense, locally restricted populations, particularly on scalded areas with limited soil on latrite rocks. Typical density is 10 to 20 plants per 10 m by 10 m area.

Ecology

Philotheca sporadica is a woody shrub with a lifespan of at least several years, probably typically over a decade. It prefers skeletal soils, especially associated with lateritic geologies. (Halford 1996) indicated *Philotheca sporadica* plants shrubs survive fire by coppicing regrow from the base of stems. Plants have also been observed regrowing after mechanical disturbance along powerline tracks. Therefore, *Philotheca sporadica* has a capacity for multiyear persistence at a site following moderate disturbance of above ground parts, however will likely be killed by disturbance to roots.

Records Relevant to the SGP

The majority of *Philotheca sporadica* plants grow within the Arrow lease, concentrated within a 10 km radius of Kogan, on its eastern side (Figure 4.8). These plants grow on private land and State Forest. Populations may cover extensive areas although the margins of populations are generally discrete.

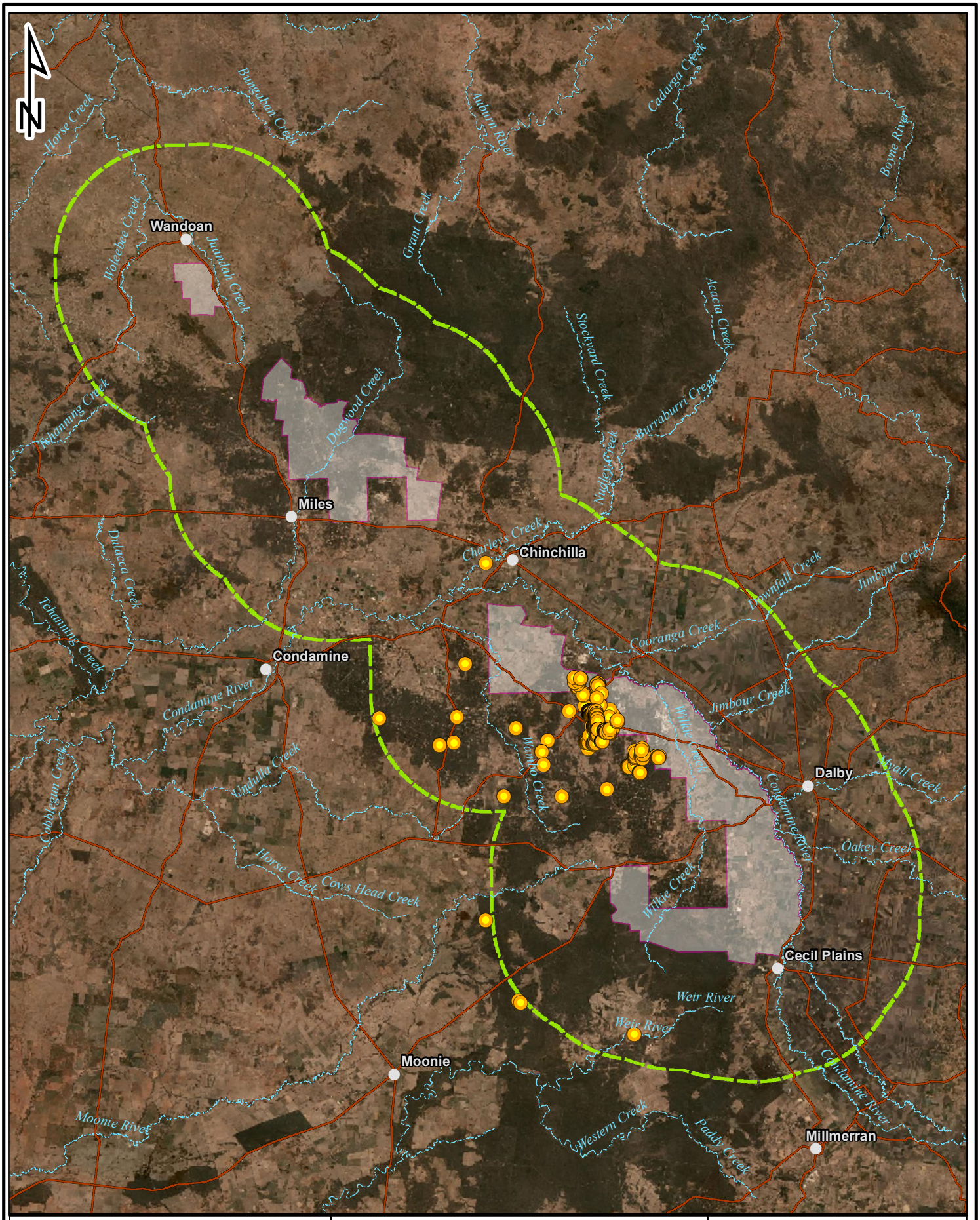
Rule(s) for Habitat Mapping:

1. The species will most likely occur within a 25 km wide buffer surrounding Kogan although cannot be discounted as occurring within suitable habitats throughout the SGP.
2. REs 11.7.4, 11.7.5 and 11.7.7 are classified as "Core habitat Possible" within 25 km from Kogan.

3. Regrowth habits (non-remnant) derived from RE 11.7.4, 11.7.5 and 11.7.7 within 25 km from Kogan are classified as "General Habitat'.
4. All areas of RE 11.5.1 within 25 km from Kogan are classified as 'General Habitat'.
5. All 'Core Habitat Possible' and 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
6. The remaining areas of RE 11.7.4 throughout the SGP are classified as 'General Habitat'
7. All other areas are classified as 'Absence Suspected'.

Mapping Confidence

The detailed ground surveys undertaken throughout habitats for this species in the SGP area and highly localised populations gives habitat mapping a high confidence.



Legend

Philotheca sporadica

NC Act, EPBC

- Near Threatened, Vulnerable
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.8. Spatial distribution of *Philotheca sporadica*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

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4.2 GRASSES AND SEDGES

4.2.1 *Digitaria porrecta* (Finger Panic Grass)

Near Threatened NC Act

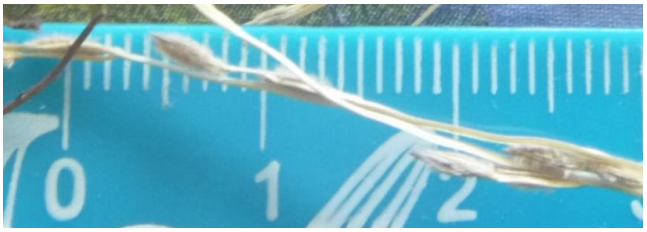
Description

Digitaria porrecta is a perennial grass with a panicle-type seed head. The plant base, nodes along the stem and seeds are hairy. Most lower arms of the seed head are branched, which distinguishes *Digitaria porrecta* from similar species of Digitaria.

Digitaria porrecta seed head – note branching on lower arms (Photograph by David Stanton)

Distribution and Habitat

Finger panic grass is known from four disjunct areas extending over 1000 km across NSW and Queensland. The Queensland distribution includes broad populations in the Nebo district; the Central Highlands between Springsure and Rolleston; and from Jandowae south to Warwick. In NSW, it is known from near Inverell, south to the Liverpool Plains near Coonabarabran and Werris Creek (TSSC 2008a).



Digitaria porrecta seed (Photograph Paul Williams)

Finger panic grass grows in grasslands, woodlands and open forests with a grassy understory, on black soil plains of the Darling Downs, and lighter textured soils to the west (Goodland 2000; Fensham 1998). Fensham (1998) found it is most abundant in grassland, but is "relatively unspecific" in its habitat preference. It is not restricted to high quality native grasslands, but also grows along roadsides and can be found in highly disturbed sites (Goodland 2000). Finger panic grass been recorded inside the project development area, within roadside remnant grasslands on dark cracking clay plains (RE 11.3.21); poplar box (*E. populnea*) open forest and woodland with grassy understorey, on dark cracking clay plain (RE 11.3.2); and along disturbed railway reserves on dark cracking clay soils (DEHP 2013). The primary habitats for this species in the project development area are RE 11.3.2, RE 11.3.21 and non-remnant derived grasslands.

Ecology

Finger panic grass is a spreading perennial that can reproduce vegetatively (Halford 1995b). Older clumps are reported to die in the centre, with the outer edges of the clump becoming separate plants. Seeds drop to the ground when mature, but appear to have a six month to one year dormancy prior to germinating (Halford 1995b). This is similar to some other sub -

tropical grasses, such as black spear grass, and delays germination until the wet season rains. The species produces fertile material from March to April (TSSC 2008f).

Records Relevant to the SGP

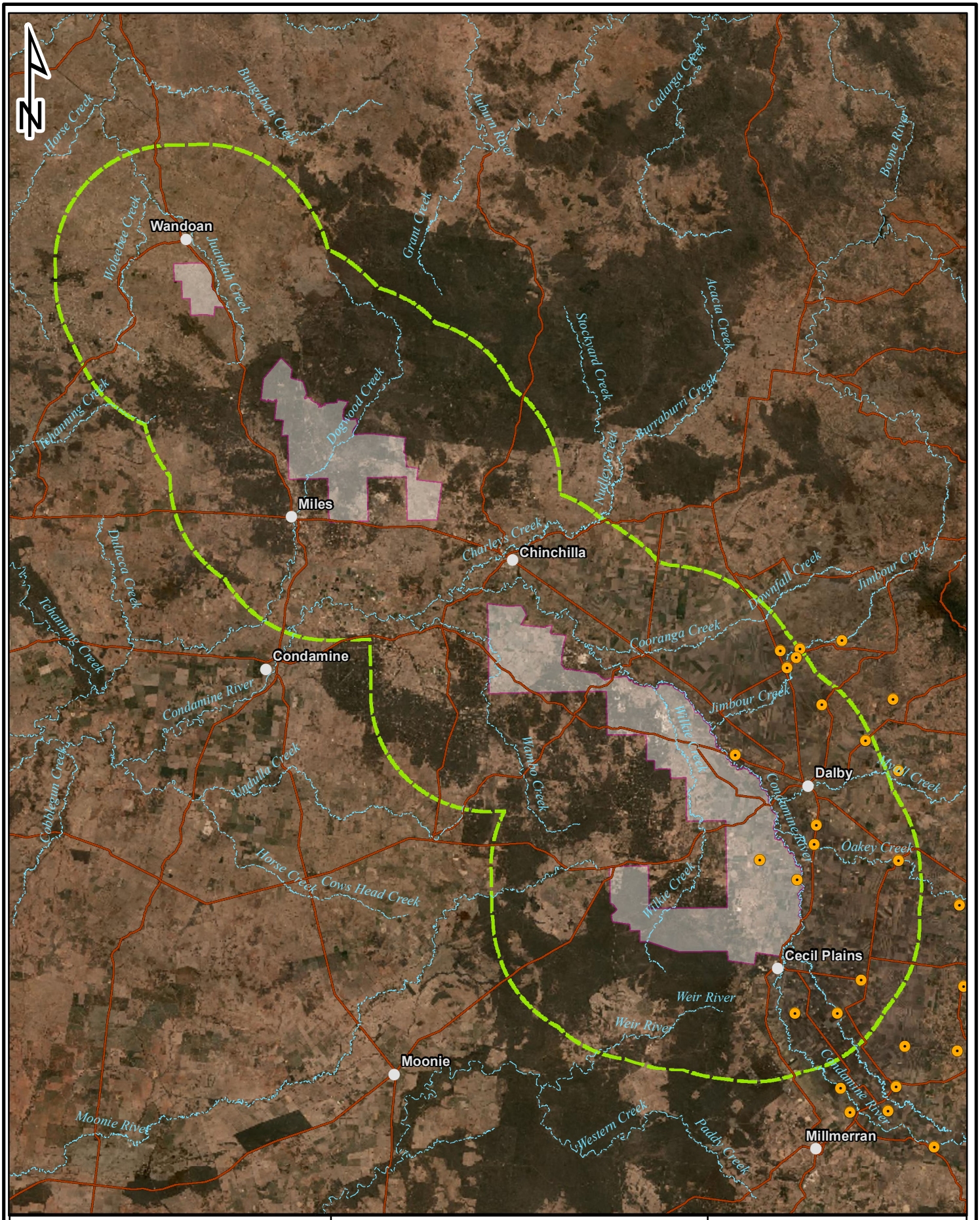
Two records within the SGP, both in non-remnant derived grasslands adjacent to roadside easements between Dalby and Cecil Plains. Both records collected in 1995. A further 15 records located outside the SGP, approximately 25 km to the east (Figure 4.9).

Rule(s) for Habitat Mapping:

1. The species is most likely to occur on heavy clay soils associated with the Condamine Alluvium although may occur throughout the entire SGP.
2. Regional Ecosystem 11.3.2 should be treated as 'General Habitat'.
3. Derived native grassland where it is associated with the Condamine Alluvium or other heavy clay soil should be considered 'General Habitat'.
4. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
5. All other remnant vegetation in the project development area and all cleared agricultural and grazing land should be treated as 'Absence Suspected'.

Mapping Confidence

Digitaria porrecta has relatively predictable habitat preferences and with the availability of project scale mapping (1:50 000), it is considered that the habitat mapping has a high level of confidence. It should be noted that no records of the species have been formally documented since 1995.



Legend

Digitaria porrecta

NC Act, EPBC Act

- Near Threatened, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.9. Spatial distribution of *Digitaria porrecta*

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0 15 30 45 60

Kilometers

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4.2.2 Fimbristylis vagans

Endangered NC Act

Description

Fimbristylis vagans is a small sedge with rhizomes and branching seed heads.

Distribution and Habitat

A little-known Queensland endemic restricted to the Darling Downs between Lake Broadwater and Nudley Creek (30 km NE of Chinchilla) (DEHP 2013). The species occupies habitats fringing ephemeral watercourses and lagoons on alluvium, typically RE 11.3.2, 11.3.4, 11.3.14, 11.3.26 and 11.3.27. The species is not known to be associated with non-remnant habitats.

Ecology

Species ecology is poorly documented although like most species associated with wetland habitats, is likely to be a seasonally dependent species that flowers and reproduces following rainfall.

Fimbristylis vagans specimen (Image by Queensland Herbarium)

Records Relevant to the SGP

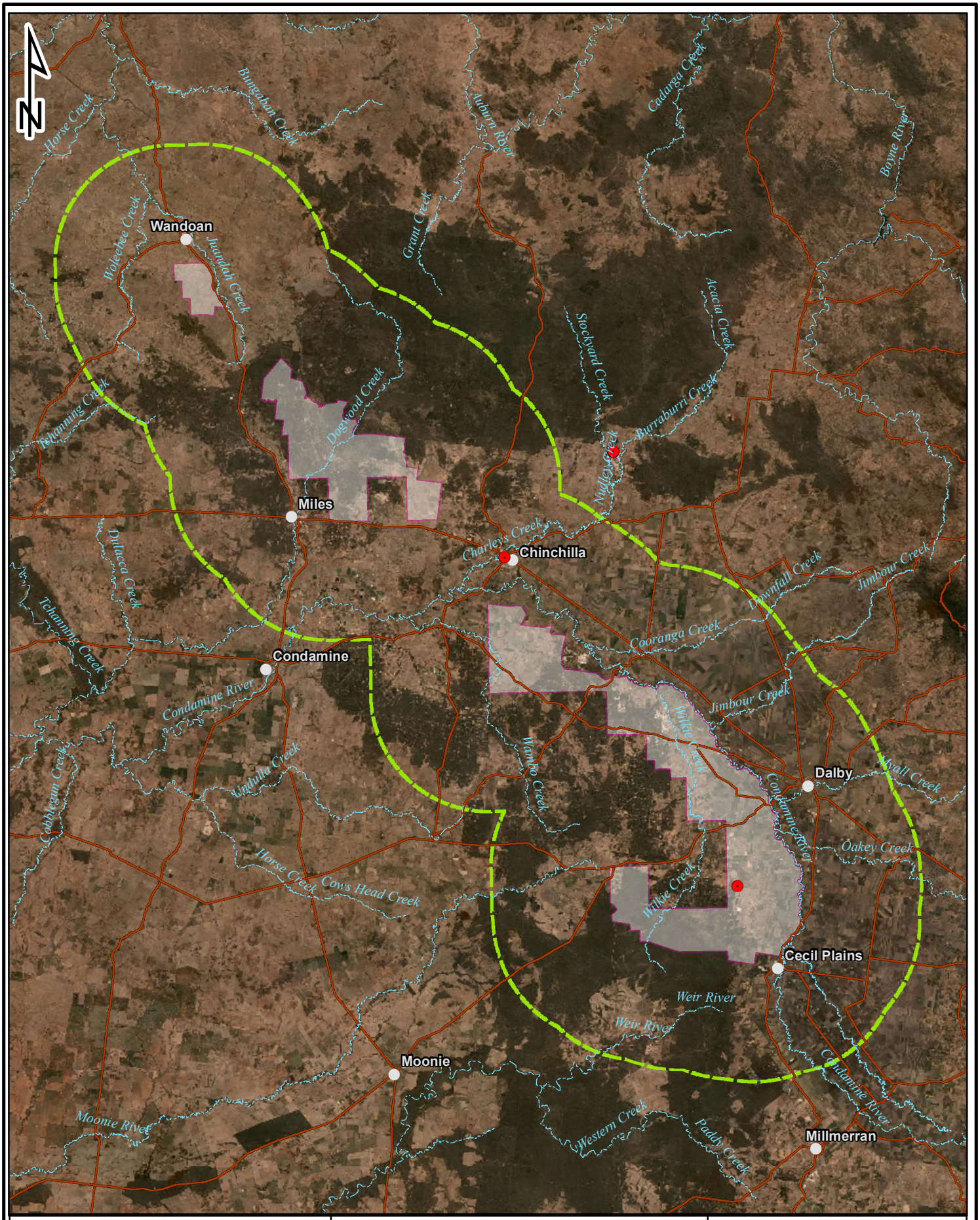
A single herbarium record from the SGP associated with the swampy inlet of Lake Broadwater (Figure 4.10). The species has not been recorded or collected since 1984.

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP.
2. 'Core Habitat Possible' includes the wetland fringe of Lake Broadwater characterised by RE 11.3.27f and wetland habitats of Long Swamp.
3. REs 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.25 and 11.3.26 throughout the SGP are classified as 'General Habitat'.
4. All Core Habitat Possible and General Habitat within 1 km of a recent (1950+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
5. All remaining remnant and non-remnant vegetation is mapped as 'Absence Suspected'.

Mapping Confidence

Habitat characteristics for this species are well understood and can be matched to regional ecosystem descriptions. The mapping is considered to be highly accurate.



Legend

Fimbristylis vagans

NC Act, EPBC Act

- Endangered, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.10. Spatial distribution of *Fimbristylis vagans*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

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4.2.3 *Homopholis belsonii* (Belson's Panic)

Vulnerable EPBC Act (effective Jul 2000)
Endangered NC Act

Description

Homopholis belsonii is a 0.5 m tall perennial grass that spreads vegetatively via stolons. The ligule, where the base of leaves join the stem, are clear membranes rather than hairs. Its seedheads are a branched panicle, with seeds only at the ends of each arm.

Homopholis belsonii (Belson's panic*)*. Copyright © Boobook

Distribution and Habitat

In Queensland, major populations occur on the Darling Downs near Oakey, Jondaryan, Bowenville, Dalby, Acland, Sabine, Quinalow, Goombungee, Gurulmundi and Millmerran, and further west between Miles and Roma (Goodland 2000). Also known from the north-western slopes and plains of NSW (TSSC 2008b).

Belson's panic prefers moderate to highly fertile soils, especially those derived from basalt and fertile alluvial flats. It is generally associated with poplar box and brigalow woodlands on light red/brown earths (Goodland 2000; Fensham and Fairfax 2003). Based on Herbrecs specimens, the species is most commonly associated with habitats on heavy clay soils, particularly those dominated by Brigalow including REs 11.3.1, 11.3.17, 11.4.3, 11.9.5 ad 11.9.10. Herbarium records also indicate some potential for the species to overlap with RE 11.3.2.

Belson's panic is also capable of growing within disturbed habitats. Of the 22 collections within the study area, 15 (68%) are located in non-remnant areas such as roadside easements. It has been seen growing among fallen timber at the base of trees or shrubs, among branches and the bottom of netting fences (TSSC 2008b).

Ecology

Belson's panic tends to grow in shade under trees but can also grow in cleared regrowth. As a rhizomatous perennial grass, it probably is capable of living for many years, and to have some tolerance to fire and at least low levels of grazing. It is reported to spread out very rapidly (Menkins 1998). Flowers have been recorded between February and May (Sharp and Simson 2002).

Records Relevant to the SGP

A considerable number of records to the east of Dalby with the nearest 12 km from the eastern boundary of the SGP. Two records within 8 km of the boundary of the northern SGP area within 10 km of Wandoan (Figure 5.1). There is a single record of the species in the Arrow threatened species database from near Weroona in the central region of the SGP, plus several recent unvouchered records along the Moonie Highway west of Dalby.

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP although is most likely to occur in Brigalow associated habitats in the northern SGP area.
2. Regional Ecosystems 11.9.5, 11.9.10 and 11.3.17 including derived non-remnant regrowth is mapped as 'Core Habitat Possible' in the northern SGP area.
3. REs 11.3.1, 11.3.17, 11.4.3 and 11.9.5 including non-remnant derived regrowth in central and southern SGP areas are classified as 'General Habitat'.
4. All Core Habitat Possible and General Habitat within 1 km of a recent (1950+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
5. All remaining remnant and non-remnant vegetation is mapped as 'Absence Suspected'.

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the SGP area and resolution of the revised mapping database, mapping is considered to have a high degree of confidence.

Legend

Homopholis belsonii

NC Act, EPBC

- Endangered, Vulnerable
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.11. Spatial distribution of *Homopholis belsonii*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

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4.3 FORBS AND HERBS

4.3.1 Cryptandra ciliata

Near Threatened NC Act

Description*Cryptandra ciliata* is a woody herb growing to 50 cm in height, with hairy young branchlets. It has tiny (3 mm long) leaves that cluster at the end of branches. Leaf margins are recurved obscuring much of the lower surface. Tiny, hairy white flowers are produced in leaf axils near the ends of branchlets.

Cryptandra ciliata specimen (Image from *Atlas of Living Australia)*

Distribution and Habitat

Restricted to the Gurulmundi, Barakula and Cracow areas of south-eastern Queensland (DNR 2000; Chinchilla Field Naturalists Club 2017). Typical habitat is eucalypt dominant woodland, lancewood (*Acacia shirleyi*) woodland and Triodia grassland on rocky on low lateritic and sandstone ridges. Habitat in the SGP is consistent with RE 11.7.5, 11.7.4, 11.7.6, 11.5.1, 11.5.4, 11.5.21.

Ecology

There is little documented information on the ecology of this species.

Records Relevant to the SGP

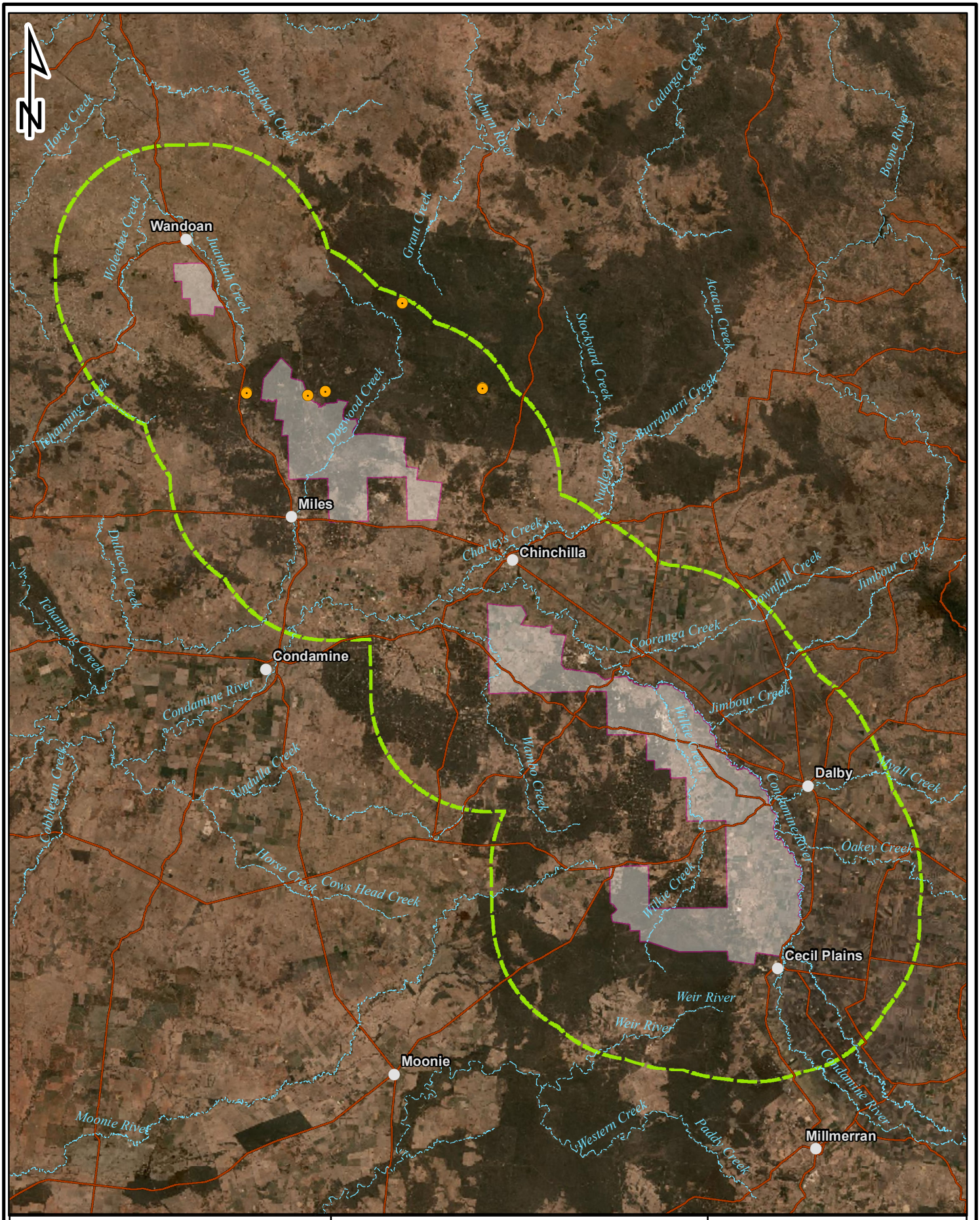
Three herbarium records within 5 km of the SGP boundary with a single record within 1 km of the eastern boundary, 30 km to the north of Miles (Figure 4.12).

Rule(s) for Habitat Mapping:

1. The species is only likely to occur in the central SGP area where the following REs should be treated as 'General Habitat'; 11.5.1, 11.5.4, 11.5.21, 11.7.4, 11.7.5, 11.7.6 and 11.7.7.
2. All General Habitat within 1 km of a recent (1950+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
3. All other remnant vegetation in the project development area, regrowth vegetation and cleared agricultural land should be treated as 'Absence Suspected'.

Mapping Confidence

Due to the general habitat requirements, intensity of the field survey and detailed mapping revision available, mapping is considered to have a high degree of confidence.



Legend

Cryptandra ciliata

NC Act, EPBC Act

- Near Threatened, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.12. Spatial distribution of *Cryptandra ciliata*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

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4.3.2 Cymbonotus maidenii

Endangered NC Act

Description

Cymbonotus maidenii is a yellow flowered daisy with deeply toothed leaves forming a rosette at ground level. The underside of the leaves are hairy.

Cymbonotus maidenii (Photo from iNaturalist)

Distribution and Habitat

The species occurs in scattered populations throughout central areas of NSW and in southern inland districts as far west as Mitchell (Holland and Funk 2006).

The species is associated with a range of remnant and non-remnant habits with records occurring on disturbed roadside drains, native and derived grasslands. It is typically associated with heavy brown to grey cracking clay soils (Holland and Funk 2006). Habitats favoured by the species are RE 11.3.21 from which it is known to occur. The woodland RE 11.3.2 and derived native grassland also present potential habitat for the species. It can however occur in a range of highly disturbed locations and hence its occurrence may not be readily predicted.

Ecology

Other than being a perennial, very little is known about this species although, though as a daisy it is probably fairly short-lived (e.g. living < 5 years). The species is known to flower throughout the year but most prominently in spring, possibly in response to rainfall. The seeds are likely to be wind dispersed, which should assist colonisation. It has the ability to survive along disturbed roadsides in in other highly disturbed habitats.

Records Relevant to the SGP

Five Herbrecs specimens recorded within 10 km of the eastern boundary of the SGP area, mostly in the Cecil Plains / Millmerran Area including collections on road reserves on the Cecil Plains - Millmerran Road (Figure 4.13).

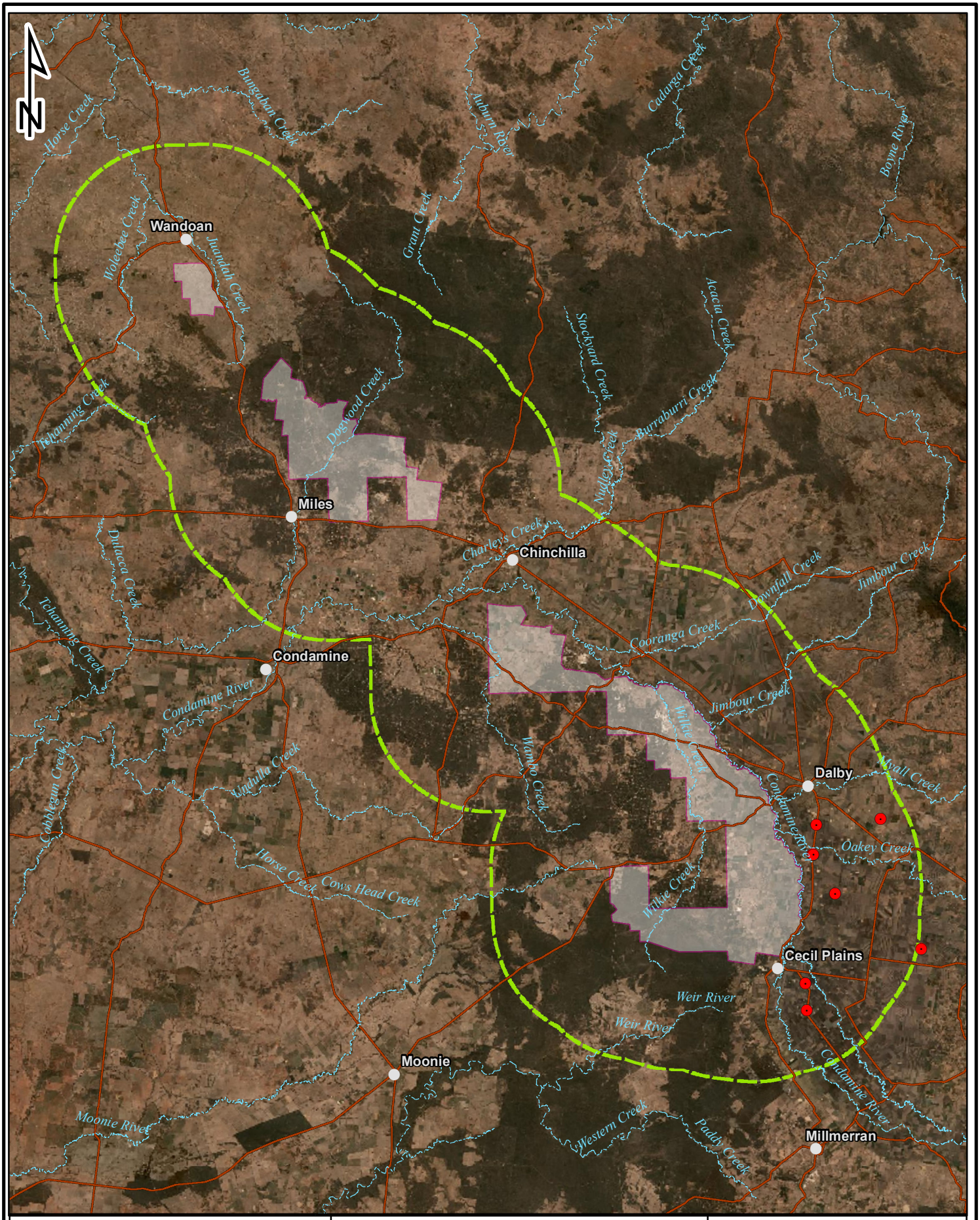
Rule(s) for Habitat Mapping:

1. The species is most likely to occur from the Dalby area (-27.00) south to Millmerran (-27.9) generally on the Condamine Alluvium.
2. RE 11.3.2 , derived regrowth of RE 11.3.2, and associated derived grasslands occurring between in this area should be treated as 'General Habitat'.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.

4. All other remnant vegetation and cleared agricultural land in the SGP should be treated as 'Absence Suspected'.

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the SGP area and resolution of the revised mapping database, mapping is considered to have a high degree of confidence. There may however be a number of potential habitats adjacent to roadsides that are beyond mapping resolution.



Legend

Cymbonotus maidenii

NC Act, EPBC Act

- Endangered, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.13. Spatial distribution of *Cymbonotus maidenii*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

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4.3.3 Picris barbarorum

Vulnerable NC Act

Description

Picris barbarorum is a yellow flowered daisy with small flower heads. Leaves are rough and hairy.

Distribution and Habitat

Occurs from the Darling Downs and Warrego pastoral districts in southern Queensland (Bostock and Holland 2016), to north of the north-west plains of NSW. In the Darling Downs, it has a restricted distribution but may be locally abundant. Known to occur from the Jandowae, Macalister, Norwin localities and along the Warrego highway west of Dalby.

Herbrecs specimens indicate occurrence in native grassland (RE 11.3.21) of *Dichanthium sericeum* in stock routes, road reserves adjacent to disturbed areas such as cultivated paddocks and road and rail lines on black clay soil (DEHP 2013).

Picris barbarorum specimen (Image from Atlas of Living Australia)

Ecology

Poorly known, though as a daisy probably short-lived (e.g. < 5 years). Flowering phenology not documented though likely to be re-invigorated in response to rainfall, particularly in spring.

Records Relevant to the SGP

Four herbarium records within 5 km of the SGP with the nearest less than 2 km from the SGP boundary, 14 km north-west of Dalby (Figure 4.14).

Rule(s) for Habitat Mapping:

1. The following REs and habitats should be classified as 'General Habitat' where they are in association with the Condamine Alluvium.
   - RE 11.3.2 and derived regrowth vegetation.
   - Non-remnant derived native grasslands
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other remnant and non-remnant vegetation should be treated as 'Absence Suspected'.

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the SGP and resolution of the revised mapping database, mapping is considered to have high accuracy. However, there may be a number of potential habitats adjacent to roadsides that are beyond mapping resolution.

Legend

Picris barbarorum

NC Act, EPBC Act

- Vulnerable, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.14. Spatial distribution of *Picris barbarorum*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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4.3.4 *Rutidosis glandulosa*

Near Threatened NC Act

Description

Rutidosis glandulosa is a 40 cm tall herb, with glandular hairy (not pale woolly) stems and leaves (Holland 1999). Its leaves are approximately 7 cm long and 0.5 cm wide. It has yellow-orange daisy flowers and has been recorded flowering or seeding in most months of the year. It is distinguished from similar species by the dense glandular hairs and yellow-orange flower head.

Rutidosis glandulosa specimen (Image from Atlas of Living Australia)

Distribution and Habitat

Known locations of *Rutidosis glandulosa* populations are scattered from near Stanthorpe to the Blackdown Tablelands, west of Rockhampton.

Records Relevant to the SGP

The species has recently been recorded (though without a vouchered specimen) near a road edge adjacent to Dalby State Forest, on the Dalby-Kogan Road, about 13 km south-east of Kogan (Figure 4.15). Near the lease, it is also known from Barakula State Forest where is grows in ironbark woodland on plains.

Ecology

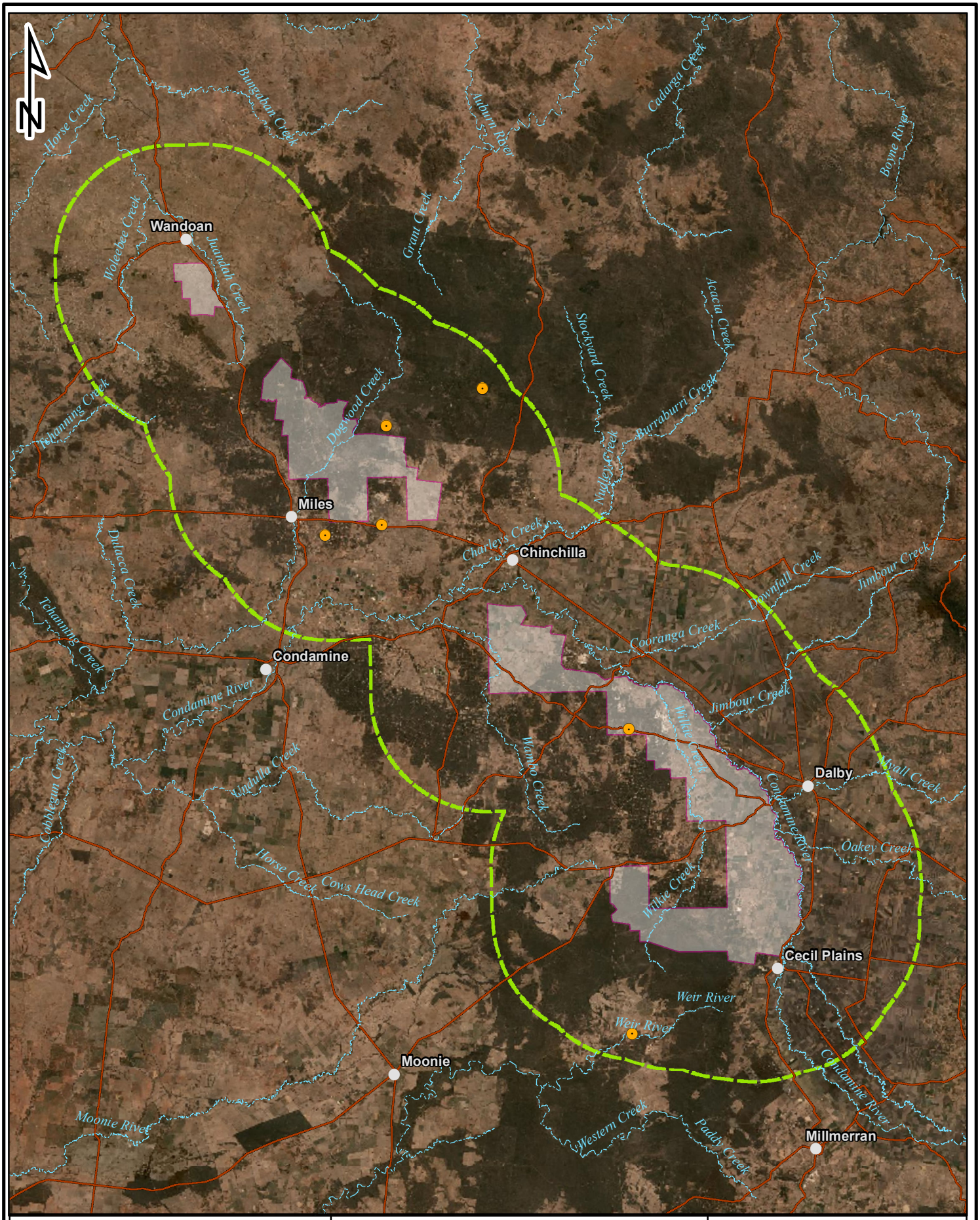
Rutidosis glandulosa grows in eucalypt woodlands, especially near sandstone on sandy or skeletal soils. It recruits in areas of soil disturbance, such as road edges (Barker 1997).

Rule(s) for Habitat Mapping:

1. The following REs and habitats should be classified as 'General Habitat'. REs 11.9.9 (including regrowth derived from this RE) and 11.5.4 (including derived regrowth).
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All remaining remnant and non-remnant vegetation is mapped as 'Absence suspected'.

Mapping Confidence

The primary feature of vegetation containing *Rutidosis glandulosa* is of sandy or gravelly soil dominated by a mix of eucalypts, and often on road edges. These features are not specific to a small number of REs and therefore it is likely *Rutidosis glanudulosa* may also grow in REs not listed here. Therefore there is a low confidence in correlating this species distribution with specific REs.



Legend

Rutidosis glandulosa

NC Act, EPBC

- Near Threatened, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.15. Spatial distribution of *Rutidosis glandulosa*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

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4.3.5 Rutidosis lanata

Vulnerable NC Act

Description

Rutidosis lanata is a yellow flowered daisy which grows to about 30 cm tall. The stems and lower leaf surface are pale and woolly. Leaves are 1-4.5 cm long, margins can be wavy but are not recurved (as they are in *Rutidosis galndulosa*).

Rutidosis lanata specimen (Image from Atlas of Living

Distribution and Habitat

Endemic to south central Queensland from near Jackson to Hannaford on the western Darling Downs (DNR 2000). Mainly found in roadside vegetation of Acacia and Eucalypt woodland/open forest on red sandy ridges and clay flats between 280-320 m altitude adjacent to cleared or partly cleared grazing and cropping land (DNR 2000). Based on Herbrecs notes, associated vegetation includes open grassy woodland of *Eucalyptus populnea* with *Eremophila mitchellii; Acacia harpophylla, Casuarina cristata*, and *Eucalyptus woollsiana* woodland on reddish-brown loamy clay; remnant *Acacia harpophylla, Eucalyptus coolabah, Eucalyptus populnea* open forest on alluvium clay loam and gentle sedimentary rises; and in cleared areas along powerlines adjoining *Acacia aprepta* thicket.

Ecology

Rutidosis lanata flowers and fruits from October to March and produces a soil-stored seed bank that lasts for less than one year (DES 2022d).

Records Relevant to the SGP

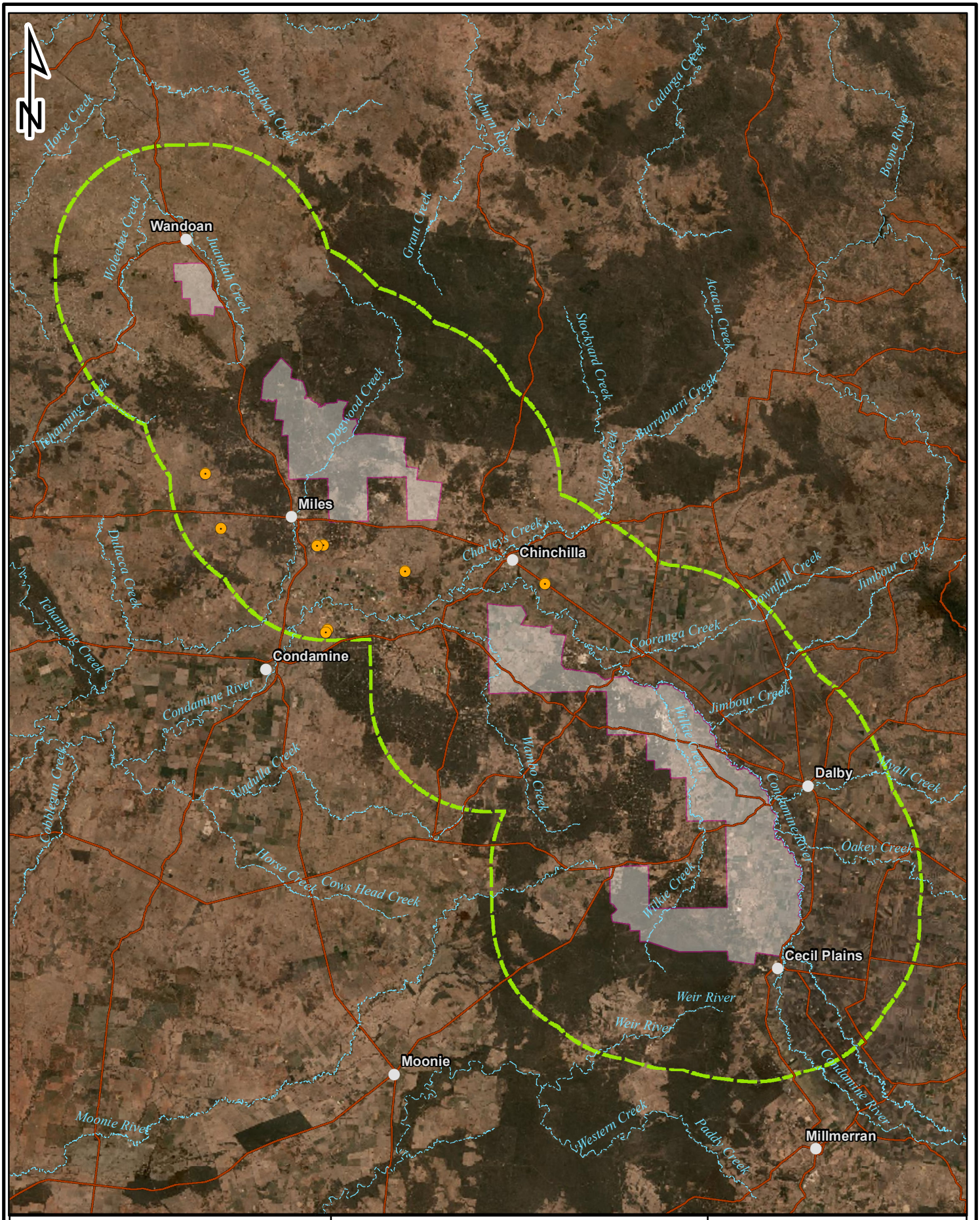
Eight Herbarium records within 20 km from the SGP, all recorded in the Miles / Chinchilla area (Figure 4.16).

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire project area although is more likely north from Chinchilla based on vouchered herbarium records. Throughout the SGP, the following REs should be treated as 'General Habitat'; 11.3.4, 11.3.2, 11.3.17, 11.9.5 and 11.9.7.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other remnant vegetation in the project development area, regrowth vegetation and cleared agricultural land should be treated as 'Absence Suspected'.

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the SGP and resolution of the revised mapping database, mapping is considered to have a high degree of confidence.



Legend

Rutidosis lanata

NC Act, EPBC Act

- Near Threatened, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.16. Spatial distribution of *Rutidosis lanata*

Client ARROW ENERGY

0 15 30 45 60
Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 25-Jul-23 A4

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4.3.6 Solanum papaverifolium

Endangered NC Act

Description

Solanum papaverifolium is a prickly herb with deeply lobed leaves 4-7 cm long and 3-5 cm wide. The stems and leaves lack star shaped hairs (present on *Solanum stenopterum*). Flowers are purple, with 12 to 40 prickles on the calyx (i.e. the outer sepals of the flower).

Solanum papaverifolium (Photo D. Stanton)

Distribution and Habitat

Recorded from three locations between Jimbour and Warwick (Bean 2004) as well as a number of old records in the Dalby-Cecil Plains area. Goodland (2000) reports two populations west of Dalby on the Warrego Highway before Kogan Rd, and large populations up to 100 m in extent off Cecil Plains Rd. Also occurs in in NSW (Bean 2004). Occupies wetter areas of grasslands or eucalypt woodland on heavy alluvial soils (Goodland 2000; Bean 2004).

Ecology

Little is documented on the ecology of the species. It has been observed flowering throughout the year and populations are most likely rejuvenated following rainfall. The species occurs on soils utilised by intensive agriculture and remains on roadside reserves and stock routes. Populations remain threatened by habitat destruction, weed invasion, and roadworks (Goodland 2000; Bean 2004).

Records Relevant to the SGP

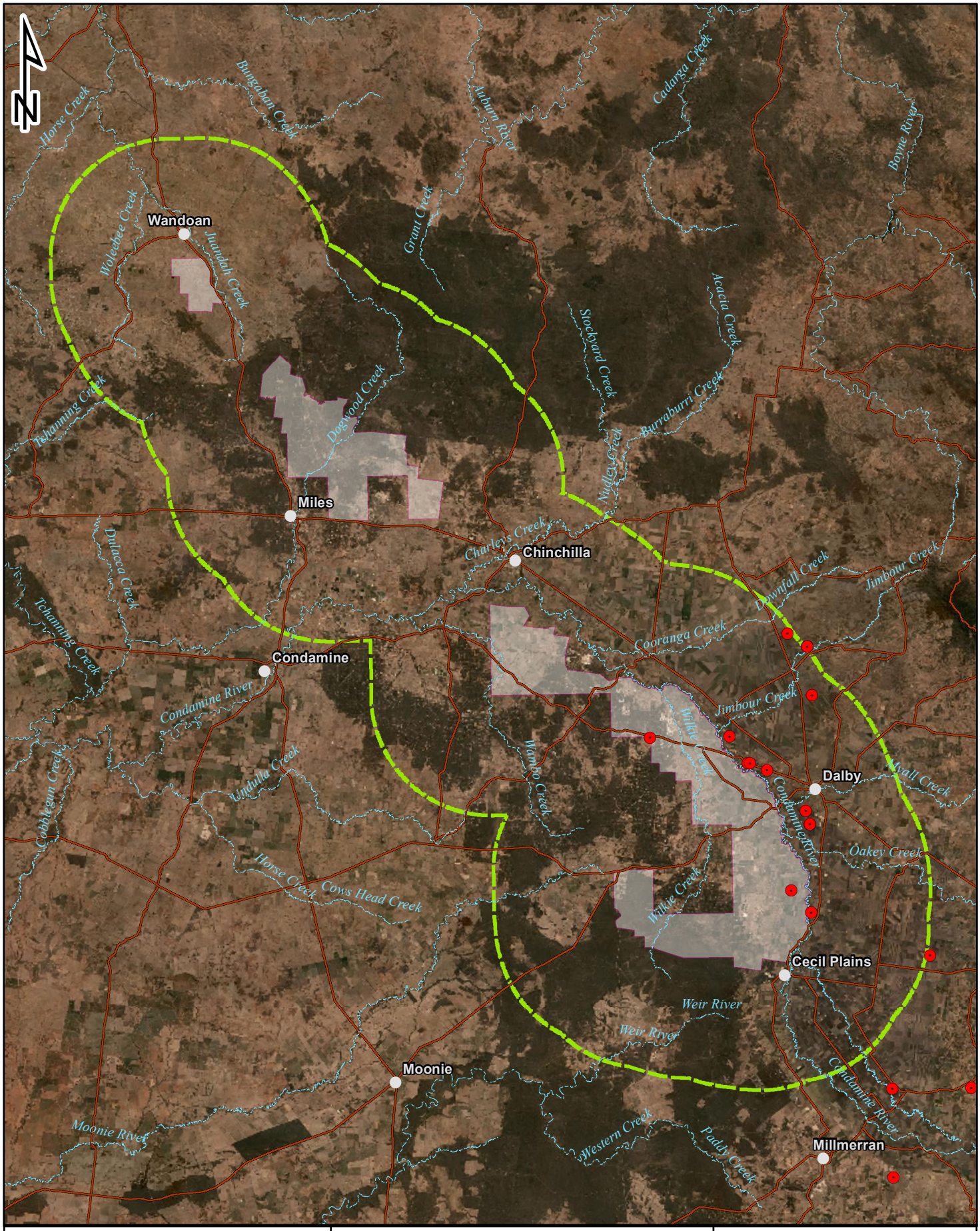
Two records are contained within the SGP assessment area to the south of Dalby with an large number of herbarium records to the east of the SGP assessment area between Chinchilla and Dalby (Figure 4.17).

Rule(s) for Habitat Mapping:

1. The species is most likely to occur on habitat formed by heavy clay soils associated in particular with the Condamine Alluvium.
2. Regional Ecosystems 11.3.2 and Derived Native Grassland (non-remnant) provide the most suitable habitats for the species. Where these habitats occur on the alluvial landforms to the west and south of Dalby, they are mapped as "General Habitat".
3. All General Habitat within 1km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".
4. All remaining remnant and non-remnant vegetation is mapped as "Absence Suspected".

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the assessment area and resolution of the revised mapping database, mapping is considered to have a high degree of confidence.



Legend

Solanumn papaverifolium

NC Act, EPBC Act

- Endangered, Not Listed
- Major Watercourse
- Major Roads
- SGP_Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.17. Spatial distribution of *Solanum papaverifolium*

Client ARROW ENERGY

0 15 30 45 60
Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 5/09/2023 A4

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4.3.7 Solanum stenopterum

Vulnerable NC Act

Description

Solanum stenopterum is a prickly herb growing to 40 cm tall. Leaves are lobed, 3 to 7 cm long, with star-shaped hairs on the lower surface. Both the upper and lower leaf surfaces have between 1 and 15 prickles. Flowers are purple.

Solanum stenopterum specimen (Image from Atlas of Living Australia)

Distribution and Habitat

Recorded in Queensland from Gayndah in the Burnett Pastoral district to Moonie and west to Glenmorgan and Yuleba (Bean 2004; Bostock and Holland 2016). Known in NSW from Ashford (Bean 2004). The species is Known to occur in non-remnant grassland approximately 7.5 km south of Dalby; 3.5 km east of Cecil Plains in a roadside gravel pit; and approximately 6 km south east of Cecil Plains in remnant Eucalyptus populnea woodland on alluvium (11.3.2).

Ecology

Little is documented on the ecology of the species although similar to many solanum species in the Brigalow Belt, likely flowers at multiple times throughout the year in response to rainfall events.

Records Relevant to the SGP

Known to occur in non-remnant grassland approximately 7.5 km south of Dalby; 3.5 km east of Cecil Plains in a roadside gravel pit; and approximately 6 km south east of Cecil Plains in remnant *Eucalyptus populnea* woodland on alluvium (RE 11.3.2). All herbarium records are outside SGP (Figure 4.18).

Rule(s) for Habitat Mapping:

1. REs 11.3.2, 11.3.1 and 11.3.17 to the west and south of Dalby should be classed as 'General Habitat' on account of comprehensive surveys.
2. Regrowth vegetation derived from RE 11.3.2, 11.3.1 and 11.3.17 south and west of Dalby are classed as 'General Habitat'.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. All other vegetation is mapped as 'Absence Suspected'.

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the SGP and resolution of the revised mapping database, mapping is considered to have a high degree of confidence.

Legend

Solanum stenopterum

NC Act, EPBC

- Vulnerable, NA
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.18. Spatial distribution of *Solanum stenopterum*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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4.3.8 *Thesium australe* (Austral Toadflax)

Vulnerable EPBC Act (effective Jul 2000)
Vulnerable NC Act

Distribution and Habitat

Historical collections (including the late 1800's) were made from Tasmania, but it is now considered extinct in that state (DSE 2003). Austral Toadflax occurs in eastern Victoria, NSW and southern Queensland. The majority of southern Queensland collections are from the Darling Downs and Moreton districts (Bostock and Holland 2016). The Dalby area represents the species western limits on the Darling Downs.

Austral toadflax has been collected within popular box (*Eucalyptus populnea*) woodland on alluvial flats (RE 11.3.2) north-west of Dalby, within the project development area. Other Herbarium collection records of Austral toadflax are from along roadsides, mountain coolibah (*Eucalyptus orgadophila*) grassy open woodlands with kangaroo grass (*Themeda triandra*) and Queensland blue grass (*Dichanthium sericeum*). RE 11.3.2 in the Dalby region is considered the most likely habitat in the SGP.

Ecology

A root parasite of kangaroo grass (*Themeda triandra*) and other grasses, Austral toadflax lives for at least two years. Flowers have been recorded from spring to autumn with fruit developing in summer. Austral toadflax has been observed to germinate prolifically after fire and also after drought. The species is relatively short lived, persisting up to two years after germination (DSE 2003).

Records Relevant to the SGP

Two herbarium records within 10 km of the SGP with the nearest record 2.7 km east of the SGP boundary, 25 km north west of Dalby (Figure 4.19).

Rule(s) for Habitat Mapping:

1. Intact representation of Poplar Box dominant woodland (RE 11.3.2) associated with the Condamine River Alluvium (Condamine River Floodplain) should be treated as "General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other REs and non-remnant vegetation (including regrowth) should be treated as 'Absence Suspected'.

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the SGP and resolution of the revised mapping database, mapping is considered to have a high degree of confidence.

Legend

Thesium australe

NC Act, EPBC Act

- Vulnerable, Vulnerable
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.19. Spatial distribution of *Thesium australe*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 04-Sep-23 A4

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4.3.9 Xerothamnella herbacea

Endangered EPBC Act (effective Jul 2000)
Endangered NC Act

Description

Xerothamnella herbacea is a 30 cm tall herb. Leaves are soft textured and opposite each other on the stem. Flowers are pink to mauve and lobed.

Xerothamnella herbacea. Photograph Copyright © Boobook

Distribution and Habitat

Xerothamnella herbacea is known from seven locations between Goondiwindi and Theodore. Scattered populations occur to the north-east of Chinchilla (between Chinchilla and Boondooma Lake), within Palmgrove and Expedition National Parks to the southwest of Moura. Two isolated population occur between Goondiwindi and Millmerran.

Occurs in remnant and disturbed Brigalow (*Acacia harpophylla*) and Belah (*Casuarina cristata*) dominated communities in shaded situations, often in leaf litter (TSSC 2008 c). The species is associated with Brigalow dominated communities, preferring shady locations where it grows in leaf litter (TSSC 2008 c). The plant often occurs in gilgais in vertic clay soils (vertosols) and is known to occur in non-remnant and highly disturbed habitats. Regional ecosystems associated with this species are typically dominated by Brigalow or Belah and include REs 11.3.1, 11.4.3 and 11.9.5.

Ecology

Little is known in regard to the ecology of *Xerothamnella herbacea* although it can live for a few years and establish vegetatively by rooting from nodes along stems. It can die back to roots in dry conditions and subsequently resprout (Shapcott *et al.* 2017)

Records Relevant to the SGP

Two herbarium records to within 20 km of the SGP Boundary, 20 km to the east and north of Chinchilla (Figure 4.20).

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire project area where it may be associated with Brigalow dominant habitats 11.3.1, 11.4.3 and 11.9.5. Throughout the SGP these REs and any derived regrowth Brigalow should be treated as 'General Habitat'.

2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other remnant vegetation in the SGP, regrowth vegetation and cleared agricultural land should be treated as 'Absence Suspected'.

Mapping Confidence

Due to the relatively specific habitat requirements, detailed survey throughout the SGP and resolution of the revised mapping database, mapping is considered to have a high degree of confidence.

Legend

Xerothamnella herbacea

NC Act, EPBC

- Endangered, Endangered
- Major Watercourse
- Major Roads
- Arrow Lease Boundary
- Arrow Lease Boundary 25km Buffer

Figure 4.20. Spatial distribution of *Xerothamnella herbacea*

Client ARROW ENERGY

0 15 30 45 60

Kilometers

Scale 1:1,050,026 **Drawn By** DG **Date** 24-Jul-23 A4

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5.0 POSSIBLE OR KNOWN THREATENED FAUNA

5.1 INVERTEBRATES

5.1.1 *Adclarkia cameroni* (Brigalow Woodland Snail)

Endangered EPBC Act (effective Dec 2016)
Vulnerable NC Act

Ecology and occurrence within the SGP

The Brigalow Woodland Snail is located in the southern portion of the Brigalow belt associated with the Condamine catchment, particularly the Condamine floodplain between Dalby and Chinchilla (Stanisic *et al.* 2011), though recent work has found the species from the Balonne River floodplain near Surat to the eastern Darling Downs including Jondaryan, Brookstead, Millmerran and Bringally State Forest (Eddie 2023). The species is recorded in available databases at 27 discrete locations within 50 km of the SGP (Figure 5.1). This includes three records on the eastern boundary of the SGP – near the Condamine River – and six records within the SGP. All records within the database are post 1994.

The species is found in Brigalow and alluvial eucalypt woodlands, which have dense cover and scattered debris, especially logs, dense leaf-litter, piles of fallen bark and flood debris. While egg-laying has not been recorded, it is assumed eggs are deposited in small depressions in the soil under logs and other debris where soil moisture is high. Desiccation to adults and eggs is the greatest threat to the species (TSSC 2016a).

The species has limited mobility and, while they can move between patches of habitat under favourable conditions, fragmentation is likely to lead to isolation (TSSC 2016a).

Habitat Mapping

This species inhabits Brigalow communities on clay soils as well as most eucalypt woodlands on floodplains. Within the SGP these habitats seem most consistent with REs 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.17, 11.3.25, 11.3.27, 11.4.3, 11.4.3a. 11.9.5, 11.9.7 and 11.9.10. The species can also occasionally occur in 11.5.1 when nearby favourable habitat is removed (Eddie 2023). This vegetation type, 11.5.1, is not consistent with the high amenity habitat, though revision of this understanding may be required in the future as additional surveys and information sheds light on the species requirements.

While the species is described as occurring within the Condamine floodplain, several records are located considerable distance from this waterway (e.g., two from within Barakula State Forest, ~50 Km to the north-east). This is sufficient to suggest the species could occur anywhere within the SGP.

Rule(s) for Habitat Mapping:

1. The species could occur anywhere within the SGP.
2. The following regional ecosystems, including derived regrowth, should be mapped as 'Core Habitat Possible': 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.17, 11.3.25, 11.3.27 (all sub-types), 11.4.3, 11.4.3a, 11.9.5, 11.9.7 and 11.9.10.

3. The following regional ecosystems, including derived regrowth, should be mapped as 'General Habitat': 11.3.14, 11.3.18, 11.3.26, 11.5.1, 11.5.1a, and 11.5.20.
4. All 'Core Habitat Possible' and 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
5. All remaining vegetation is mapped as 'Absence suspected'.

Mapping Confidence

Current information suggests most Brigalow Woodland Snail populations will be restricted to Brigalow and/or alluvial/riparian vegetation within floodplains. These can be matched to REs with some confidence. However, records from alternative communities suggests the species sometimes occupy less favourable habitats. Understanding the significance of these additional habitats may be possible in the future as information is accumulated.

This species has been recorded from highly disturbed and cleared habitats if there is suitable shelter on the ground (e.g., logs). These habitats are not captured by the above rules and pre-clearing mitigation measures are likely necessary to minimise impacts.

There are several undescribed species of Camaenidae which occupy the same range and habitats as *A. cameroni*. Identification of these species requires careful examination of shell microsculpture as shell shape, size and thickness are variable. Specimen-backed records identified by experts are therefore required to establish presence/absence of this species.

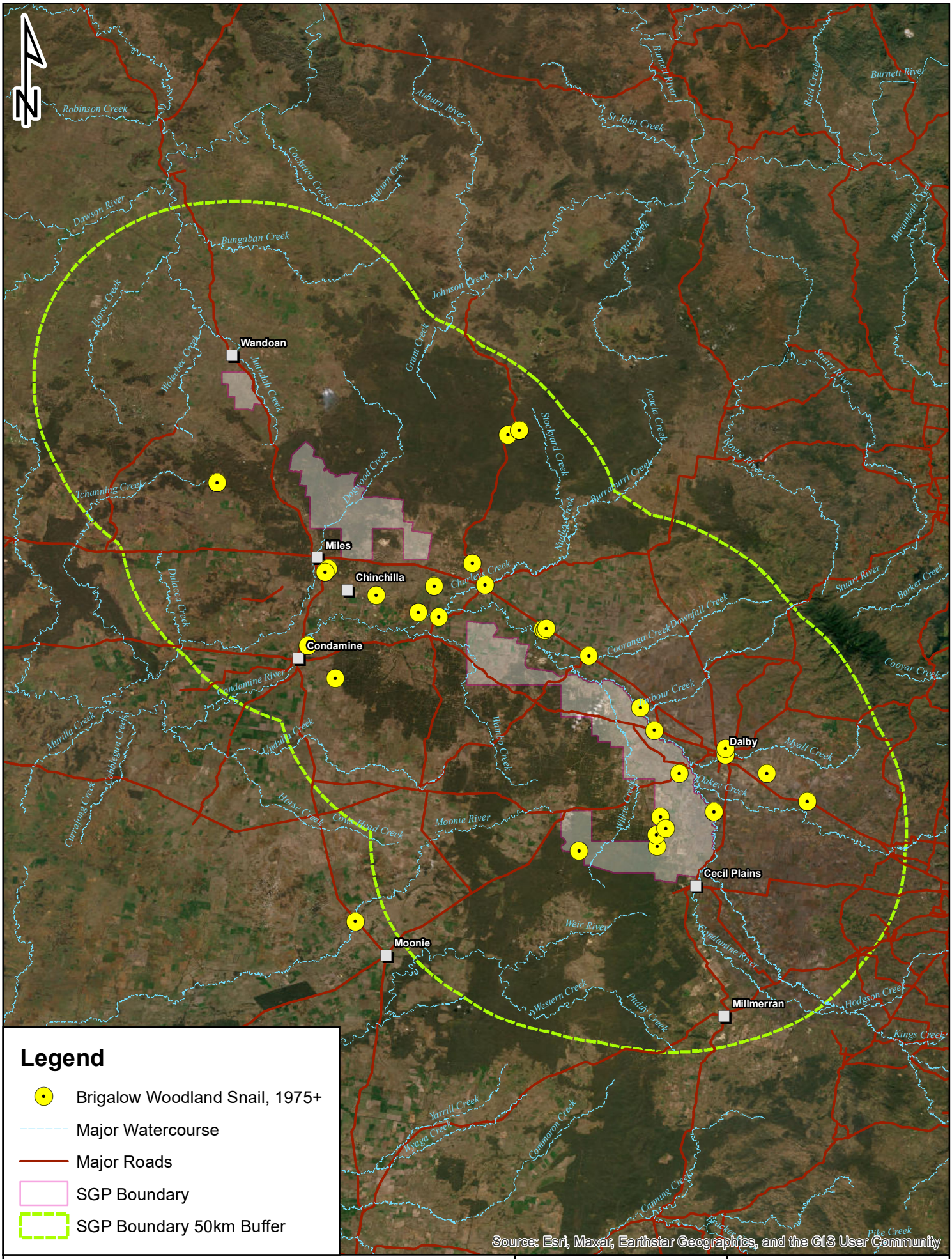


Figure 5.1
Records of the Brigalow Woodland Snail within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.1.2 *Adclarkia dulacca* (Dulacca Woodland Snail)

Endangered EPBC Act (effective Dec 2016)
Endangered NC Act

Ecology and occurrence within the SGP

Publicly available records suggest the Dulacca Woodland Snail is restricted to the southern Brigalow Belt between Miles, Dulacca, Wandoan and Meandarra, though recent work has found the species west to the Yuleba area and east to the Chinchilla area (Eddie 2023). It has been recorded in available databases at 13 discrete locations within 50 km of the SGP including the nearby Gurulmundi State Forest. The species has been recorded once in the SGP and at one location to the east of the SGP near Barakula State Forest. Current record and distributions suggest the species will occur only as far south as Kogan, although no targeted surveys have been undertaken.

The species has been located in a variety of habitats including vine thicket and Brigalow (*A. harpophylla*) woodland with rock outcrops and Lancewood (*A. shirleyi*), Ironbark and *E. woollsiana* woodlands on ridges with and without rock (TSSC 2016b). It shelters in moist microhabitats under wood, rocks and other debris, as well as under bark at the base of trees. It has been found persisting in brigalow regrowth but only where there is abundant suitable microhabitats (e.g., logs, dense leaf litter). Eggs are laid in suitable microhabitat locations during summer rains.

The Dulacca woodland snail has limited mobility. Recruitment is likely to be low, with recruitment events limited to periods of rainfall (TSSC 2016b).

Habitat Mapping

Conservation advice (TSSC 2016b) indicates the species is known from Brigalow and Semi-evergreen vine thickets, which in the SGP includes REs 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5 and 11.9.10. Based on expert advice (Eddie 2023) the species has also been recorded from, or core habitats should be expected in, 11.5.20, 11.7.6, 11.7.7 and 11.9.5. General habitats include RE 11.5.1, 11.5.1a, and 11.9.10. It tends to avoid areas susceptible to flooding and so is not prevalent on alluvial systems.

Rule(s) for Habitat Mapping:

1. The species could occur within the northern and central regions of the SGP, but is not expected to the north of Kogan (latitude -27.06) in the southern SGP area.
2. North of -27.06, any areas of the following REs (including derived regrowth) are mapped as 'Core Habitat Possible': 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5 and 11.9.10.
3. Within the central and northern SGP, any areas of the following REs (including derived regrowth) are mapped as 'General Habitat': 11.5.1, 11.5.1a and 11.9.10.
4. All 'Core Habitat Possible' and 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
5. All remaining vegetation is mapped as 'Absence suspected'.

Mapping Confidence

While high amenity habitats can be matched with some confidence to RE descriptions, this species remains relatively poorly known. The current mapping has moderate confidence and should be reviewed as more information becomes available.

This species has been recorded from highly disturbed and cleared habitats if there is suitable shelter on the ground (e.g., logs). These habitats are not captured by the above rules and pre-clearing mitigation measures are likely necessary to minimise impacts.

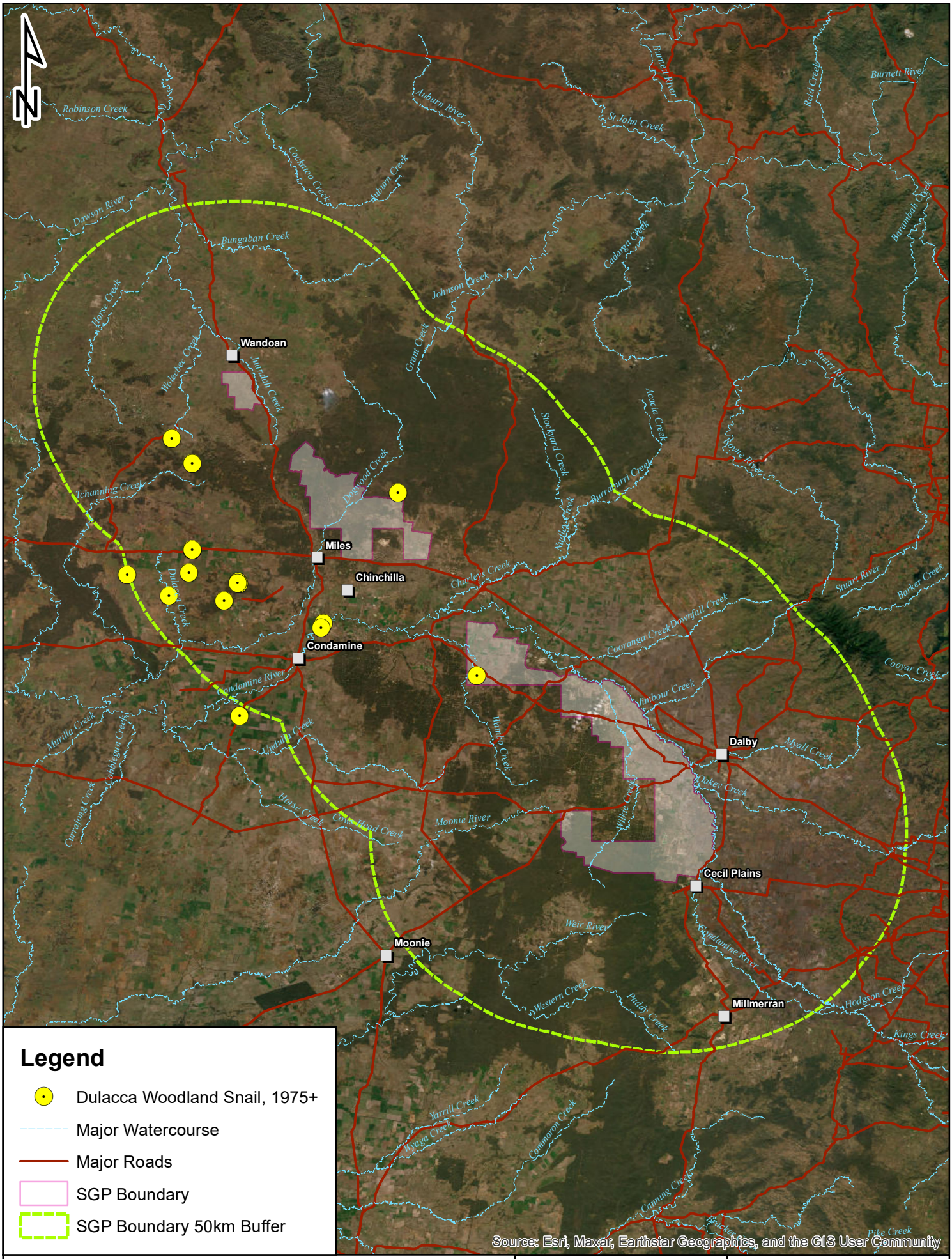


Figure 5.2
Records of the Dulacca Woodland Snail within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.1.3 *Jalmenus eubulus* (Pale Imperial Hairstreak)

Vulnerable NC Act

Ecology and occurrence within the SGP

Jalmenus eubulus is restricted to the eastern Brigalow Belt Bioregion. The northern limit of its distribution appears to be around the latitude of Mackay and ranges south to around Boggabilla in northern NSW. The eastern limit of its distribution is roughly designated by the Great Dividing Range, being found near Kroombit Tops, Binjour Plateau, Bunya Mountains and Jondaryan (Eastwood *et al.* 2008). It may be found as far west as Carnarvon (Sands and New 2002).

The species has been recorded at approximately 18 descrete locations surrounding the SGP, most since 1975 (Figure 5.4). The number of records and locations is likely to underestimate its occurrence due to a lack of systematic survey effort.

The species is restricted to Brigalow (*Acacia harpophylla*)-dominated woodlands and open-forests. Its core habitat is old-growth Brigalow, particularly those areas with Belah (*Casuarina cristata*), emergent eucalypts such as *Eucalyptus populnea* and understorey shrubs and adults are always observed in association with old-growth (remnant) *A. harpophylla* communities (Breitfuss and Hill, C. J. 2003; Eastwood *et al.* 2008). Being highly mobile, isolated patches may also provide suitable habitat.

Jalmenus eubulus feeds exclusively on Brigalow (*A. harpophylla*) shrubs ranging in height from 0.5 to 5 m and (Braby 2000; Breitfuss and Hill, C. J. 2003; Eastwood *et al.* 2008). The species has also been documented as feeding on other *Acacia* species (Sands and New 2002), but this has been discarded as erroneous in recent reviews (Eastwood *et al.* 2008).

It is likely that eggs enter diapause shortly after being laid. Emergence is triggered by summer rainfall, which may fall irregularly throughout the species' range, resulting in apparent different activity patterns between populations and years. Adults have been recorded between October and April, with peak activity in February and March. Peak activity appears to occur approximately two months after the wettest months of the year (December and January) (Eastwood *et al.* 2008).

Larvae feed singly, or occasionally in small groups of up to three individuals (Braby 2000). As in many lycaenid butterflies, the larvae are always attended by ants of the *Iridomyrmex* group, on which they are likely to be reliant for survival (Braby 2000; Sands and New 2002; Eastwood *et al.* 2008).

Habitat Mapping

This species is an old-growth Brigalow specialist and, with the exception of occasional transient individuals, will be largely restricted to Brigalow patches. Suitable REs within the SGP include 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5.

Rule(s) for Habitat Mapping:

1. The species may occur throughout the SGP area.
2. Within the SGP all remnant Brigalow (11.3.1, 11.3.17, 11.4.3 11.4.3a, 11.9.5) is classed as 'Core Habitat Possible'.

3. All 'Core Habitat Possible' within 1 km of a recent (1975+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. The remaining REs, regrowth and non-remnant areas are classed as 'Absence Suspected'.

Mapping Confidence

The life-cycle and habitat requirements for the Pale Imperial Hairstreak is well documented and understood. Correlation between important habitat characteristics and Regional Ecosystem descriptions is high. The habitat mapping for this species is expected to be highly accurate.

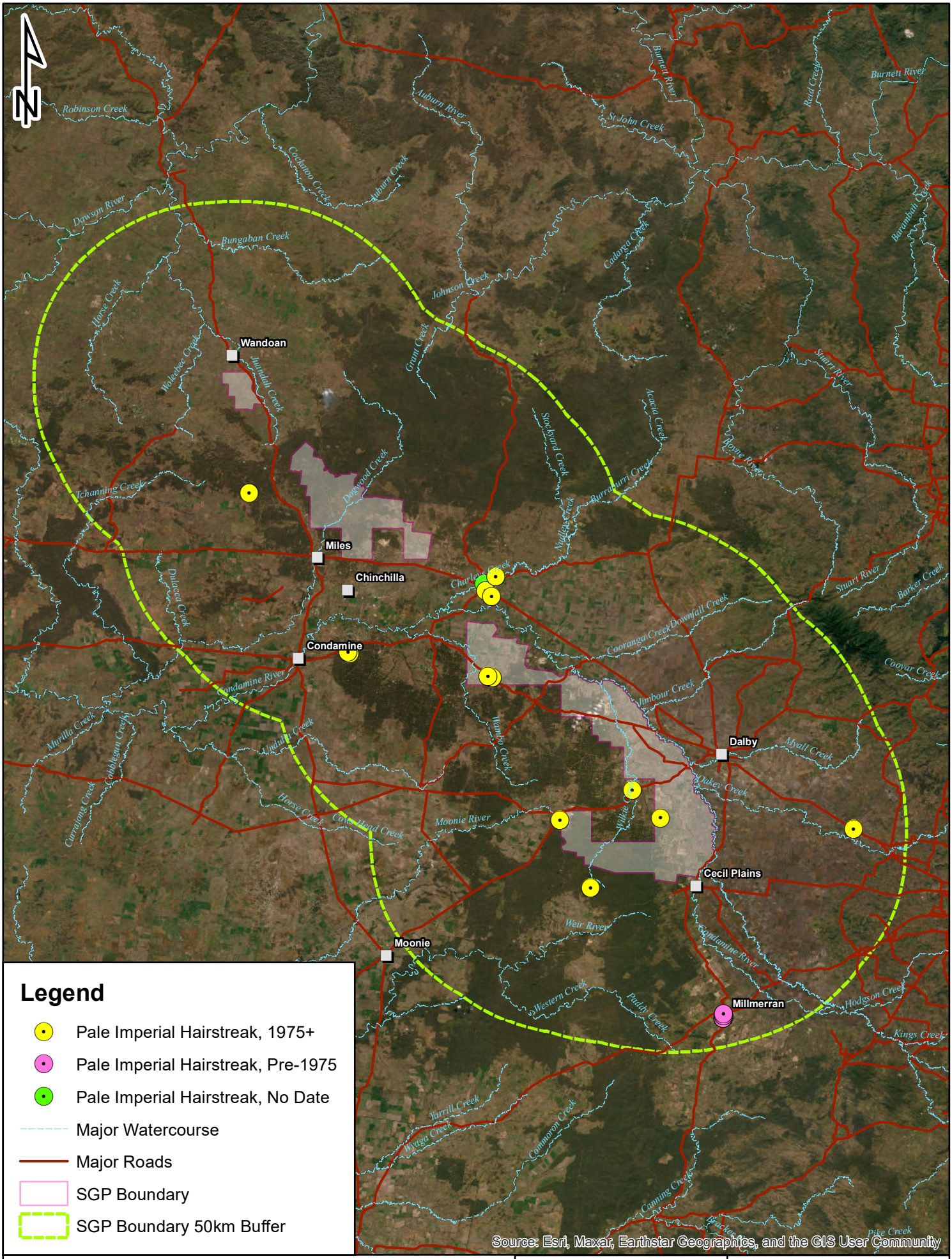


Figure 5.3
Records of the Pale Imperial Hairstreak within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.2 REPTILES

5.2.1 *Acanthophis antarcticus* (Common Death Adder)

Vulnerable NC Act

Ecology and occurrence within the SGP

Common Death Adders can be found throughout most of Queensland (Wilson and Swan 2020). Once abundant in the Brigalow Belt, they are now rarely observed and, when located, often associated with large contiguous tracts of vegetation. For example, records are more abundant with the state forests around Inglewood and Southwood National Park. In addition to their size, these areas have low grazing pressure and retain a complex and healthy ground strata (in particular ground debris). They may represent strongholds for the species in the southern Brigalow Belt (EPA 2008).

Death Adders are found in a wide variety of habitats, including rainforest, open woodland, shrubland and heath (Ehmann 1992; Wilson and Swan 2020). They are typically not associated with grasslands or very open woodlands as these lack complex ground strata layers and abundant debris.

The Common Death Adder is a slow-moving, sedentary snake that lies motionless while partially buried in leaf litter, vegetation or soil. Breeding takes place in spring and autumn (Ehmann 1992). Diet consists of lizards and small mammals, and to a lesser extent frogs (Shine *et al.* 2014). Diet changes with age, young animals consuming more reptiles and frogs, whilst adults feed predominantly on small mammals and birds (Shine 1980). Their hunting style and diet make them particularly susceptible to Cane Toad ingestion (Hagman *et al.* 2009). This threat might explain their low abundance within the SGP where Toads are abundant and widespread.

The Common Death Adder has been recorded from 11 unique locations within 50 km of the SGP (Figure 5.4). Most recently the species was recorded near Tara in 2021, and a second from 1984 near Lake Broadwater (though with low accuracy ±2,500 m), represent all the records since 1975. One record from Dalby is pRE 1975 and all others are undated. The Lake Broadwater record is the only occurrence of the species within the SGP. While of low probability, these records suggest the species might have some potential to occur within the SGP, however, as the species appears to be sparce and quite uncommon, large areas of suitable habitat are likely to be uninhabited.

Habitat Mapping

Only two records within the database were spatially accurate enough to extract habitat data and both occurred in non-remnant habitats. Suitable REs within the SGP must therefore be ascertained by comparing the REs description to the species known ecology. On examination, all remnant vegetation is considered suitable for this species.

However, within the Brigalow Belt the Common Death Adder is typically associated with large contiguous patches of vegetation. Smaller patches are more likely to suffer degradation and less likely to support the species. As such, suitable habitat is better mapped based on landscape context and patch size with patches greater than 1,000 ha of highest value.

Rule(s) for Habitat Mapping:

1. Potential Death Adder habitat is most likely in contiguous and near-contiguous areas of vegetation (i.e., reduced fragmentation). Potentially important habitat is therefore likely restricted to vegetation within or abutting the 'large tracts remnant veg.shp'. Within this area, all remnant vegetation (irrespective of RE designation) should be classed as 'Core Habitat Possible'.
2. Any remnant vegetation (irrespective of RE designation) outside the 'large tracts remnant veg.shp' is mapped as 'General Habitat'.
3. Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
4. All non-remnant habitats, including regrowth, are mapped as 'Absence Suspected'.

Mapping Confidence

The presence of Death Adders is difficult to predict; they may occur in any remnant habitat yet are absent from seemingly good habitat within the Brigalow Belt. This may reflect historic land use, or events that affected ground structure such as fire history. Following fire, recolonisation may only occur if remaining patches are large or well connected to nearby populations. Local abundance of Cane Toads may also affect populations viability. Due to these difficulties, the habitat map for this species is considered to have low accuracy in predicting the species occurrence. While mapped areas are likely to represent suitable habitats, occupied habitat is likely to be overestimated.

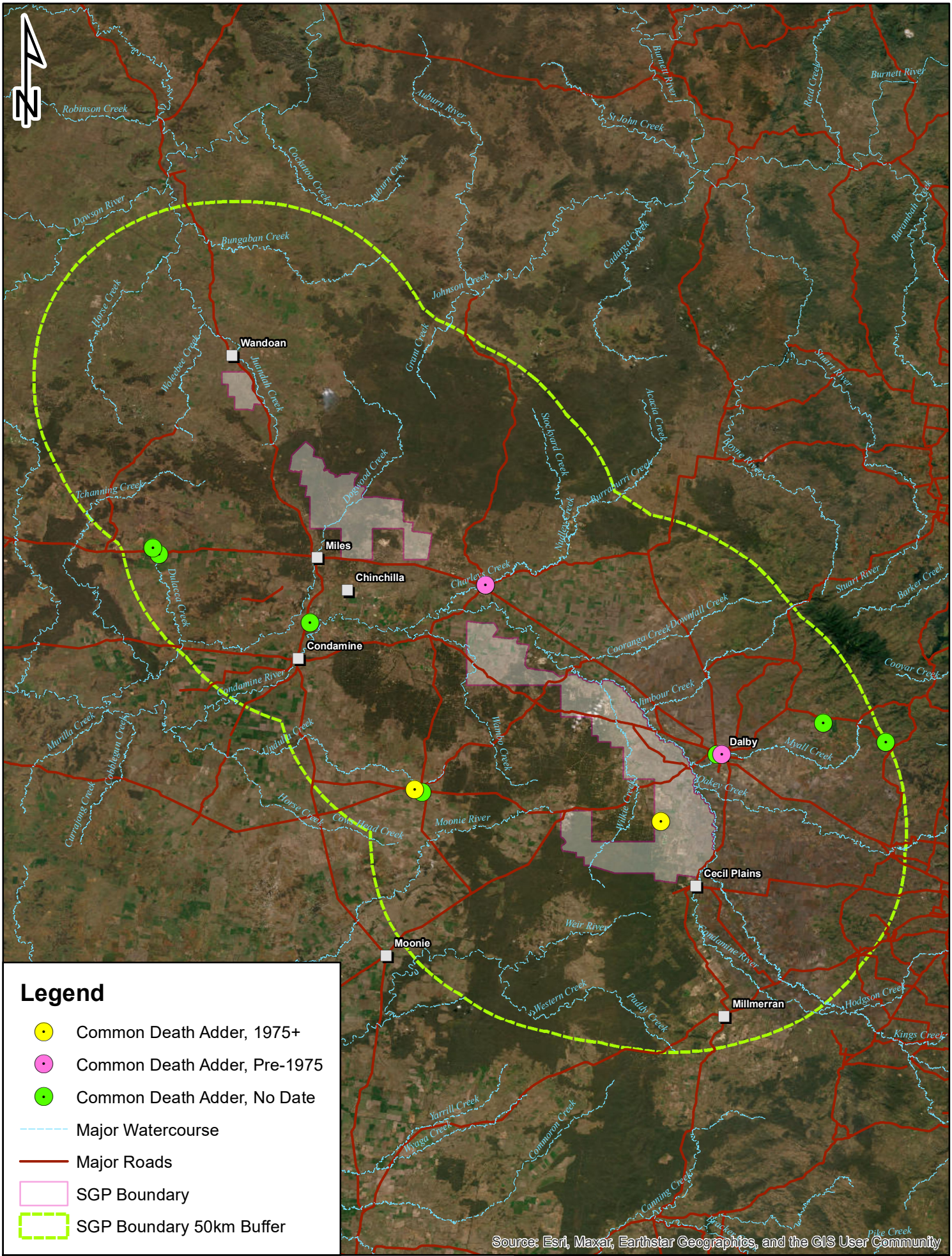


Figure 5.4
Records of the Common Death Adder within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.2.2 *Glyphodon (Furina) dunmalli* (Dunmall's Snake)

Vulnerable EPBC Act (effective Jul 2000)
Vulnerable NC Act

Ecology and occurrence within the SGP

Dunmall's Snake (*Glyphodon dunmalli,* previously *Furina dunmalli*) is confined to the Brigalow Belt bioregion of south-eastern Queensland and north-eastern New South Wales, occurring north to Clermont and near Rockhampton. Most records are from the Dalby-Tara area of the Darling Downs (Hobson 2012). The SGP area is entirely contained within the species distribution. The species is very rarely encountered, even in areas of known habitat, and has been described as 'extremely secretive, rarely encountered, possibly genuinely scarce' (Wilson 2022).

The Dunmall's Snake has been recorded from a number of locations surrounding the SGP including two records approximately 6-7 km to the west. One of these is undated and likely very old while the second is dated as the year 2000. Three records fall within the SGP, two at Lake Broadwater (dated as 1984 and 1993) and a third recent record (2017) in the north (Figure 5.5). These three onsite records have been recorded from RE 11.5.1 and regrowth RE 11.5.20.

Limited information is available on habitat preferences of the Dunmall's Snake. It has been recorded from a wide range of habitats, including forests and woodlands dominated by brigalow (*Acacia harpophylla*) and other acacias (*A. burowii, A. deanii, A. leiocalyx*), cypress (*Callitris* sp.) or Buloke (*Allocasuarina luehmannii*) on black alluvial cracking clay and clay loams (Covacevich *et al.* 1998; Stephenson and Schmida 2007; Brigalow Belt Reptiles Workshop 2010; Hobson 2012). It also occurs in Spotted Gum (*Corymbia citriodora*) and ironbark (*Eucalyptus crebra* and *E. melanophloia*) on sandstone derived soils and there is a record from the edge of dry vine scrub (Stephenson and Schmida 2007; Brigalow Belt Reptiles Workshop 2010). However, preferred habitat appears to be brigalow growing on cracking black clay and clay loams (Chapple *et al.* 2019), with the majority of records from between 200 to 500 m elevation (Hobson 2012). The species can, on rare occasions, inexplicably appear in sub-optimal vegetation. Advanced regrowth habitat should not be discounted, particularly when adjacent or linking areas of suitable habitat.

Habitat Mapping

Modelling completed by Johnson *et al.* (2017) failed to find any reliable attributes for predicting suitable habitat for this species. The study noted the types of BVG's in which Dunmall's Snakes have been recorded, several of which occur within the SGP (Table 5.1).

This list should not be considered exhaustive as the species is poorly known and the number of records low. Additional REs within the SGP which are structurally similar and likely suitable based on the species known habitat use includes RE 11.3.14, 11.5.21 and 11.7.2.

Table 5.1. Association of Dunmall's Snake records with 1:1 m Broad Vegetation Groups (Modified from Johnson *et al* 2017; only BVGs/REs relevant to the SGP listed)

BVG	Description	Representative REs within SGP
10a	Dry woodlands to open woodlands dominated by *Corymbia citriodora* (Spotted Gum). (land zones 10, 7, 12, 11).	11.7.6
12a	Dry woodlands to open woodlands dominated by ironbarks such as *Eucalyptus decorticans* (Gum-topped Ironbark), *E. fibrosa* subsp. *nubila* (Blue-leaved Ironbark), or *E. crebra* (Narrow-leaved Red Ironbark) and/or bloodwoods such as *Corymbia trachyphloia* (Yellow Bloodwood), *C. leichhardtii* (Rustyjacket), *C. watsoniana* (Watson's Yellow Bloodwood), *C. lamprophylla, C. peltata* (Yellowjacket). Occasionally *E. thozetiana* (Mountain Yapunyah), *E. cloeziana* (Gympie Messmate) or *E. mediocris* are dominant. Mostly on sub-coastal/inland hills with shallow soils. (land zones 7, 9, 10).	11.7.4, 11.7.7
13d	Woodlands dominated by *Eucalyptus moluccana* (Gum-topped Box or *E. microcarpa,* Inland Grey Box) on a range of substrates. (land zones 3, 5, 8, 9, 11, 12).	11.3.26, 11.5.20
17a	Woodlands dominated by *Eucalyptus populnea* (Poplar Box) (or *E. brownii*, Reid River Box) on alluvium, sand plains and footslopes of hills and ranges. (land zones 3, 4, 5, 9, 10, 11, 12).	11.3.2, 11.3.18, 11.5.1a, 11.9.7
18b	Woodlands dominated *Eucalyptus crebra* (*sens. lat.*) (Narrow-leaved Red Ironbark) frequently with *Corymbia* spp. or *Callitris* spp. on flat to undulating plains. (land zones 3, 5).	11.5.1, 11.5.4
25a	Open forests to woodlands dominated by *Acacia harpophylla* (Brigalow) sometimes with *Casuarina cristata* (Belah) on heavy clay soils. Includes areas co-dominated with *A. cambagei* (Gidgee) and/or emergent eucalypts. (land zones 3, 4, 7, 9, 11).	11.3.1, 11.3.17, 11.4.3/a, 11.4.10, 11.9.5, 11.9.10

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire SGP.
2. All areas of remnant vegetation with a combined extent >50 ha consisting of the following REs should be classed as 'Core Habitat Possible': 11.3.1, 11.3.17, 11.3.18, 11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.4, 11.7.6, and 11.7.7.
3. Smaller vegetation patches (<50ha) of the above REs may be mapped as 'General Habitat' if they are in close proximity (≤500 m) to areas of 'Core Habitat Possible'.
4. All areas of remnant vegetation with a combined extent >50 ha consisting of the following REs should be classed as 'General Habitat': 11.3.14, 11.5.21, 11.7.2.
5. Advanced regrowth of all the above REs are mapped as 'General Habitat' if they are adjacent (≤500 m) or connect to large areas of 'Core Habitat Possible' or 'General Habitat'.
6. Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
7. Remaining REs, regrowth and non-remnant areas are mapped as 'Absence Suspected'.

Mapping Confidence

This species is very poorly understood and records are scarce. Predicting its occurrence is extremely difficult and the mapping is likely to have low accuracy. The species is likely absent from large areas of mapped habitat.

After extensive surveys in suitable habitat under favourable conditions failed to locate Dunmall's Snake, Johnson *et al.* (2017) concluded 'As potential habitat is currently so poorly defined, improving knowledge may be a more useful conservation action for this species than would be offsetting land selected on the basis of existing knowledge.' They suggested offsets committing to long-term targeted work (i.e., several years field work at appropriate times, in appropriate habitats) to help refine habitat understanding may be of higher value than land-based offsets.

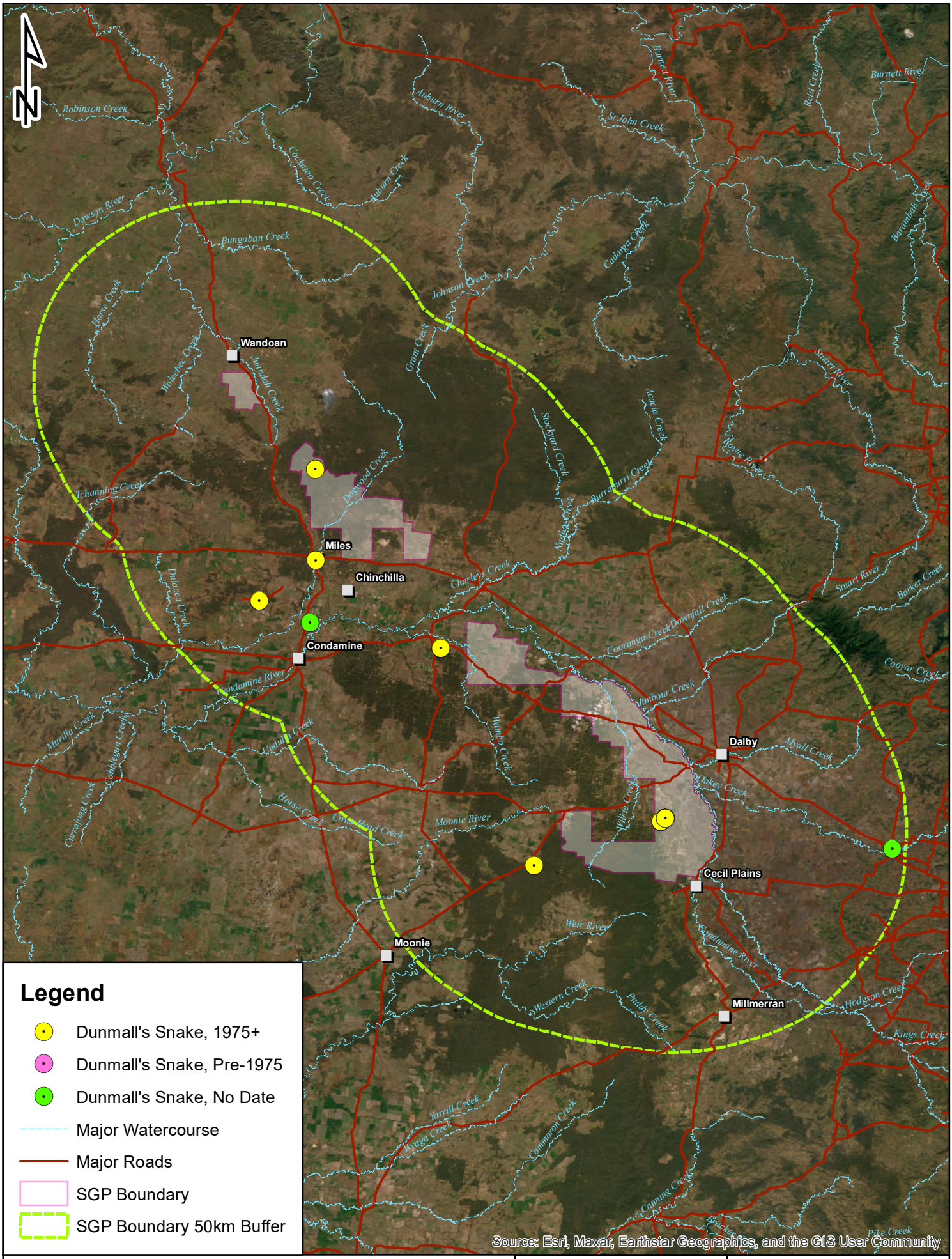


Figure 5.5
Records of the Dunmall's Snake within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.2.3 *Hemiaspis damelii* (Grey Snake)

Endangered EPBC Act (effective Oct 2022)
Endangered NC Act

Ecology and occurrence within the SGP

Grey snakes occur throughout the Brigalow Belt, from coastal districts near Rockhampton, south-east to the Lockyer Valley in South East Queensland (Wilson and Swan 2020; Wilson 2022). The SGP is entirely within their distribution and the species has been often recorded within 50 km. This includes eight records since 1975, all located in the south and five associated with Lake Broadwater.

They inhabit dry eucalypt forest and occasionally pasture favouring cracking, flood-prone soils along floodplains and near watercourses (Hobson 2002; Rowland 2012; Covacevich and Wilson 2020; Wilson 2022). Most records are not associated with large river channels, but rather they typically inhabit the adjacent floodplains with ephemeral ponds or wetlands.

Grey Snakes are weakly venomous nocturnal frog specialists (Shine 1987; Wilson and Swan 2020), sheltering during the day under fallen logs, within soil cracks and down animal burrows. They are known to give birth to up to 10 live young (Covacevich and Wilson 2020), but little else is recorded of their breeding biology.

Habitat Mapping

Important remnant vegetation within the SGP for this species will include Brigalow (*A. harpophylla*) ± Belah (*Casuarina cristata*) and grasslands on dark cracking clays (TSSC 2023a). These areas form gilgais - a microrelief which readily collects water attracting large numbers of frogs following rain. Within the SGP, such habitats are confined to RE 11.4.3, 11.4.3a and 11.9.5. Accurate recent (1975+) records within the SGP have also been located in RE 11.3.27f and 11.5.20. The latter record occurred in an isolated low-lying area of pooling water (M. Sanders *pers obs*) within 300 m of a minor creek line map as RE 11.3.25. Large areas of RE 11.5.20 are unlikely to support resting surface water and, on balance, probably do not warrant mapping as 'core habitat possible'. In contrast, most ecosystems on landzones 3 and 4 are likely to have areas of inundation, gilgais or similar. These features will attract frogs and therefore Grey Snakes.

Within the 50 km of the SGP records are also associated with RE 11.5.20, and 11.7.4/11.7.7. However, most records within 50 km are associated with non-remnant habitats (88%), and this may suggest the species is less influenced by dominant vegetation type than microrelief characteristics.

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire SGP.
2. All remnant vegetation where surface water could collect provides potential habitat for these species. In particular, vegetation on Landzones 3, and 4 should be classed as 'Core Habitat Possible' (11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.18, 11.3.25, 11.3.26, 11.3.27, 11.4.3 and 11.4.3a). In addition, the following REs have clay soils, gilgai's or are likely to be subject to temporal ponding and should also be 'Core Habitat Possible'; 11.9.5.

3. Derived Grasslands, which occur in alluvial floodplains in the SGP, are mapped as 'Core Habitat Possible'.
4. Larger contiguous areas of REs 11.5.1, 11.5.1a, 11.5.20, and 11.5.21, or where these are immediately adjacent Core Habitat Possible, are included as 'General Habitat'.
5. Artificial waterbodies are mapped as 'General Habitat'.
6. All remnant vegetation, non-remnant vegetation, regrowth or grazing land (but not tilled land, tracks or cultivated land) within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
7. Regrowth be classed according to its parent regional ecosystem.
8. Tilled crops, tracks and cultivated land (i.e., areas with frequently surface disturbed) are mapped as 'Absence Suspected'.

Mapping Confidence

This species may occur in a number of habitats, including modified grazing land with exotic grasses where suitable microrelief is retained. The mapping rules provided here are based on the Regional Ecosystem model, but increasingly it seems this approach is poor at predicting this species habitat. The mapping is likely to have low confidence in predicting suitable habitat.

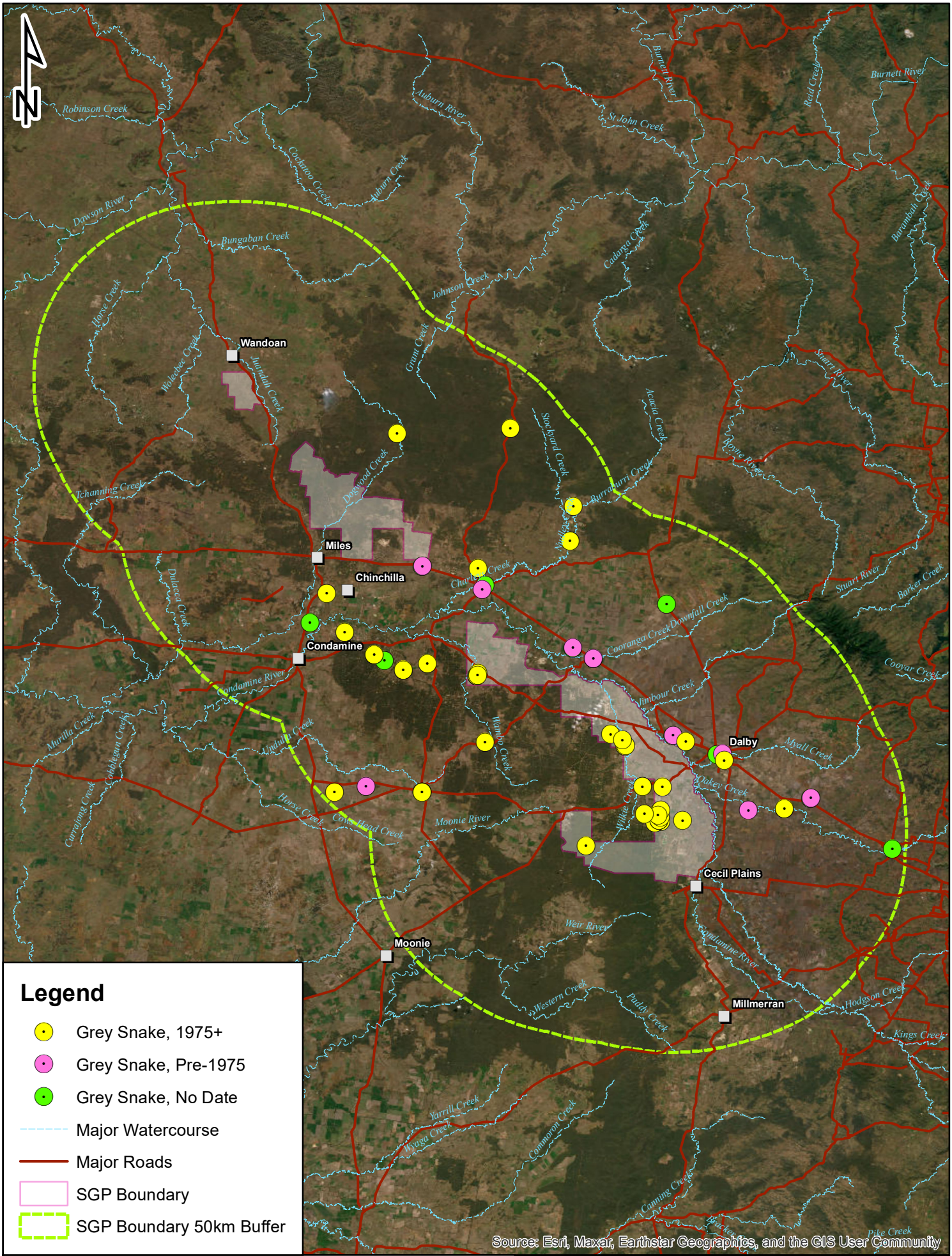


Figure 5.6
Records of the Grey Snake within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.2.4 *Strophurus taenicauda* (Golden-tailed Gecko)

Near Threatened NC Act

Ecology and occurrence within the SGP

Golden-tailed geckos are found from the western slopes of the Great Dividing Range to Carnarvon, and from Emerald in the north to Inglewood/Millmerran in the south. The SGP therefore encompasses a sizable portion of the species' range. The area around Barakula may represent a stronghold for this species (Richardson 2006). It has often been recorded within and surrounding the SGP (Figure 5.7).

Golden-tailed geckos are found mainly in association with Brigalow (*Acacia harpophylla*), Cypress (*Callitris* spp.) and Buloke (*Allocasuarina luehmannii*) ironbark (*Eucalyptus* spp.) (Brown *et al.* 2012). Ground cover, tree hollows and loose or peeling bark on standing trees may be important shelter sites for this species (Richardson 2006). The species appears tolerant to fragmentation, provided the vegetation is largely unaffected by grazing and there is abundance of cypress pine (Thompson and Eldridge 2005; Ngugi *et al.* 2013; Pavey *et al.* 2021). They are also known to utilise regrowth (Pavey *et al.* 2021) and are often at highest densities in vegetation with abundant shrub, especially *Acacia* and *Callitris*.

During the daytime, Golden-tailed Geckos shelter under loose bark and in tree hollows (Wilson 2022). They may also bask during the daytime. In Spring/Summer, females lay a clutch of two eggs. Females may lay more than one clutch in a season.

Movement patterns of the species have not been documented. However, individuals have been recorded crossing dual lane roads during warm summer nights.

Habitat Mapping

An analysis of recent (1975+) records within the SGP and surrounding area (Table 5.2) found Golden-tailed Geckos inhabiting the following BVG groups: 10a, 12a, 13d, 16a, 17a, 18a, 18b, 25a and 29b. This analysis suggests the following REs could contain suitable habitat within the SGP: 11.3.1, 11.3.2, 11.3.14, 11.3.17, 11.3.18, 11.3.26, 11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.20, 11.5.21, 11.3.26, 11.5.4, 11.7.4, 11.7.6, 11.7.7, 11.9.5, 11.9.7 and 11.9.10.

While there is some evidence the species might occur in one of the following REs, these are generally not considered high amenity due to the lack of a suitable shrub layer: 11.3.2, 11.3.25, 11.7.2 and 11.9.5. Similarly Brown *et al.* (2012) also list RE 11.3.3, 11.3.4 and 11.9.2, though these too seem less than ideal. These REs can be mapped as general habitat.

Table 5.2. Association of Golden-tailed Gecko records with 1:1 m Broad Vegetation Groups within the SGP and surrounding 50 km area

BVG (1 m)	Count of records			Representative REs in the SGP
	SGP	50 km	% of total	
10a	2	9	3.1	11.7.6
12a	24	61	23.7	11.7.4, 11.7.7
13d	5	6	3.1	11.3.26, 11.5.20
16a	3	0	0.8	11.3.25
17a	0	7	2.0	11.3.2, 11.3.18, 11.5.1a, 11.9.7
18a	2	11	3.6	11.3.14, 11.5.21
18b	41	43	23.5	11.5.1, 11.5.4
25a	0	2	0.6	11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5, 11.9.10
29b	4	6	2.8	11.7.5
Non-remnant	38	94	36.9	
Total	*119*	*239*	*100.0*	

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP area.
2. Within the SGP, REs 11.3.1, 11.3.14, 11.3.17, 11.3.18, 11.4.3 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.5.21, 11.3.26, 11.7.4, 11.7.6, 11.7.7, 11.9.5, 11.9.7, 11.9.10 are mapped as 'Core Habitat Possible'.
3. Within the SGP, REs 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.7.2, 11.7.5 and 11.9.2 are mapped as 'General Habitat'.
4. All areas of advanced regrowth (10+ yrs) should be treated as remnant vegetation and classed accordingly.
5. Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. Habitat patches <5ha and greater than 200 m in distance from other remnant vegetation (i.e., isolated) are downgraded to 'Absence Suspected'.
7. 'Core Habitat Possible' (as identified in the steps above) between 5ha and 10ha in size and more than 200 m in distance from other remnant vegetation (i.e., isolated) is downgraded to 'General Habitat'.
8. 'General Habitat' (as identified in the steps above) between 5ha and 10ha in extent and more than 200 m in distance from other remnant vegetation (i.e., isolated) is downgraded to 'Absence suspected'.
9. Remaining regrowth and REs are classed as 'Absence Suspected'.

Mapping Confidence

Golden-tailed Geckos appear to be unevenly distributed throughout suitable habitat. However, they can also inhabit regrowth. As such, the mapped habitat area is likely to have a moderate accuracy.

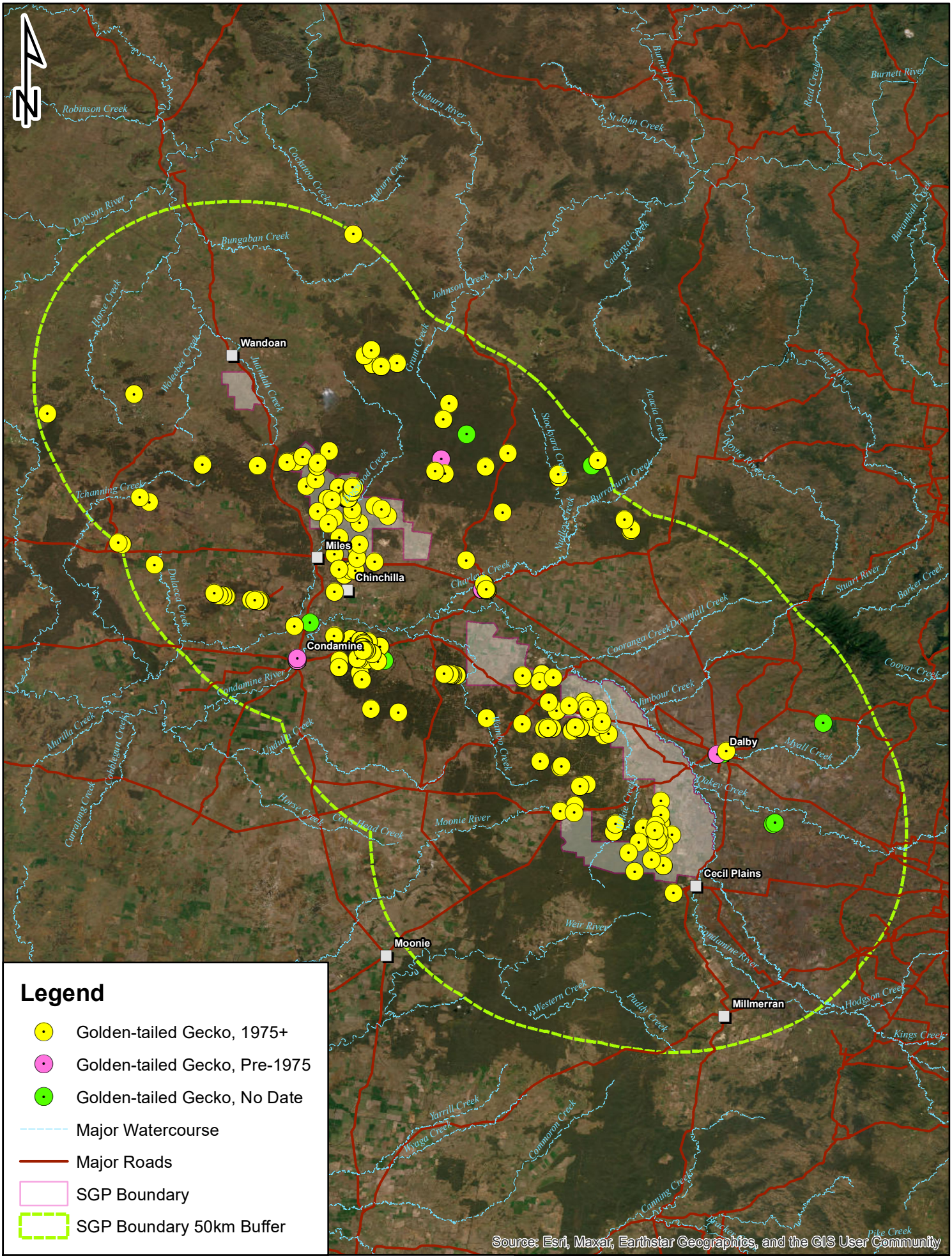


Figure 5.7
Records of the Golden-tailed Gecko within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.3 BIRDS

5.3.1 *Rostratula australis* (Australian Painted Snipe)

Endangered EPBC Act (effective May 2013)
Vulnerable NC Act

Ecology and occurrence within the SGP

Most records of the species occur east of a line between Eyre Peninsula and the Gulf of Carpentaria, excluding Cape York Peninsula where they appear to be absent (Marchant and Higgins 1993). However, scattered individuals occur west as far as Western Australia, where they may have once been common in the Kimberley and Swan Coastal Plain (Johnstone and Storr 1998). Recent records mostly centre on the Murray-Darling basin of eastern Queensland and New South Wales (Marchant and Higgins 1993; Rogers *et al.* 2005). Lake Broadwater is considered to be important habitat for this species within Brigalow Belt South, although there is no known breeding record from this location (EPA 2008).

Birds may be recorded singly or in small groups in freshwater marshes. They are extremely nomadic, coming and going in response to local rainfall and flooding. Although its occurrence in a location is often erratic, with the bird absent some years and common in others (Marchant and Higgins 1993) there is indication of some regular seasonal migration, e.g., to central and north coastal Queensland in autumn and winter (Black *et al.* 2010). Breeding only occurs in swamps with temporary water regimes and complex shorelines forming islands, shallow water, exposed wet mud and dense low fringing vegetation (Rogers *et al.* 2005; Geering *et al.* 2007). During non-breeding periods, they may be found in a wider range of habitats including dams, rice paddocks, waterlogged grasslands, roadside drains and even brackish waterways (Marchant and Higgins 1993).

The Australian painted snipe appears to be crepuscular and nocturnal, feeding on mudflats or in shallow water during the morning and evening and throughout the night (Geering *et al.* 2007). A variety of foods are eaten, including vegetation, seeds, insects, worms, molluscs, crustaceans and other invertebrates including beetles (Marchant and Higgins 1993; Johnstone and Storr 1998).

Nesting occurs in spring and summer in southern Australia and during the wet season in northern Australia (Geering *et al.* 2007). Nests consist of a simple scrap in the ground lined by dry grasses, fine twigs and other vegetation. These nests are located in specific positions such as on a small island surrounded by shallow water, or occasionally on small mounds of purpose-built vegetation surrounded by water (Beruldsen 2004; Rogers *et al.* 2005). Breeding occurs only in suitable temporary wetlands with low relief and complex shorelines after an influx of water (Rogers *et al.* 2005).

Migration patterns are poorly known for the species (Pringle 1987). They are possibly dispersive or migratory. It is possible that such movements are due to local conditions, moving to flooded areas from drying wetlands (Marchant and Higgins 1993).

Habitat Mapping

Fourteen records were identified in databases, with all but four post 1975 (Figure 5.8). All recent records are known from within the vicinity of Lake Broadwater. The species is likely to be a vagrant and rare visitor to the SGP, though there is a low possibility the species might occur at Long Swamp. It is not considered likely elsewhere within the SGP.

Rule(s) for Habitat Mapping:

1. Lake Broadwater (RE 11.3.27c and 11.3.27f) is mapped as 'Core Habitat Known'.
2. Long Swamp (RE 11.3.27d and 11.3.27f) is mapped as "Core Habitat Possible'.
3. Core Habitat Possible within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
4. All remaining REs and non-remnant vegetation (including regrowth) is mapped as 'Absence Suspected'

Mapping Confidence

While the Australian Painted Snipe can occur on a variety of wetlands (including minor waterbodies), it is only known to occur within the immediate area of Lake Broadwater. Habitats outside these are likely to be marginal.

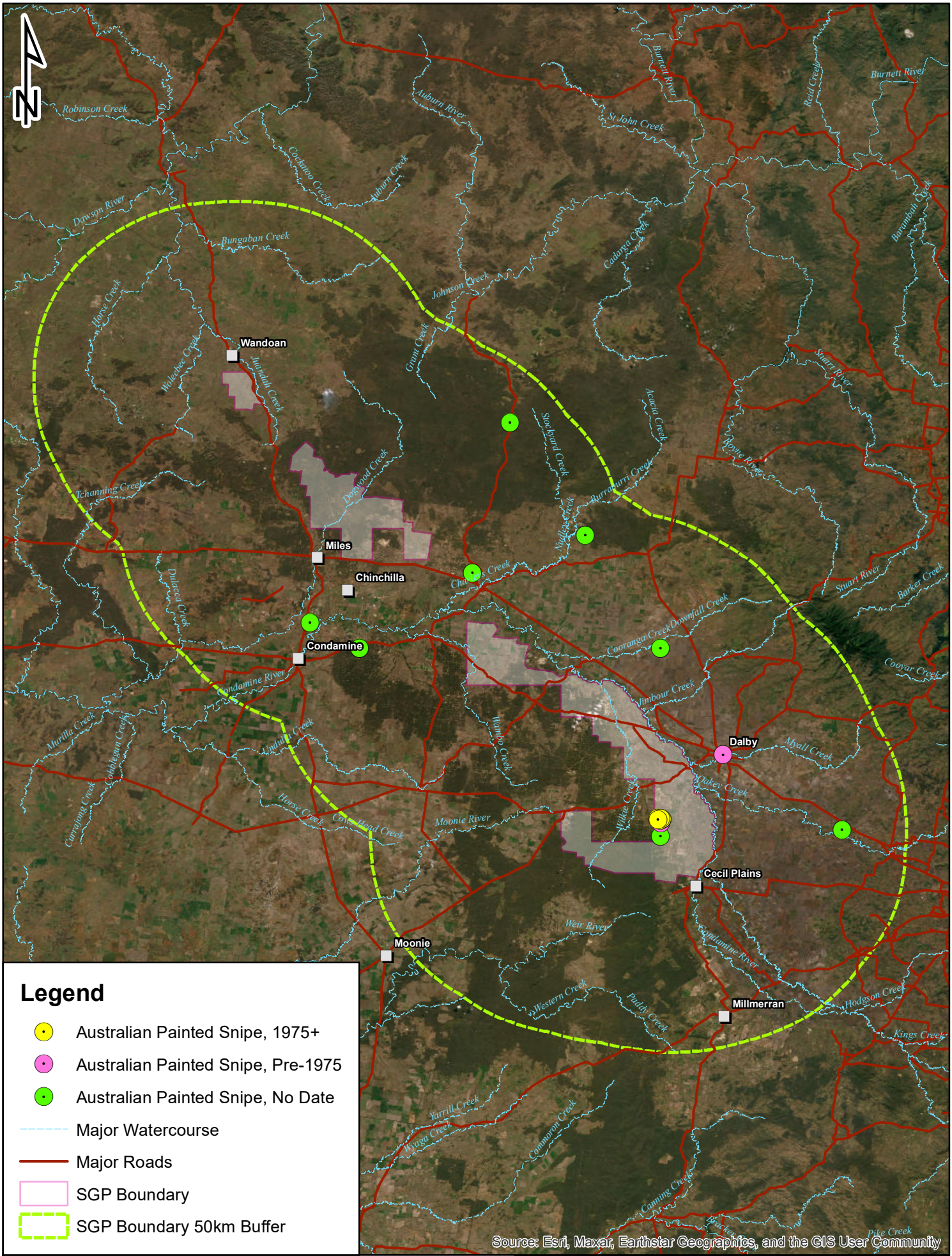


Figure 5.8
Records of the Australian Painted Snipe within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.3.2 *Calyptorhynchus lathami lathami* (Glossy Black Cockatoo)

Vulnerable EPBC Act (effective Aug 2022)
Vulnerable NC Act

Ecology and occurrence within the SGP

Glossy Black-Cockatoos (*Calyptorhynchus lathami*) have a patchy distribution along the east coast and ranges south from near the Paluma Range to Gippsland in Victoria. They are uncommon and declining, especially in the south-western parts of its range, and are now extinct in mainland South Australia (Garnett and Baker 2021). There has been concern for the status of Glossy Black-Cockatoos in the Southern Downs due to the loss of feeding and nesting resources (EPA 2008).

Birds inhabit woodlands and forests that contain abundant *Allocasuarina* spp. and large hollows suitable for nesting. Many populations are restricted to remnant vegetation within hills and gullies surrounded by agricultural land (Higgins 1999); however, some populations move through artificial landscapes such as semi-urban parks, gardens and golf courses to access favoured food resources (Higgins 1999; M. Sanders *pers. obs.*). Groups are never far from waterbodies, which are visited daily. Being highly mobile, birds may travel considerable distances to isolated fragments in search of food. Advanced regrowth may also provide some foraging opportunity.

Typically encountered in small family parties, Glossy Black-Cockatoos are dietary specialists, feeding exclusively on the seeds of *Allocasuarina* and less frequently *Casuarina* spp. Favoured species include *A. torulosa*, *A. littoralis*, *A. distyla*, *A. diminuta*, *A. gymnanthera* and *A. verticillata* (Chapman 2007). While poorly documented Glossy Black-Cockatoos feed on *A. inophloia* in and around the Kumbarilla to Inglewood area (M. Sanders *pers. obs.*). Although a *Allocasuarina* species, *A. luehmannii* has small seeds and is infrequently used.

Observations of the species feeding on other resources (e.g., *Callitris* and *Banksia* spp.) are likely to represent food switching during periods of poor *Allocasuarina* cone production (Chapman 2007). It is unclear if the use of *A. inophloia* by local populations reflect food switching, or if local populations rely on stands of *A. inophloia*. However, given the abundance of orts (feeding signs) in some locations, and their repeated observation over consecutive years, the latter seems plausible.

Birds show a preference for productive trees (e.g., higher seed/cone weight ratio), notwithstanding the influence of other factors such as distance from water or breeding hollows (Clout and Clout 1989; Pepper *et al.* 2000; Crowley and Garnett 2001; Cameron and Cunningham 2006; Chapman and Paton 2006; Chapman 2007). Stands of *Allocasuarina* spp. are not, therefore, of uniform value and the loss of individual stands or trees can have disproportionate impacts.

Pairs breed during winter, mainly from April to July, although breeding has been recorded as late as August or as early as March (Beruldsen 2004). Nests are located in a large vertical hollow extending one or two meters deep. Hollows may be reused over many years (Beruldsen 2004). Females incubate and care for the young alone, but are regularly attended and fed by the male. Only one egg is produced, which hatches in about 30 days. Once hatched the chick

fledges in around 60 days, but remains with its parents and is fed for another three months (Garnett and Baker 2021).

Glossy Black Cockatoos are well represented in the SGP area, though records in the very north are less frequent than in the south. Birds or their signs have been often recorded in and around Lake Broadwater and Kumbarilla State Forest (Figure 5.9).

Habitat Mapping

Accurate, recent records identified five 1 m BVG's and non-remnant vegetation as potential habitat for Glossy Black Cockatoo (Table 5.3). Within the SGP, this corresponds to the following REs: 11.3.1, 11.3.14, 11.3.17, 11.4.3, 11.4.3a, 11.5.1, 11.5.4, 11.5.21, 11.7.4, 11.7.6, 11.7.7, 11.9.5 and 11.9.10. However not all these REs will have *Allocasuarina* or *Casuarina* foraging resources and the list can be narrowed based on RE composition to: 11.3.1, 11.3.17, 11.4.3, 11.4.3a and 11.9.5. The REs 11.5.4 and 11.7.4 can also be included due to the presence of *A. inophloia* and *A. littoralis*, though in the case of 11.7.4 *Allocasuarina* seems to be present only south of the Warrego Highway. In fact, analysis of records in the southern section of the SGP (south of the Warrego Highway) suggests RE 11.7.4 is disproportionately favoured with more records present than expected based on the percentage of RE extent (11 actual records, versus a predicted 3.5 records).

Table 5.3. Association of Glossy Black Cockatoo records with 1:1 m Broad Vegetation Groups within the SGP and surrounding 50 km area

BVG (1 m)	Count of records			Representative REs in the SGP
	SGP	50 km	% of total	
10a	0	7	7.1	11.7.6
12a	13	3	16.2	11.7.4, 11.7.7
18a	3	8	11.1	11.3.14, 11.5.21
18b	3	9	12.1	11.5.1, 11.5.4
25a	7	15	22.2	11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5, 11.9.10
Non-remnant	5	26	31.3	
Total	31	68	100.0	

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire SGP.
2. Regional Ecosystems containing *Casuarina cristata* (11.3.1. 11.3.17, 11.4.3, 11.4.3a, 11.9.5) and *Allocasuarina inophloia* (11.5.4) are classed as 'Core Habitat Possible'.
3. South of the Warrego Highway areas of RE 11.7.4 may also have *Allocasuarina littoralis* and should be mapped as 'Core Habitat Possible'.
4. Regrowth of the above REs, which could contain larger trees with suitable foraging resources, are mapped as 'Core Habitat Possible'.
5. Core Habitat Possible within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.

6. All remaining REs and non-remnant vegetation (including regrowth) is mapped as 'Absence Suspected'.

Mapping Confidence

Within the SGP Core Habitat Possible accurately predicts the presence of *Allocasuarina* foraging resources, though it is acknowledged individual trees can be scattered throughout remnant vegetation or modified landscapes. While Core Habitat Possible is abundant in the south region (Dalby region) of the SGP, it is more scattered in the central region, reducing the likelihood Glossy Black-cockatoos will occur. This is generally sported by the distribution of Glossy Black Cockatoo records which become less common the further north.

A hot wildfire severely damaged large areas of Glossy Black-cockatoo habitat in Kumbarilla State forest in late 2016. It may take several decades for foraging and nesting resources to recover in this area.

Nests are located in large tree hollows, usually in proximity to foraging resources. Predicting where suitable nest trees might occur is difficult and no attempt has been made to capture possible nest areas in the mapping product. Nevertheless, most ecosystems included within the mapping rules are likely to have large-hollow bearing trees.

A supply of water is also important for Glossy Black-cockatoo populations, and suitable locations which may attract birds are likely to be scattered throughout areas of vegetation; these are not mapped.

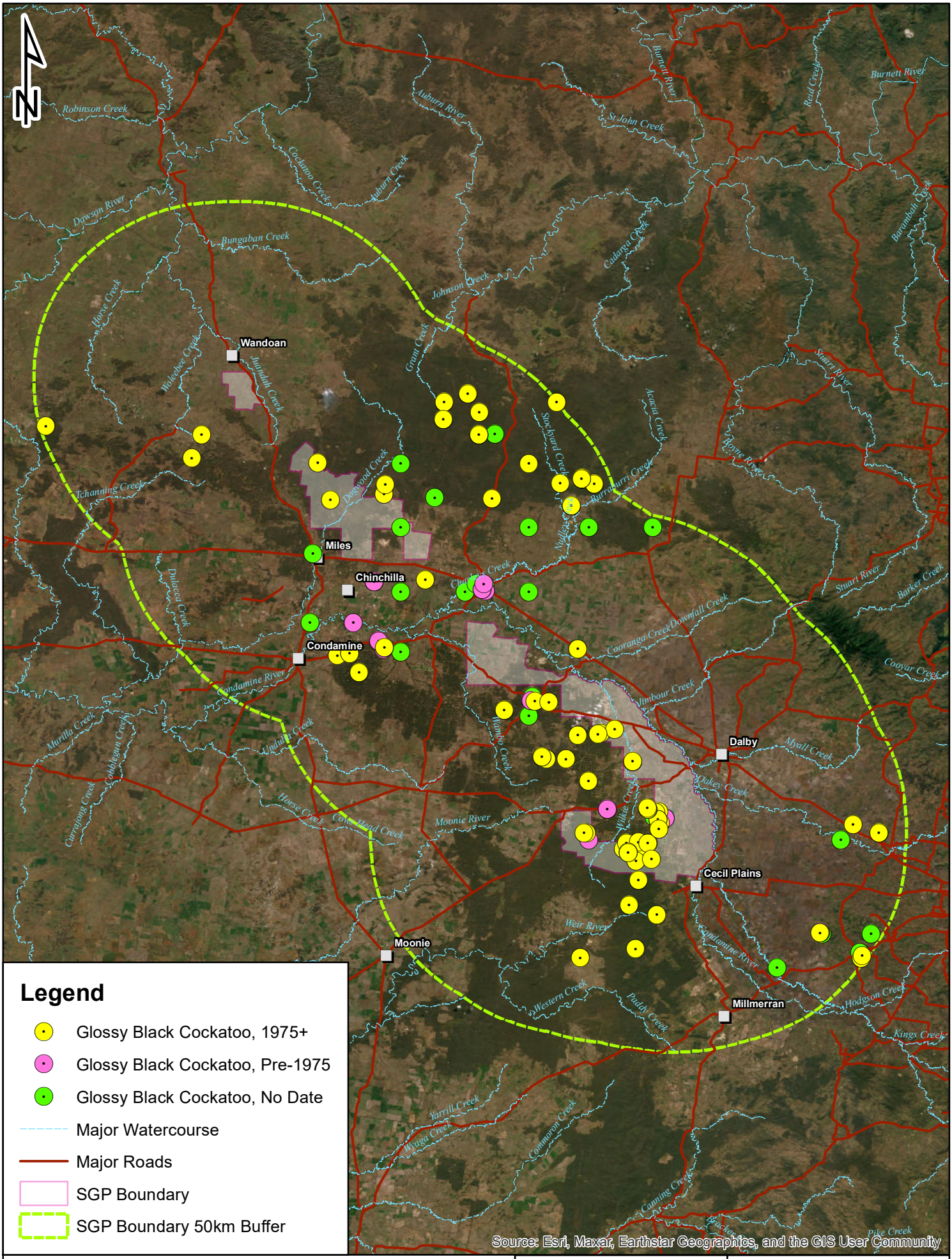


Figure 5.9
Records of the Glossy Black Cockatoo within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.3.3 *Hirundapus caudacutus* (White-throated Needletail)

Vulnerable EPBC Act (effective Jul 2019)
Vulnerable NC Act

Ecology and occurrence within the SGP

The White-throated Needletail is a migrant to Australia between spring and autumn, overwintering from its breeding grounds in eastern Siberia, China and Japan (Higgins 1999). During this time White-throated Needletails occur throughout east and southeast Australia. In Queensland the species is mostly observed to the east of the Great Dividing Range, but has been regularly recorded further inland (Higgins 1999). The species has been seen throughout the SGP and commonly in the surrounding areas (Figure 5.10).

The species is found above a variety of habitat types, most often treed areas such as open forest or rainforest, but also frequently over cleared land and even urban cities (Higgins 1999).

The White-throated Needletail is a predominantly aerial species, flying from almost ground level to altitudes of over 1000 m above ground level (Watson 1955; Coventry 1989). Individuals are rarely observed to alight but have been recorded roosting in trees, and it is thought they may also roost on cliff-faces though there have been no direct observations of this behaviour (Day 1993; Tarburton 1993; Higgins 1999; Tarburton 2021). It is possible that birds also roost aerially, or at least sometimes fly late into the night (Schulz and Kristensen 1994; Higgins 1999; Tarburton 2021).

White-throated Needletails are generalist insectivores, with consumption likely linked to availability of swarming prey rather than a preferential diet (Burwell and Pavey 1992). The species has been recorded feeding on a range of insect taxa including flying ants, beetles, cicadas, and grasshoppers (Cameron 1968; Burwell and Pavey 1992; Tarburton 1993; Rose 1997; Lepschi 1993). They rarely, if ever, alight while feeding (Higgins 1999). White-throated Needletails have been recorded feeding at disturbed sites including bushfires and recently ploughed farmland (Cameron 1968; McCulloch 1966), through which activities large swarms of insects are disrupted and able to be taken on the wing.

Habitat Mapping

This species forages in the airspace over all types of terrestrial land systems including forests, cleared grazing land, tilled and cropped farmland and even urban cities. If 'core' habitat represents areas regularly inhabited or of high importance, then the airspace above the entire SGP, irrespective of landuse, is 'Core Habitat Possible'. The species has little interaction or reliance on terrestrial ecosystems, except perhaps for roosting in large trees (Tarburton 1993).

Considering the above, the definitions of 'Core Habitat Possible' and 'General Habitat' applied elsewhere in this work are not applicable. Mapping for this species is not possible.

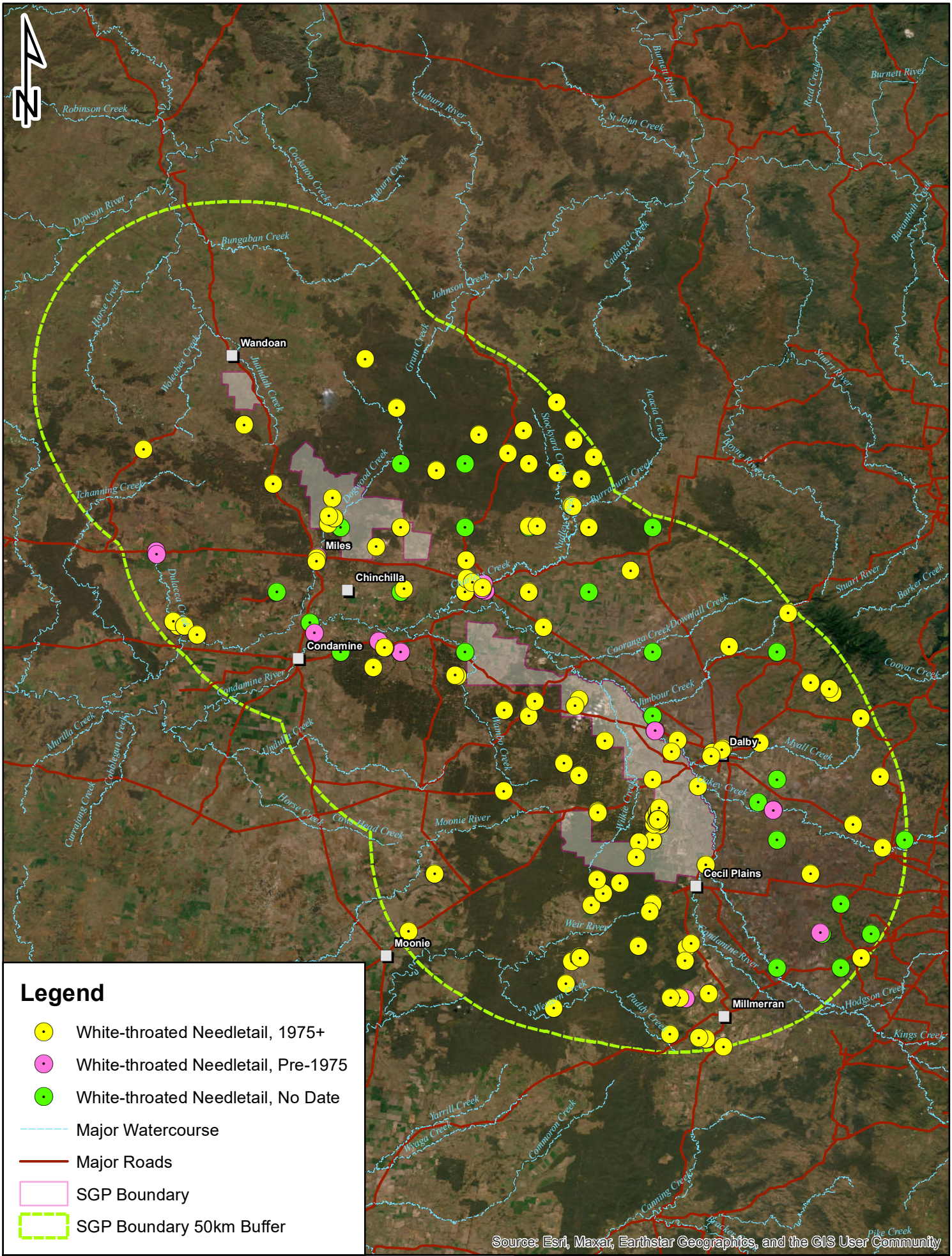


Figure 5.10
Records of the White-throated Needletail within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.3.4 *Aphelocephala leucopsis* (Southern Whiteface)

Vulnerable EPBC Act (effective Mar 2023)
Vulnerable NC Act

Ecology and occurrence within the SGP

The Southern Whiteface (*Aphelocephala leucopsis*) has a widespread but patchy distribution across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range (Schodde and Mason 1999). While the SGP falls entirely within the distribution of the species, it is located near its eastern limit. Based on ALA data there are only but a few (~4) records east of the SGP within the Brigalow Belt.

Southern Whiteface are a small stocky thornbill-like bird who can be found in woodlands and tall shrublands with grassy or low shrub understorey or both (Schodde and Mason 1999; Menkhorst *et al.* 2019). They are encountered in small flocks or pairs, often with other species, cleaning food from the ground, leaf litter and/or debris, occasionally foraging on lower tree trunks, branches and stumps, often moving into low foliage or shrubs when resting or disturbed (Antos and Bennett 2006; Menkhorst *et al.* 2019). Habitat critical to the survival of the Southern Whiteface includes areas of relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both; habitat with low tree densities and herbaceous understory litter cover which provides essential foraging habitat (Antos *et al.* 2008); and living and dead trees with hollows and crevices which are essential for roosting and nesting (TSSC 2023a).

Based on publicly available data, the species has not been recorded within the SGP and has been recorded infrequently in the surrounding area (Figure 5.11). The species has been recorded only twice since 1975 within 50 km of the SGP, with the remain records are either prior to 1975 (6 records) or without date (6 records). These records, along with the presence of suitable habitat within the SGP (see discussion below), suggests the species has some potential to occur, all be it low.

Southern Whiteface breeding occurs from July to October, however, the timing of breeding can be affected by rainfall in arid regions (Higgins and Peter 2002). Breeding may occur outside the usual season following sufficient rainfall, or may not occur at all during drought. Nest are large bulky domed constructions of grass, bark and roots, usually in a hollow or crevice, although sometimes in low bushes (Higgins and Peter 2002).

Habitat loss and fragmentation are likely to have caused Southern Whiteface declines in recent years, especially in the parts of the species' range where there has been complete removal of habitat for intensive agriculture. The population has declined substantially by an estimated 30 to 50% every ten years since 1999, with no indication that the declines are slowing (Ehmke *et al.* 2021).

Habitat Mapping

Only four Southern Whiteface records within 50 km have sufficiently accurate data to extract Regional Ecosystem information. Two of these records fall within RE 11.9.5 and another two in 11.5.20/11.3.18/11.3.25. In the latter instance, it seems likely the birds were present in

11.5.20 as the other two REs typically have thick ground layers (grasses) preventing birds foraging on the ground. Based on a similar 1 m BVG classification the following REs might be structurally similar: 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.5.26 and 11.9.10. Areas of 11.3.2, 11.5.1, 11.5.1a and 11.7.7 might also be considered. While these habitats are likely to have the highest amenity for the species within the SGP they remain, on balance, typically too thick to be considered high amenity habitat.

This, however, is not to deny the above REs can have areas of reduced canopy and ground cover. While the Southern Whiteface cannot be discounted from occurring in these types of locations, our impression is these habitats are too infrequent and too isolated to elevate any of the above REs to 'Core Habitat Possible'. All are better considered 'General Habitat'.

One study in NSW found Southern Whiteface were more common in planted (regrowth) habitats than remnant or paddock sites (Barrett *et al.* 2008). Indeed, Southern Whitefaces can be found in areas where thinning or past clearing activities have reduced the canopy density creating conditions simulating open woodland habitats (M. Sanders *pers obs*). Ironically, it may be possible high amenity habitats within the SGP occur in non-remnant habitats. Finding a consistent method to accurately show where non-remnant habitats might be suitable is a problematic, if not a nearly impossible task without exhaustive field survey program. It seems better to also leave these as 'General habitat' and elevate them to a higher rating if the species is recorded in pre-clearing surveys.

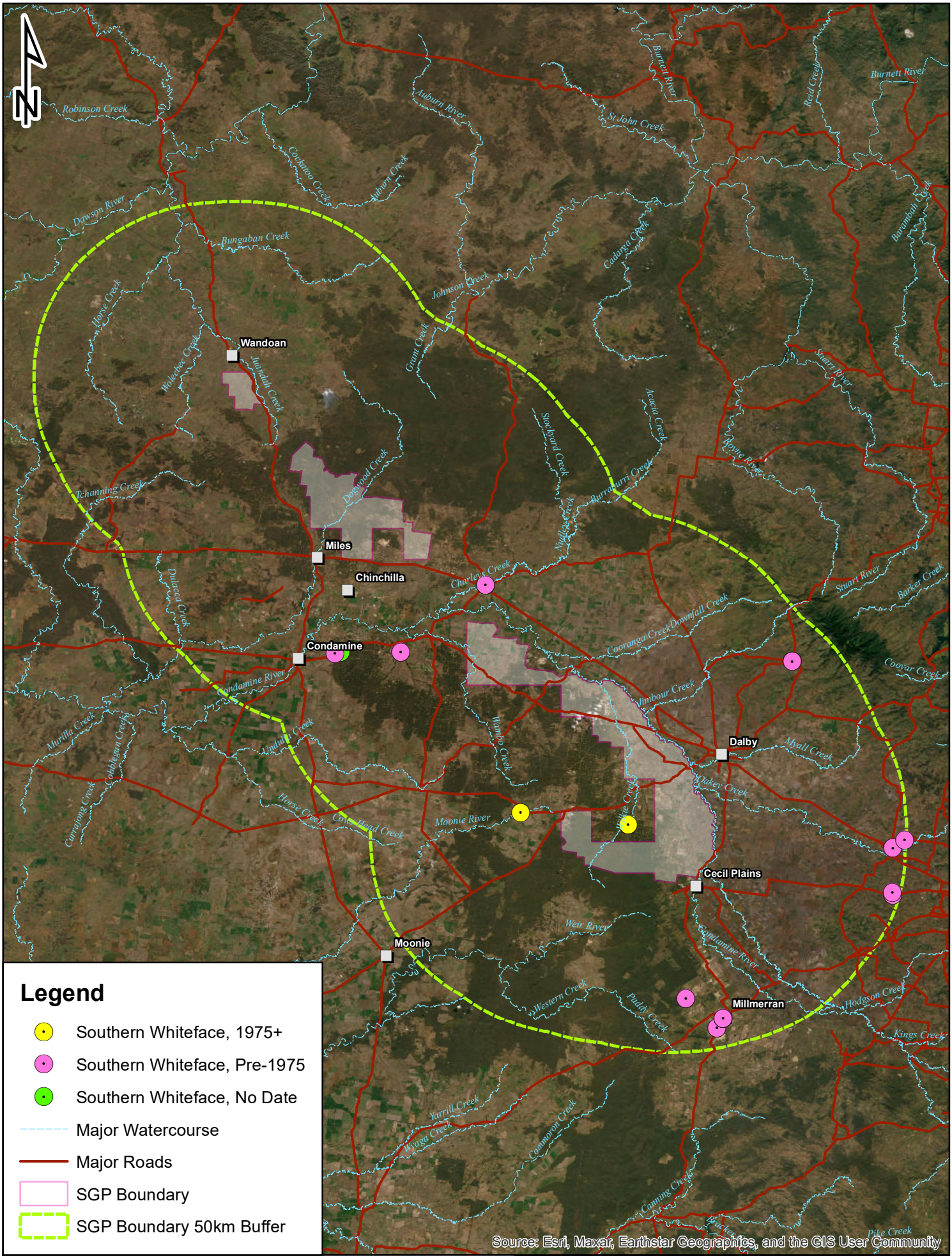
A study from northern Victoria (Antos and Bennett 2006) failed to record these birds from riparian 'Black Box' and 'River Red Gum' woodlands, which seems likely due to prolific grass in riparian habitats. Our observations within the SGP also suggest, with the exception of those listed above, the remaining REs on Landzone 3 will have low amenity due to thick grass (e.g., 11.3.25, 11.3.27, 11.3.18 etc) or dense canopy.

Rule(s) for Habitat Mapping:

1. It is assumed the species could occur throughout the entire SGP.
2. All remnant and regrowth vegetation of RE 11.3.1, 11.3.2, 11.3.17, 11.4.3, 11.4.3a, 11.5.20, 11.5.26, 11.9.5, 11.9.10 should be mapped as 'General Habitat'.
3. General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known' (as of writing no such areas exist within the SGP).
4. All remaining remnant and non-remnant vegetation (including regrowth) is mapped as 'Absence suspected'.

Mapping Confidence

While Southern Whiteface habitat preference is relatively well understood, mapping habitat amenity based on the available REs within the SGP is difficult. We cannot exclude the possibility the species could occur but, in general, habitats are typically not ideal. More open habitats become increasingly common further west and this is reflected in the species distribution; the SGP is near the eastern limit of the species occurrence in southern Queensland. Should the records of this species within the SGP increase, these rules should be refined based on improved habitat understanding.



Legend

- Southern Whiteface, 1975+
- Southern Whiteface, Pre-1975
- Southern Whiteface, No Date
- Major Watercourse
- Major Roads
- SGP Boundary
- SGP Boundary 50km Buffer

Figure 5.11
Records of the Southern Whiteface within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.3.5 *Grantiella picta* (Painted Honeyeater)

Vulnerable EPBC Act (effective Jul 2015)
Vulnerable NC Act

Ecology and occurrence within the SGP

Endemic to Australia, the Painted Honeyeater may be found from the eastern Northern Territory to Victoria and southern regions of South Australia (Pizzey *et al.* 2012). Rare in the Northern Territory, they are widespread throughout Queensland, absent only from Cape York and high rainfall areas. The SGP area occurs entirely within the distribution of the Painted Honeyeater and the species has been frequently recorded within 50 km. Despite the abundance of local records, evidence of the species within the SGP is scattered. This likely reflects habitat availability - suitable habitat is generally uncommon.

Painted Honeyeaters inhabit open dry woodlands and forests. They prefer extensive stands of remnant woodlands with mature trees, but will use narrow strips and small blocks if sufficient mistletoe fruit is available (Higgins *et al.* 2001; DCCEEW 2023 c). A key component of Painted Honeyeaters habitat is Mistletoe, the fruit of which they feed on almost exclusively, but may also collect nectar and invertebrates (Oliver *et al.* 2003). Most foraging is undertaken within the canopy (Higgins *et al.* 2001).

Nesting occurs during spring-summer (Sept.-Feb.), predominantly in the south-east of its range north to around Brisbane. The breeding season is determined by photoperiod to coincide with warmer summer months, but actual breeding is cued in relation to the progression of mistletoe fruiting. This ensures that breeding is matched by peak resource availability, avoiding temporal variation inherent in unpredictable environments (Barea and Watson 2007).

Small, frail cup-shape nests with narrow sides are constructed in the outer foliage and branchlets of eucalypts, casuarinas and acacias. However, a disproportionately large number of nests are placed in mistletoe clumps in taller trees (Whitmore and Eller 1983; Beruldsen 2004; Barea 2008).

While not well understood, movement patterns are generally described as a north-south migration (Keast 1968). Populations move north during winter and return south of approximately 26° latitude during spring-summer to breed (Higgins et al. 2001). At some locations they can be irruptive in response to abundant mistletoe fruiting (Oliver *et al.* 2003).

Habitat Mapping

Within the southern Brigalow belt vegetation which supports abundant Needle-leaved (*Amyema cambagei*) and Grey Mistletoe (*A. quandang*) are particularly favoured. Needle-leaved Mistletoe is associated with *Casuarina cunninghamiana* and *Casuarina cristata,* while Grey Mistletoe is associated with larger *Acacia* species (especially *A. harpophylla*). Riparian woodlands (e.g., *E. camaldulensis* waterways) can also be utilised if mistletoe is abundant.

Analysis of spatially accurate and recent records identifies five BVG groups as containing Painted Honeyeater Records (Table 5.4). From the data it is immediately obvious the vast majority, 97% of records, fall within BVG 25a and non-remnant habitats. Closer examination shows that, of the records within BVG 25a, all but one occurs in RE 11.3.17. This is appears to be a critical habitat for the species in the SGP region. Spatial inspection also reveals many

records (>250) in non-remnant habitats are associated with (i) patches of regrowth 11.3.17, 11.9.6 and 11.9.10 around Jondaryan and (ii) fragments/regrowth 11.3.1 and 11.9.6 in the Jandowae areas. These habitats are dominated by Brigalow, presenting a clear picture of habitat preference.

Table 5.4. Association of Painted Honeyeater with 1:1 m Broad Vegetation Groups within the SGP and surrounding 50 km area

BVG (1 m)	Count of records			Representative REs in the SGP
	SGP	50 km	% of total	
11a	0	1	0.2	None
12a	0	3	0.6	11.7.4, 11.7.7
16a	0	0	0.0	11.3.25
17a	0	1	0.2	11.3.2, 11.3.18, 11.5.1a, 11.9.7
25a	1	143	26.9	11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5, 11.9.10
29b	0	4	0.7	11.7.5
Non-remnant	1	381	71.4	
Total	*2*	*533*	*100.0*	

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP.
2. REs dominated by Brigalow including 11.3.1, 11.3.17, 11.4.3, 11.4.3a and 11.9.5 (including 'disturbed' communities) are mapped as 'Core Habitat Possible'.
3. Regrowth derived from RE 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5 (i.e., brigalow regrowth) is mapped as 'Core Habitat Possible'.
4. The above REs and REs 11.5.20 and 11.3. 27a and 11.3.27f are mapped as 'Core Habitat Known' around Lake Broadwater.
5. All remaining areas of RE 11.3.25 and 11.3.27 (including all subtypes) are mapped as 'General Habitat',
6. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
7. All remaining REs and non-remnant (including regrowth) areas are 'Absence Suspected'.

Mapping Confidence

While RE units do not account for this species key resource, mistletoe density, mistletoe is most often associated with the REs identified here as 'Core Habitat Possible'. However, these REs do not always have mistletoe. The mapping product is likely to slightly overestimate habitat availability but, on balance, is considered to have high accuracy.

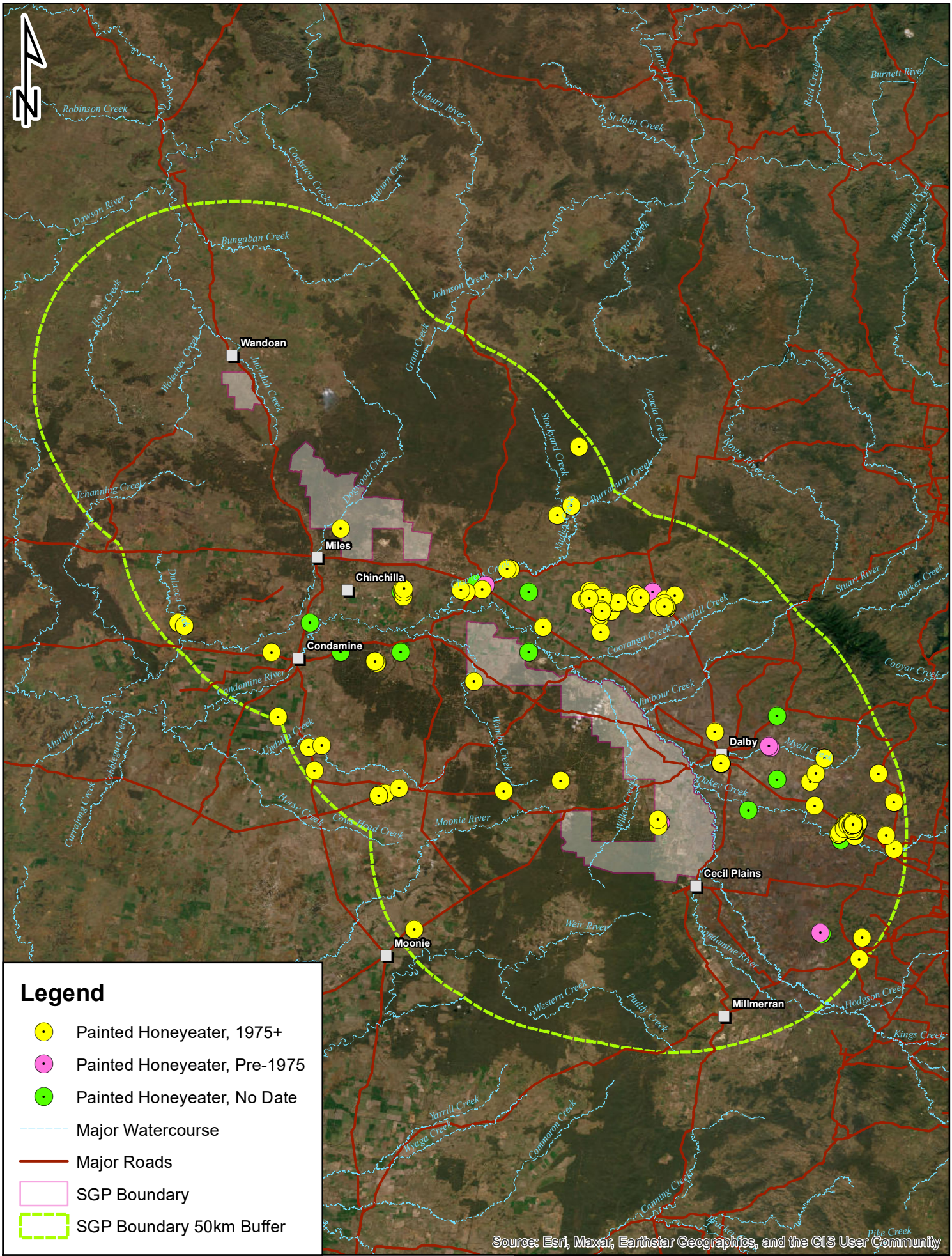


Figure 5.12
Records of the Painted Honeyeater within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.3.6 *Stagonopleura guttata* (Diamond Firetail)

Ecology and occurrence within the SGP

The Diamond Firetail occurs in south-eastern Australia, from south-east Queensland to the Eyre Peninsula in South Australia (TSSC 2023b). Within this distribution, the species occurs across a range of habitat types, including eucalypt woodland, banksia shrubland, and cypress forest (Cooney and Watson 2005; McGuire and Kleindorfer 2007; Antos *et al.* 2008; Hodder 2019). Populations appear unable to persist in fragmented areas which lack remnant patches of vegetation larger than 200 ha (TSSC 2023b).

Records of the species are scattered from around the SGP (Figure 5.13). However, ascertaining occurrence in the SGP has been thwarted by the lack of accurate records within available public databases – no records are available through Wildnet and all records on ALA have been rounded to a 10 km grid. Our work within the SGP, and other works undertaken by Arrow, have failed to locate the species suggesting it at this time is not known.

The Diamond Firetail is granivorous, with a diet consisting predominantly of grass seeds, with the remainder of the diet typically made up of forbs (Read 1994; Hodder 2019). Both native and introduced grasses and forbs are utilised dependent on availability (Read 1994; Hodder 2019). In South Australia, the species is also reported to at least occasionally feed on the seeds of *Allocasuarina* spp., which appears to represent a case of diet switching during a period of grass seed scarcity over winter (Read 1994; Hodder 2019). Foraging occurs almost exclusively on the ground, with only a small number of foraging bouts at 1-2 m above the ground (Ford *et al.* 1986; Antos and Bennett 2006). Ideal foraging habitat for Diamond Firetails is characterised by mostly open areas with low tree density, low percentage cover of fallen logs, and high percentage cover of grass, with patches of bare ground, moss and forbs (Antos *et al.* 2008; Antos and Bennett 2006).

Breeding takes place from August to February. Nests are built up to 4-5 m above the ground in a range of plant species depending on location, including *Eucalyptus* spp., *Banksia* spp., *Allocasuarina* spp. and mistletoe, and are often adorned with flowers around the entrance (Cooney and Watson 2005; McGuire and Kleindorfer 2007). Females lay an average clutch size of 4-5 eggs, although as many as seven may be laid (Higgins *et al.* 2006). Diamond Firetails mature within 10-20 weeks depending on location and climate. Nests may be utilised for more than one season but typically a new nest is built each year (McGuire and Kleindorfer 2007).

Habitat Mapping

No accurate records are available for this species and, in the absence of this data, evaluating important REs can only be achieved though descriptive comparison of each RE to known high amenity habitat features. This suggests all forest and woodlands within the SGP could be potentially inhabited though, on balance, 11.7.5 and 11.7.2 are likely too thick and with reduced grass cover.

Based on DCCEEW (2023h), a patch size threshold of 200 ha has been included in the mapping rules.

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP, but is considered less likely to persist in combined patches <200ha (where a combined patch includes all remnant vegetation types and ignores non-remnant gaps <200 m wide).
2. All remnant REs within the SGP *except* 11.7.5 and 11.7.2, with a combined remnant patch size (irrespective of RE designation) greater than 200 ha is 'Core Habitat Possible'.
3. All remnant REs within the SGP *except* 11.7.5 and 11.7.2, with a combined remnant patch size (irrespective of RE designation) less than 200 ha but within 500 m of core habitat possible is 'General Habitat'.
4. All regrowth of the above REs with a combined patch size greater than 200 ha is 'General Habitat'.
5. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. Remaining isolated areas of remnant and non-remnant vegetation (including regrowth) are mapped as 'Absence Suspected'.

Mapping Confidence

The frequency and location of contemporary records of the Diamond Firetail surrounding the SGP is difficult to ascertain based on currently available data. However, in general, they are scattered suggesting that, while the species could occur, its presence might be sporadic. It is possible large areas of suitable habitat remain uninhabited. Should records of this species within the SGP increase, these rules should be refined based on improved habitat understanding.

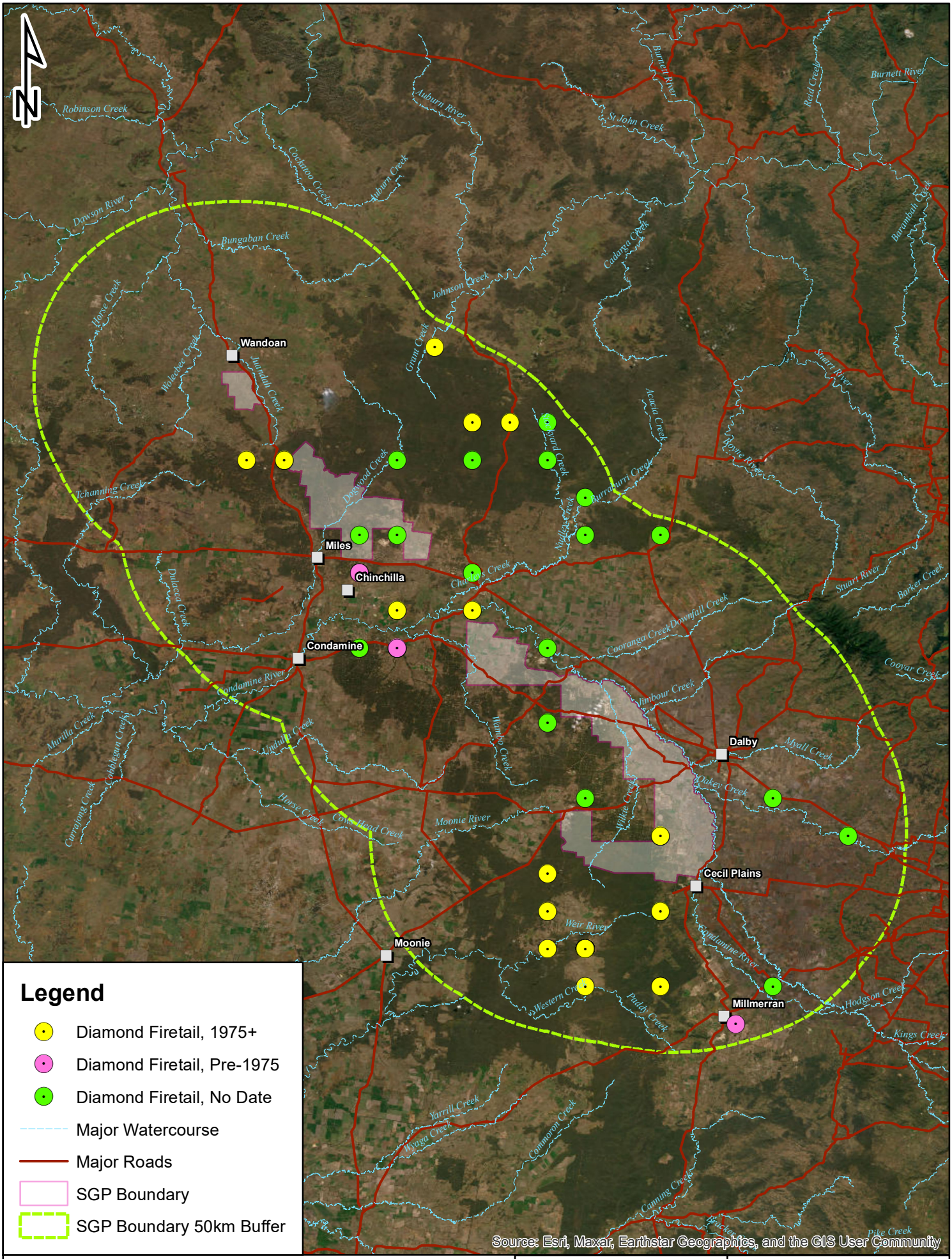


Figure 5.13
Records of the Diamond Firetail within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.4 MAMMALS

5.4.1 *Nyctophilus corbeni* (South-eastern Long-eared Bat)

Vulnerable EPBC Act (effective Apr 2001)
Vulnerable NC Act

Ecology and occurrence within the SGP

The South-eastern Long-eared Bat (*Nyctophilus corbeni*) is largely restricted to the Murray-Darling Basin (Churchill 2008; Baker and Gynther 2023) with its stronghold in the Pilliga forests of New South Wales (Turbill and Ellis 2006). In Queensland, it is mainly recorded in the south of the Brigalow Belt (Curtis *et al.* 2012) and from large tracts of vegetation, approximately 5000+ ha in size (e.g., Southwood National Park), although the species can be recorded from smaller vegetation tracts of 600 ha (e.g., Erringibba National Park) (EPA 2008). A similar association for large continuous vegetation has been noted in NSW (Turbill and Ellis 2006).

Records of the species are scattered around the SGP, though few fall within 50 km. A cluster of records is located in the central block of the SGP, situated roughly between Gurulmundi and Barakula State Forests. Another cluster of records is located in Condamine State Forest to the west of the SGP. Both these areas fall within large relatively contiguous areas of vegetation (Figure 5.14). The species requires targeted survey effort and is likely to be more widely distributed throughout these large forest areas. Law *et al.* (2016, 2018) found wildfires have deleterious impacts and extensive fires in Kumbarilla during late 2016 may have adversely affected populations in these areas (if present).

The species is common in box/ironbark/cypress pine woodland and vegetation dominated by Buloke (*Allocasuarina luehmannii*) on sandy soils, though it can also occur in Brigalow (*Acacia harpophylla*) and Belah (*Casuarina cristata*) communities, dry sclerophyll forests with *Corymbia citriodora*, and semi-evergreen vine thickets (Turbill and Ellis 2006; Churchill 2008; Baker and Gynther 2023). The species prefers areas with a distinct overlapping canopy and a dense understorey (Churchill 2008; Law *et al.* 2016).

Roosting has been recorded in hollows and fissures of trees and occasionally under exfoliating bark and even within foliage (Churchill 2008; Curtis *et al.* 2012; Baker and Gynther 2023). While living and dead Eucalypts are most commonly used, several studies in NSW suggest they disproportionately selecting dead trees and in particular dead Buloke (*Allocasuarina luehmannii*) for roosting. Most roost trees are <40 cm DBH and, despite being common in the landscape, hollows in larger trees (e.g., *Eucalyptus camaldulensis*) are not utilised. Typically, individuals do not use a roost location over sequential nights, preferring to regularly move between roosts (Law *et al.* 2016, 2018; Gonsalves *et al.* 2022).

With broad, short wings, the South-eastern Long-eared Bat is highly manoeuvrable and well-adapted to its cluttered habitat. They fly close to vegetation, often through the canopy and can drop suddenly to almost ground level after prey (Churchill 2008). South-eastern Long-eared Bats typically forage up to about 4 km from their roost, although individuals have been captured up to 7 km from roost. Average forage distance is thought to be ~1-2 km (Law *et al.* 2016).

Available evidence suggests the species is reluctant to move into open habitats including wildfire regrowth (Law *et al.* 2016, 2018). This may, in part, explain why most records are

associated with larger continuous intact vegetation. Further, minor fragments and linear strips of native vegetation are vulnerable to understorey damage and loss of dead trees, especially when combined with grazing.

Mating occurs in autumn and winter. Females are able to store spermatozoa until ovulation and conception in early spring. Two young are usually born in late October to November and lactation continues until January (Baker and Gynther 2023).

Habitat Mapping

Nine accurate records are available to derive habitat information, five fall within RE 11.5.1, one in a heterogeneous area of RE 11.7.4/11.7.7 and three within RE 11.7.5/11.7.7. The RE 11.7.5 refers to low shrubland and is unlikely to be suitable habitat. Extrapolation based on BVG grouping (BVG 12a and 18b) suggests suitable habitat could also include RE 11.5.4.

However, considering the low number of records from which to gain habitat data, other REs should be considered based on habitat description. Studies have found the species preferring areas with abundant shrub layers and Buloke (Law *et al.* 2016). REs within the SGP matching this description include 11.3.1, 11.3.14, 11.3.18, 11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.21, 11.7.4, 11.7.7, 11.9.5 and 11.9.10. Other REs that may also be considered, but are less likely to have a dense understorey, include: 11.3.25, 11.3.27, 11.5.20, 11.7.2 and 11.7.6.

Rule(s) for Habitat Mapping:

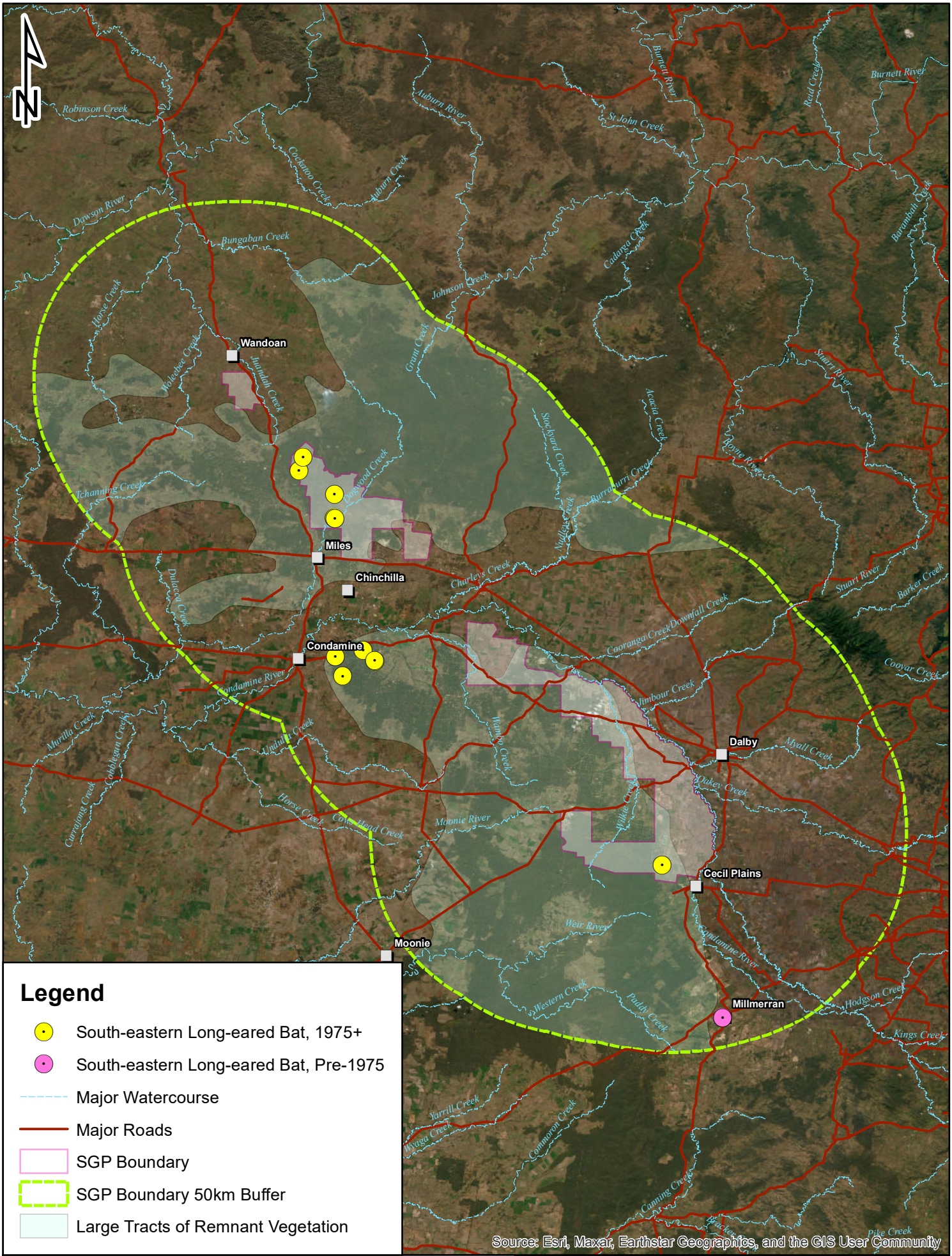
1. Potential South-eastern Long-eared Bat habitat is restricted to contiguous or near-contiguous areas of vegetation (i.e., reduced fragmentation). Within the SGP, potentially important habitat is restricted to vegetation within or abutting the 'large tracts remnant veg.shp'.
2. Within the area defined in step 1 above, REs 11.3.1, 11.3.14, 11.3.18, 11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.21, 11.7.4, 11.7.7, 11.9.5 and 11.9.10 are mapped as 'Core Habitat Possible'.
3. Within the area defined in step 1 above, REs 11.3.25, 11.3.27, 11.5.20, 11.7.2 and 11.7.6 are mapped as 'General Habitat'.
4. Within the designated area in step 1, isolated patches (>500 m from any other remnant vegetation) of the REs listed in step 2 above are reclassed as 'General Habitat'.
5. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. All remaining remnant and non-remnant vegetation, including regrowth, is mapped as 'Absence Suspected'.

Mapping Confidence

Identifying suitably large tracts of remnant vegetation within the SGP is relatively easy. Predicting where the species might occur within this vegetation is more complex. While those REs listed as 'Core Habitat Possible' accurately reflect the best areas of habitat, large tracts of 'General Habitat' may have suitable structure and provide good habitat for the species. Should

records of this species within the SGP increase, these rules should be refined based on improved habitat understanding.

While several REs have been excluded as not suitable ('Absence Suspected') in the mapping product, their landscape position often contributes to patch integrity and they may therefore provide an important role in ensuring a populations persistence.



Legend

- South-eastern Long-eared Bat, 1975+
- South-eastern Long-eared Bat, Pre-1975
- Major Watercourse
- Major Roads
- SGP Boundary
- SGP Boundary 50km Buffer
- Large Tracts of Remnant Vegetation

Figure 5.14
Records of the South-eastern Long-eared Bat within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.4.2 *Petauroides volans sensu lato* (Greater Glider)

Endangered EPBC Act (effective Jul 2022)
Endangered NC Act (also as *P. armillatus*)

Recent genetic research (McGregor *et al.* 2020) suggests *P. volans* may be paraphyletic, consisting of three closely related taxa. Some agencies and jurisdictions have accepted this work and recognise *P. armillatus* (Central Greater Glider) as a separate species. However no formal description of the new taxa has been published, their distributions are poorly understood, and taxonomic change has not been formally recognised by the Australian Mammal Taxonomic Consortium (AMTC 2022). Nor has the new taxonomy been recognised in the recently published Mammals of Australia (Baker and Gynther 2023). In the interests of taxonomic stability, we retain *P. volans* (southern and central populations) as a single species here (*sensu lato*), but recognise this may change in the future. Irrespective of the taxonomic uncertainty, both southern and central Greater Glider are currently listed under state and federal legislation as Endangered.

Ecology and occurrence within the SGP

The Greater Glider (*Petauroides volans*) is the largest gliding possum in Australia. Its distribution extends from the Windsor Tableland in north Queensland, south to Wombat State Forest in central Victoria (Woinarski *et al.* 2014). Inland isolated subpopulations are also known from the Gregory Range (west of Townsville) (Winter *et al.* 2004), and another in the Einasleigh Uplands bioregion of Queensland (Vanderduys *et al.* 2012).

The Greater Glider has been recorded at 23 discrete locations within and surrounding the SGP (Figure 5.15). Most of these records are associated with larger areas of remnant vegetation, in particular vegetation spanning between Barakula, Binkey and Gurulmundi State Forests, and vegetation associated with Condamine, Braemar, Vickery and Kumbarilla State Forests. However a number of records fall in fragmented vegetation, usually long narrow linear strips associated with Wilkie and Condamine River.

The species is predominately restricted to eucalypt forests and woodlands, and are most common in taller, montane, moist eucalypt forests with larger, relatively old trees and abundant hollows (Andrews *et al.* 1994; Kavanagh 2000; Eyre 2004; van der Ree *et al.* 2004; Vanderduys *et al.* 2012). In areas west of the Great Dividing Range they are found in low woodlands (McKay 2008).

Greater Gliders are described as having a strictly 'eucalyptus' diet but will also occasionally take flowers and rarely *Acacia* phyllodes or mistletoe leaves (Lindenmayer 2002; Kavanagh and Wheeler 2004; Woinarski *et al.* 2014). Studies have found a preference for young leaves or particular eucalypt species, with selection likely related to leaf nutrient concentration (Kavanagh and Lambert 1990; Lindenmayer 2002; Eyre 2006). Dietary selection in the southern Brigalow Belt is poorly understood with a single study finding foraging animals most often in *E. moluccana, E. fibrosa* and *Corymbia citriodora* (Smith *et al.* 2007; Eyre *et al.* 2022). A study of Greater Gliders across the broader southeast Queensland region (including the Brigalow Belt Bioregion) also identified *E. tereticornis* and *E. citriodora* as predictors of Greater Glider presence in drier forests (Eyre 2006). In contrast (Comport *et al.* 1996) found Greater Gliders

showing a preference for *E. acmenoides* over other eucalypts, which included *E. tereticornis* and *C. citriodora*, despite other eucalypts having higher nutrient content.

Greater Gliders require large old-growth trees with abundant large hollows for denning and its abundance is often linked to hollow density (Kehl and Borsboom 1984; Lindenmayer *et al.* 1991; Andrews *et al.* 1994; Smith *et al.* 2007; Goldingay 2011). Both live and dead trees can be used but most dens are located in living trees (Kavanagh and Wheeler 2004). Preferred hollows are typically higher in the canopy and comparatively deeper, with a large internal cavity preferred over smaller shallower hollows (Lindenmayer 2002). Hollow entrance size is poorly documented but is likely around 18 cm (Goldingay 2011).

In southern Queensland the Greater Glider requires at least 2–4 live den trees for every 2 ha of suitable forest habitat (Eyre 2002). Studies in Barakula State Forest found female Greater Gliders inhabited areas with, on average, 3.8 den trees per hectare while male home ranges had far fewer, on average 0.9 den trees per hectare (Smith *et al.* 2007), though males used slightly more hollow-bearing trees overall (4-20, average 11) than females (6-18, average 10).

Home ranges are usually 1-4 ha in size, however in dry and more open woodland home ranges can be up to 19 ha (Kehl and Borsboom 1984; Comport *et al.* 1996; Gibbons and Lindenmayer 2002; Pope *et al.* 2004; Eyre 2004; Smith *et al.* 2007; Eyre *et al.* 2022). Males have a larger home range size than females and sexes usually share a den when the breeding season commences (Kavanagh and Wheeler 2004; Pope *et al.* 2004; McKay 2008).

Females give birth to only one young from March to June. Juveniles emerge from the pouch when three to four months old and become independent at around nine months. However, Greater Gliders do not reach their sexual maturity and start breeding until their second year (Tyndale-Biscoe and Smith 1969; McKay 2008). It is estimated the species can live up to 15 years (Harris and Maloney 2010).

Habitat Mapping

Based on available research, Greater Gliders in the southern Brigalow Belt are primarily associated with forests dominated by *E. tereticornis*, *E. moluccana, E. fibrosa* and *C. citriodora* (Eyre 2006; Smith *et al.* 2007). *Eucalyptus crebra* and *E. melanophloia* forests are also possibly important based on RE analysis (Eyre *et al.* 2022). These correspond with REs 11.3.4, 11.3.25, 11.3.26, 11.3.27, 11.5.1, 11.5.20, 11.7.6, 11.7.7 and they should be included as core habitat. Five additional REs have been identified using accurate records within 50 km of the SGP (Table 5.5): 11.3.14, 11.5.21, 11.7.4, 11.9.2 and 11.9.7. The description of these REs match the habitat profile for Greater Glider.

Two other REs within the SGP warrant consideration, despite lacking records, 11.3.2 and 11.3.3. Both these contain large eucalypts which readily for hollows but may be too open to be frequently utilised by the species. They can be mapped as General Habitat.

While the species is more likely to occur in contiguus eucalypt forests (Youngentob *et al.* 2013), estimating minimum patch thresholds is difficult. In Queensland, Eyre (2006) suggested Greater Gliders are associated with remnant patches exceeding 160 ha. However, careful inspection of accurate records within and surrounding the SGP show several observations have occurred in highly fragmented landscapes though, in general, these observations are from long

narrow linear strips which connect to larger patches. Other authors have also noted this species persisting in small fragmented patches (Lindenmayer 2002; Pope *et al.* 2004; Eyre *et al.* 2022) and, as a consequence, no patch threshold is applied here. This approach is consistent with Queensland mapping practice (Eyre *et al.* 2022).

Table 5.5. Association of Greater Glider records with 1:1 m Broad Vegetation Groups within the SGP and surrounding 50 km area

BVG (1 m)	Count of records			Representative REs in the SGP
	SGP	50 km	% of total	
10a	1	10	23.4	11.7.6
12a	1	6	14.9	11.7.4, 11.7.7
13d	0	6	12.8	11.3.26, 11.5.20
16a	4	7	23.4	11.3.25
16 c	1	0	2.1	11.3.3, 11.3.4
17b	0	2	4.3	11.9.2, 11.9.7
18a	0	2	4.3	11.3.14, 11.5.21
18b	2	0	4.3	11.5.1, 11.5.4
Non-remnant	2	3	10.6	
Grand Total	*11*	*36*	*100*	

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP.
2. Mapped habitat (core habitat possible or general habitat) is restricted to remnant vegetation patches with an accumulative size >10 ha (i.e., entire extent, regardless of RE types, and ignoring non-remnant gaps of less than 150 m).
3. Within combined patches > 10 ha, 'Core Habitat Possible' includes REs 11.3.4, 11.3.14, 11.3.21, 11.3.25, 11.3.26, 11.3.27 (including all subtypes), 11.5.1, 11.5.4, 11.5.20, 11.5.21, 11.7.4, 11.7.6, 11.7.7, 11.9.2 and 11.9.7.
4. Within combined patches > 10 ha, Polygons of REs 11.3.2 and 11.3.3, immediately adjacent Core Habitat Possible are mapped as 'General Habitat'.
5. All Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. All regrowth and other non-remnant habitats are mapped as 'Absence Suspected'.

Mapping Confidence

Important habitat characteristics for this species are well understood and can be matched to regional ecosystem descriptions. However, areas within the SGP have been subject to historic logging removing larger hollow-bearing trees and reducing denning opportunities for Greater Glider. It is possible the resulting map overestimates potential habitat.

Furthermore, our mapping varies considerably from mapping developed and produced by the Queensland Department of Science (Eyre *et al.* 2022), which factors in Species Distribution Modelling (SDM). SDM evaluates a species climatic envelop based on known records, and its

inclusion appears to have removed most vegetation within the SGP. This is surprising as the map does not seem to account for many records within and surrounding the SGP, including records to the west. While the mapping rules above may overestimate habitat due to anthropogenic impacts (e.g., logging), the DES mapping seems too pessimistic. The REs identified in our analysis, on balance, match those identified as suitable by (Eyre *et al.* 2022).

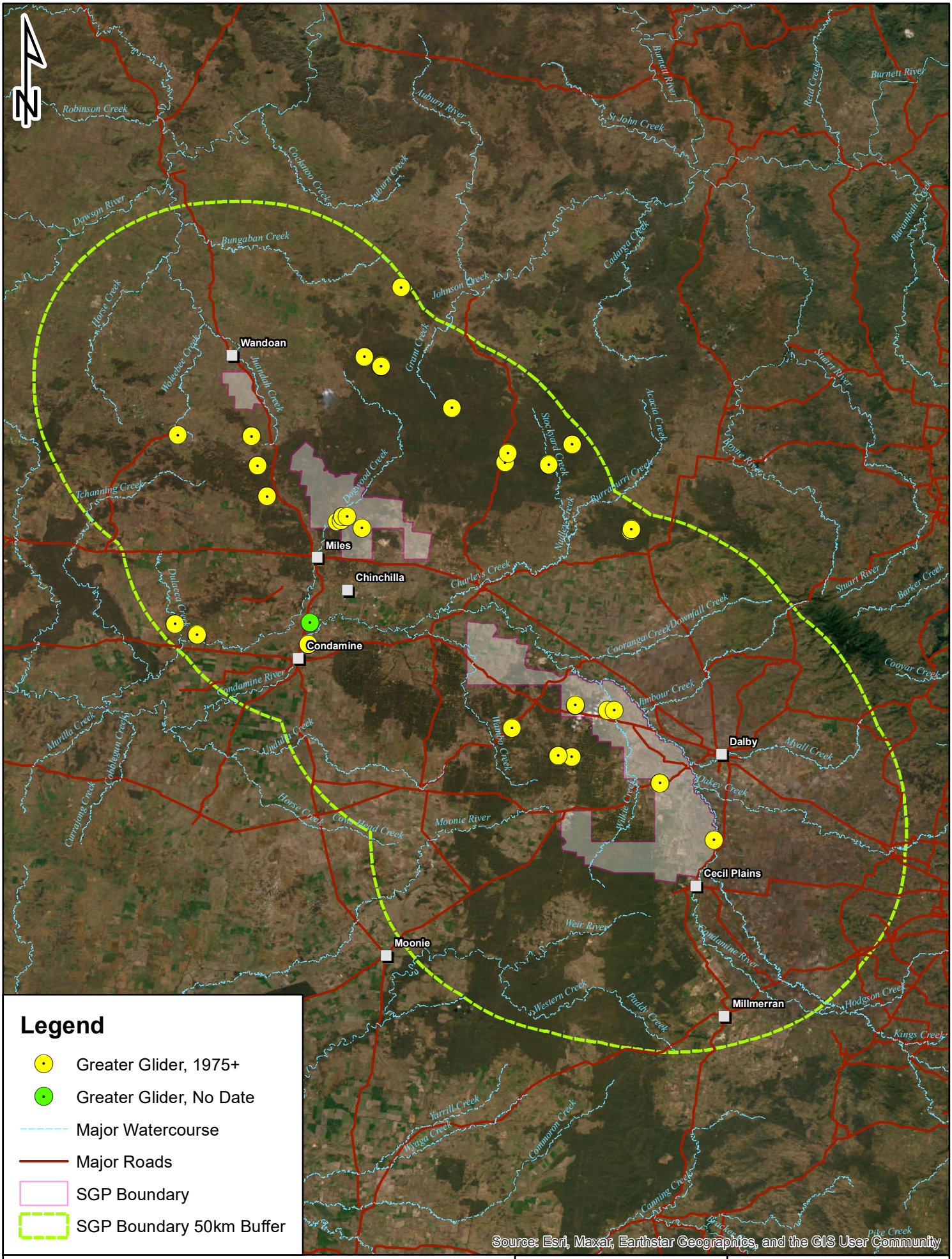


Figure 5.15
Records of the Greater Glider within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.4.3 *Petaurus australis australis* (Yellow-bellied Glider)

Vulnerable EPBC Act (effective Mar 2022)
Vulnerable NC Act

Ecology and occurrence within the SGP

The Yellow-bellied Glider is found in coastal forests and mountain ranges from the Wet Tropics to Victoria, extending inland as far as Blackdown Tablelands and Carnarvon Gorge National Parks (Woinarski *et al.* 2014). The species occurs as two disjunct populations: a small Wet Tropics population, and a more widespread southeastern population (*P. a. australis*) ranging from Mackay, QLD, to Victoria (Brown *et al.* 2007). The species is typically restricted to large contiguous or near contiguous forest patches with areas less than 18,000ha (180 km^2) unlikely to support viable populations (Goldingay and Possingham 1995; TSSC 2022).

While records can be found to the north, east and west of the SGP, there are few records of to the south (Figure 5.16). The species is well represented in the nearby Barakula and Gurulmundi State Forests, and remnant vegetation within the SGP connects these areas to form a considerably large contiguous forested area (Figure 5.16). Records are also present to the west of the southern SGP in Braemar State Forest, which also contributes to a large area of remnant forest vegetation stretching south to Kumbarilla State Forest. Based on this information, and the presence of suitable habitat, the species is likely to occur within the SGP but is yet to be detected. Significant wildfire through much of Kumbarilla State forest in late 2016 may have reduced habitat amenity and affected populations (if present) in the south.

Habitat requirements for the species broadly encompass tall, mature Eucalyptus forest in large contiguous forest reserves of thousands of hectares in area (Goldingay and Possingham 1995; Eyre 2007). In northern and central Australia they are associated with dry Eucalypt-dominated forest (Eyre 2007), while in southern Australia they are more closely associated with cool, moist montane forest with high rainfall (>600 mm; Rees *et al.* 2007). Typically, Yellow-bellied Gliders are associated with smooth- and gum-barked trees (Goldingay 1987; Kavanagh 1987; Kambouris *et al.* 2013; Bilney *et al.* 2022) with deep, narrow and high hollows (Craig 1985; Goldingay *et al.* 2018). Winter-flowering trees are important in some areas (Irish and Kavanagh 2011).

The majority of the species energy requirements are derived from tree sap (exudates) as well as nectar, often supplemented with insects, particularly of the order Coleoptera (Smith and Russell 1982; Craig 1985, 1985; Goldingay 1990). Sap is harvested by making uniquely recognisable notches or gouges in the Eucalypts bark using its sharp front incisors. Larger trees are disproportionately harvested for sap (Eyre and Goldingay 2005).

The frequency of consumption and proportion of sap and nectar in the diet varies by both location and forest phenology i.e. timing of flowering (Kavanagh 1987; Goldingay 1990; Goldingay and Kavanagh 1991; Carthew *et al.* 1999). Within a given home range, Yellow-bellied Gliders only feed on a small subset of species of Eucalyptus, and only a small number of individual trees, with a preference for smooth- and gum-barked trees with a DBH >60 cm (Craig 1985; Goldingay 1987; Kavanagh 1987; Goldingay and Quin 2004; Kambouris *et al.* 2013; Jessup *et al.* 2020).

Breeding is somewhat opportunistic, with a single young born between early winter and early summer, with timing of birth probably dependent on resource availability (Craig 1985; Goldingay and Kavanagh 1991).

Average home range size of the Yellow-bellied Glider varies from 25 ha to 85 ha (Goldingay and Kavanagh 1990; Goldingay and Possingham 1995). Within these home ranges, Yellow-bellied Gliders den in hollow-bearing trees and regularly change dens, as often as nightly in some instances (Craig 1985). They den in stable family groups, consisting of either a monogamous pair with or without a single dependent offspring, or a polygynous group of up to six individuals, consisting of a single male and multiple females with or without dependent offspring (Craig 1985; Goldingay and Kavanagh 1990; Goldingay 1992; Brown *et al.* 2007).

Habitat Mapping

Based on the available location data, the majority of Yellow-bellied Glider records within 50 km of the SGP are located within BVG 10a. Closer examination shows that the dominant RE present where these observations occur are 11.7.6 and 11.10.1, both dominated by *Corymbia citriodora*. These are obviously critical vegetation types for the species in the local area.

Cross-referencing known Yellow-bellied Glider tree associations (TSSC 2022) with tree species identified within the SGP identify the following: *Corymbia trachyphloia*, *Eucalyptus tereticornis, E. crebra, E. fibrosa* and *E. moluccana*. Within the SGP these trees can be found in REs 11.3.4, 11.3.25, 11.3.26, 11.5.1, 11.5.20, 11.5.21, 11.7.4 and 11.7.7 – these match the BVGs listed in Table 5.6 except BVG 25a. Closer examination of Yellow-bellied Glider records within BVG 25a reveal these occur in mixed polygons containing one of the above mentioned REs. The REs associated with BVG 25a are not consistent with good Yellow-bellied Glider habitat.

Table 5.6. Association of Yellow-bellied Glider records with 1:1 m Broad Vegetation Groups within the SGP and surrounding 50 km area

BVG (1 m)	Count of records			Representative REs in the SGP
	SGP	50 km	% of total	
10a	0	52	66.7	11.7.6
12a	0	10	12.8	11.7.4, 11.7.7
13d	0	8	10.3	11.3.26, 11.5.20
16 c	0	2	2.6	11.3.3, 11.3.4
18a	0	2	2.6	11.3.14, 11.5.21
25a	0	4	5.1	11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.10, 11.9.5
Total	*0*	*78*	*100.0*	

Patch size is also an important factor in determining high habitat amenity areas for Yellow-bellied Gliders, with connected patches greater than 18,000ha needed to support viable populations (Goldingay and Possingham 1995; TSSC 2022). Suitable habitat should only fall within the two areas shown in Figure 5.16 above - vegetation connected with Gurulmundi, Binkey and Barakula State Forests, and vegetation connected with Condamine, Braemar, Vickery and Kumbarilla State Forests. These areas are contained within the provided 'large tracts remnant veg.shp' layer.

Rule(s) for Habitat Mapping:

1. Potential Yellow-bellied Glider habitat is restricted to contiguous or near-contiguous areas of vegetation (i.e., reduced fragmentation). Within the SGP, potentially important habitat is restricted to vegetation within or abutting the 'large tracts remnant veg.shp'.
2. Within the above area, REs 11.3.4, 11.3.25, 11.3.26, 11.5.1, 11.5.4, 11.5.20, 11.5.21, 11.7.4, 11.7.6 and 11.7.7 are mapped as 'Core Habitat Possible'.
3. RE 11.5.4 and 11.9.2 can be structurally similar to the above REs (forest) but lack known tree associations; within the area defined in step 1 above these REs are mapped as 'General Habitat'.
4. Within the designated area in step 1, isolated patches (>400 m from *any* other remnant vegetation) of the REs listed in step 2 and 3 above are mapped as 'General Habitat'.
5. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. Remaining areas of remnant, non-remnant and regrowth vegetation is 'Absence suspected'.

Mapping Confidence

The habitat requirements for this species are relatively well understood and match well to the Regional Ecosystem classification system. Combining suitable REs with a patch size threshold should produce a map of relatively high accuracy.

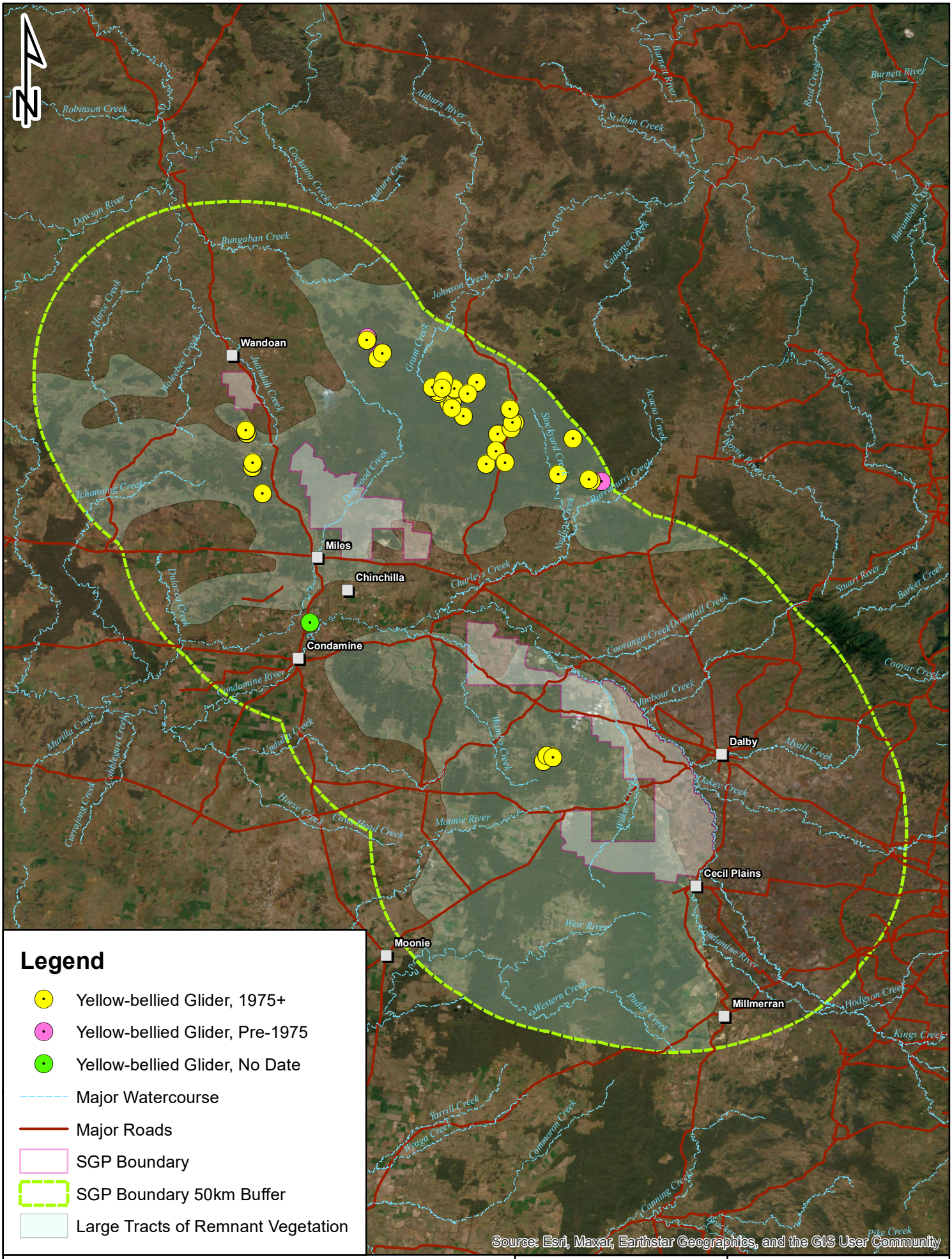


Figure 5.16
Records of the Yellow-bellied Glider within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

5.4.4 *Phascolarctos cinereus* (Koala)

Endangered EPBC Act (effective Feb 2022)
Endangered NC Act

Ecology and occurrence within the SGP

Endemic to eastern Australia, the Koala is a solitary species which is widespread across coastal and inland areas from Cooktown, Queensland to the Mt. Lofty ranges, South Australia (Baker and Gynther 2023). Restricted to altitudes below 800 m ASL (Munks *et al.* 1996), Koalas occur in a diversity of habitats including temperate, sub-tropical and tropical forest, woodland and semi-arid communities, and sclerophyll forest, on foothills, plains and in coastal areas (Martin *et al.* 1999; Baker and Gynther 2023). Closer to the western extent of their distribution they are often associated with water courses though are not restricted to them (Melzer *et al.* 2000; Sullivan *et al.* 2004; Davies *et al.* 2013). The Koala has been located in nine biogeographic regions of Queensland, including the southern Brigalow Belt (DCCEEW 2023d).

Koalas feed on eucalyptus trees but show dietary preference based on geographical region and the types of tree species present. In the Brigalow Belt Koalas have at least 24 species of Eucalyptus upon which they preferentially forage (ANU 2021). Of these tree species the following have been recorded within the SGP: *Corymbia tessellaris, C. citriodora, Eucalyptus camaldulensis, E. chloroclada, E. coolabah, E. crebra, E. exserta, E. fibrosa, E. melanophloia, E. moluccana, E. ochrophloia, E. populnea,* and *E. tereticornis*.

Koalas are not strongly territorial and home ranges will overlap. Home ranges vary in size from 1-2 hectares in optimum habitat up to 135 hectares in semi arid regions (Ellis *et al.* 2002; Baker and Gynther 2023). Movements are often as short as the distance between feed trees; however dispersing individuals will move over larger distances. Established individuals have been known to make exploratory movements over larger distances before returning to home ranges (Dique *et al.* 2004).

The breeding season occurs between October and May with females producing up to one offspring per year (Baker and Gynther 2023). Juveniles become independent from one year of age with males living for over 12 years and females living for over 15 years (Martin *et al.* 1999). Breeding occurs from two years of age, and is often determined by the establishment of a male hierarchy as males become vocal and fiercely fight for females (Baker and Gynther 2023).

Habitat Mapping

Analysis of available spatially accurate recent (1975+) Koala records identifies their presence in a wide range of BVGs which correspond to many of the REs present within the SGP (Table 5.7). While some identified REs (e.g., 11.3.1, 11.3.27a, 11.4.3, 11.3.4a, 11.7.2, 11.7.5) do not initially appear to contain Eucalypts based on their description, closer examination of the REDD reveals emergent Eucalypts are often present. In fact, based on the REDD, potential foraging trees are present in all remnant types *except* 11.9.5.

Koalas are surprisingly mobile and able to move large distances across artificial land. There are no limitations on suitable patch size. They are also often seen in regrowth. The abundance of records in non-remnant habitats likely reflect these behaviours with individuals able to utilise isolated trees in an otherwise unsuitable landscape.

Table 5.7. Association of Koala records with 1:1 m Broad Vegetation Groups within the SGP and surrounding 50 km area

BVG (1 m)*	Count of records			Representative REs in the SGP
	SGP	50 km	% of total	
10a	0	9	1.9	11.7.6
11a	0	18	3.8	None
12a	6	5	2.4	11.7.4, 11.7.7
13d	4	0	0.9	11.3.26, 11.5.20
16a	4	17	4.5	11.3.25
16 c	5	0	1.1	11.3.3, 11.3.4
17a	6	31	7.9	11.3.18, 11.3.2, 11.5.1a, 11.9.7
18a	1	2	0.6	11.3.14, 11.5.21
18b	26	19	9.6	11.5.1, 11.5.4
25a	6	10	3.4	11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.10, 11.9.5
30a	0	4	0.9	None
34a	5	0	1.1	None
Undifferentiated Non-remnant	12	278	62.0	
Total	*75*	*393*	*100*	

* Includes records from differentiated regrowth, records from undifferentiated regrowth added to non-remnant tally

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire SGP.
2. All remnant and regrowth REs *except* 11.9.5 are mapped as 'Core Habitat Possible'.
3. All Core Habitat Possible within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.

Mapping Confidence

Our understanding of Koala habitat use in the SGP has increased substantially and it is now recognised that the species can use a wider variety of REs than initially recognised. The mapping is now considered to have high accuracy.

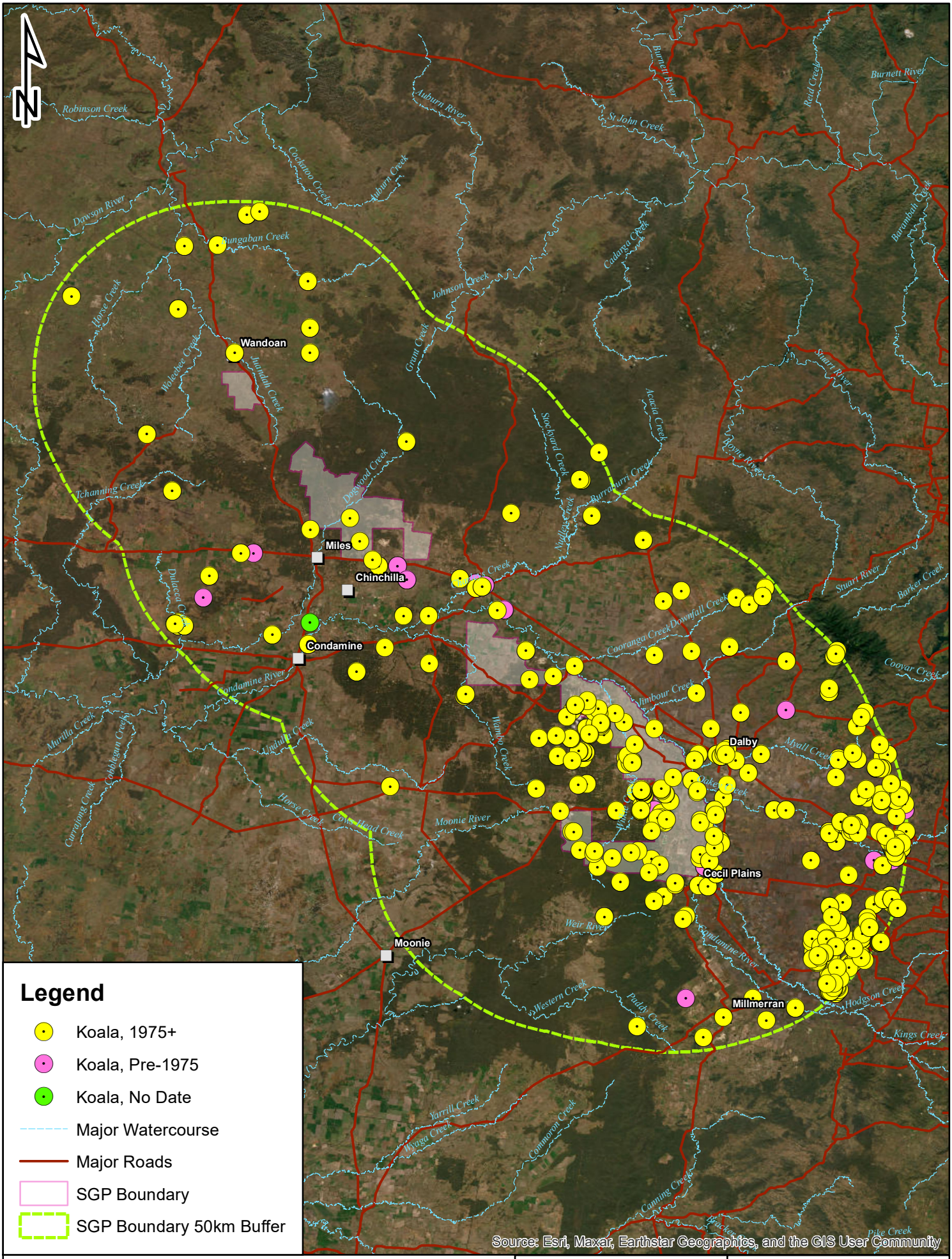


Figure 5.17
Records of the Koala within and surrounding the SGP

Scale
1:1,427,963
0 12.5 25 50 km

Client: Arrow Energy

Project: Surat Gas Project

ecosmart ECOLOGY

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Appendix A
Likelihood of Occurrence Assessment

LIKELIHOOD OF ASSESSMENTS

The table below lists flora and fauna species that either known from within 50 km of the SGP or have been identified in the EPBC online Protected Matters search. The Likelihood assessment has been based on the SGP having a Life of Operation of approximately 25 years. Mobile fauna species which could occur within the SGP over this timeframe, but are unlikely to represent a permanent population or a population relying on the SGP for its long-term viability are assessed as 'Transient'.

Scientific Name Common Name	Status#		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
FLORA						
Trees and shrubs						
Acacia barakulensis Waaje Wattle	Vul	-	HERBRECS specimen records indicate species is associated with woodland and shrubland habitats formed by *Eucalyptus tenuipes, Corymbia trachyphloia, Calytrix gurulmundensis*, *and Triodia mitchellii.* Habitat is consistent with RE 11.7.4, 11.7.5, 11.7.6, and 11.7.7.	The species is considered to possibly occur based on suitability of habitat in the SGP and contiguity of adjacent habitats	Herbrecs identifies 5 confirmed populations 28 km to the north-east of the SGP study area within Barakula State Forest.	Possible
Acacia curranii Curly Bark Wattle	Vul	Vul	Plants are known to occur in shrubby heaths, dry sclerophyll forests and semi-arid woodlands where they can occur as widely scattered thickets in very species-rich heathy scrub with emergent eucalypts (Pickard 1995c, Threatened Species Scientific Committee 2008). Curly-bark wattle grows on sandy clay soils that are poorly drained on weathered sandstone.	The species is considered to possibly occur based on suitability of habitat in the SGP and contiguity of adjacent habitats	Sixteen local populations are recorded in Herbrecs with the nearest population 11 km west of the SGP study area with Gurulmundi State Forest (excluding low precision records).	Possible

Scientific Name Common Name	Status#		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Acacia handonis Hando 's Wattle	Vul	Vul	Hando's wattle has only been collected on rocky ridges and slopes on sandstone-derived geology in eucalypt woodland and open forest. The vegetation it grows within is a shrubby woodland of *Eucalyptus fibrosa subsp. nubila, Eucalyptus watsoniana subsp. watsoniana, Lysicarpus angustifolius*, and Allocasuarina inophloia (Halford 1995). This is consistent with RE11.7.7	The species is considered to possibly occur based on suitability of habitat in the SGP and contiguity of adjacent habitats	Seventeen local populations are recorded in Herbrecs with the nearest population 35 km east of the SGP study area within Barakula SF (54 km west-north-west of Miles)	Possible
Acacia lauta Tara Wattle	Vul	Vul	Associated with sandy soils hosting ironbark woodland. Known populations have been mapped within REs 11.7.7, 11.7.4 and 11.7.5. These REs provide a representative mix of shrubland and woodland of which ironbark (*Eucalyptus crebra, Eucalyptus sideroxylon or Eucalyptus fibrosa)* forms a dominant to sub-dominant component (TSSC 2008o).	Populations are localised to the area surrounding Tara and Inglewood. Due to a lack of survey record following comprehensive survey, this species is considered unlikely to occur.	Nearest record is 20km west of the Kumbarilla State Forest in the vicinity of Tara (64 km west of Dalby).	Unlikely
Acacia wardellii	NT	-	The species inhabits gravelly soils on shallow weathered sandstone in eucalypt woodland (Pedley, 1978). Herbrecs data (EHP 2013) indicates typical habitats including RE 11.7.4, RE 11.7.7 and RE 11.7.5.	Potential habitats include REs 11.7.4 and 11.7.7 to in the vicinity of Kogan although extensive ground survey in this locality suggest a new population within the SGP is unlikely.	Three populations recorded all approximately 16 km west of the SGP study area and 25 km west of Chinchilla. Greater than 30km west of the nearest suitable habitat near Kogan.	Unlikely

Scientific Name Common Name	Status#		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Apatophyllum teretifolium Sandstone Pricklebush	NT	-	This small shrub grows in eucalypt forest on rocky surfaces, including cliffs.	The primary habitats that may contain *Apatophyllum teretifolium* are REs 11.7.4 and 11.7.7	One population is known from approximately 28 km to the east of the SGP study area, in Barakula SF, north of Chinchilla.	Unlikely
Callitris bayleyii Bailey's cypress pine	NT	-	A 3D Environmental survey record associated with the Surat EIS (3D Environmental 2011) confirms its presence in low open forest (11-15m) of *Eucalyptus exserta, E. crebra* and *Callitris glaucophylla* with a mid-dense shrubby understorey dominated by *Micromyrtus sessilis with Acacia crassa, Alphitonia excelsa,* and *Petalostigma pubescens*. Habitat typical of RE11.7.4	Extensive tracts of suitable habitat occur in the central portion of the SGP area. The extent of habitat including core habitat possible and general habitat has been provided within the attached GIS package.	Nearest local record is 2.6 km west of the SGP study area (40 km north of Miles) in Gurulmundi State Forest.	Possible
Calytrix gurulmundensis Gurulmundi Fringe Myrtle	Vul	Vul	Grows in patches of shrubland on shallow lateritic soils at sandstone ridges. Vegetation is predominately eucalypt, acacia, casuarina dense shrublands with spinifex, and spinifex grassland with scattered shrubs. This habitat description is consistent with RE 11.7.5 (shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks).	Suitable habitats include patches of RE11.7.5 and RE11.7.4 in to the west and north-west of the central assessment area. The extent of habitat including core habitat possible and general habitat has been provided within the attached GIS package.	Nearest local record is 12 km west of the SGP study area (30 km north of Miles) within Gurulmundi State Forest. A population also exists in Waaje Scientific Reserve 36 km east of Wandoan.	Possible

Scientific Name Common Name	Status#		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Cadellia pentastylis Ooline	Vul	Vul	Ooline grows in semi-evergreen vine thickets, brigalow and occasionally in adjacent eucalypt woodland, where it maybe locally dominant in the canopy layer or occur as an emergent (TSSC 2008e) and also residual trees in cleared paddocks. Substrates include clay plains, sandstone and residual ridges (Eddie 2007).	Although Ooline occupies a range of substrates, local records are located in sandstone ravines in Gurulmundi State Forest. There are no known similar habitats in the SGP study area.	Nearest local collected sample is 23 km west of the SGP area and 50 km NE of Miles. There are no other local records. A 1963 record at Myall Park is included in AVH, although accompanying notes indicate that this plant is cultivated. An additional low precision (5121 m) observation is also shown in ALA approximately 5 km north of the Myall Park. This is considered most likely to be the same cultivated record. Extensive searches for this large distinctive species throughout the SGP have been unsuccessful and it is considered 'unlikely' to occur.	Unlikely
Denhamia parviflora Small-leaved Denhamia	Vul	Vul	Small-leaved Denhamia grows in semi-evergreen vine thickets, vine scrubs and brigalow (*Acacia harpophylla*) softwood communities on fertile, red brown sandy clay loam hillslopes and crests (DNR 2000).	Suitable habitat and substrate within the assessment area is extremely limited.	2 pre-1985 records located to the east of Chinchilla, approximately 20 km east of the SGP study area.	Unlikely

Scientific Name Common Name	Status#		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Eucalyptus argophloia Chinchilla white gum	Vul	Vul	Exists largely in disturbed regrowth vegetation with associated tree species of brigalow (*A. harpophylla*), grey box (*E. molluccana/ E. microcarpa*) white cypress pine (*C. glauca*) and poplar box (*E. populnea*). The tree is associated with red loams, grey brown clays and clay loams of moderate to high fertility. According to TSSC, no known populations occur in vegetation classified as remnant under the VM Act.	Suitable red high fertility loamy substrates have not been identified in the SGP.	Nine records located east of the SGP study area with the nearest population 25 km from the SGP boundary and 18 km north-west of Chinchilla	Unlikely
Eucalyptus curtisii Plunkett Mallee	NT	-	Lateritic sandstone and sandstone rises/ridges and slopes often with *Eucalyptus exserta, E. fibrosa* subsp. *nubila, Corymbia trachyphloia,* and *Callitris glaucophylla.* Typical habitats include RE11.7.7, 11.7.5 and 11.7.5.	Has potential to occur throughout the SGP study area in suitable habitats. Estimated extent of suitable habitat within the SGP provided in GIS package.	Numerous local records mostly west of the SGP study area with the nearest record 2.5 km west of the SGP study area and 35km north of Miles	Possible
Eucalyptus pachycalyx subsp. waajensis *Pumpkin gum*	End	-	Grows in an apparently unique small area of sandy plateau, as an emergent tree, with *Eucalyptus sideroxylon subsp improcera* in a shrubland of *Melaleuca uncinata*, RE 11.7.5	Similar habitat present although extensive field survey did not identify any populations of this distinctive tree in the SGP.	Known from 29 km north-east of SGP, in northern Barakula State Forest.	Unlikely
Eucalyptus sideroxylon subsp. improcera *Red ironbark*	Vul	-	Grows in an apparently unique small area of sandy plateau, as an emergent tree in a shrubland of *Melaleuca uncinata*, RE 11.7.5	Similar habitat present although extensive field survey did not identify any populations in the SGP.	Known from northern Barakula State Forest, 29 km to the east of SGP.	Unlikely

Scientific Name Common Name	Status#		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Eucalyptus virens Shiny-leaved Ironbark	Vul	Vul	The species is known to inhabit plateaus and sandstone escarpments and sandy soils which form low rises. Based on Herbrecs data (EHP 2013), populations are mapped as occurring in association with REs11.7.7, 11.7.4. 11.7.5, 11.7.6 and11.5.1, all associated with residual soils.	Similar habitat present although extensive field survey did not identify any new populations.	Extremely localised population with 2 records from the vicinity of Tara, 9 km west of the SGP study area (64 km west of Dalby).	Unlikely
Homoranthus decumbens	Vul	End	This low shrub grows in a unique sandy lateritic and sandstone outcrop area with *Eucalyptus pachycalyx* subsp *waajensis* and *Eucalypus sideroxylon* subsp *improcera*, RE 11.7.5	Similar habitat present although extensive field survey did not identify any populations of this distinctive tree in the SGP.	Known from 29km north-east of SGP, in northern Barakula State Forest.	Unlikely
Homoranthus papillatus	CE	-	Areas of soil amongst granite outcrop heath.	No suitable habitat present.	This shrub has only been collected at Girraween National Park, near Stanthorpe. Wildnet and Atlas of Living Australia list one 2001 observation (lacking a plant sample specimen) from Binkey State Forest, north of Miles. However, Tony Bean, the Homoranthus expert at the Queensland Herbarium, considers this most likely a mis-identification.	Unlikely
Melaleuca groveana Groves Paperbark	NT	-	A small shrub of rocky outcrop shrubland areas, RE 11.7.5.	Similar habitat present although extensive field survey did not identify any populations of this distinctive tree in the SGP.	Known from 29 km north-east of SGP, in northern Barakula State Forest.	Unlikely

Scientific Name Common Name	Status#		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Micromyrtus carinata	End	-	Herbrecs records indicate suitable habitat in heathland and low woodland typical of REs 11.7.4 and 11.7.5.	Estimated extent of suitable habitat within the SGP provided in GIS package.	Nearest Herbarium Record is 10km north-west of Miles and 4 km west of the SGP study area on the Wyona Property.	Possible
Micromyrtus patula	End	-	A small shrub of rocky outcrop shrubland areas, RE 11.7.5.	Similar habitat present although extensive field survey did not identify any populations of this distinctive tree in the SGP.	Known from 30 km north-east of SGP, in northern Barakula State Forest.	Unlikely
Philotheca sporadica Kogan Waxflower	NT	Vul	Based on field survey observation, the species is universally restricted to open scalds and low *Eucalyptus exserta* dominant woodlands associated with RE11.7.4,as well as associated non remnant areas such as powerline tracks. .	The extent of habitat including known, core habitat possible and general habitat has been provided within the attached GIS package	There are 11 known populations, seven occur on road verges, seven extend onto freehold land and one population is within Braemar State Forest (Halford 1995c in TSSC 2008j). The extent of known populations and habitat has been expanded considerably as a result of the current assessment.	Known
Pomaderris coomingalensis	End	-	Occurs in Eucalyptus and Callitris woodland in shallow sandy soil or Eucalyptus woodland on hard sandstone jump ups. Herbarium records (DERM 2011) include woodland of narrow leaved ironbark (*Eucalyptus crebra*) and *E. fibrosa subsp nubila*.	Extensive areas of potential habitat in the Kogan / Kumbarilla areas in RE11.5.1, 11.7.4 and 11.7.7.	A single record to then west of Kumbarilla State forest, 10km from the west of the SGP study area. Not recorded in field surveys despite extensive survey effort in suitable habitat	Unlikely
Sophora fraseri Brush Sophora	Vul	Vul	Grows in vine thicket and dry rainforests.	No suitable habitat within SGP	Has been collected in vine thicket near Toowoomba and further east.	Unlikely

Scientific Name Common Name	Status[#] NCA	EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Grasses and Sedges						
FLORA	Vul	-	Known from heavy soils with records from remnant and disturbed *Eucalyptus orgadophila* woodland on basaltic soils and grassland on heavy alluvium.	Limited suitable remnant habitat in the assessment area and the species is not known to be associated with non-remnant habitats.	A single 1995 herbarium record exists in the Jandowae area, 18 km east of the SGP study area and 25 km north of Dalby.	Unlikely
Dichanthium queenslandicum King bluegrass	Vul	End	*Dichanthium queenslandicum* is in mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, open downs) on undulating plains, typically growing with other bluegrass species including *Dicanthium setosum*	While suitable habitat occurs in native grassland habitats RE 11.3.21 and 11.3.24, the species has never been recorded to the west of Bowenville.	The nearest record occurs 23 km to the east of the SGP near Bowenville, collected in 2011. Additional records occur 25 km to the north near Jandowae, although these are historic (both 1951).	Unlikely
Digitaria porrecta Finger Panic Grass	NT	-	Finger panic grass grows in grasslands, woodlands and open forests with a grassy understory, on black soil plains of the Darling Downs, and lighter textured soils to the west (Goodland 2000; Fensham 1998). Fensham (1998) found it is most abundant in grassland, but is "relatively unspecific" in its habitat preference. It is not restricted to high quality native grasslands, but also grows along roadsides and can be found in highly disturbed sites.	The most suitable habitats are associated with derived grassland habitats, typically associated with roadside easements between Chinchilla and Cecil Plains.	Two records within the SGP study area , both in non-remnant derived grasslands adjacent to roadside easements between Dalby and Cecil Plains. Both records collected in 1995. A further 15 records within 25 km east of the SGP study area boundary.	Known

Scientific Name Common Name	Status[#]		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Fimbristylis vagans	End	-	A sedge to 80cm tall that that fringes ephemeral watercourses and lagoons on alluvium.	A large number of potential habitats associated with swamps and drainage lines.	A single record from the SGP study area associated with the swampy inlet of Lake Broadwater. Has not been recorded or collected since 1984.	Known
Homopholis belsonii	End	Vul	Belson's panic prefers moderate to highly fertile soils, especially those derived from basalt and fertile alluvial flats. It is generally associated with poplar box and brigalow woodlands on light red/brown earths (Fensham and Fairfax 1997, Goodland 2000). It is most likely to be associated with RE11.3.1, 11.3.17, 11.4.3, 11.9.5, 11.9.10.	Regional ecosystems associated with heavy clay, typically brigalow. Scattered remnants of REs 11.3.1, 11.3.17, 11.4.3, 11.9.5, 11.9.10 occur throughout the SGP EIS Area.	A considerable number of records to the east of Dalby with the nearest 12 km from the eastern boundary of the SGP study area. Two records within 8 km of the boundary of the northern study region within 10 km of Wandoan.	Possible
Forbs and herbs						
Cryptandra ciliata	NT	-	Suitable habitat in eucalypt dominated woodland, lancewood (Acacia shirleyi) woodland and Triodia grassland on rocky on low lateritic and sandstone ridges. Habitat in the PDA is consistent with RE 11.7.5, 11.7.4, 11.7.6, 11.5.1, 11.5.4, 11.5.21.	Woodlands in the Chinchilla/Miles region in the Central assessment area provide for potential habitat for the species.	Three herbarium records within 5km of the assessment area boundary with a single record within 1km of the eastern boundary, 30km to the north of Miles.	Possible

Scientific Name Common Name	Status[#]		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Cymbonotus maidenii	End	-	The species is associated with a range of remnant and non-remnant habits with records occurring on disturbed roadside drains, native and derived grasslands. It is typically associated with heavy brown to grey cracking clay soils (Holland & Funk 2006).	Suitable habitat occurs within derived grassland habitats to the south of Dalby.	Five Herbrecs specimens recorded within 10 m of the eastern boundary of the SGP study area, mostly in the Cecil Plains / Millmerran Area including collections on road reserves on the Cecil Plains - Millmerran Road.	Possible
Leuzea australis Sunflower	Vul	Vul	Grows in basalt-derived grasslands on cracking clay soils, RE 11.8.11.	Similar habitat occurs in the far south of SGP.	Closest known plants grow 40 km to the south east of Dalby. This is a distinctive looking herb.	Unlikely
Picris barbarorum	Vul	-	Known from native grassland (12.3.21) of *Dichanthium sericeum* in stock routes, road reserves adjacent to disturbed areas such as cultivated paddocks and road and rail lines on black clay soil.	Potential habitat associated with derived grassland in road reserves to the north and south of Dalby.	Four herbarium records within 5km of the SGP study area with the nearest less than 2 km from the assessment area boundary, 14km north-west of Dalby.	Possible
Picris evae Hawk weed	Vul	Vul	Heavy cracking clay soils derived from basalt, e.g. RE 11.8.11.	Similar but not specific habitat within SGP.	Closest known plants grow 26 to 30 km to the south east of Dalby.	Unlikely
Prostanthera sp. (Dunmore D.M.Gordon 8A)	Vul	Vul	Forests and woodlands on rocky outcrops.	Similar habitat occurs in the SGP.	Records from the 1940's and 1950's from the Millmerran area, but no recent records near the SGP	Unlikely
Rutidosis glandulosa	NT	-	Mainly found in roadside vegetation of Acacia and Eucalypt woodland/open forest on red sandy ridges and clay flats between 280-320m altitude adjacent to cleared or partly cleared grazing and cropping land (DNR 2000).	It has been recorded within REs 11.5.4 and 11.9.9 although may occur in various mixed eucalypt woodlands within project area.	Two records within the SGP study area and two Herbarium records within 20 km from the SGP study area.	Known

Scientific Name Common Name	Status[#]		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Rutidosis lanata	NT	-	Mainly found in roadside vegetation of Acacia and Eucalypt woodland/open forest on red sandy ridges and clay flats between 280-320m altitude adjacent to cleared or partly cleared grazing and cropping land (DNR 2000).	Most likely to be recorded within REs 11.3.4, 11.3.2 and 11.3.3 in the vicinity of Chinchilla although may occur in these habitats throughout the entire project area.	Eight Herbarium records within 20 km from the SGP study area, all recorded in the Miles / Chinchilla area.	Known
Solanum papaverifolium	End	-	Occurs in wetter (swampy) areas of grasslands or open eucalypt woodland on heavy alluvial soils (Goodland 2000). The species is often recorded in non-remnant habitat.	Suitable habitat occurs within derived grassland and associated woodlands typically associated with roadside reserves.	Two records contained within the SGP study area to the south of Dalby with an large number of herbarium records to the east of the SGP study area between Chinchilla and Dalby.	Known
Solanum stenopterum	Vul	-	Occurs in disturbed grassland, *Casuarina cristata* forest or *Eucalyptus populnea* woodland on clay soils (Bean 2004).	Derived grassland, Brigalow and grassy woodlands of *Eucalyptus populnea* between Dalby and Cecil Plains.	Known to occur in non-remnant grassland approximately 7.5km south of Dalby; 3.5 km east of Cecil Plains in a roadside gravel pit; and approximately 6 km south east of Cecil Plains in remnant Eucalyptus populnea woodland on alluvium (11.3.2). All herbarium records outside SGP study area.	Possible
Thesium australe Austral toadflax	Vul	Vul	Austral toadflax has been collected within popular box (*Eucalyptus populnea*) woodland on alluvial flats (RE 11.3.2) north-west of Dalby, within the project development area.	Most likely to occur on habitats formed on heavy clay associated with the Condamine Alluvium. RE11.3.2 provides the most suitable habitat within the assessment area.	Two herbarium records within 10km of the SGP study area, with the nearest record 2.7k east of the eastern SGP study area boundary, 25km north west of Dalby.	Possible

Scientific Name Common Name	Status[#] NCA	EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Vincetoxicum forsteri	End	End	*Vincetoxicum forsteri* (previously called *Tylophora linearis*) is a vine of eucalypt woodland, and associated non remnant areas	Potentially could occur in any eucalypt woodland area.	Has been recorded north of Miles	Possible
Xerothamnella herbacea	End	End	Occurs in remnant and disturbed brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*) dominated communities in shaded situations, often in leaf litter (TSSC 2008n).	Numerous brigalow habitats (RE11.3.1, 11.4.3, 11.9.5), both remnant and disturbed have potential to host this species.	Two herbarium records to within 20km of the SGP Boundary, 20km to the east and north of Chincilla.	Possible
FAUNA						
Invertebrates						
Adclarkia cameroni Brigalow Woodland Snail	End	Vul	Brigalow and alluvial eucalypt woodlands, which have dense cover and scattered debris, especially logs, dense leaf-litter, piles of fallen bark and flood debris	Within the SGP habitats possibly suitable include: RE 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.17, 11.3.25, 11.3.27, 11.4.3, 11.4.3a. 11.9.5, 11.9.7 and 11.9.10	Known from at least six locations within the SGP and three on the eastern boundary.	Known
Adclarkia dulacca Dulacca Woodland Snail	End	End	A variety of habitats including vine thicket, Brigalow, Lancewood, Ironbark and *E. woollsiana* woodlands	Numerous potentially suitable habitats are present. In particular RE 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5 and 11.9.10	Known from one location within the SGP, most other records located further west	Known

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Jalmenus eubulus Pale imperial hairstreak	Vul	-	Restricted to Brigalow (*Acacia harpophylla*)-dominated woodlands and open-forests, particularly those areas with Belah (*Casuarina cristata*), emergent eucalypts such as *Eucalyptus populnea* and understorey shrubs (Breitfuss and Hill 2003; Eastwood et al. 2008).	Old-growth remnant brigalow communities occur within the SGP.	Three records are located within the SGP, the most recent of which is 25 years old. Additional records within 50km of the SGP are predominantly >20y old,, with the exception of a single record from 2008 in Gurulmundi SF, and two records from 2012 in Condamine SF The species requires targeted surveys to detect, even during suitable conditions. Current number of records are likely to underestimate abundance and distribution	Known
Amphibians						
Adelotus brevis Tusked Frog	-	Vul	More permanent ponds and streams in rainforest to wet and dry forests including suitable modified and artificial waterbodies (Anstis 2013)	Some low amenity habitat possible around farm dams and within major creeklines. However habitats are typically drier than those where this species is encountered.	No records within the SGP. Three records within 50km, one from Barakula SF from 1996, a second from Kaimkillenbun in 1978. The third, recent record from Miles in 2021, supported by a photograph, is a deceased Cane Toad (*Rhinella marina*).	Will not occur
Litoria cooloolensis Cooloola Tree Frog	-	NT	Permanent wallum wetlands – coastal heaths on sand with tannin stained acidic waters.	None.	A single record from 1972 ~12km SE of Wandoan near the northern SGP is an artefact of rounding. The verbatim locality provided on ALA is from Coolamera Lake, Cooloola	Will not occur

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Mixophyes iteratus Giant Barred Frog	End	End	Deep, slow-flowing creeks with steep, undercut banks. May occur in disturbed areas but prefer pristine habitat (Lemckert 1999). Require dense leaf litter and low vegetation for daytime shelter.	None.	A single recent record from 2021 ~25km NE of Dalby, supported by a photograph, shows a tadpole of a species other than *M. iteratus*	Will not occur
Reptiles						
Acanthophis antarcticus Common Death Adder	Vul	-	Found in a wide variety of habitats, including rainforest, open woodland, shrubland and heath (Wilson and Swan 2003).	Suitable vegetation is found in the larger tracks of vegetation associated with Barakula State forest in the north and Kumbarilla SF in the south.	12 records within 50km of the SGP, mostly very old (>90y) or with no date recorded. A single recent record from 2021 is located in Tara. A single record within the SGP, from Lake Broadwater, is 39y old.	Known
Anomalopus mackayi Long-legged worm-skink	Vul	End	Open grasslands with cracking black soil.	No suitable remnant habitats. Derived grasslands may provide some low-amenity habitat.	No records within the SGP; one record within 10km of the SGP. Most recent records (<20 years old) centred around Oakey and Dalby. Never recorded west of the Condamine River.	Will not occur
Delma torquata Collared Delma	Vul	Vul	Rocky outcrops in dry, open eucalypt-acacia woodlands, including Briglaow, with an understorey of grass and shrubs. Can be found in disturbed habitats (Chapple 2017).	Low amenity habitat possible in isolated locations of small jump-ups.	No records within 50km of the SGP boundary.	Unlikely (but considered in detail in Section 5.0)

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Egernia rugosa Yakka skink	Vul	Vul	Usually occurs on well-drained, coarse, gritty soils in the vicinity of low ranges, foothills and undulating terrain (Wilson and Swan 2008; Richardson 2006), but can also be found on loam and clay soils (Eddie 2012).	Suitable habitat is present throughout much of the SGP	Two records within 50km of the SGP, one ~2km east of Gurulmundi SF, another ~6km east of Condamine SF. Also anecdotally said to have been recently recorded somewhere in Barakula SF. Rare and scattered in the east of its range.	Unlikely (but considered in detail in Section 5.0)
Furina dunmalli Dunmall's snake	Vul	Vul	Wide range of habitats, including forests and woodlands dominated by brigalow (*Acacia harpophylla*) and other Acacia spp., cypress (*Callitris* spp.) or bulloak (*Allocasuarina luehmannii*) on black alluvial cracking clay and clay loams (Covacevich *et al*. 1988; Stephenson and Schmida 2008).	Suitable habitat is present throughout much of the SGP	Two records, either old (>30y) or undated exist at Lake Broadwater. An additional two records are located within 8km outside the SGP area, with the most recent record from 2000.	Known
Hemiaspis damelii Grey snake	End	-	Inhabits dry eucalypt forest and occasionally pasture, favouring areas of cracking, flood-prone soils along floodplains and near watercourses within the Brigalow Belt (Wilson 2005).	Suitable habitat present across much of the Condamine floodplain on landzone 3 and 4, including non-remnant cleared areas of gilgai black soil in the north-west extent of the southern SGP portion.	61 records within 50km of the SGP, including 15 within the southern SGP, mostly centred around Lake Broadwater and just east of Braemar SF.	Known
Strophurus taenicauda Golden-tailed gecko	NT	-	Found mainly in association with brigalow (*Acacia harpophylla*), cypress (*Callitris* spp.) and ironbark (*Eucalyptus* spp.).	Suitable habitat is present throughout much of the SGP	Regularly recorded within 50km of the SGP (>300 records, including 92 within the SGP). Species recorded during surveys.	Known

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Tympanocryptis condaminensis Condamine Earless Dragon	End	End	Open grasslands and cropland with cracking black soil	No suitable remnant habitats. Derived grasslands may provide some low-amenity habitat.	Closest accurate record from 2023 ~16km from SGP, ~30km SE of Dalby. No records known west of the Condamine River.	Will not occur
Birds						
Anthochaera phrygia Regent Honeyeater	CE	CE	Forests and woodlands of ironbark, box, swamp mahogany and river oak.	Limited low-amenity habitat associated with riparian stretches of *E. tereticornis.*	Only six records within 50km of the SGP, all undated or >20y old, centred around Dalby and Chinchilla. Vagrant within the southern Brigalow Belt.	Unlikely
Aphelocephala leucopsis Southern Whiteface	Vul	Vul	Low-density open woodland and shrublands with grassy and/or shrubby understorey, abundant leaf litter and debris, and hollow- and crevice-bearing trees (DCCEEW 2023)	Some, likely low-amenity, habitat scattered throughout the SGP.	Scattered records within 50km of southern SGP, all undated or at least 15y old. Nearest recent record (2008) from Wilkie Creek in north of Kumbarilla SF, surrounded by southern SGP.	Possible
Botaurus poiciloptilus Australasian Bittern	LC	End	Freshwater wetlands with dense vegetation, particularly reeds and sedges.	Low amenity habitat, only associated with artificial waterbodies, possible. Suitable habitat at Lake Broadwater.	Nine records within 50km of the SGP, all either undated or >50y old. This species is highly vagrant and would be a very rare visitor to the SGP area.	Unlikely (LB)
Calidris ferruginea Curlew Sandpiper	End	CE	Saline and freshwater wetlands, saltmarshes, estuaries, mudflats. Prefers areas with exposed mud for foraging.	Only likely at Lake Broadwater.	Six old (>30y) records from Lake Broadwater in the southern SGP. Most recent record from 2007 on a dam ~7km south of Lake Broadwater. While it is likely to occur at Lake Broadwater, the species has a low probability of occur at other locations within the SGP during Life of Operation.	Will not occur (LB)

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Calyptorhynchus lathami Glossy Black-cockatoo	Vul	Vul	Inhabits woodlands and forests that have abundant Allocasuarina species and abundant large hollows suitable for nesting. Many populations are restricted to remnant vegetation within hills and gullies surrounded by agricultural land (Higgins 1999).	Habitat throughout the SGP except the very northern portion. Higher amenity habitat more prevalent in the southern SGP area.	Regularly recorded (160 records) in and within 50km of the SGP. Within the SGP most records are associated with Lake Broadwater and Kumbarilla SF. Recorded during surveys.	Known
Erythrotriorchis radiata Red Goshawk	End	End	Open forests, woodlands, wetlands, rainforest fringes	Suitable habitat present throughout the SGP	Two records within the southern SGP in the vicinity of Lake Broadwater, and an additional 9 within 50km of the SGP centred around Chinchilla and Oakey. All records are old (i.e. >40 years) and the species is rarely recorded in the Brigalow Belt. No known likely population.	Unlikely/ Transient
Falco hypoleucos Grey Falcon	Vul	Vul	Lightly treed inland plains, gibber deserts, pastoral lands	Typically occurs in dyer more open habitats than those present in the SGP.	Four undated records within 50km of the SGP and one old (>20y) record from Lake Broadwater likely represent misidentifications or a very occasional vagrant. The species is rarely recorded within the Brigalow Belt.	Unlikely/ Transient

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Geophaps scripta scripta Squatter Pigeon	Vul	Vul	Occurs mainly in dry grassy eucalypt woodlands and open forests and also inhabits cypress pine (Callitris spp.) and Acacia dominated woodlands (Frith 1982)	Non-remnant habitats present throughout the SGP. Remnant habitats are, throughout much of the SGP, too heavily wooded to be considered high-amenity.	Periodically recorded in and withing 50km of SGP. most recently from 20222 near Nudley SF ~70km E of central SGP. Three records within the central SGP, the most recent from 2012. Despite suitable habitat being present, this species is likely to vagrant, with individuals not representing a resident or seasonal population. May sporadically occur in the northern and central regions of the SGP during Life of Operation.	Transient
Grantiella picta Painted honeyeater	Vul	Vul	Found mainly in dry open woodlands and forests, particularly box-ironbark woodlands. It may also occur in riparian forest, on plains with scattered eucalypts and in remnant trees on farmland and their occurrence is strongly associated with mistletoe.	Isolated areas of remnant brigalow present high-amenity habitat within the SGP	Within 50km of the SGP, multiple records exist, notably from Jondaryan and Jandowae, with an array of records from Jondaryan and Dalby in the past five years, although these may represent repeat sightings of only a few individuals. Four records within the SGP in the southern portion near Lake Broadwater the most recent from 2016. Likely to occur within the SGP infrequently.	Known
Hirundapus caudacutus White-throated Needletail	Vul	Vul	Possible over all land types due to aerial foraging habit	Entire SGP provides suitable foraging habitat.	Regularly recorded within 50km of the SGP, including during surveys. Multiple occurrences within the central and southern SGP, particularly in the vicinity of Lake Broadwater and	Known

Scientific Name Common Name	Status[#] NCA	EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Lathamus discolour Swift Parrot	End	CE	Flowering trees in forests and woodlands	Low amenity habitat associated with riparian E. tereticornis. Typically in a region too dry for the species which is more coastal	Six records within 50km of the SGP, all undated or >50yr old. Any possible current or future occurrence would be of vagrant individuals.	Unlikely
Limosa lapponica baureri Bar-tailed Godwit	Vul	Vul	Saline and freshwater wetlands, saltmarshes, estuaries, mudflats. Prefers areas with exposed mud for foraging, usually within proximity to the coast.	Only likely at Lake Broadwater.	With the exception of two pre-1900 records, this species has been recorded on only three occasions between 1980 and 1987. All records are from the vicinity of Lake Broadwater	Will not occur (LB)
Lophochroa leadbeateri Pink Cockatoo	Vul	-	Sparsely timbered open grasslands, *Callitris* and *Casuarina* woodlands, mulga woodlands, trees in proximity to watercourses	Habitats within the SGP are, on balance, too closed and more mesic than areas inhabited by this species.	Two records exist within the project site in the Lake Broadwater area, both >30yr old. Several undated or old (>50yr) exist within 50km of the SGP. and the age of these sparse records indicate the species does not occur in the area with any frequency.	Will not occur
Ninox strenua Powerful Owl	Vul	-	Eucalypt forests on ranges with densely vegetated gullies, drier and lower elevation forest with sufficient prey and large hollows	Low-amenity habitat associated with large tracks of forest dissected by riparian corridors with E. tereticornis. Arboreal mammals throughout much of the SGP are not common.	No records within the SGP and all records are old (i.e. >20 years). Rarely recorded within the Brigalow Belt.	Unlikely
Pedionomus torquatus Plains-wanderer	Vul	Vul	Open grasslands with patches of bare ground, low sparse shrublands	None.	Outside of known range and all records are old (ie. >40 years).	Will not occur

Scientific Name Common Name	Status[#] NCA	EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Psephotus pulcherrimus Paradise Parrot	Ex	Ex	Eucalypt woodland in lightly timbered river valleys with grassy understorey, often with termite mounds (DCCEEW 2023)	N/A. Species is extinct. Most forested areas too dense.	Historic records from Dalby and Oakey Creek; however, species is extinct and therefore no longer occurs within the SGP.	Will not occur
Rostratula australis Australian Painted Snipe	Vul	End	Found in a wide range of habitats including ephemeral swamps, dams, rice paddocks, waterlogged grasslands, roadside drains and even brackish waterways (Marchant and Higgins 1993).	Most restricted to Lake Broadwater, though some moderate to low-amenity habitat is possible at the adjacent Long-swamp under favourable conditions.	Records within 50km of SGP are sparse and mostly undated. Eight records known from the southern section of the SGP, in the vicinity of Lake Broadwater, the most recent from 2013.The species could occur within the SGP Life of Operation, though most likely restricted to this area.	Possible
Stagonopleura guttata Diamond Firetail	Vul	Vul	A range of habitat types including eucalypt woodland, banksia shrubland and cypress forest, provided a grassy understorey is present for foraging.	Suitable habitat present throughout the SGP	Multiple records exist within 50km of the SGP; however, all records have been subjected to rounding and are therefore inaccurate, so it impossible to determine how many actually fall within 50km of the SGP, or within the SGP itself. The most recent records are from 2021 and are all within the vicinity of the block of SF comprised of Kumbarilla, Dunmore and Western Creek SFs.	Possible
Poephila cincta cincta	End	End	Open Eucalypt woodlands and grasslands	Limited	Two undated (likely very old) records relating to an isolated, but now extinct, population centred on the Tablelands of NSW.	Will not occur

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Turnix melanogaster Black-breasted button-quail	Vul	Vul	Leaf litter in drier rainforests, vine thickets, lantana on rainforest edges, hoop pine plantation	None	A single 30y old record from Barakula SF. Also known from state forests north of, but connected to, Barakula SF. No known record from within the SGP.	Will not occur
Mammals						
Chalinolobus dwyeri Large-eared Pied Bat	Vul	Vul	Often observed along ecotones on rainforest edges or in association with sandstone escarpments (DoE 2017).	Largely absent. Only very poor habitat present in minor jump-ups.	A single 30yr old record from Western Creek SF, ~36km S of southern SGP.	Will not occur
Dasyurus hallucatus Northern Quoll	LC	End	Most common in rocky eucalypt woodland and open forest within 200 kilometres of the coast.	Largely absent. Only very poor habitat present in minor jump-ups.	No records within 50km of the SGP.	Will not occur
Dasyurus maculatus maculatus Spotted-tailed quoll	Vul	End	Inhabits a variety of forested habitats including subtropical and temperate rainforests, vine thickets, wet and dry sclerophyll forests, woodland and coastal scrub.	Spot-tailed Quoll populations are typically constrained to contiguous forested areas. Contiguous areas of SF including Barakula SF adjacent the central SGP, and the SF block comprising Kumbarilla, Dunmore and Western Creek SFs adjacent the southern SGP likely provide suitable habitat.	Three records within the SGP and several within 20km of the SGP boundary, however, all records are old (i.e. >40 years), with the exception of a confirmed sighting of an injured animal near Tara within the past 5 years, and a record from 2022 on the Warrego Hwy between Dalby and Oakey. These were likely transient individuals. The current status of this species in the Brigalow Belt is uncertain, and transient individuals may occur throughout the SGP, although this would a rare occasion.	Unlikely

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Macroderma gigas Ghost Bat	End	Vul	Habitats used for foraging vary from dry open woodlands to tropical rainforests (Wilmer 2012).	No suitable roosting structures occur.	No records within 50km of the SGP. Presumed locally extinct in the area.	Will not occur
Nyctophilus corbeni South-eastern long-eared bat	Vul	Vul	Found more commonly in box/ironbark/cypress pine woodland on sandy soils. It also occurs in bulloak (*Allocasuarina luehmannii*), brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*) communities (Turbill and Ellis 2006; Churchill 2008).	Suitable habitat is present within the SGP, particularly in larger contiguus areas associated with Barakula State Forest in the north and Kumbarilla State Forest in the south.	Recorded within the past 10yrs at six locations in central SGP, and a single location in the southern SGP adjacent Kumbarilla SF. Records outside the SGP are >20y old.	Known
Onychogalea frenata Bridled Nailtail Wallaby	End	End	Woodland, especially Brigalow scrub, along with eucalypt woodland and other *Acacia* spp. scrub. Dense shrub, grass and hollow log cover are important for sheltering. Grassland abutting dense woodland and scrub provides important foraging habitat (DCCEEW 2023).	N/A. Species is locally extinct.	Three very old (>80y) records from the Oakey and Milmerran regions. Species now only known from a small number of isolated populations within national parks and nature refuges. Locally extinct.	Will not occur
Petauroides armillatus/volans Greater Glider	End	End	Mainly restricted to eucalypt forests and woodlands where they typically occur in highest abundance in taller, montane, moist eucalypt forests with larger, relatively old trees and abundant hollows (Eyre 2004). In areas west of the Great Dividing Range, they are found in low woodlands (McKay 2008).	Possible habitat present in woodland areas and riparian habitats with *E. tereticornis*	Recorded within central and southern SGP. Scattered records from outside the SGP within the past 30yrs are largely restricted to state forests.	Known

Scientific Name Common Name	Status[#] NCA	 EPBC	Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
Petaurus australis australis Yellow-bellied Glider	Vul	Vul	Contiguous tracts of thousands of hectares comprising tall, mature eucalypt forest, especially dominated by smooth- and gum-barked species with high, deep hollows (Craig 1985; Goldingay and Possingham 1995; Eyre 2007 Goldingay et al. 2018). In southern QLD *E. tereticornis, C. citriodora* and *E. moluccana* are particularly favoured (Eyre 2007)	Possible habitat present in woodland areas and riparian vegetation in larger tracts of contiguous vegetation, in particular vegetation associated with Barakula State Forest in the north and Kumbarilla State Forest in the south.	Not recorded within the SGP. Multiple records within Barakula SF, although all are >20yr old. Sparse records from Gurulmundi and Braemar SFs are ~15yrs old.	Possible
Petrogale penicillata Brush-tailed Rock-wallaby	Vul	Vul	Inhabits rock piles and cliff lines in vegetation ranging from rainforest to dry sclerophyll forests.	None	Two records from ~10km north of Lake Broadwater are likely erroneous as no suitable habitat exists within the vicinity of the records.	Unlikely

Scientific Name Common Name	Status[#]		Typical Habitat	Habitat within the SGP	Local Records	Likelihood Assessment
	NCA	EPBC				
Phascolarctos cinereus Koala	Vul	Vul	Found in a diversity of habitats including temperate, sub-tropical and tropical forest, woodland and semi-arid communities, and sclerophyll forest, on foothills, plains and in coastal areas (Dyck & Stratham 2008). On the western side of the Great Dividing Range at the western edges of their range, the species is often associated with riparian vegetation although are not restricted to them (Melzer et al. 2000; Sullivan et al. 2003).	Eucalypt forest areas throughout the SGP, less likely in the northern SGP area.	>700 records within 50km of SGP. Recorded during surveys, with most records within the SGP confined to the southern portion in association with the Condamine River, Braemar SF, Dalby SF, Kumbarilla SF and Lake Broadwater	Known
Pseudomys australis Plains Rat	End	Vul	Cracking clay depressions and small drainage lines on arid gibber plains, and vast, cracking clay plains (Van Dyck et al 2013).	None	Two very old records (i.e. >100 years) within 50km of the SGP. Presumed locally extinct in the area.	Will not occur
Pteropus poliocephalus Grey-headed flying-fox	LC	Vul	Foraging habitat includes rainforests, open eucalypt forests, woodlands, Melaleuca swamps and Banksia woodlands. Roosts are commonly within dense vegetation close to water, primarily rainforest patches, stands of Melaleuca, mangroves or riparian vegetation (Nelson 1965).	Limited habitat available in riparian corridors with abundant *E. tereticornis*.	Three locations within 50km of SGP, including records from 2011. Individuals are known to occasionally use a seasonal flying-fox camp along Myall Creek in Dalby. The species is a typically a vagrant west of the Great Dividing Range and would be a rare visitor to the SGP.	Unlikely

[#] LC = Least Concern, NT = Near Threatened, Vul = Vulnerable, End = Endangered, CE = Critically Endangered, EX = Extinct, Mig = Migratory

Appendix B
Consolidated 2023 Species Mapping Rules

Consolidated Mapping Rules (alphabetical)

FLORA

Acacia barakulensis

1. The species will only likely occur in the central SGP area.
2. Within the central area of the SGP, REs 11.5.1, 11.5.14, 11.5.21, 11.7.4, 11.7.5, 11.7.6 and 11.7.7 are mapped as 'General Habitat' due to lack of local records.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. Non-remnant and regrowth habitats are mapped as 'Absence Suspected'.

Acacia curranii (Curly-bark Wattle)

1. The species will likely only occur in the central SGP area to the north of Miles.
2. In the absence of survey records within the SGP area, RE 11.7.5, 11.7.4, 11.7.7 in the potential area of occurrences have been allocated as 'General Habitat'.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. All other regional ecosystems, regrowth and cleared areas are mapped as 'Absence Suspected'.

Acacia handonis (Hando's Wattle)

1. Regional Ecosystems 11.7.4, 11.7.5, 11.7.6, 11.7.7 and 11.5.1 in the Central region of the SGP (North of Miles) should be classed as 'General Habitat' on account of the intensive survey undertaken in the SGP.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Non-remnant and regrowth derived from these habitats are mapped as 'Absence Suspected'.

Callitris baileyi (Bailey's Cypress pine)

1. REs 11.5.1, 11.7.4, 11.7.5, 11.7.6 and 11.7.7 in the Gurulmundi area to the north of Chinchilla (-27.75) in the central SGP area should be considered 'General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Other habitats including all regrowth and non-remnant habitats should be assigned to 'Absence Suspected'.

Callitrix gurulmundensis (Gurulmundi Fringe Myrtle)

1. REs 11.5.1, 11.7.4, 11.7.5, 11.7.6 and 11.7.7 in the Gurulmundi area to the north of Chinchilla (-27.75) in the central SGP area should be considered 'General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Other habitats including all regrowth and non-remnant habitats should be assigned to "Absence Suspected

Cryptandra ciliata

1. The species is only likely to occur in the central SGP area where the following REs should be treated as 'General Habitat'; 11.5.1, 11.5.4, 11.5.21, 11.7.4, 11.7.5, 11.7.6 and 11.7.7.
2. All General Habitat within 1 km of a recent (1950+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
3. All other remnant vegetation in the project development area, regrowth vegetation and cleared agricultural land should be treated as 'Absence Suspected'.

Cymbonotus maidenii

1. The species is most likely to occur from the Dalby area (-27.00) south to Millmerran (-27.9) generally on the Condamine Alluvium.
2. RE 11.3.2 , derived regrowth of RE 11.3.2, and associated derived grasslands occurring between in this area should be treated as 'General Habitat'.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. All other remnant vegetation and cleared agricultural land in the SGP should be treated as 'Absence Suspected'.

Digitaria porrecta (Finger Panic Grass)

1. The species is most likely to occur on heavy clay soils associated with the Condamine Alluvium although may occur throughout the entire SGP.
2. Regional Ecosystem 11.3.2 should be treated as 'General Habitat'.
3. Derived native grassland where it is associated with the Condamine Alluvium or other heavy clay soil should be considered 'General Habitat'.
4. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
5. All other remnant vegetation in the project development area and all cleared agricultural and grazing land should be treated as 'Absence Suspected'.

Eucalyptus curtisii (Plunkett Mallee)

1. Eucalyptus curtisii may occur throughout the entire SGP area.
2. Through the SGP, REs 11.7.2, 11.7.4, 11.7.5, 11.7.6 and 11.7.7 should be classified as 'General Habitat' in recognition of the extensive survey effort undertaken.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. All other REs including regrowth and non-remnant vegetation should be classified as 'Absence Suspected'.

Fimbristylis vagans

1. The species may occur throughout the entire SGP.
2. 'Core Habitat Possible' includes the wetland fringe of Lake Broadwater characterised by RE 11.3.27f and wetland habitats of Long Swamp.
3. REs 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.25 and 11.3.26 throughout the SGP are classified as 'General Habitat'.
4. All Core Habitat Possible and General Habitat within 1 km of a recent (1950+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
5. All remaining remnant and non-remnant vegetation is mapped as 'Absence Suspected'.

Homopholis belsonii (Belson's Panic)

1. The species may occur throughout the entire SGP although is most likely to occur in Brigalow associated habitats in the northern SGP area.
2. Regional Ecosystems 11.9.5, 11.9.10 and 11.3.17 including derived non-remnant regrowth is mapped as 'Core Habitat Possible' in the northern SGP area.
3. REs 11.3.1, 11.3.17, 11.4.3 and 11.9.5 including non-remnant derived regrowth in central and southern SGP areas are classified as 'General Habitat'.
4. All Core Habitat Possible and General Habitat within 1 km of a recent (1950+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
5. All remaining remnant and non-remnant vegetation is mapped as 'Absence Suspected'.

Micromyrtus carinata (Gurulmundi Heath-myrtle)

1. REs 11.7.4 and 11.7.5 in the Gurulmundi area to the north of Chinchilla (-27.75) in the central SGP area should be considered 'General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. Other habitats should be assigned to "Absence Suspected. Non-remnant and regrowth derived from these habitats are mapped as 'Absence Suspected'.

Philotheca sporadica (Kogan Waxflower)

1. The species will most likely occur within a 25 km wide buffer surrounding Kogan although cannot be discounted as occurring within suitable habitats throughout the SGP.
2. REs 11.7.4, 11.7.5 and 11.7.7 are classified as "Core habitat Possible" within 25 km from Kogan.
3. Regrowth habits (non-remnant) derived from RE 11.7.4, 11.7.5 and 11.7.7 within 25 km from Kogan are classified as "General Habitat'.
4. All areas of RE 11.5.1 within 25 km from Kogan are classified as 'General Habitat'.
5. All 'Core Habitat Possible' and 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
6. The remaining areas of RE 11.7.4 throughout the SGP are classified as 'General Habitat'
7. All other areas are classified as 'Absence Suspected'.

Picris barbarorum

1. The following REs and habitats should be classified as 'General Habitat' where they are in association with the Condamine Alluvium.
    - RE 11.3.2 and derived regrowth vegetation.
    - Non-remnant derived native grasslands
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other remnant and non-remnant vegetation should be treated as 'Absence Suspected'.

Rutidosis glandulosa

1. The following REs and habitats should be classified as 'General Habitat'. REs 11.9.9 (including regrowth derived from this RE) and 11.5.4 (including derived regrowth).
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All remaining remnant and non-remnant vegetation is mapped as 'Absence suspected'.

Rutidosis lanata

1. The species may occur throughout the entire project area although is more likely north from Chinchilla based on vouchered herbarium records. Throughout the SGP, the following REs should be treated as 'General Habitat'; 11.3.4, 11.3.2, 11.3.17, 11.9.5 and 11.9.7.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other remnant vegetation in the project development area, regrowth vegetation and cleared agricultural land should be treated as 'Absence Suspected'.

Solanum papaverifolium

1. The species is most likely to occur on habitat formed by heavy clay soils associated in particular with the Condamine Alluvium.
2. Regional Ecosystems 11.3.2 and Derived Native Grassland (non-remnant) provide the most suitable habitats for the species. Where these habitats occur on the alluvial landforms to the west and south of Dalby, they are mapped as "General Habitat".
3. All General Habitat within 1km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".
4. All remaining remnant and non-remnant vegetation is mapped as "Absence Suspected".

Solanum stenopterum

1. REs 11.3.2, 11.3.1 and 11.3.17 to the west and south of Dalby should be classed as 'General Habitat' on account of comprehensive surveys.
2. Regrowth vegetation derived from RE 11.3.2, 11.3.1 and 11.3.17 south and west of Dalby are classed as 'General Habitat'.
3. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. All other vegetation is mapped as 'Absence Suspected'.

Thesium australe (Austral Toadflax)

1. Intact representation of Poplar Box dominant woodland (RE 11.3.2) associated with the Condamine River Alluvium (Condamine River Floodplain) should be treated as "General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other REs and non-remnant vegetation (including regrowth) should be treated as 'Absence Suspected'.

Xerothamnella herbacea

1. The species may occur throughout the entire project area where it may be associated with Brigalow dominant habitats 11.3.1, 11.4.3 and 11.9.5. Throughout the SGP these REs and any derived regrowth Brigalow should be treated as 'General Habitat'.
2. All 'General Habitat' within 1 km of a recent (1950+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
3. All other remnant vegetation in the SGP, regrowth vegetation and cleared agricultural land should be treated as 'Absence Suspected'.

FAUNA

Acanthophis antarcticus (Common Death Adder)

1. Potential Death Adder habitat is most likely in contiguous and near-contiguous areas of vegetation (i.e., reduced fragmentation). Potentially important habitat is therefore likely restricted to vegetation within or abutting the 'large tracts remnant veg.shp'. Within this area, all remnant vegetation (irrespective of RE designation) should be classed as 'Core Habitat Possible'.
2. Any remnant vegetation (irrespective of RE designation) outside the 'large tracts remnant veg.shp' is mapped as 'General Habitat'.
3. Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
4. All non-remnant habitats, including regrowth, are mapped as 'Absence Suspected'.

Adclarkia cameroni (Brigalow Woodland Snail)

1. The species could occur anywhere within the SGP.
2. The following regional ecosystems, including derived regrowth, should be mapped as 'Core Habitat Possible': 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.17, 11.3.25, 11.3.27 (all sub-types), 11.4.3, 11.4.3a, 11.9.5, 11.9.7 and 11.9.10.
3. The following regional ecosystems, including derived regrowth, should be mapped as 'General Habitat': 11.3.14, 11.3.18, 11.3.26, 11.5.1, 11.5.1a, and 11.5.20.
4. All 'Core Habitat Possible' and 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
5. All remaining vegetation is mapped as 'Absence suspected'.

Adclarkia dulacca (Dulacca Woodland Snail)

1. The species could occur within the northern and central regions of the SGP, but is not expected to the north of Kogan (latitude -27.06) in the southern SGP area.
2. North of -27.06, any areas of the following REs (including derived regrowth) are mapped as 'Core Habitat Possible': 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5 and 11.9.10.
3. Within the central and northern SGP, any areas of the following REs (including derived regrowth) are mapped as 'General Habitat': 11.5.1, 11.5.1a and 11.9.10.
4. All 'Core Habitat Possible' and 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
5. All remaining vegetation is mapped as 'Absence suspected'.

Aphelocephala leucopsis (Southern Whiteface)

1. It is assumed the species could occur throughout the entire SGP.
2. All remnant and regrowth vegetation of RE 11.3.1, 11.3.2, 11.3.17, 11.4.3, 11.4.3a, 11.5.20, 11.5.26, 11.9.5, 11.9.10 should be mapped as 'General Habitat'.
3. General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known' (as of writing no such areas exist within the SGP).
4. All remaining remnant and non-remnant vegetation (including regrowth) is mapped as 'Absence suspected'.

Calyptorhynchus lathami lathami (Glossy Black Cockatoo)

1. The species could occur throughout the entire SGP.
2. Regional Ecosystems containing Casuarina cristata (11.3.1. 11.3.17, 11.4.3, 11.4.3a, 11.9.5) and Allocasuarina inophloia (11.5.4) are classed as 'Core Habitat Possible'.
3. South of the Warrego Highway areas of RE 11.7.4 may also have Allocasuarina littoralis and should be mapped as 'Core Habitat Possible'.
4. Regrowth of the above REs, which could contain larger trees with suitable foraging resources, are mapped as 'Core Habitat Possible'.
5. Core Habitat Possible within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. All remaining REs and non-remnant vegetation (including regrowth) is mapped as 'Absence Suspected'.

Glyphodon (Furina) dunmalli (Dunmall's Snake)

1. The species could occur throughout the entire SGP.
2. All areas of remnant vegetation with a combined extent >50 ha consisting of the following REs should be classed as 'Core Habitat Possible': 11.3.1, 11.3.17, 11.3.18, 11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.4, 11.7.6, and 11.7.7.
3. Smaller vegetation patches (<50ha) of the above REs may be mapped as 'General Habitat' if they are in close proximity (≤500 m) to areas of 'Core Habitat Possible'.
4. All areas of remnant vegetation with a combined extent >50 ha consisting of the following REs should be classed as 'General Habitat': 11.3.14, 11.5.21, 11.7.2.
5. Advanced regrowth of all the above REs are mapped as 'General Habitat' if they are adjacent (≤500 m) or connect to large areas of 'Core Habitat Possible' or 'General Habitat'.
6. Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
7. Remaining REs, regrowth and non-remnant areas are mapped as 'Absence Suspected'.

Grantiella picta (Painted Honeyeater)

1. The species may occur throughout the entire SGP.
2. REs dominated by Brigalow including 11.3.1, 11.3.17, 11.4.3, 11.4.3a and 11.9.5 (including 'disturbed' communities) are mapped as 'Core Habitat Possible'.
3. Regrowth derived from RE 11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.9.5 (i.e., brigalow regrowth) is mapped as 'Core Habitat Possible'.
4. The above REs and REs 11.5.20 and 11.3. 27a and 11.3.27f are mapped as 'Core Habitat Known' around Lake Broadwater.
5. All remaining areas of RE 11.3.25 and 11.3.27 (including all subtypes) are mapped as 'General Habitat',
6. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
7. All remaining REs and non-remnant (including regrowth) areas are 'Absence Suspected'.

Hemiaspis damelii (Grey Snake)

1. The species could occur throughout the entire SGP.
2. All remnant vegetation where surface water could collect provides potential habitat for these species. In particular, vegetation on Landzones 3, and 4 should be classed as 'Core Habitat Possible' (11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.18, 11.3.25, 11.3.26, 11.3.27, 11.4.3 and 11.4.3a). In addition, the following REs have clay soils, gilgai's or are likely to be subject to temporal ponding and should also be 'Core Habitat Possible'; 11.9.5.
3. Derived Grasslands, which occur in alluvial floodplains in the SGP, are mapped as 'Core Habitat Possible'.
4. Larger contiguous areas of REs 11.5.1, 11.5.1a, 11.5.20, and 11.5.21, or where these are immediately adjacent Core Habitat Possible, are included as 'General Habitat'.
5. Artificial waterbodies are mapped as 'General Habitat'.
6. All remnant vegetation, non-remnant vegetation, regrowth or grazing land (but not tilled land, tracks or cultivated land) within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
7. Regrowth be classed according to its parent regional ecosystem.
8. Tilled crops, tracks and cultivated land (i.e., areas with frequently surface disturbed) are mapped as 'Absence Suspected'.

Hirundapus caudacutus (White-throated Needletail)

No Rules

Jalmenus eubulus (Pale Imperial Hairstreak)

1. The species may occur throughout the SGP area.
2. Within the SGP all remnant Brigalow (11.3.1, 11.3.17, 11.4.3 11.4.3a, 11.9.5) is classed as 'Core Habitat Possible'.
3. All 'Core Habitat Possible' within 1 km of a recent (1975+), accurate (≤500 m) record is reclassified as 'Core Habitat Known'.
4. The remaining REs, regrowth and non-remnant areas are classed as 'Absence Suspected'.

Nyctophilus corbeni (South-eastern Long-eared Bat)

1. Potential South-eastern Long-eared Bat habitat is restricted to contiguous or near-contiguous areas of vegetation (i.e., reduced fragmentation). Within the SGP, potentially important habitat is restricted to vegetation within or abutting the 'large tracts remnant veg.shp'.
2. Within the area defined in step 1 above, REs 11.3.1, 11.3.14, 11.3.18, 11.4.3, 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.21, 11.7.4, 11.7.7, 11.9.5 and 11.9.10 are mapped as 'Core Habitat Possible'.
3. Within the area defined in step 1 above, REs 11.3.25, 11.3.27, 11.5.20, 11.7.2 and 11.7.6 are mapped as 'General Habitat'.
4. Within the designated area in step 1, isolated patches (>500 m from any other remnant vegetation) of the REs listed in step 2 above are reclassed as 'General Habitat'.
5. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. All remaining remnant and non-remnant vegetation, including regrowth, is mapped as 'Absence Suspected'.

Petauroides volans sensu lato (Greater Glider)

1. The species may occur throughout the entire SGP.
2. Mapped habitat (core habitat possible or general habitat) is restricted to remnant vegetation patches with an accumulative size >10 ha (i.e., entire extent, regardless of RE types, and ignoring non-remnant gaps of less than 150 m).
3. Within combined patches > 10 ha, 'Core Habitat Possible' includes REs 11.3.4, 11.3.14, 11.3.21, 11.3.25, 11.3.26, 11.3.27 (including all subtypes), 11.5.1, 11.5.4, 11.5.20, 11.5.21, 11.7.4, 11.7.6, 11.7.7, 11.9.2 and 11.9.7.
4. Within combined patches > 10 ha, Polygons of REs 11.3.2 and 11.3.3, immediately adjacent Core Habitat Possible are mapped as 'General Habitat'.
5. All Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. All regrowth and other non-remnant habitats are mapped as 'Absence Suspected'.

Petaurus australis australis (Yellow-bellied Glider)

1. Potential Yellow-bellied Glider habitat is restricted to contiguous or near-contiguous areas of vegetation (i.e., reduced fragmentation). Within the SGP, potentially important habitat is restricted to vegetation within or abutting the 'large tracts remnant veg.shp'.
2. Within the above area, REs 11.3.4, 11.3.25, 11.3.26, 11.5.1, 11.5.4, 11.5.20, 11.5.21, 11.7.4, 11.7.6 and 11.7.7 are mapped as 'Core Habitat Possible'.
3. RE 11.5.4 and 11.9.2 can be structurally similar to the above REs (forest) but lack known tree associations; within the area defined in step 1 above these REs are mapped as 'General Habitat'.
4. Within the designated area in step 1, isolated patches (>400 m from any other remnant vegetation) of the REs listed in step 2 and 3 above are mapped as 'General Habitat'.
5. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. Remaining areas of remnant, non-remnant and regrowth vegetation is 'Absence suspected'.

Phascolarctos cinereus (Koala)

1. The species may occur throughout the entire SGP.
2. All remnant and regrowth REs except 11.9.5 are mapped as 'Core Habitat Possible'.
3. All Core Habitat Possible within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.

Rostratula australis (Australian Painted Snipe)

1. Lake Broadwater (RE 11.3.27c and 11.3.27f) is mapped as 'Core Habitat Known'.
2. Long Swamp (RE 11.3.27d and 11.3.27f) is mapped as "Core Habitat Possible'.
3. Core Habitat Possible within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
4. All remaining REs and non-remnant vegetation (including regrowth) is mapped as 'Absence Suspected'

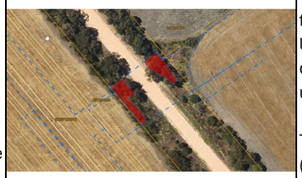
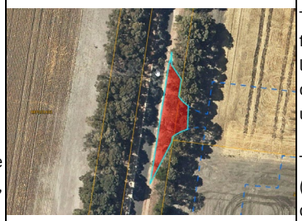
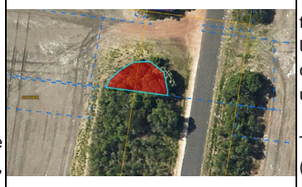
Stagonopleura guttata (Diamond Firetail)

1. The species may occur throughout the entire SGP, but is considered less likely to persist in combined patches <200ha (where a combined patch includes all remnant vegetation types and ignores non-remnant gaps <200 m wide).
2. All remnant REs within the SGP except 11.7.5 and 11.7.2, with a combined remnant patch size (irrespective of RE designation) greater than 200 ha is 'Core Habitat Possible'.
3. All remnant REs within the SGP except 11.7.5 and 11.7.2, with a combined remnant patch size (irrespective of RE designation) less than 200 ha but within 500 m of core habitat possible is 'General Habitat'.
4. All regrowth of the above REs with a combined patch size greater than 200 ha is 'General Habitat'.
5. All 'Core Habitat Possible' or 'General Habitat' within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. Remaining isolated areas of remnant and non-remnant vegetation (including regrowth) are mapped as 'Absence Suspected'.

Strophurus taenicauda (Golden-tailed Gecko)

1. The species may occur throughout the entire SGP area.
2. Within the SGP, REs 11.3.1, 11.3.14, 11.3.17, 11.3.18, 11.4.3 11.4.3a, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.5.21, 11.3.26, 11.7.4, 11.7.6, 11.7.7, 11.9.5, 11.9.7, 11.9.10 are mapped as 'Core Habitat Possible'.
3. Within the SGP, REs 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.7.2, 11.7.5 and 11.9.2 are mapped as 'General Habitat'.
4. All areas of advanced regrowth (10+ yrs) should be treated as remnant vegetation and classed accordingly.
5. Core Habitat Possible and General Habitat within 1 km of a recent (1975+), accurate (≤500 m) record is classed as 'Core Habitat Known'.
6. Habitat patches <5ha and greater than 200 m in distance from other remnant vegetation (i.e., isolated) are downgraded to 'Absence Suspected'.
7. 'Core Habitat Possible' (as identified in the steps above) between 5ha and 10ha in size and more than 200 m in distance from other remnant vegetation (i.e., isolated) is downgraded to 'General Habitat'.
8. 'General Habitat' (as identified in the steps above) between 5ha and 10ha in extent and more than 200 m in distance from other remnant vegetation (i.e., isolated) is downgraded to 'Absence suspected'.
9. Remaining regrowth and REs are classed as 'Absence Suspected'.

Appendix F: Breakdown of Impacts to RE 11.3.1 Regrowth

Project Name	Geographic coordinates (GDA2020)	Regional Ecosystem	Vegetation Community Definition	Impacted Area (ha)	Description of Existing Environment	Location view	ESA Criteria Remnant vegetation within urban or industrial areas may only be considered for delineation if it meets the minimum thresholds of 1 hectare in area and/or 35 metres in width[1] [1]Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Richter, D., Addicott, E.P. and Appelman, C.N. (2023) Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 7.0. Updated December 2023. Queensland Herbarium, Queensland Department of Environment, Science and Innovation, Brisbane	ESA
Daandine Nandi Rd	56J 313628 6992499	11.3.1	Regrowth	0.04	A narrow, fragmented patch of vegetation—measuring approximately 0.5 hectares and averaging 20 metres in width—extends along the road reserve. The area is characterised by a range of disturbance features, including soil compaction, weed invasion, and evidence of previous clearing activities, which have altered the natural structure and composition of the vegetation. Within the disturbed sections of this patch, no individuals of Acacia harpophylla were observed. However, A. harpophylla are present to the southeast. The impact area does not overlap with any government mapped regulated vegetation, Category A, B, or C, so the Protected Wildlife Habitat (PWH) ESA CAT C restriction does not apply to this site. Although these areas are not classified as ESA CAT B or PWH CAT C ESA, they can still provide habitat for protected wildlife species and, as such, must be accounted for and offset appropriately.		This vegetation patch falls well below both thresholds, being highly fragmented and significantly narrower than the required width. Given these limitations, and considering the level of disturbance observed, this patch does not qualify as remnant vegetation or Essential Sensitive Area (ESA) under the defined criteria and should not be mapped as such. This disturbance has been accounted for in the Significant Residual Impact (SRI) Assessment, and offsets will be provided accordingly. As it is not defined as an ESA, there is no despite required in Schedule D, Table 4.	None
Duleen Kupunn Part 3	56J 313864 6985532	11.3.1	Regrowth	0.03	A narrow, fragmented patch of vegetation—measuring approximately 0.2 hectares and averaging 7 metres in width—extends along the road reserve. The area is characterised by a range of disturbance features, including soil compaction, weed invasion, and evidence of previous clearing activities, which have altered the natural structure and composition of the vegetation. The impact area does not overlap with any government mapped regulated vegetation, Category A, B, or C, so the Protected Wildlife Habitat (PWH) ESA CAT C restriction does not apply to this site. Although these areas are not classified as ESA CAT B or PWH CAT C ESA, they can still provide habitat for protected wildlife species and, as such, must be accounted for and offset appropriately.		This vegetation patch falls well below both thresholds, being highly fragmented and significantly narrower than the required width. Given these limitations, and considering the level of disturbance observed, this patch does not qualify as remnant vegetation or Essential Sensitive Area (ESA) under the defined criteria and should not be mapped as such. This disturbance has been accounted for in the Significant Residual Impact (SRI) Assessment, and offsets will be provided accordingly. As it is not defined as an ESA, there is no despite required in Schedule D, Table 4.	None
Duleen Kupunn Part 3	56J 313800 6985217	11.3.1	Regrowth	0.04	A narrow, fragmented patch of vegetation—measuring approximately 0.7 hectares and averaging 10 metres in width—extends along the road reserve. The area is characterised by a range of disturbance features, including soil compaction, weed invasion, and evidence of previous clearing activities, which have altered the natural structure and composition of the vegetation. The impact area does not overlap with any government mapped regulated vegetation, Category A, B, or C, so the Protected Wildlife Habitat (PWH) ESA CAT C restriction does not apply to this site. Although these areas are not classified as ESA CAT B or PWH CAT C ESA, they can still provide habitat for protected wildlife species and, as such, must be accounted for and offset appropriately.		This vegetation patch falls well below both thresholds, being highly fragmented and significantly narrower than the required width. Given these limitations, and considering the level of disturbance observed, this patch does not qualify as remnant vegetation or Essential Sensitive Area (ESA) under the defined criteria and should not be mapped as such. This disturbance has been accounted for in the Significant Residual Impact (SRI) Assessment, and offsets will be provided accordingly. As it is not defined as an ESA, there is no despite required in Schedule D, Table 4.	None
Duleen Kupunn Part 3	56J 313791 6985172	11.3.1	Regrowth	0.01	A narrow, fragmented patch of vegetation—measuring approximately 0.4 hectares and averaging 16 metres in width—extends along the road reserve. The area is characterised by a range of disturbance features, including soil compaction, weed invasion, and evidence of previous clearing activities, which have altered the natural structure and composition of the vegetation. The impact area does not overlap with any government mapped regulated vegetation, Category A, B, or C, so the Protected Wildlife Habitat (PWH) ESA CAT C restriction does not apply to this site. Although these areas are not classified as ESA CAT B or PWH CAT C ESA, they can still provide habitat for protected wildlife species and, as such, must be accounted for and offset appropriately.		This vegetation patch falls well below both thresholds, being highly fragmented and significantly narrower than the required width. Given these limitations, and considering the level of disturbance observed, this patch does not qualify as remnant vegetation or Essential Sensitive Area (ESA) under the defined criteria and should not be mapped as such. This disturbance has been accounted for in the Significant Residual Impact (SRI) Assessment, and offsets will be provided accordingly. As it is not defined as an ESA, there is no despite required in Schedule D, Table 4.	None
Duleen Kupunn Part 3	56J 312315 6991407	11.3.1	Regrowth	0.03	A narrow, fragmented patch of vegetation—measuring approximately 0.8 hectares and averaging 25 metres in width, between a Cultivated land. The area is characterised by a range of disturbance features, including soil compaction, weed invasion, and evidence of previous clearing activities, which have altered the natural structure and composition of the vegetation. The impact area does not overlap with any government mapped regulated vegetation, Category A, B, or C, so the Protected Wildlife Habitat (PWH) ESA CAT C restriction does not apply to this site. Although these areas are not classified as ESA CAT B or PWH CAT C ESA, they can still provide habitat for protected wildlife species and, as such, must be accounted for and offset appropriately.		This vegetation patch falls well below both thresholds, being highly fragmented and significantly narrower than the required width. Given these limitations, and considering the level of disturbance observed, this patch does not qualify as remnant vegetation or Essential Sensitive Area (ESA) under the defined criteria and should not be mapped as such. This disturbance has been accounted for in the Significant Residual Impact (SRI) Assessment, and offsets will be provided accordingly. As it is not defined as an ESA, there is no despite required in Schedule D, Table 4.	None

Duleen Kupunn Part 3	56J 313275 6991421	11.3.1	Regrowth	0.05	The proposed disturbed area is within a fragmented patch of vegetation totaling 8 hectares. The widest part of the patch is approximately 75 meters, and the narrowest is 12 meters. The impact area does not overlap with any government mapped regulated vegetation, Category A, B, or C, so the Protected Wildlife Habitat (PWH) ESA CAT C restriction does not apply to this site. Field survey has established it meets the criteria to be considered ESA CAT B, and disturbance at this location requires authorisation through the despite table. The area could be habitat for protected wildlife species and, as such, must be accounted for and offset appropriately.		This vegetation does qualify as an Essential Sensitive Area (ESA) under the defined criteria, and a despite has been included in Schedule D, Table 4. This disturbance has also been accounted for in the Significant Residual Impact (SRI) Assessment, and offsets will be provided accordingly.	ESA CAT B
Total				0.21				