

Jammat Pipelines (PPL2047) Environmental Authority (EA0002166)

EA Amendment Application Supporting Report

February 2025

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1 Introduction 6

2 Scope..... 7

 2.1 Existing and proposed disturbance 7

3 Proposed Amendments..... 9

 3.1 Authorised petroleum activities..... 9

3.1.1 Existing Condition..... **9**

3.1.2 Proposed Variation **9**

3.1.3 Rationale **10**

 3.2 Environmentally sensitive areas..... 10

3.2.1 Existing Condition..... **10**

3.2.2 Proposed Variation **10**

3.2.3 Rationale **12**

 3.3 Schedule C – Operating standards 13

3.3.1 Existing Condition..... **13**

3.3.2 Proposed Addition/Variation..... **13**

3.3.3 Rationale **13**

 3.4 Fauna Management 13

3.4.1 Existing Condition..... **13**

3.4.2 Proposed Variation **13**

3.4.3 Rationale **13**

 3.5 PPSCE 10 to PPSCE 12 – Blasting 14

3.5.1 Existing Conditions..... **14**

3.5.2 Proposed Variation **14**

3.5.3 Rationale **14**

 3.6 PPSCF 4 Final acceptance criteria for rehabilitation 15

3.6.1 Existing Condition..... **15**

3.6.2 Proposed Variation **15**

3.6.3 Rationale **16**

4 Methodology..... 17

 4.1 Desktop assessment 17

4.1.1 Likelihood of Occurrence Matrix **18**

 4.2 Field-based assessment..... 18

4.2.1 Flora survey effort..... **18**

4.2.2 Fauna survey effort..... **18**

5 Description of Environmental values 26

 5.1 Description of environmental values – general 26

5.1.1 Environmentally Sensitive Areas..... **26**



5.2 Description of environmental values – terrestrial flora 41

5.2.1 Vegetation communities 41

5.2.2 Conservation-significant flora 47

5.2.3 Protected plants trigger map 47

5.3 Description of environmental values – terrestrial fauna 53

5.3.1 Habitat types and condition 53

5.3.2 Watercourses 56

5.3.3 Wetlands 56

5.3.4 State Forests 56

5.3.5 Conservation-significant fauna 56

5.3.6 Near Threatened fauna species 77

5.3.7 Essential habitat mapping 77

6 Impact Assessment 84

 6.1 Planning and design 84

6.1.1 Co-location 84

6.1.2 Waterway crossing methodologies 84

 6.2 Overview of impacts 85

6.2.1 Vegetation clearing 85

6.2.2 Habitat fragmentation and landscape connectivity 86

6.2.3 Impacts to hollow-bearing trees 86

6.2.4 Indirect impacts 87

 6.3 Impacts on State Forests 87

 6.4 Impacts on terrestrial flora values 87

6.4.1 Impacts on conservation significant flora species 87

6.4.2 Endangered REs by VM Class 87

6.4.3 Of Concern REs by VM Class 87

6.4.4 Impacts on watercourse vegetation 87

 6.5 Impacts on terrestrial fauna values 87

6.5.1 Impacts on habitat for endangered fauna species 89

6.5.2 Impacts on habitat for vulnerable fauna species 101

6.5.3 Impacts on habitat for Special Least Concern species 112

6.5.4 Impacts on mapped essential habitat 114

6.5.5 Impacts to fish passage 114

7 Conclusion 117

Appendix A. Legislative requirements 118

 Assessment level decision 118

 Amendment application requirements 122

 Great Barrier Reef Catchments 127

 Public notification 127



Appendix B. Attexo Biodiversity Impact Assessment Report, February 2025..... 128

Appendix C. CHEC Project Environmental Clearance (PEC) Report, January 2025..... 129

Appendix D. Draft EA Conditions 130

Definitions..... 143

Figure 2-1 Jammatt Pipeline overview 8

Figure 4-1 Supplementary survey efforts 22

Figure 5-1: Ecological context 28

Figure 5-2: Environmentally Sensitive Areas (Category B) 29

Figure 5-3: Environmentally Sensitive Areas (Category C)..... 33

Figure 5-4: Environmentally Sensitive Areas (Category C) – protected wildlife habitat..... 37

Figure 5-5: State RE Mapping..... 42

Figure 5-6: Ground-truthed Regional Ecosystem mapping 48

Figure 5-7: Conservation significant flora species records 52

Figure 5-8: Conservation-significant fauna records that are known likely to occur in the Study area 60

Figure 5-9: Conservation-significant fauna records (birds) 63

Figure 5-10: Conservation-significant fauna records (invertebrates)..... 67

Figure 5-11: Conservation-significant fauna records (mammals)..... 73

Figure 5-12: Conservation significant fauna records (reptiles)..... 79

Figure 5-13: Essential Habitat mapping 83

Table 4-1: Summary of Ecological Surveys conducted either within the Study area or in the broader vicinity 18

Table 4-2: Summary of main survey effort 20

Table 4-3: Supplementary fauna survey effort 21

Table 5-1: Jammatt Environmentally Sensitive Areas 26

Table 5-2: State Regional Ecosystem mapping by VM Act Status 41

Table 5-3: Ground-truthed Regional Ecosystems by Biodiversity Status..... 46

Table 5-4: Summary of fauna species known or likely to occur in the Study area 58

Table 6-1: Vegetation clearing for the pipeline footprint by RE type..... 85

Table 6-2: Summary of the Project impacts on protected wildlife habitat 88

Table 6-3: Significant Residual Impact Assessment for the Endangered Brigalow Woodland Snail 89



Table 6-4: Significant Residual Impact Assessment for the Endangered Greater Glider..... 92

Table 6-5: Significant Residual Impact Assessment for the Endangered Koala..... 95

Table 6-6: Significant Residual Impact Assessment for the Endangered Grey Snake..... 98

Table 6-7: Significant Residual Impact Assessment for the Vulnerable Dunmall’s snake 101

Table 6-8: Significant Residual Impact Assessment for the Vulnerable Glossy Black-cockatoo..... 104

Table 6-9: Significant Residual Impact Assessment for the Vulnerable diamond firetail..... 107

Table 6-10: Assessment of significant residual impacts for the Vulnerable white-throated needletail 109

Table 6-11: Significant Residual Impact Assessment for the Special Least Concern short-beaked echidna
..... 112

Table 6-12: Significant Residual Impact Assessment for impacts to fish passage 115

Table 7-1 - Assessment against Ch 5, Pt 7, Div 2 of the Environmental Protection Act 1994 122

Table 7-2 – Standard Criteria (EP Act)..... 125

1 Introduction

Under Section 224 of the *Environmental Protection Act 1994* (EP Act), the holder of an environmental authority (EA) may, at any time, apply to the administering authority to amend the EA (i.e., submit an *amendment application*).

The purpose of this report is to provide sufficient information to enable the Department of Environment, Tourism, Science and Innovation (DETSI) to decide on the application to amend the Jammatt Pipelines (PPL2047) EA (EA0002166).

Arrow CSG Australia Pty Ltd (Arrow) believes that the amendment application does not significantly increase the level of environmental harm caused by a relevant activity. Arrow believes that the authorisation to construct and operate the PPL has been approved subsequently and that the proposed amendment does not seek to increase the level of disturbance proposed or authorised and meets the criteria for a minor amendment (threshold). Instead, the application proposes to correctly reflect the impacts on prescribed environmental matters (PEMs) based on the already approved PPL and EA.

The pipeline route, the subject of the original application was preliminary and subject to further detailed design work. The route has undergone further design work and the route is now at Final Layout Approved (FLA). This certainty of the route has enabled Arrow to finalise impact to environmental values in general and to MSES in particular. In fact, there is a reduction in disturbance with the existing approved RoW being 40m in width and the disturbance associated with the PEMS linked to a 30m RoW for 9.5km (produced water and gas), and a further reduced RoW being 20m for the produced water pipeline. As such, Arrow believes the scale and intensity has reduced by 30% of the previously authorised disturbance that was based on a 40m RoW.

Details of the assessments of environmental matters included in this report are provided in Section 5.

This amendment proposes changes to Table 2 Protecting biodiversity values— ‘Significant residual impacts to prescribed environmental matters’ of the EA as outlined in Section 3 and authorisation in Environmentally Sensitive Areas (ESAs).

During the recent assessment of Significant Residual Impacts (SRI) for Jammatt Pipelines (PPL2047) (hereafter ‘the Project’), using recently acquired verification data, it was identified that matters 1 to 13 are not currently included within Table 2 Protecting biodiversity values – ‘Significant residual impacts to prescribed environmental matters’ within EA0002166. To enable offsets to be appropriately assessed for the proposed disturbance during construction of the Project, the relevant PEMs need to be included within this table. A copy of the Significant Residual Impact Assessment is provided in Appendix B.

A notice of election has not been included as part of the application and will be submitted subject to approval and confirmation of the SRI assessment and required PEMS to be offset under the *Environmental Offsets Act 2014* (EO Act). Arrow will provide a financial offset to offset any matters.

The offsets will not be staged.

This EA amendment application report has been developed and structured in accordance with the relevant provisions of the EP Act and DETSI guideline *Major and minor amendments* (ESR/2015/1684, Version 11.02, 11 June 2024 (hereafter ‘DETSI Guideline’).

2 Scope

The scope of the proposed works for the Project has not changed to the application which was submitted and approved by DETSI on 6 November 2019. The current EA0002166 which was issued on 16 April 2020 already authorises the construction and operation of two 9.5 km produced gas and one 12.5 km produced water pipeline, access tracks, Inlet Processing Facility (IPF) and incidental activities required to transfer produced gas and water in support of Arrow's Surat Gas Project (SGP) in the vicinity of the Jammatt Field Compression Station (FCS) and Kenya East pond (see Figure 2-1) located and authorised under QGC Pty Limited Environmental Authority EPPG00889613. The pipeline route, the subject of the original application, was preliminary and subject to further design work. The route has undergone further design work and the route is now FLA. This certainty of the route has enabled Arrow to finalise impact to environmental values in general and to MSES in particular.

This pipeline was also assessed and approved as part of the EPBC referral 2018/8223. As noted in the original application, Matters of National Environmental Significance (MNES) have been prescribed and will be offset in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Species Impact Management and Offset Plans, specifically the EPBC approval for the Surat Gas Project Off-tenure Pipelines and Associated Infrastructure (EPBC 2018/8223). However, it is the residual impacts to State PEMs which this application explicitly seeks.

2.1 Existing and proposed disturbance

Arrow can confirm that no disturbance has occurred under this EA to date.

3 Proposed Amendments

Arrow has reviewed the Eligibility Criteria and standard conditions for Petroleum pipeline activities and can comply with all the stated eligibility criteria. However, Arrow proposes to vary the following standard petroleum pipeline conditions:

- PPSCA 1 (S);
- PPSCA 3;
- PPSCC1 (S) and PPSCC2 (S);
- PPSCE 7 (S);
- PPSCE 10 (S);
- PPSCE 11 (S);
- PPSCE 12 (S); and
- PPSCF 4.

The Tables and information below describe the proposed changes to the EA0002166, which is required to carry out the proposed pipeline.

3.1 Authorised petroleum activities

Variation to the EA to include an authorised activity table in Schedule A – Authorised Activities.

3.1.1 Existing Condition

PPSCA 1 (S)	All reasonable steps must be taken to ensure the petroleum activities comply with the eligibility criteria for the activity.
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3.1.2 Proposed Variation

Variation 1	<p>The environmental authority authorises the carrying out of petroleum activities listed in Table 1 – Authorised petroleum activities to the extent they are carried out in accordance with the activity’s corresponding scale and location.</p> <p>Table 1 – Authorised petroleum activities</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Authorised petroleum activity</th> <th colspan="2">Scale</th> <th rowspan="2">Maximum disturbance (ha)</th> </tr> <tr> <th>Maximum size</th> <th>Location</th> </tr> </thead> <tbody> <tr> <td>Jammat pipeline</td> <td>9.5km long gas, 12.5km long produced water, 30m wide</td> <td>PPL 2047 and according to Jammat EA0002166 spatial data</td> <td>33.5</td> </tr> <tr> <td>Workspaces/laydowns</td> <td>N/A</td> <td>EA0002166</td> <td>1.0</td> </tr> </tbody> </table>			Authorised petroleum activity	Scale		Maximum disturbance (ha)	Maximum size	Location	Jammat pipeline	9.5km long gas, 12.5km long produced water, 30m wide	PPL 2047 and according to Jammat EA0002166 spatial data	33.5	Workspaces/laydowns	N/A	EA0002166	1.0
Authorised petroleum activity	Scale		Maximum disturbance (ha)														
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Workspaces/laydowns	N/A	EA0002166	1.0														

	Inlet Processing Facility (IPF)	2	<i>_surveycorridor_181224</i>	9
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3.1.3 Rationale

The provision of the above table clearly articulates what activities are permitted under this EA. The original application submitted contemplated and authorised a single IPF however, as there was no authorised activity table it is not clear that is the case. As such as part of this application is to clearly show through the inclusion of the authorised activity table that an IPF was authorised. The preexisting authorisation of an IPF is consistent and supported with the inclusion of the existing flaring conditions in Variation 21 and Variation 22.

As part of optimizing field development, Arrow are proposing to construct a second IPF at the same location, which will be compliant with the existing conditions under EA0002166. The second IPF would be a duplicate of the first Jammam IPF facility. The IPF provides basic gas conditioning prior to export to the downstream QGC plant at the Jammam FCS authorised under QGCs EA. The IPF comprises filtration to remove solids carried with the gas, a slugcatcher and associated tank and pump to handle any water slugs received from the wellfield. The (vertical) flare an additional flare would be required for the second IPF (flaring is approved under the existing EA) handles distressed gas from the wellfield during short-lived plant trip events. Supporting utility systems include a small instrument air package and a power generator. The generator is of comparable capacity to a wellhead unit. Arrow will maintain compliance with the existing EA for operational activities associated with the two IPFs and supporting infrastructure.

3.2 Environmentally sensitive areas

3.2.1 Existing Condition

PPSCA 3 (S)	Only low impact petroleum activities can be undertaken within Category A Environmentally Sensitive Areas (ESAs), or Category B ESAs or Category C ESAs other than state forests or timber reserves, or within the ESAs' primary protection zone.
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3.2.2 Proposed Variation

It is proposed to delete PPSCA 3 and replace it with the following conditions.

Variation 2	The only impacts permitted within Category B ESAs primary protection zone, or secondary protection zone, ESAs or Category C ESAs, or primary protection zones, within the boundary of the spatial data <i>EA0002166_surveycorridor_181224</i> .
Variation 3	Spatial records must be kept for the life of the environmental authority that are sufficient to demonstrate compliance with the following conditions: a) Condition (Variation 2) relating to ESA and PPZ impacts within the pipeline footprint; b) Condition (Variation 7) relating to prescribed environmental matters impacts; c) Condition (Variation 8) relating to record keeping of prescribed environmental matters impacts. For clarity, this includes mapped biodiversity values, confirmed on-the-ground biodiversity values (including key habitat features), location of the activity, environmentally sensitive areas and their protection zones, prescribed environmental matters and impacts to prescribed environmental matters.
Variation 4	For conditions (Variation 5) to (Variation 6), where mapped biodiversity values differ from those confirmed under condition (PPSCD 3), petroleum activities may proceed in

	accordance with the conditions of the environmental authority based on the confirmed on-the-ground biodiversity values.																								
Variation 5	The location of the petroleum activity(ies) must be selected in accordance with the following site planning principles: (a) maximise the use of areas of pre-existing disturbance; (b) in order of preference, avoid, minimise or mitigate any impacts, including cumulative impacts, on areas of native vegetation or other areas of ecological value; (c) minimise disturbance to land that may result in land degradation; (d) in order of preference, avoid then minimise isolation, fragmentation, edge effects or dissection of tracts of native vegetation; and (e) in order of preference, avoid then minimise clearing of native mature trees																								
Variation 6	A report must be prepared for each annual return period for all petroleum activities that involved clearing of any environmentally sensitive area or protection zone which includes: a. <u>records able to demonstrate compliance with conditions (PPSCD 2) and (Variation 1) to (Variation 5) inclusive;</u> b. <u>a description of the works;</u> c. <u>a description of the area and its pre-disturbance values (which may include maps or photographs, but must include GPS coordinates for the works); and</u> d. <u>based on the extent of environmentally sensitive areas and primary protection zones on the relevant resource authority(ies), the proportion of native vegetation cleared per environmentally sensitive area and primary protection zone, including regional ecosystem type, over the annual return period.</u>																								
Variation 7 (SMC Biodiversity 10)	<p>Prescribed Environmental Matters – Matters of State Environmental Significance</p> <p>Impacts to Prescribed Environmental Matters (PEMs) are only authorised for the total area of impact listed in Table 2 - Authorised impacts to Prescribed Environmental Matters.</p> <p>The location of impacts in Table 2 - Authorised impacts to Prescribed Environmental Matters must remain within the boundary of the spatial data EA0002166_surveycoridor_181224.</p> <p>Table 2—Significant residual impacts to prescribed environmental matters.</p> <table border="1"> <thead> <tr> <th><u>Prescribed environmental matters</u></th> <th><u>Significant residual impact and Offset Required</u></th> <th><u>Total maximum area of impact (ha)</u></th> </tr> </thead> <tbody> <tr> <td colspan="3">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</td> </tr> <tr> <td>RE 11.3.25 (16a)</td> <td>Yes</td> <td>0.5</td> </tr> <tr> <td colspan="3">Connectivity areas</td> </tr> <tr> <td>Landscape Fragmentation and Connectivity Tool</td> <td>Yes</td> <td>17.9</td> </tr> <tr> <td colspan="3">Habitat for an animal that is endangered wildlife</td> </tr> <tr> <td>Brigalow Woodland Snail, <i>Adclarkia cameroni</i></td> <td>Yes</td> <td>1.3</td> </tr> <tr> <td>Koala, <i>Phascolarctos cinereus</i>¹</td> <td>Yes</td> <td>16.1</td> </tr> </tbody> </table>	<u>Prescribed environmental matters</u>	<u>Significant residual impact and Offset Required</u>	<u>Total maximum area of impact (ha)</u>	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 11.3.25 (16a)	Yes	0.5	Connectivity areas			Landscape Fragmentation and Connectivity Tool	Yes	17.9	Habitat for an animal that is endangered wildlife			Brigalow Woodland Snail, <i>Adclarkia cameroni</i>	Yes	1.3	Koala, <i>Phascolarctos cinereus</i> ¹	Yes	16.1
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Koala, <i>Phascolarctos cinereus</i> ¹	Yes	16.1																							

	Greater Glider, <i>Petauroides volans</i>	Yes	1.3
	Habitat for an animal that is vulnerable wildlife		
	Glossy Black-cockatoo, <i>Calyptorhynchus lathami lathami</i>	Yes	0.9
	Diamond Firetail, <i>Stagonopleura guttata</i>	Yes	9.3
	Waterway providing for fish passage		
	Fish passage (not in an urban area) – to be surveyed before ground disturbance	Yes	0.1
Variation 8 (SMC Biodiversity 11)	Records demonstrating compliance with Variation 7 must be: (a) completed by a suitably qualified person; and (b) kept for the life of the environmental authority.		
Variation 9 (SMC Biodiversity 12)	<p><u>An environmental offset made in accordance with the <i>Environmental Offsets Act 2014</i> and <i>Queensland Environmental Offsets Policy</i>, as amended from time to time, must be undertaken for the maximum extent of impact to each prescribed environmental matter with an offset required as identified in Table 2 – Authorised impacts to Prescribed Environmental Matters unless the administering authority confirms that the impact to the prescribed environmental matter is as follows:</u></p> <ul style="list-style-type: none"> a. <u>the same, or substantially the same, impact; and</u> b. <u>the same, or substantially the same, prescribed environmental matter; and</u> c. <u>has been assessed under a relevant Commonwealth Act.</u> 		
Variation 10	The notice of election for the environmental offset if applicable, must be provided to the administering authority no less than three months before the proposed commencement of the significant residual impacts for which the environmental offset is required, unless a lesser timeframe has been agreed to in writing by the administering authority.		

3.2.3 Rationale

While Arrow has optimised design to avoid impacts to environmental values, the construction of the proposed pipelines will result in disturbance including to PEMs and ESAs.

Assessment undertaken by a third-party ecologist (Attexo) has identified that SRIs are likely to occur to PEMs with the scale of the impacts identified in proposed condition Variation 7 (above). These have been calculated based on an indicative infrastructure layout which considered the most accurate available information at the time of assessment.

Section 6 describes the different disturbance widths allocated to this EA. The proposed Variation Conditions provide necessary operational flexibility (to account for landholder requirements, site access conditions etc.) whereby the nominated disturbance width is limited to occur within the 40m surveyed corridor referenced in the conditions and defined in spatial data which accompanies this application as *EA0002166_surveycoridor_181224*.

The proposed variations to the standard EA conditions for pipelines enables the EA to authorise the disturbance to identified ESAs. The potential for any further disturbance will be limited by defining an upper limit to the area of disturbance (Table 1- Authorised petroleum activities). Despite flexibility for placement of infrastructure within the 40m survey corridor, allowances for PEMs impacts will not be exceeded without further amendment.

3.3 Schedule C – Operating standards

An addition to the EA to include reporting and administrative improvement.

3.3.1 Existing Condition

PPSCC 1 (S)	All plans, procedures and reports must: (a) be certified by a suitably qualified person (b) be kept on record for a minimum of 5 years.
PPSCC 2 (S)	All plans and procedures required to be developed must be implemented.

3.3.2 Proposed Addition/Variation

Variation 11	All documents required to be prepared, held or kept under this environmental authority must be provided to the administering authority upon written request within the requested timeframe.
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3.3.3 Rationale

The proposed addition of Variation 14 aligns with other Arrow EAs.

3.4 Fauna Management

3.4.1 Existing Condition

Nil

3.4.2 Proposed Variation

Variation 17	Fauna must not be harmed from entrapment during the construction, operation and decommissioning of well infrastructure, dams, pipeline trenches and pipelines.
Variation 18	All vegetation clearing activities must be undertaken under the direction of a suitably qualified fauna spotter-catcher. A record must be kept detailing the name, location, condition and number of any protected wildlife encountered, other than those identified in <i>Table 2 – Authorised impacts to Prescribed Environmental Matter</i> .

3.4.3 Rationale

The inclusion of the proposed variations provides additional protections for Fauna during construction of the Project.

3.5 PPSCE 10 to PPSCE 12 – Blasting

3.5.1 Existing Conditions

PPSCE 10	A Blast Management Plan must be developed for each blasting activity in accordance with Australian Standard 2187.
PPSCE 11	Blasting operations must be designed to not exceed an airblast overpressure level of 120dB (linear peak) at any time, when measured at or extrapolated to any sensitive place.
PPSCE 12	Blasting operations must be designed to not exceed a ground-borne vibration peak particle velocity of 10mm/s at any time, when measured at or extrapolated to any sensitive place.

3.5.2 Proposed Variation

It is proposed to replace PPSCE 10 – PPSCE 12 with the following conditions.

Variation 24	<p>Blasting must not exceed the limits for peak particle velocity and air blast overpressure in Table 3 – <i>Blasting noise limits</i> when measured at any sensitive place or commercial place.</p> <p>Table 3 – Blasting noise limits</p> <table border="1"> <thead> <tr> <th>Blasting criteria</th> <th>Blasting limit</th> </tr> </thead> <tbody> <tr> <td>Airblast overpressure</td> <td>115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time.</td> </tr> <tr> <td>Ground vibration peak particle velocity</td> <td>5 mm/s peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/s peak particle velocity at any time</td> </tr> </tbody> </table>	Blasting criteria	Blasting limit	Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time.	Ground vibration peak particle velocity	5 mm/s peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/s peak particle velocity at any time
Blasting criteria	Blasting limit						
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time.						
Ground vibration peak particle velocity	5 mm/s peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/s peak particle velocity at any time						
Variation 25	<u>Blasting must be carried out in accordance with the most current edition of the Queensland Government's 'Noise and vibration from blasting guideline' (ESR/2016/2169) and with Australian Standard 2187.</u>						
Variation 26	<u>All monitoring of airblast overpressure and ground vibration peak particle velocity must be undertaken in accordance with the Queensland Government's 'Noise and vibration from blasting guideline' (ESR/2016/2169).</u>						

3.5.3 Rationale

The inclusion of the proposed variations aligns with other recent Arrow EAs and aligns with recognised industry best practice and the updated Australian standards for blasting.

3.6 PPSCF 4 Final acceptance criteria for rehabilitation

3.6.1 Existing Condition

PPSCF 4	<p>After decommissioning, all significantly disturbed land caused by the carrying out of the petroleum activity(ies) must be rehabilitated to meet the following final acceptance criteria:</p> <p>(a) any contaminated land (e.g. contaminated soils) is remediated and rehabilitated</p> <p>(b) rehabilitation is undertaken in a manner such that any actual or potential acid sulfate soils on the area of significant disturbance are treated to prevent or minimise environmental harm in accordance with the Instructions for the treatment and management of acid sulfate soils (2001).</p> <p>(c) for land that is not being cultivated by the landholder:</p> <p>i. groundcover, that is not a declared pest species is established and self-sustaining</p> <p>ii. vegetation of similar species richness and species diversity to pre-selected analogue sites is established and self-sustaining</p> <p>(d) for land that is to be cultivated by the landholder, cover crop is revegetated, unless the landholder will be preparing the site for cropping within 3 months of petroleum activities being completed.</p>
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3.6.2 Proposed Variation

It is proposed to include a variation to PPSCF 4 with the following conditions.

Variation 25	<p>After decommissioning, all significantly disturbed land caused by the carrying out of the petroleum activity(ies) <u>not being intended to be utilised by the landholder or overlapping tenure holder</u> must be rehabilitated to meet the following final acceptance criteria:</p> <p>(a) any contaminated land (e.g. contaminated soils) is remediated and rehabilitated</p> <p>(b) rehabilitation is undertaken in a manner such that any actual or potential acid sulfate soils on the area of significant disturbance are treated to prevent or minimise environmental harm in accordance with the <u>Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines</u>, as it is updated from time to time Instructions for the treatment and management of acid sulfate soils (2001)</p> <p>(c) for land that is not being cultivated by the landholder:</p> <p>groundcover, that is not a declared pest species, is not a prohibited matter and <u>is not a restricted matter</u>, is established and self-sustaining</p> <p>vegetation of similar <u>species richness</u> and <u>species diversity</u> to pre-selected analogue sites is established and self-sustaining</p> <p>(d) for land that is to be cultivated by the landholder, cover crop is revegetated, unless the landholder will be preparing the site for cropping within 3 months of petroleum activities being completed</p>
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<p>Variation 26</p>	<p>Where significant disturbance to land has occurred in an environmentally sensitive area, the following final rehabilitation criteria as measured against the pre-disturbance biodiversity values assessment (required by PPSCD 3) must be met:</p> <ul style="list-style-type: none"> (a) greater than or equal to 70% of native ground cover species richness; (b) greater than or equal to the total per cent ground cover; (c) less than or equal to the per cent species richness of plant pest species; (d) greater than or equal to 50% of organic litter cover; (e) greater than or equal to 50% of total density of coarse woody material; (f) and all predominant species in the ecologically dominant layer, that define the pre-disturbance regional ecosystem(s) are present.
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3.6.3 Rationale

The inclusion of this variation allows Arrow to facilitate frequent landholder requests to return valuable infrastructure to the landholder and/or the overlapping tenure holder. This is also consistent with the DETSI Guidelines for transferring petroleum infrastructure to landholders (ESR/2020/5043), and the Streamline Model Conditions (SMC) for petroleum activities.

4 Methodology

Environmental Authority (EA) EA002166 (the Jammatt PPL EA) is held by Arrow CSG Australia Pty Ltd (a subsidiary of Arrow) which authorises the carrying out petroleum activities on PPL2047 under the *Environmental Protection Act 1994* (Qld) (EP Act). Under the Jammatt PPL EA, Arrow is required to comply with eligibility criteria, standard conditions and varied conditions.

Attexo Group Pty Ltd (Attexo) has been engaged by Arrow to undertake an assessment of biodiversity impacts (Biodiversity Impact Assessment (BIA)) associated with the development of the Project to support an amendment application to the Jammatt PPL EA0002166.

The ecological values discussed in this Biodiversity Impact Assessment (BIA) were identified as being relevant to the Project during comprehensive Project Environmental Clearance (PEC) reports undertaken across the Study area. A separate PEC report was prepared by CHEC environmental for each land parcel that the Study area interested.

In addition to these Project specific reports, ecological survey information undertaken as part of the broader Surat Gas Project (SGP), and within the vicinity of the Project, was also used to identify ecological values that could be relevant to the Project. These studies have provided Arrow with a comprehensive understanding of the ecological values, flora and fauna assemblages, characteristic of vegetation communities and habitats in the broader SGP area. This BIA also draws on QGC's ecological survey program within the 'Upstream' and 'Midstream' project areas through CHEC Environmental's ecological survey and assessment of the Project.

The following section summarises the desktop and field-based information relevant to the Project and the processes by which this information was collected.

4.1 Desktop assessment

A comprehensive desktop assessment was undertaken in February 2025 to identify ecological values potentially relevant to the Study area. The intent of this desktop assessment was to identify ESAs and PEMs relevant to the Study area, including threatened and migratory species of conservation significance (MNES) that have been listed since the EPBC approval was granted in 2020 (EPBC 2018/8223). The following desktop resources were reviewed as part of this assessment:

- DCCEEW Species Profile and Threats Database (SPRAT);
- Queensland Government mapping products including certified Regional Ecosystem Mapping (Version 13) and Protected Plants Trigger Mapping;
- Essential habitat mapping;
- Project-specific ground-truthed regional ecosystem (GTRE) and ESA mapping for the Study area;
- Threatened flora and fauna records sourced from historical SGP ecological surveys and available online resources including Atlas of Living Australia (<https://www.ala.org.au/>) and eBird (<https://ebird.org/map>);
- Soils and land resource area mapping;
- Wetland values (MNES – high ecological significance wetlands mapping and wetland protection areas);
- Catchment and waterway values (Queensland major watercourses mapping);
- Connectivity values (Brigalow Belt Biodiversity Planning Assessment), and
- Available published ecological information for threatened flora and fauna species where available.

4.1.1 Likelihood of Occurrence Matrix

The Likelihood of Occurrence Matrix (LoOM) was developed by CHEC Environmental (CHEC) to facilitate consistency in habitat assessments by its ecologists. The LoOM, in its current version, considers the likelihood of 34 threatened (Commonwealth and/or State listed) fauna species occurring at a proposed development site. The included species are those with potential to occur within QGC’s ‘Upstream’ and ‘Midstream’ project areas (and are applicable to Arrow Energy’s Surat Gas Project areas), which are detailed in QGC’s combined Significant Species Management Plan (SSMP). The LoOM (and SSMP) is regularly reviewed and revised to ensure alignment with changes to Commonwealth and State conservation status listings. The distribution and habitat information contained in the LoOM (and SSMP) were sourced from the latest reliable reference material, including published texts and journals, SPRAT profiles, Atlas of Living Australia maps, Wildlife Online searches, Arrow and QGC GIS records.

The LoOM assessment is a systematic process, where you work across the spreadsheet from left to right for each species, starting with viewing a distribution map, then making selections (where prompted) from lists for ‘broad area of occurrence’, then ‘habitat attributes’, occurrence of ‘Essential Habitat’, ‘historical’ or ‘recent’ confirmed records. Depending on the responses, a determination of ‘Unlikely’, ‘Potential’, ‘Likely’ or ‘Known’ is provided for the species. The LoOM species habitat criteria have been included in Appendix B.

4.2 Field-based assessment

Several ecological surveys have been undertaken within the Study area and in areas immediately adjacent to the Project. A summary of these survey programs has been provided in Table 4-1, with a more detailed breakdown of the flora and fauna survey efforts provided in the following sections. Data included in the Project Environmental Clearance (PEC) reports by CHEC ecologists has been provided in Appendix C.

Table 4-1: Summary of Ecological Surveys conducted either within the Study area or in the broader vicinity

Survey	Survey Type	Timing	Undertaken by
CHEC PEC Reports	Flora and Fauna	October 2024	CHEC Environmental
Surat Gas Project: Terrestrial Ecology Report	Flora and Fauna	2016-2017	EcoSmart
Surat Gas Project: Off-tenement Terrestrial Ecology Survey Report	Fauna	March 2019	EcoSmart
Surat Ecological Studies	Flora	2017 - present	Arrow

4.2.1 Flora survey effort

Vegetation surveys relevant to the Project were undertaken in 2021 and again in May and October 2024 by CHEC Environmental as part of an ecological survey of the Project footprint and surrounds. The Project Environmental Clearance (PEC) survey reports are provided in Appendix C. The surveys were conducted in accordance with a previous version of the Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland as outlined in Appendix C.

4.2.2 Fauna survey effort

The habitat types in the Study area are widely distributed across the Brigalow Belt and have been extensively sampled as part of a substantial and sustained fauna survey effort across the broader SGP Project area between 2016 and 2024. Resultantly, fauna assemblages and characteristic microhabitats associated with the broad vegetation communities and habitats are well understood. As the fauna survey effort presented in this report represents a subset of the survey effort for the wider SGP, all sites within 15 km of the Study area have been regarded as relevant and have been included in overall effort.

The primary Project-specific field assessments that inform the description of terrestrial fauna habitats and fauna assemblages in the Study area are derived from CHEC Environmental 2024 fauna surveys and Surat Gas Project Terrestrial Ecology Report (Appendix C). Since 2017, these fauna surveys have been supplemented by habitat assessments, Koala Spot Assessment Technique (SAT) surveys and opportunistic fauna observations undertaken by Arrow field ecologists.

4.2.2.1 Main fauna survey effort

In addition to the CHEC Environmental 2024 fauna surveys (Appendix C), areas for field survey were identified based on the results of desktop searches and interpretation of aerial photography to select patches of remnant and non-remnant vegetation for targeted fieldwork. As part of the terrestrial fauna surveys conducted by EcoSmart in 2016-2017, the following methodology was applied to select sites for further assessment:

- areas with little or no historic survey effort were identified by overlaying the locations of previous fauna work on pre-existing RE mapping to identify focus areas for the fauna survey;
- Broad Vegetation Group (BVG) mapping prepared by the Queensland Herbarium was used to identify the location and extent of BVGs at the 2 million scale. The contribution of each BVG to the extent of remnant vegetation was calculated and theoretical trap effort distributed accordingly;
- a five-day pilot study was conducted in August 2016 to visually inspect focus areas, identify survey constraints and located possible detailed fauna trap surveys;
- detailed survey sites were selected on the basis of spatial and BVG stratification, taking into consideration landholder access constraints, travel logistics and limitations, notable geomorphological features such as rock outcrops and caves, habitats likely to support specially protected species and vegetation condition (in particular, fire scarring).

Once selected, each site was inspected and approved by traditional owners to ensure trapping activities would not impact upon indigenous cultural values. As no pitfall trapping could occur without prior cultural heritage assessment, trap site locations could not be relocated after the pilot study. The pilot study occurred prior the flora investigations and did not account for any subsequent vegetation mapping changes. Where possible, trap sites were surveyed during both the dry and wet season, though in some cases this was not possible without compromising spatial or BVG representation.

The following survey techniques were adopted in accordance with the with the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Appendix C):

- **Trap Sites:** These trap sites consisted of a combination of several trapping techniques that were tailored to the available habitat and the fauna species being targeted including pitfall trapping, Elliot trapping and funnel trapping, typically deployed for four nights in each location. Pitfall trapping involved the installing four 20L buckets along drift fences established in a T configuration. Funnel traps were installed at the end of these drift fences, augmenting the pitfall traps. Elliot traps were established in the vegetation surrounding the pitfall/funnel trap array, located approximately 5 m apart from each other. Trapping sites were visited twice daily, once in the morning and once in the late afternoon. Traps typically deployed for four nights at each location in accordance with the recommended survey effort set out in the Terrestrial Fauna Survey Guidelines (Appendix C):
 - 4 pitfall traps (representing 416 trap nights);
 - 6 funnel traps (representing 624 trap nights), and
 - 10 Elliot traps (representing 1,040 Elliot trap nights).

- **Harp Traps:** Insectivorous micro-bat capture was undertaken using harp traps which were deployed along obvious flyways, which are linear clearings through vegetation such as tracks and creek lines. Harp traps were typically conducted in different locations to the other terrestrial fauna trapping methods.
- **Camera Traps:** Remote sensor cameras were used to survey small to large terrestrial vertebrates for four nights at each location. Cameras were baited by smearing quantities of peanut butter and macadamia oil on the ground within the detection zone.
- **Ultrasonic Bat Call Detection:** Ultrasonic calls of micro-bats were recorded using Anabat devices that were set to record from dawn until dusk. The deployment locations were selected based on the likelihood of high bat activity, such as along flyways or over water bodies.
- **Bird Surveys:** In addition to being undertaken at each trap site, opportunistic bird surveys were also conducted within other areas of suitable habitat throughout the consolidated survey program. Each bird survey was conducted for between 20 – 30 minutes and typically before 9am.
- **Diurnal Search:** Active diurnal searches involved two observers meandering through suitable fauna habitat for 30 minutes rolling rocks and logs, searching debris, inspecting trees for scratches and searching for scats or feeding remains.
- **Koala SAT Surveys:** The Spot Assessment Technique (SAT) was adopted as the most appropriate survey technique at the time of these surveys in accordance with The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus* (Appendix C). This survey technique involved searching for Koala scats around the base of 30 suitable food trees at each survey site.
- **Spotlighting:** Spotlighting surveys were conducted by two observers (on foot) who would walking through suitable and spotlight for arboreal and terrestrial mammal, reptile and amphibian species. Spotlighting surveys were typically conducted for periods of 60 minutes over two nights at each site with animals being detected by eye shine, call or direct observation.
- **Habitat Assessments:** In addition to the direct survey methods used to detect fauna species, habitat assessments were also conducted. The focus of these assessments was to collect sufficient microhabitat information to inform the development of habitat mapping rules that have subsequently been adopted across the broader SGP.

A summary of these fauna survey efforts undertaken as part of the main fauna survey effort has been provided in Table 4-2 and the location of these survey efforts in relation to the Study area has been presented in Appendix C.

Table 4-2: Summary of main survey effort

Survey method	Main Survey Effort (number of sites and survey effort)		
	October 2016	March 2017	Total Survey Effort
Pitfall trap sites	5 sites (80 trap nights)	-	5 sites (80 trap nights)
Funnel trap sites	5 sites (120 trap nights)	-	5 sites (120 trap nights)
Elliot trap sites	5 sites (200 trap nights)	-	5 sites (200 trap nights)
Harp trap sites	3 sites (12 trap nights)	-	3 sites (12 trap nights)
Camera trap sites	4 sites (16 trap nights)	-	4 sites (16 trap nights)
Anabat	4 sites (8 trap nights)	-	4 sites (8 trap nights)
Active searches	4 sites (2 person hours)	2 sites (1 person hour)	6 sites (3 person hours)
Bird surveys	4 sites (1.3 person hours)	3 sites (1 person hour)	7 sites (2.3 person hours)
Spotlighting	4 sites (16 person hours)	-	4 sites (16 person hours)

4.2.2.2 Supplementary fauna survey efforts

In addition to the main survey efforts undertaken by EcoSmart during the 2016-2017 survey period (Appendix C), several other supplementary fauna survey programs have also been undertaken in the vicinity of the Project and were identified as being relevant to the BIA report. The most recent Project specific fauna survey is by CHEC Environmental in 2024 (Appendix B). A summary of these nearby supplementary survey efforts has been provided in Table 4-3 and shown in Figure 4-1.

Table 4-3: Supplementary fauna survey effort

Survey method	2011-2023 Supplementary Surveys	2024 Supplementary Surveys	Total Supplementary Surveys
Active searches	5 sites (2.5 person hours)	-	5 sites (2.5 person hours)
Koala SAT surveys	96 sites	106 sites	213 sites
Habitat Assessment	97 sites	113 sites	200 sites

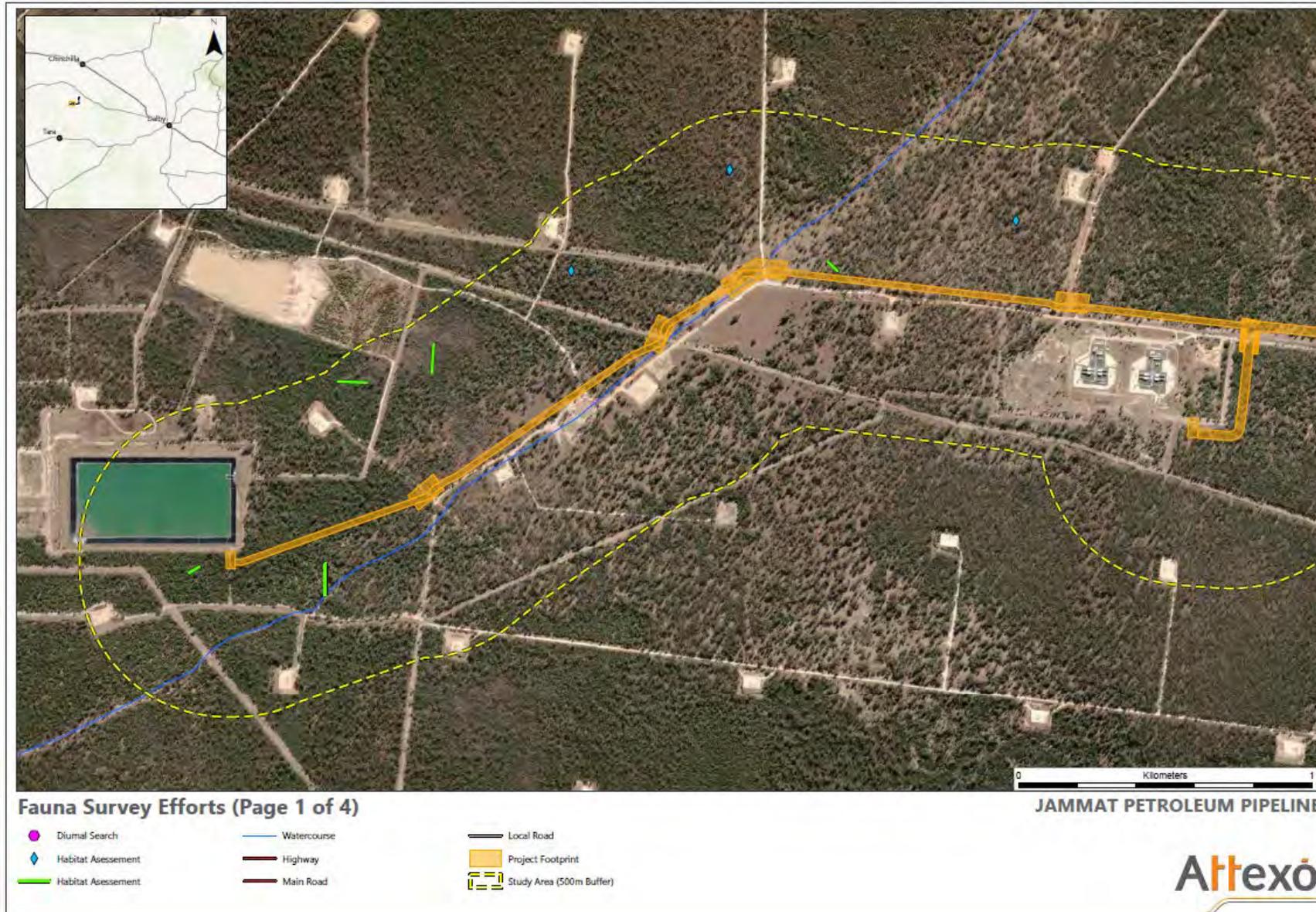
4.2.2.3 Survey for cryptic species

For the purposes of this assessment, a species is considered ‘cryptic’ if it is unlikely to be detected using standard survey techniques (trapping, searching or spotlighting). Of the fauna species considered ‘likely’ or ‘possibly occurring’ within the Study area, the following difficult to detect using these survey methods:

- Brigalow Woodland Snail, *Adclarkia cameroni*;
- Dunmall’s Snake, *Furina dunmalli*, and
- Grey Snake, *Hemiaspis damelii*.

Both snake species are subterranean by nature (i.e. they spend most of their time underground) and are recognised as difficult to detect in relevant conservation guidelines. Similarly, the brigalow woodland snail required moist environments (typically along watercourses) where there is sufficient coarse woody debris to provide shaded and moist microhabitats. These species are typically associated with Brigalow and/or riparian habitats which are limited in extent within the Study area. Whilst no specific surveys have focused on the detection of these species, the microhabitat features noted within each of the PEC reports has allowed for the development of relatively reliable habitat mapping that has been used to inform this impact assessment.

Figure 4-1 Supplementary survey efforts



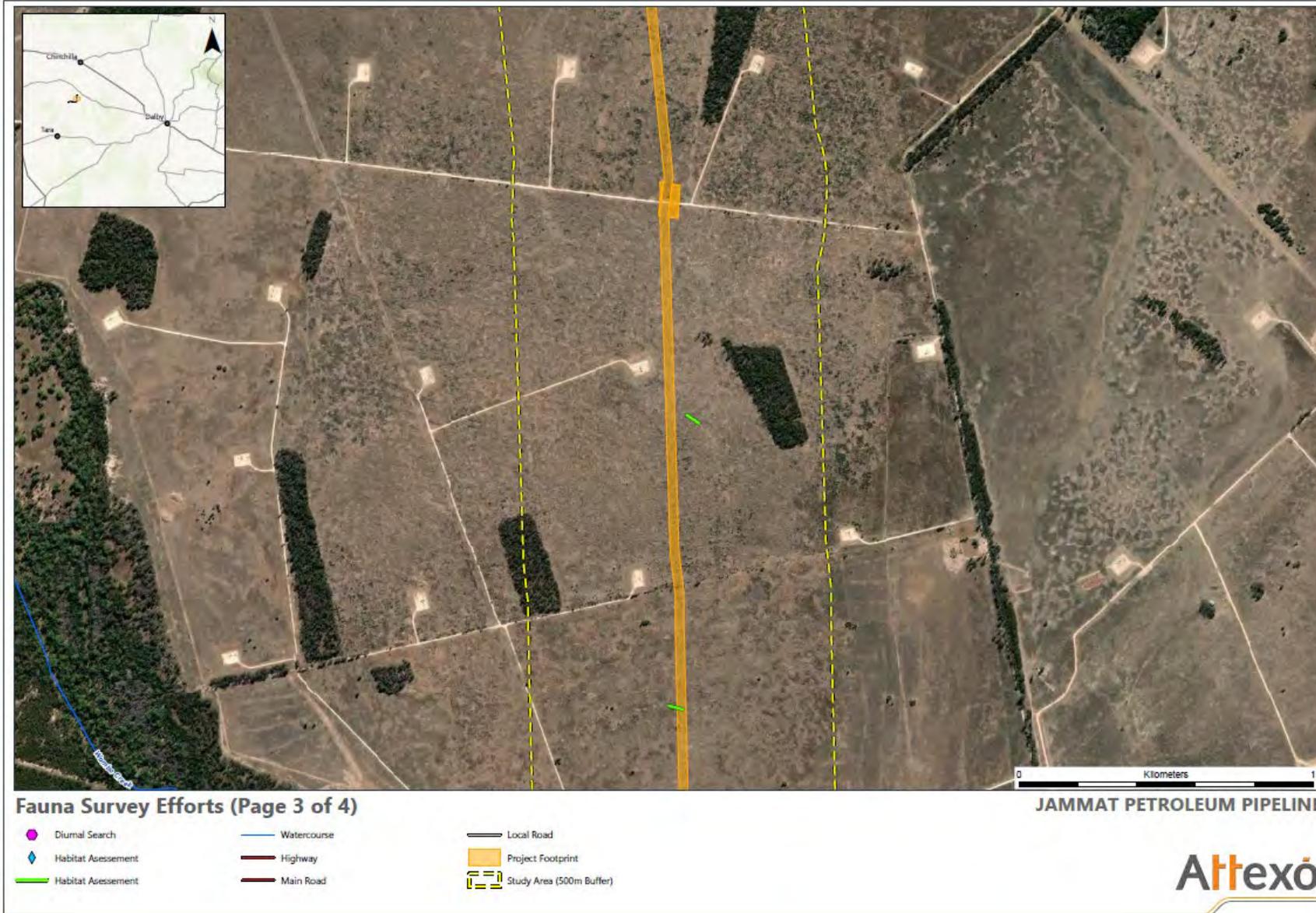


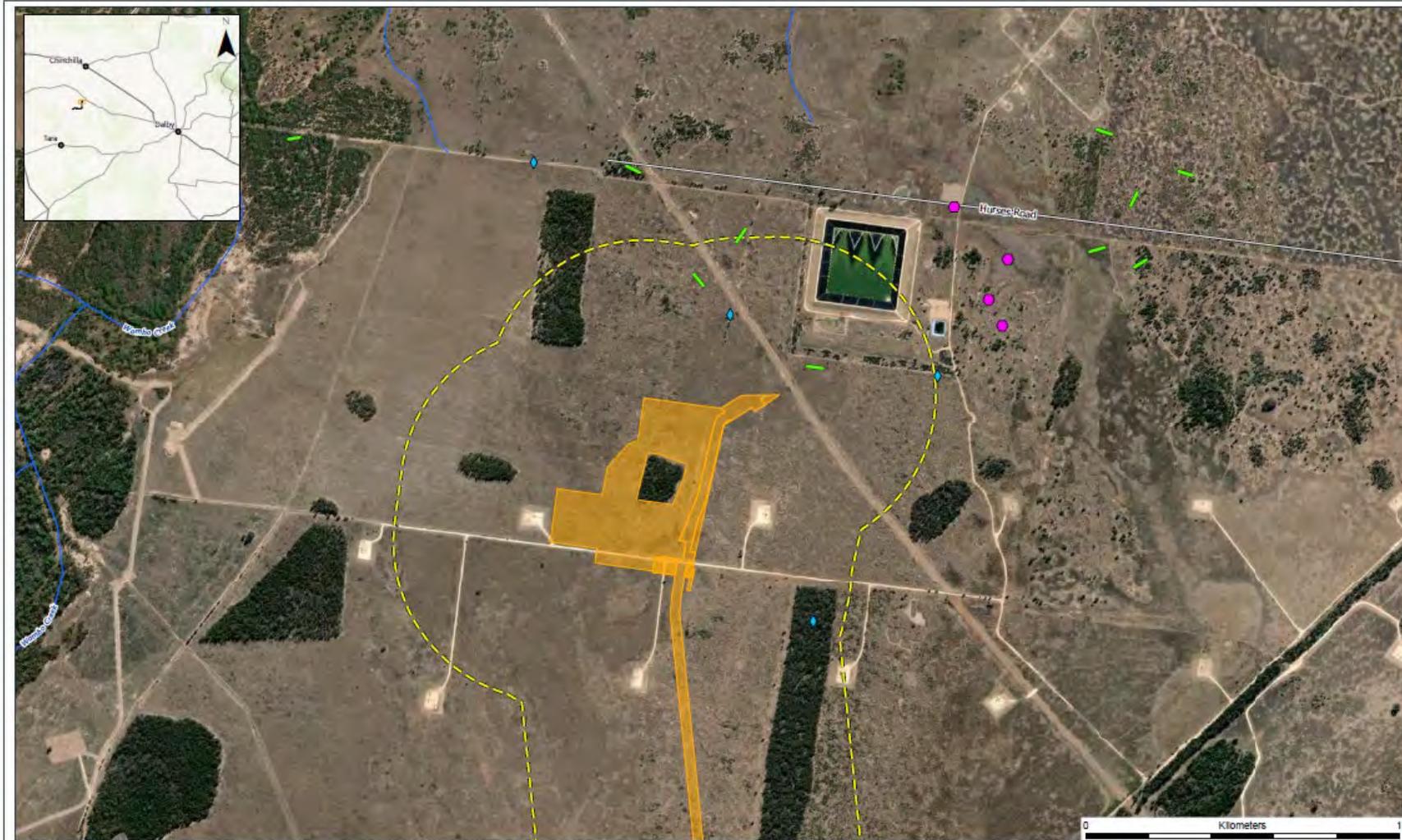
Fauna Survey Efforts (Page 2 of 4)

- | | | |
|--------------------|-------------|--------------------------|
| Diurnal Search | Watercourse | Local Road |
| Habitat Assessment | Highway | Project Footprint |
| Habitat Assessment | Main Road | Study Area (500m Buffer) |

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Fauna Survey Efforts (Page 4 of 4)

- | | | |
|--------------------|-------------|--------------------------|
| Diurnal Search | Watercourse | Local Road |
| Habitat Assessment | Highway | Project Footprint |
| Habitat Assessment | Main Road | Study Area (500m Buffer) |

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5 Description of Environmental values

5.1 Description of environmental values – general

The Project is located approximately 15.5 km to the west of Kogan in the Inglewood Sandstones subregion of the Brigalow Belt bioregion. The Study area contains both cleared grazing land and dry eucalypt woodlands dominated by a mixture of narrow-leaved ironbark (*Eucalyptus crebra*), poplar box (*E. populnea*), gum-topped box (*E. moluccana*) and white cypress pine (*Callitris glaucophylla*).

Melonhole gilgai on clay plains are present in the cleared grazing land (east of Wambo Creek) along the eastern section of the Project alignment. Small patches of brigalow (*Acacia harpophylla*) also occur on the clay plains. A narrow riparian open woodland dominated by forest red gum (*E. tereticornis*) is associated with Wambo Creek and occurs to the east of Clynes Road.

A State-significant Terrestrial biodiversity corridor is mapped in an east west alignment over the southern portion of the Study area (refer to Figure 5-1).

5.1.1 Environmentally Sensitive Areas

A summary of the ESAs as defined in the *Environmental Protection Regulation 2019* (EP Reg) (for Category A & B ESAs), and recent definitions of Category C ESAs used by DETSI that are relevant to the Project have been provided in Table 5-1 and shown on Figure 5-2, Figure 5-3 and Figure 5-4. Considering the location of the Project, ESAs relating to marine areas have been excluded from this assessment.

Table 5-1: Jammatt Environmentally Sensitive Areas

ESA Category	ESA Type	Occurrence in Study Area
Category A	A National Park, Conservation Park, Special Wildlife Reserve, or a Forest Reserve.	None
	The Wet Tropics Area under the <i>Wet Tropics World Heritage Protection and Management Act 1993</i> .	None
Category B	A coordinated conservation area, an area of critical habitat for major intersect identified under a conservation plan or an area subject to an interim conservation order.	None
	An area subject to the 'Convention on the Conservation of Migratory Species of Wild Animals', the 'Convention on Wetlands of International Importance, especially as Waterfowl Habitat' or the 'Convention Concerning the Protection of the World Cultural and Natural Heritage'.	None
	Under the <i>Queensland Heritage Act 1992</i> , a place of cultural heritage significance or a Queensland Heritage place, unless there is an exemption certificate issued under the Act.	None
	An area recorded in the Aboriginal Cultural Heritage Register established under the <i>Aboriginal Cultural Heritage Act 2003</i> , section 46, other than the area known as the 'Stanbroke Pastoral Development Holding', leased under the <i>Land Act 1994</i> .	None

ESA Category	ESA Type	Occurrence in Study Area
	A feature Protection Area, State Forest Park or Scientific area under the <i>Forestry Act 1959</i> .	None
	A declared fish habitat area under the <i>Fisheries Act 1994</i> .	None
	An 'Endangered Regional Ecosystem' identified in the REDD database (by Biodiversity Status)	There is an endangered RE in the Study area (RE 11.4.3). This RE is discussed further in Section 5.2.1.1 and mapped in Figure 5-6 .
Category C	Nature refuges as defined in the conservation agreement for that refuge under the <i>Nature Conservation Act 1992</i> Guideline Streamlined model conditions for petroleum activities.	None
	State forests or timber reserves as defined under the <i>Forestry Act 1959</i>	None
	Regional parks (previously known as resource reserves) under the <i>Nature Conservation Act 1992</i>	None
	An area validated as from ground-truthing surveys as 'essential habitat' on the Queensland Government essential habitat map in accordance with section 20AC of the <i>Vegetation Management Act 1999</i> for a species of wildlife listed as critically endangered, endangered, vulnerable under the <i>Nature Conservation Act 1992</i>	Essential habitat for one fauna species has been identified within the Study area. These areas are discussed further in Section 5.3.7 and mapped in Figure 5-13 .
	An area validated from ground-truthing surveys as 'protected wildlife habitat' that is category A, B or C on the remnant vegetation management map, in accordance with section 20A of the <i>Vegetation Management Act 1992</i> , for a species of wildlife listed as critically endangered, endangered or vulnerable under the <i>Nature Conservation Act 1992</i> .	Protected wildlife habitat for threatened species assessed in this report is presented in Section 5.3.5 and mapped in Figure 5-4 .
	'Of concern regional ecosystems' that are remnant vegetation and identified in the database called 'RE description database' containing regional ecosystem numbers and descriptions.	One 'Of concern regional ecosystems' (RE 11.3.25) occurs in the Study area. This RE is discussed in Section 5.2.1.1 and mapped in Figure 5-6 .

Figure 5-1: Ecological context

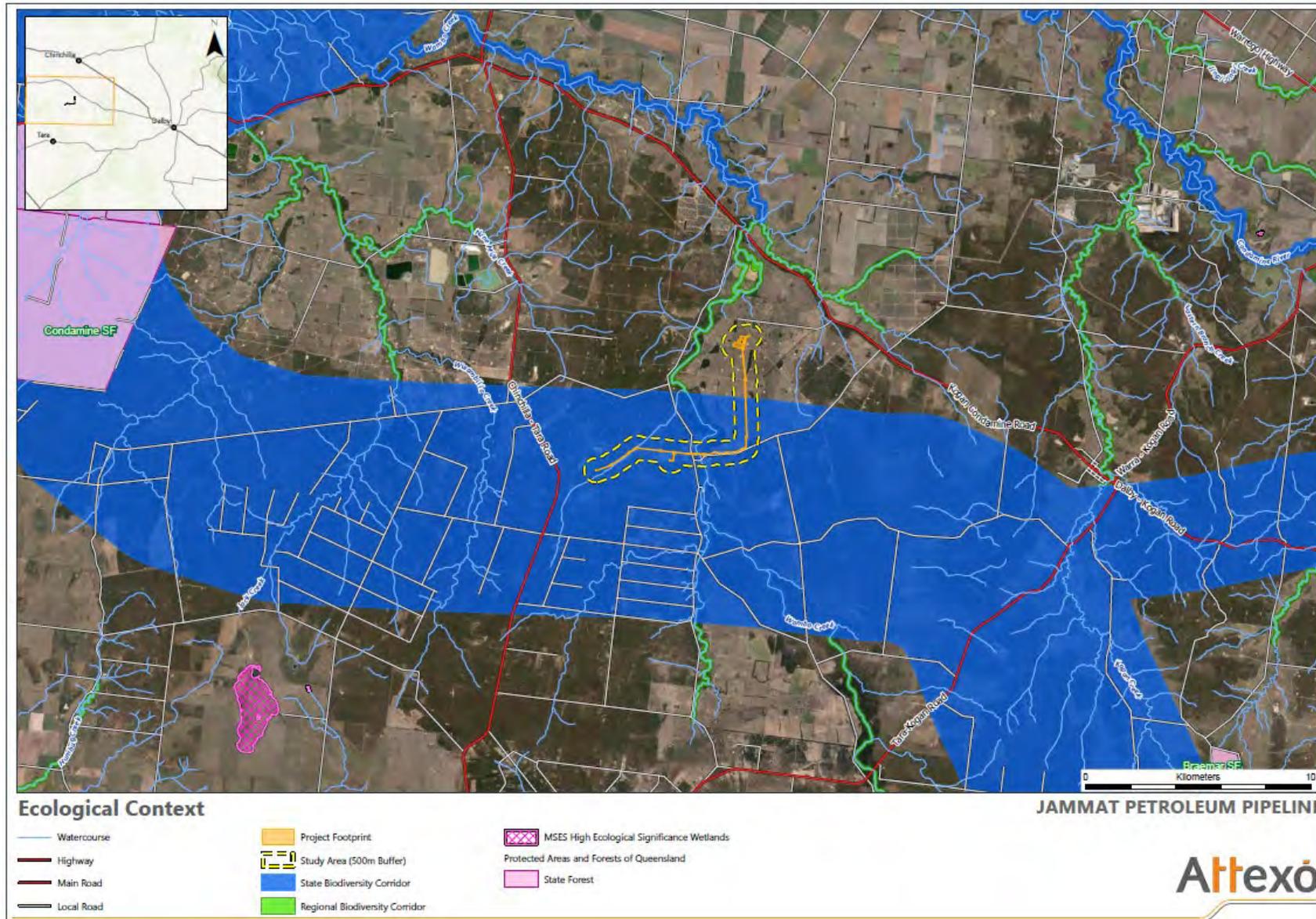
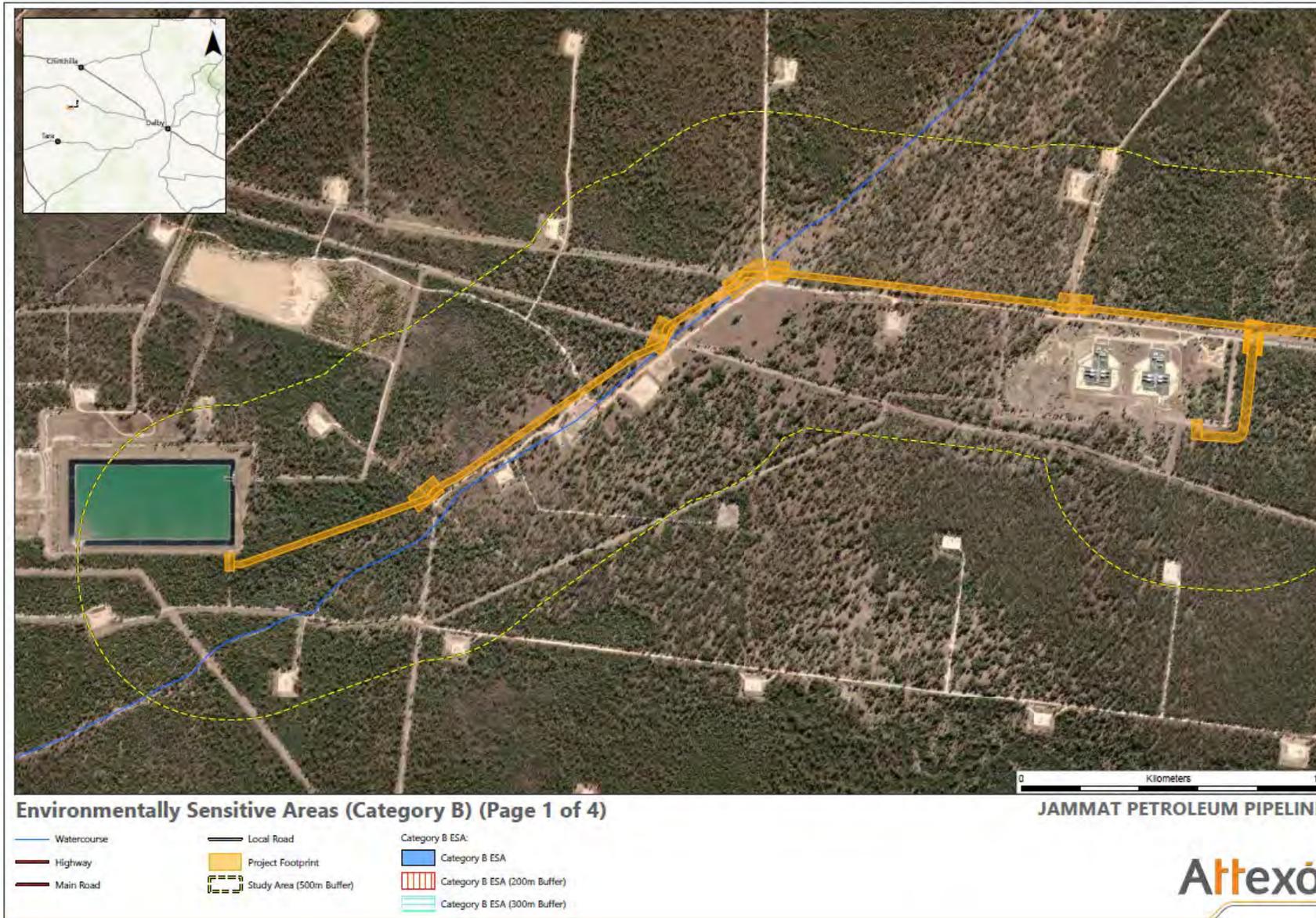
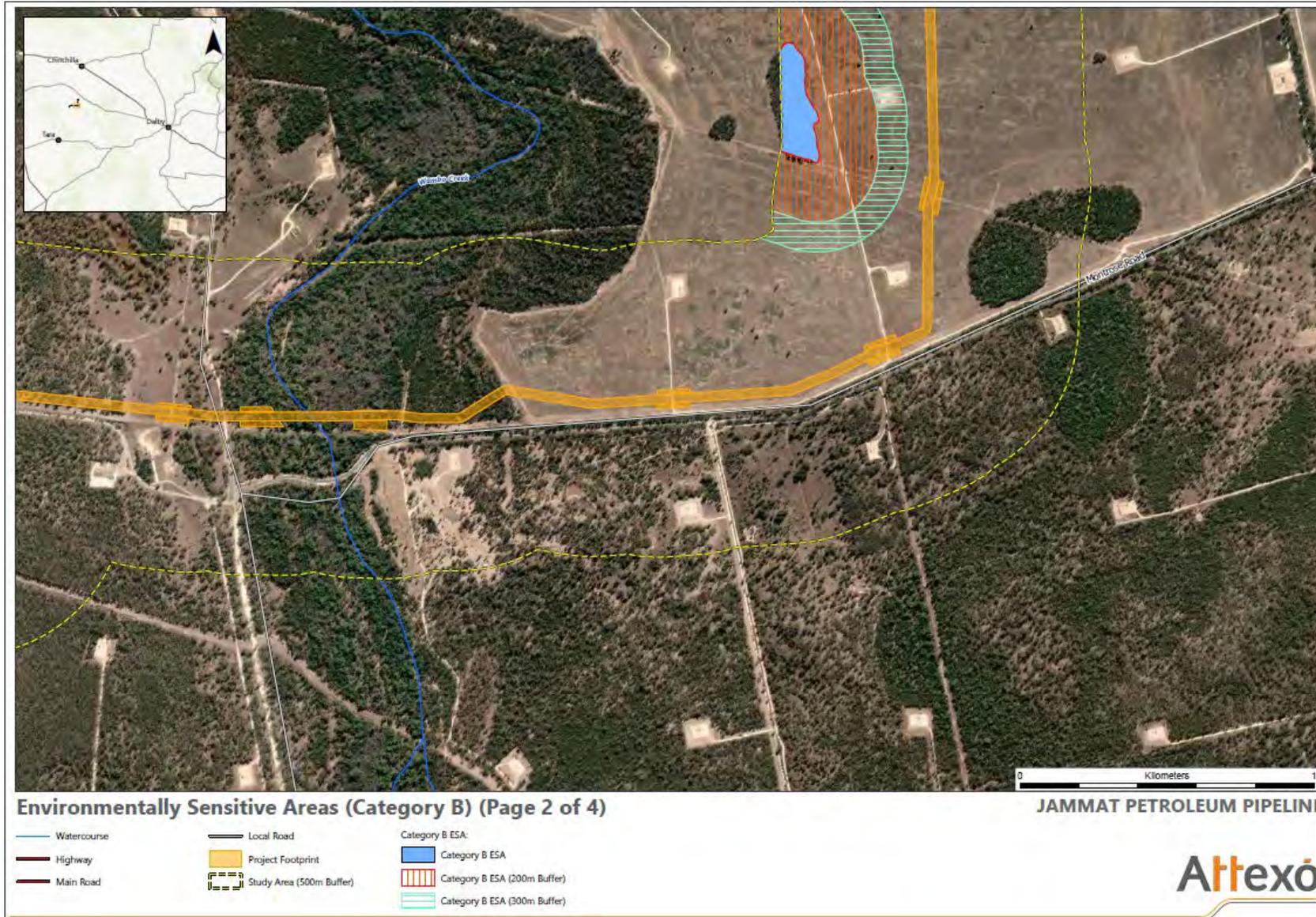
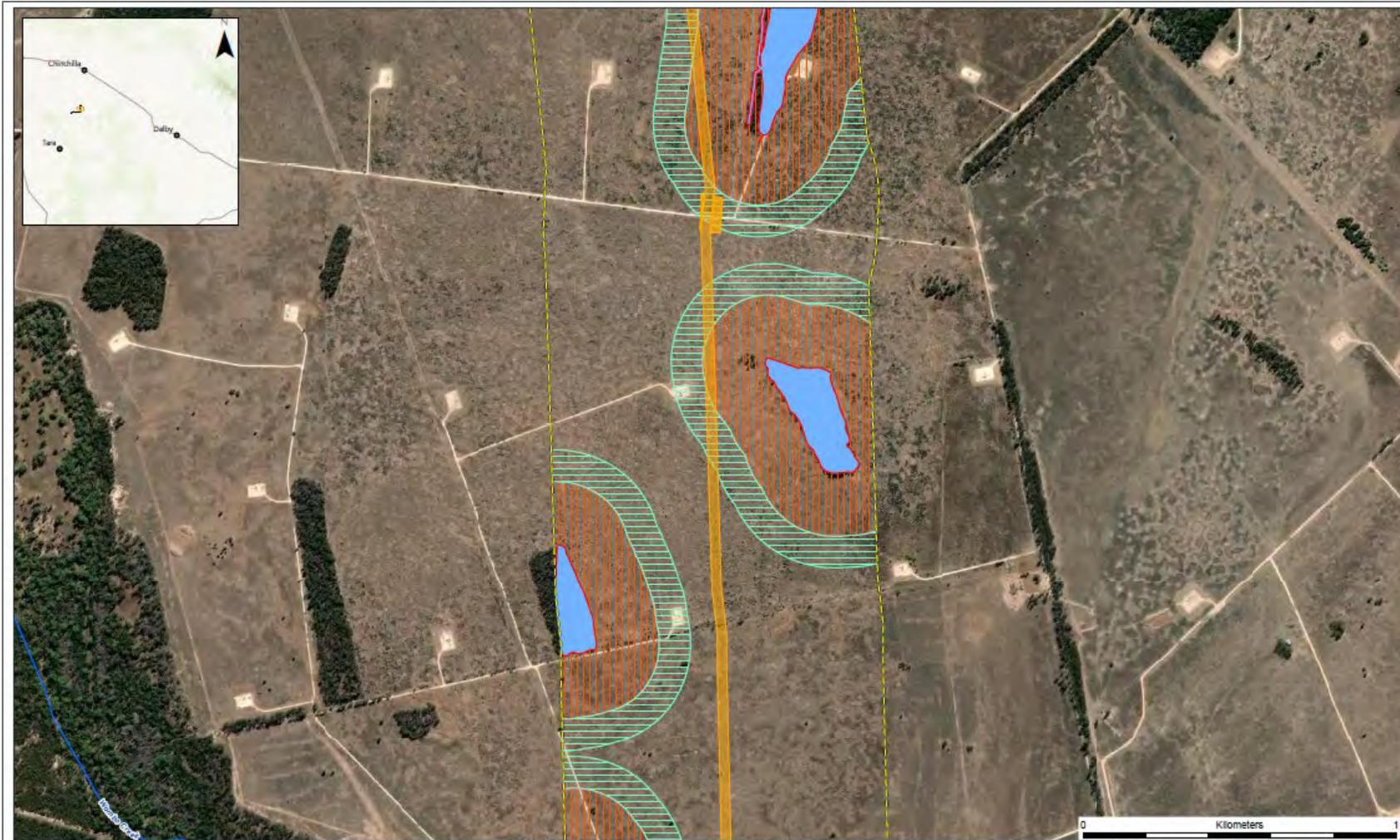


Figure 5-2: Environmentally Sensitive Areas (Category B)





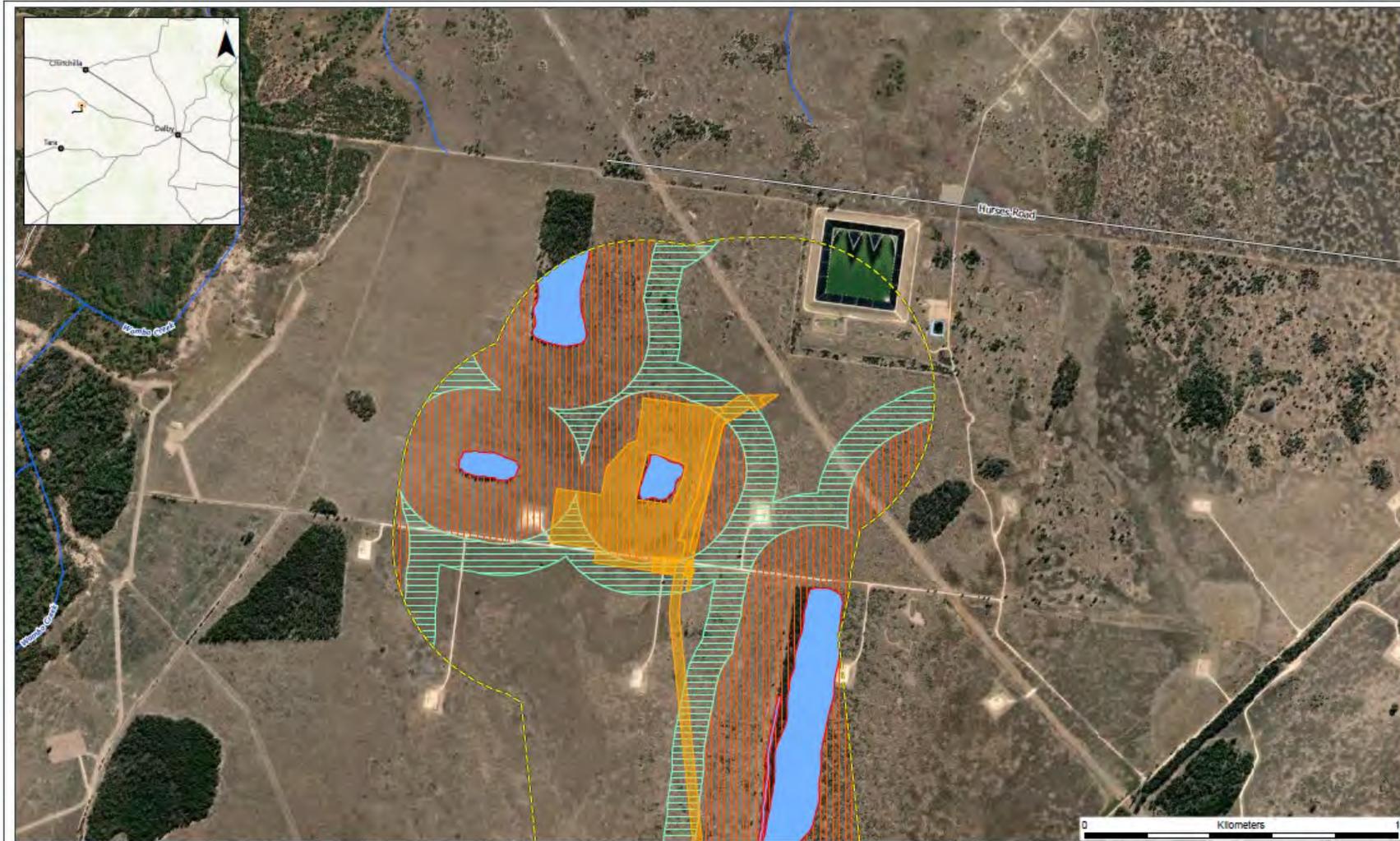


Environmentally Sensitive Areas (Category B) (Page 3 of 4)

JAMMAT PETROLEUM PIPELINE

- | | | |
|-------------|--------------------------|------------------------------|
| Watercourse | Local Road | Category B ESA: |
| Highway | Project Footprint | Category B ESA |
| Main Road | Study Area (500m Buffer) | Category B ESA (200m Buffer) |
| | | Category B ESA (300m Buffer) |





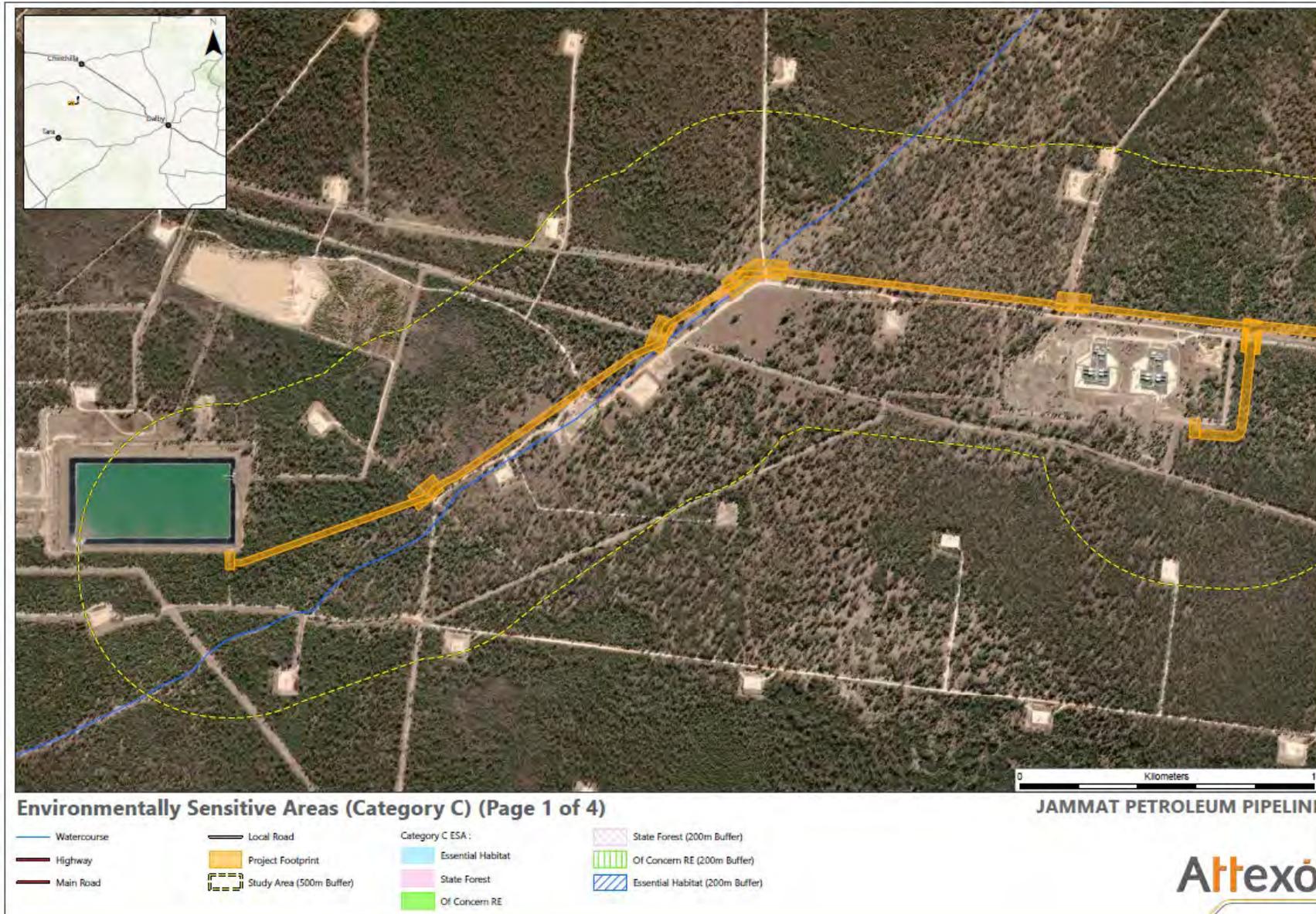
Environmentally Sensitive Areas (Category B) (Page 4 of 4)

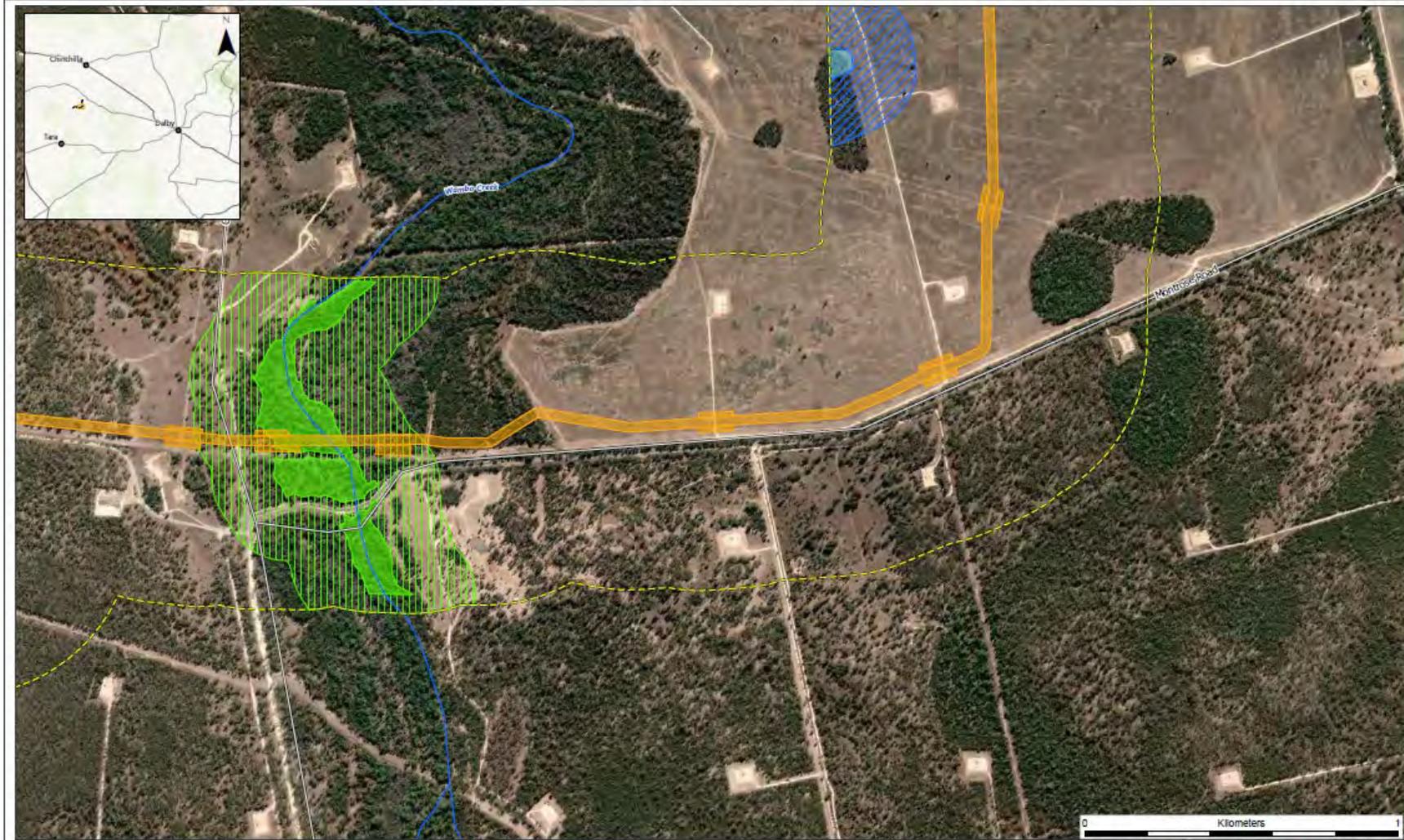
JAMMAT PETROLEUM PIPELINE

- | | | |
|-------------|--------------------------|------------------------------|
| Watercourse | Local Road | Category B ESA: |
| Highway | Project Footprint | Category B ESA |
| Main Road | Study Area (500m Buffer) | Category B ESA (200m Buffer) |
| | | Category B ESA (300m Buffer) |



Figure 5-3: Environmentally Sensitive Areas (Category C)



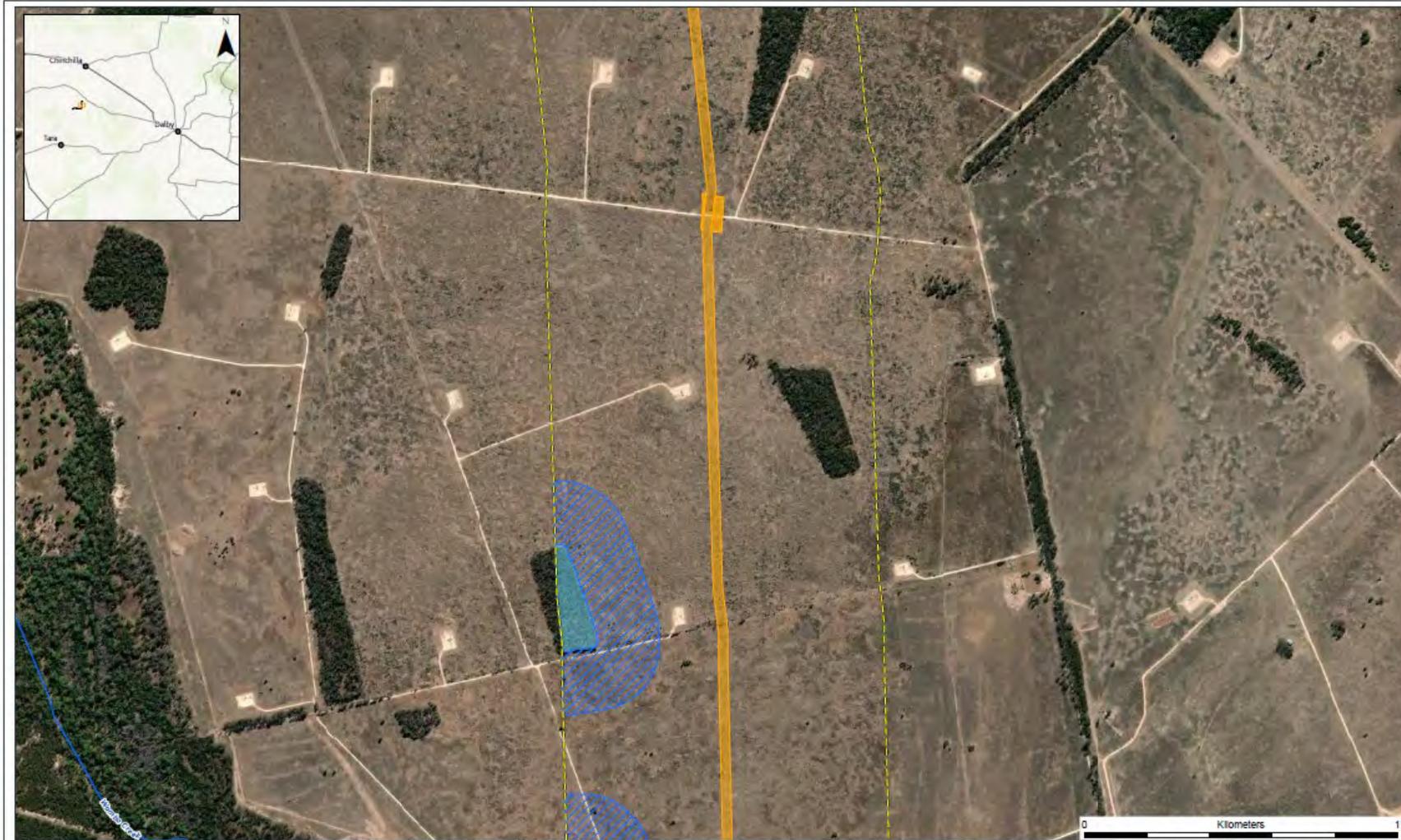


Environmentally Sensitive Areas (Category C) (Page 2 of 4)

JAMMAT PETROLEUM PIPELINE

Watercourse	Local Road	Category C ESA :	State Forest (200m Buffer)
Highway	Project Footprint	Essential Habitat	Of Concern RE (200m Buffer)
Main Road	Study Area (500m Buffer)	State Forest	Essential Habitat (200m Buffer)
		Of Concern RE	





Environmentally Sensitive Areas (Category C) (Page 3 of 4)

JAMMAT PETROLEUM PIPELINE

- | | | | |
|-------------|--------------------------|-------------------------|---------------------------------|
| Watercourse | Local Road | Category C ESA : | State Forest (200m Buffer) |
| Highway | Project Footprint | Essential Habitat | Of Concern RE (200m Buffer) |
| Main Road | Study Area (500m Buffer) | State Forest | Essential Habitat (200m Buffer) |
| | | Of Concern RE | |



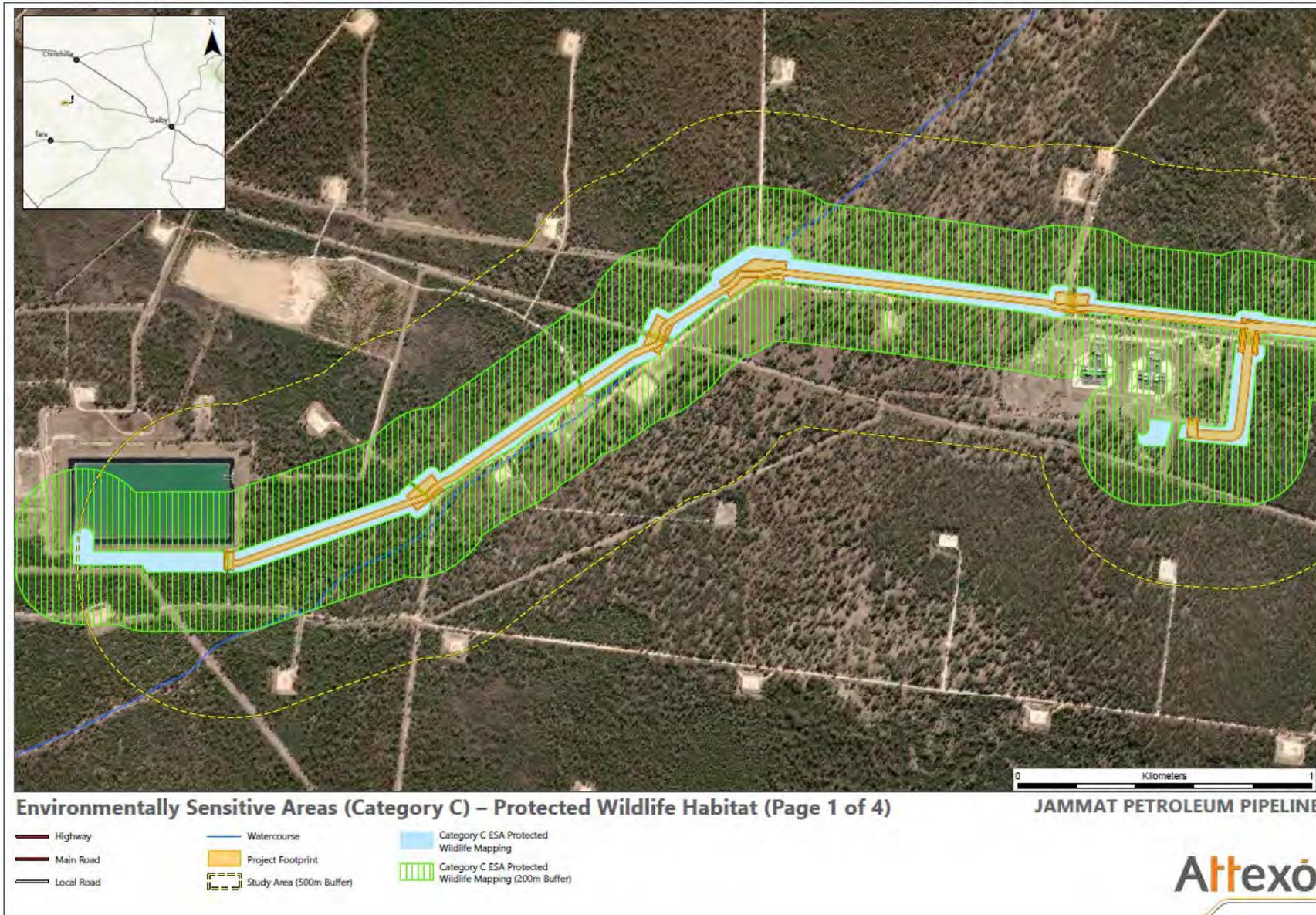
Environmentally Sensitive Areas (Category C) (Page 4 of 4)

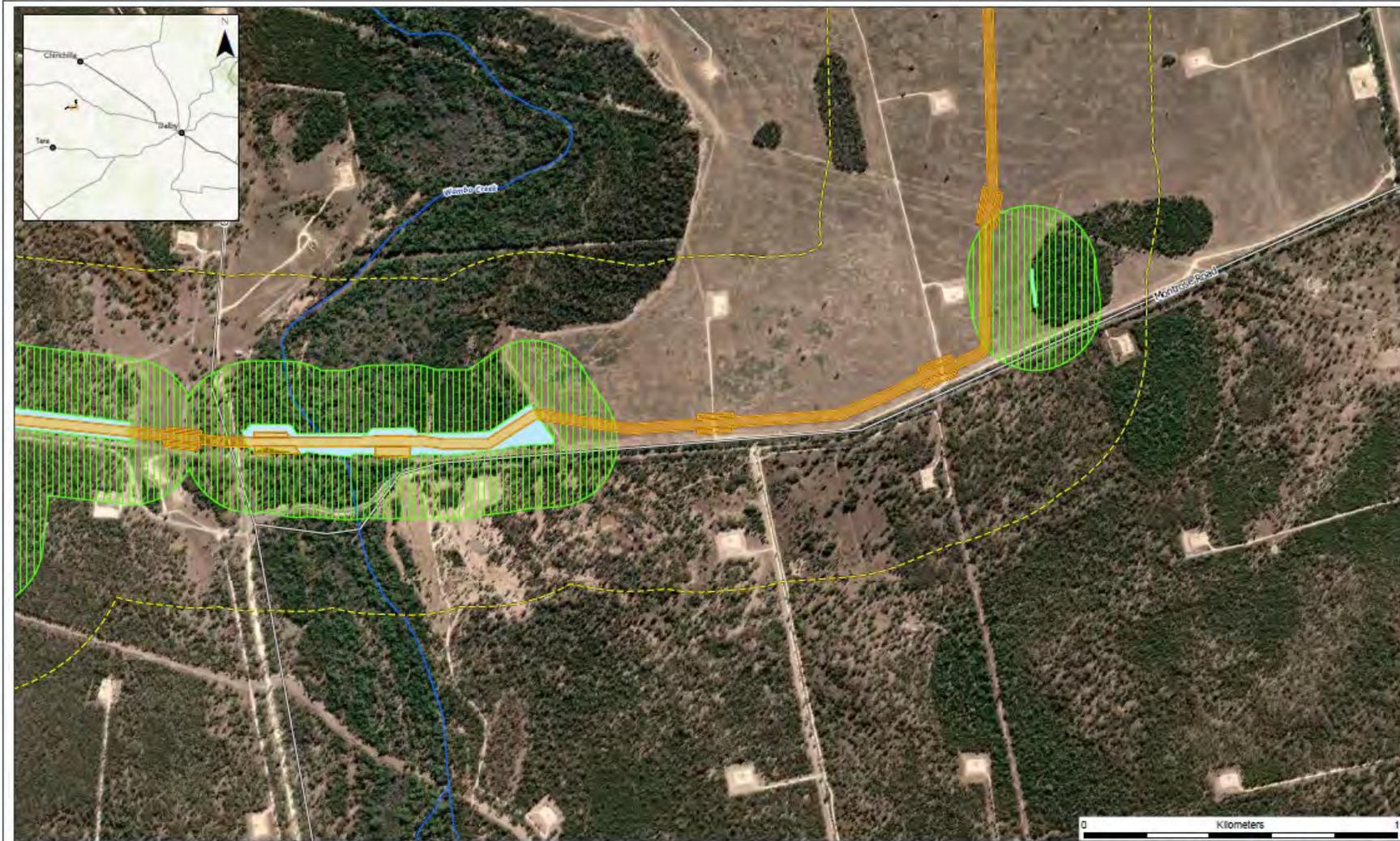
JAMMAT PETROLEUM PIPELINE

- | | | | |
|-------------|--------------------------|------------------------|---------------------------------|
| Watercourse | Local Road | Category C ESA: | State Forest (200m Buffer) |
| Highway | Project Footprint | Essential Habitat | Of Concern RE (200m Buffer) |
| Main Road | Study Area (500m Buffer) | State Forest | Essential Habitat (200m Buffer) |
| | | Of Concern RE | |



Figure 5-4: Environmentally Sensitive Areas (Category C) – protected wildlife habitat



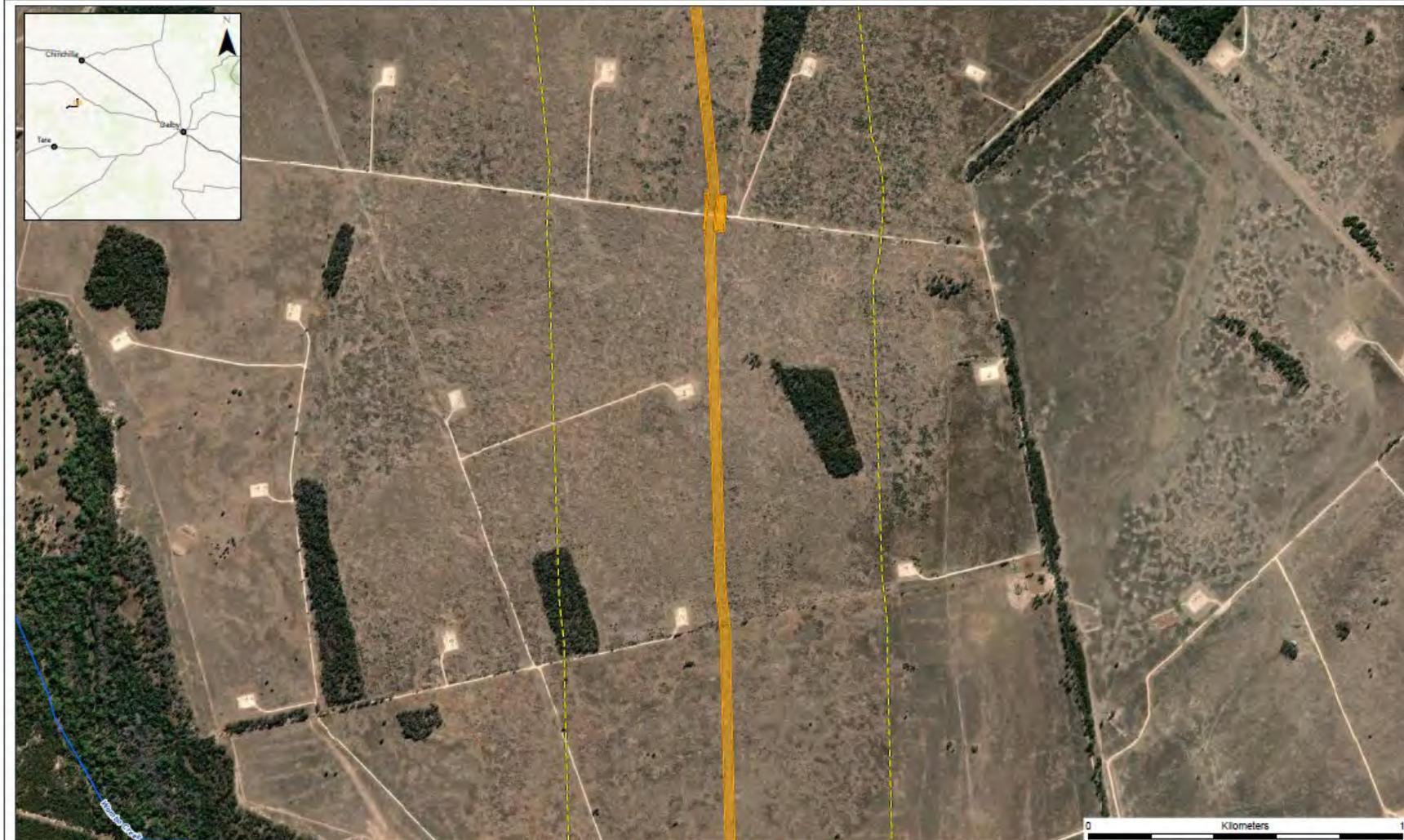


Environmentally Sensitive Areas (Category C) – Protected Wildlife Habitat (Page 2 of 4)

JAMMAT PETROLEUM PIPELINE

- Highway
- Watercourse
- Category C ESA Protected Wildlife Mapping
- Project Footprint
- Category C ESA Protected Wildlife Mapping (200m Buffer)
- Main Road
- Study Area (500m Buffer)
- Local Road



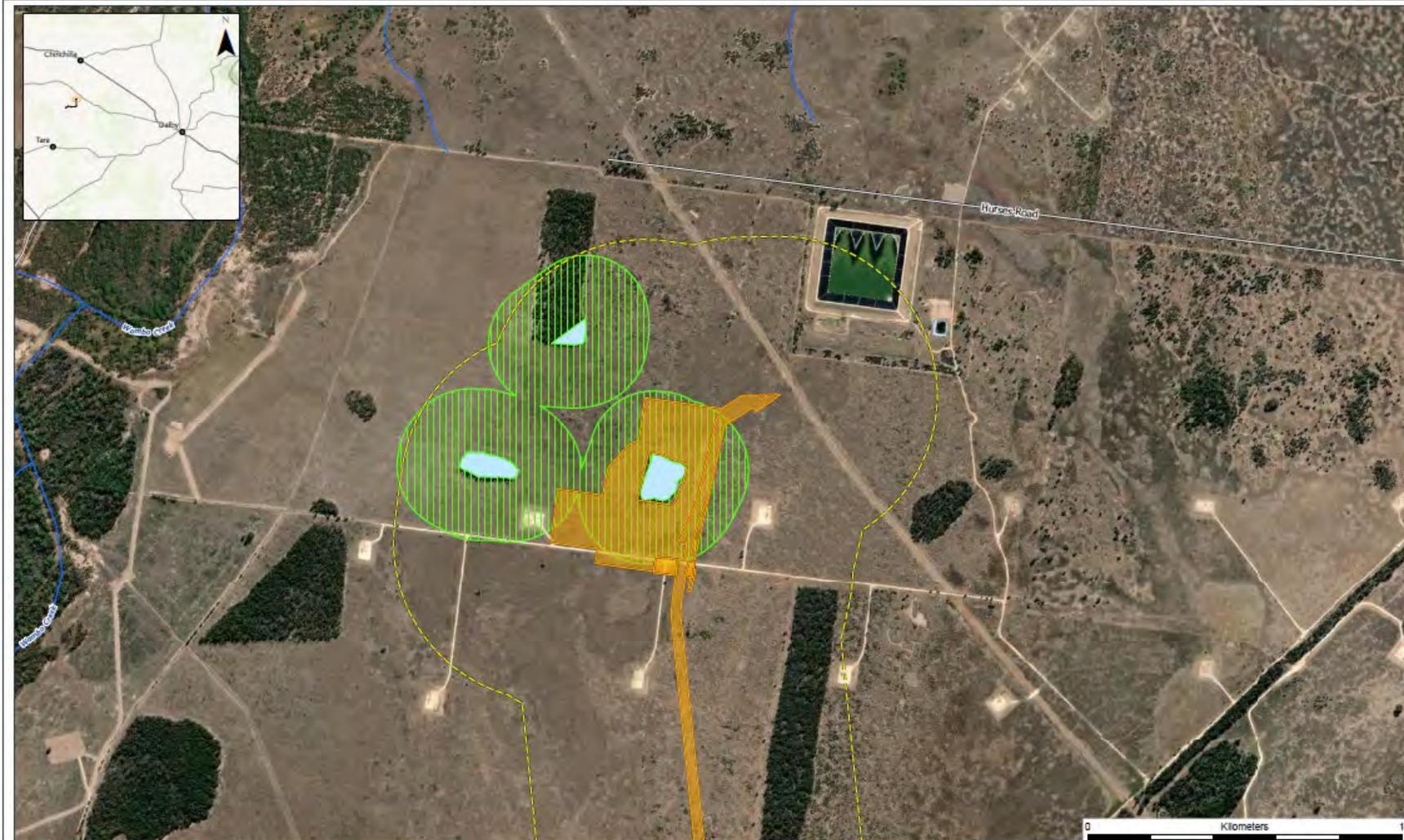


Environmentally Sensitive Areas (Category C) – Protected Wildlife Habitat (Page 3 of 4)

JAMMAT PETROLEUM PIPELINE

- Highway
- Watercourse
- Category C ESA Protected Wildlife Mapping
- Project Footprint
- Study Area (500m Buffer)
- Category C ESA Protected Wildlife Mapping (200m Buffer)
- Main Road
- Local Road





Environmentally Sensitive Areas (Category C) – Protected Wildlife Habitat (Page 4 of 4)

JAMMAT PETROLEUM PIPELINE

- Highway
- Main Road
- Local Road
- Watercourse
- Project Footprint
- Study Area (500m Buffer)
- Category C ESA Protected Wildlife Mapping
- Category C ESA Protected Wildlife Mapping (200m Buffer)

5.2 Description of environmental values – terrestrial flora

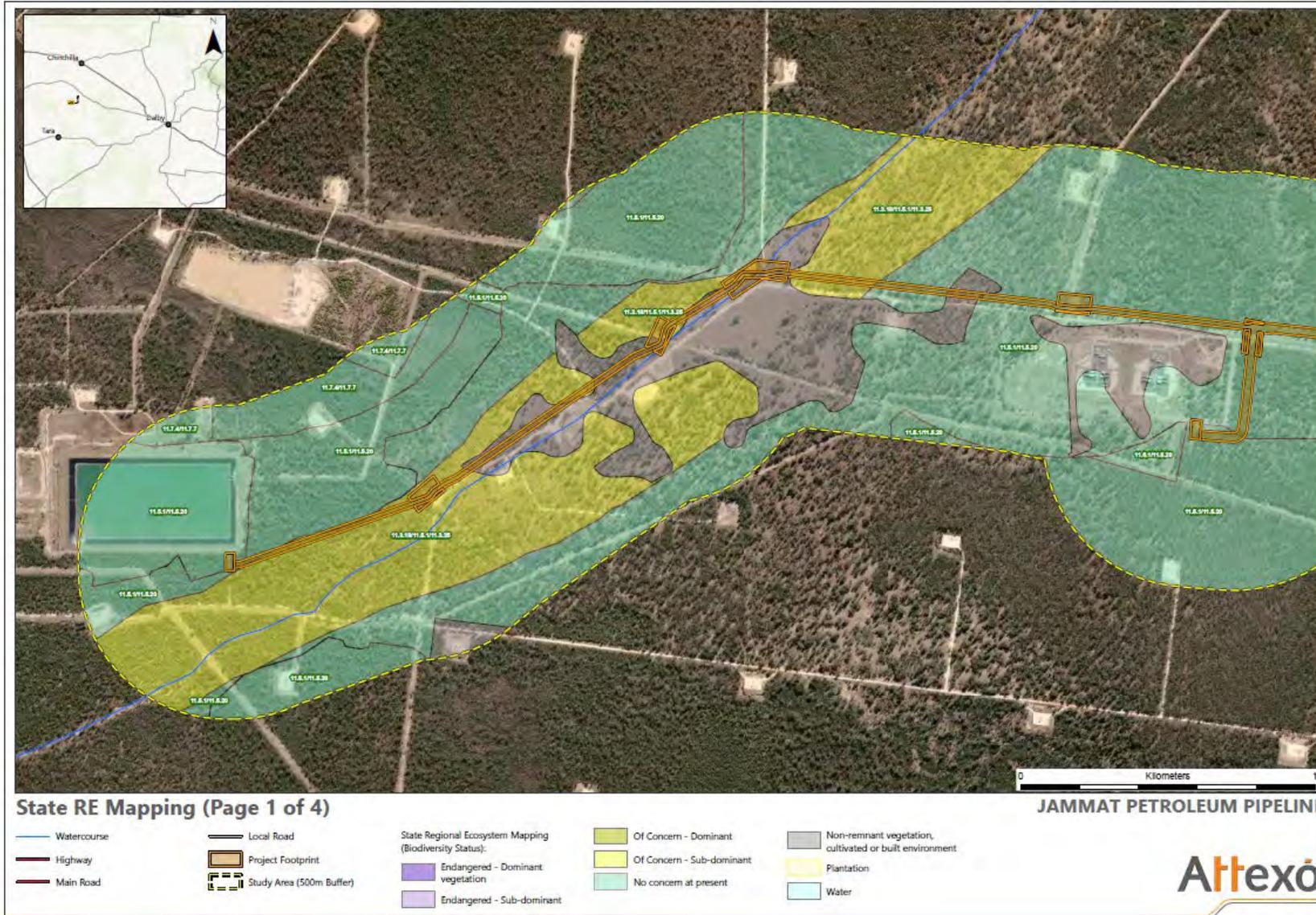
5.2.1 Vegetation communities

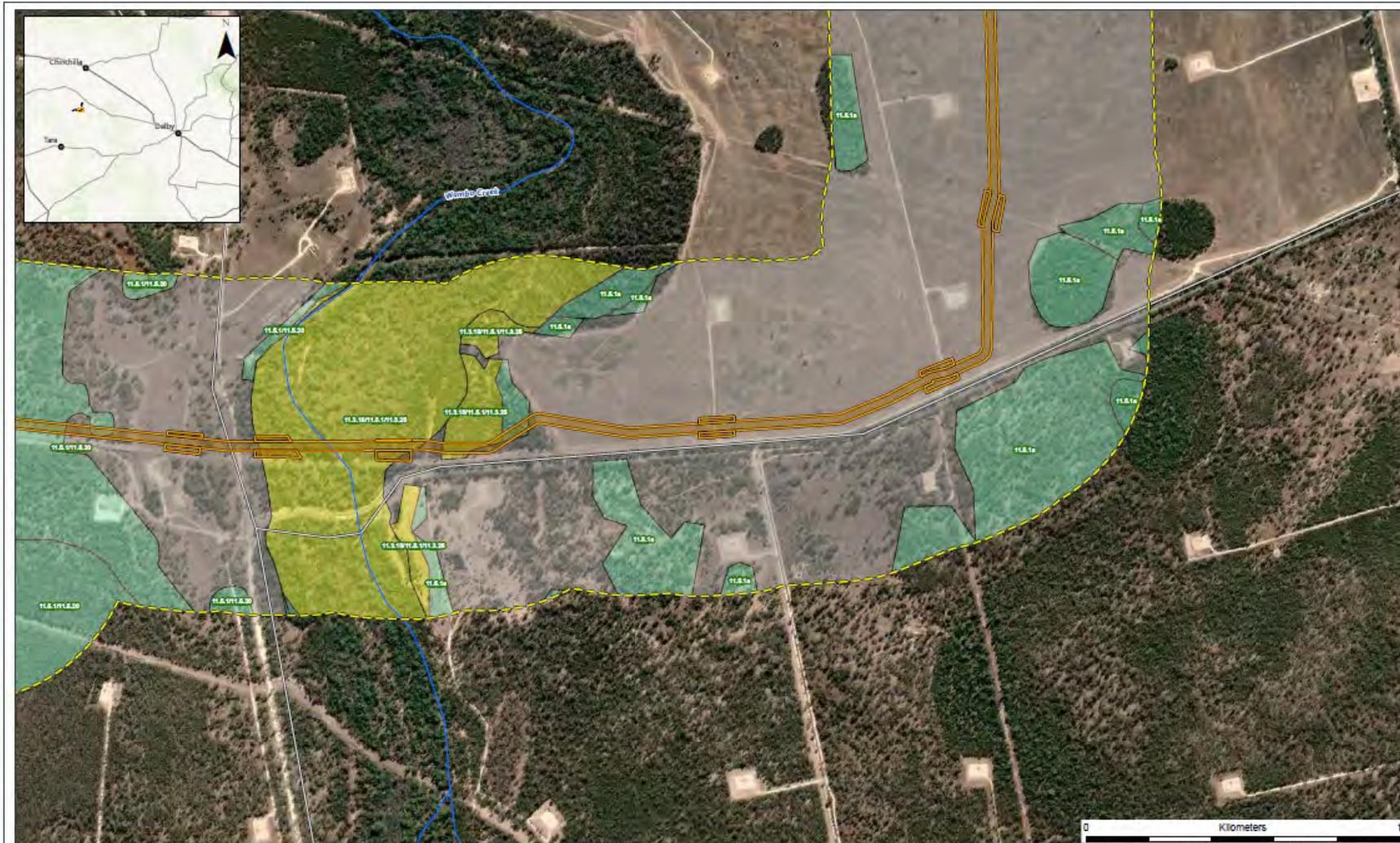
Current vegetation mapping prepared by the DoR identifies nine REs (comprising remnant vegetation communities) in the Study area Figure 5-5. Descriptions and total areas of these mapped REs have been provided in Table 5-2 and include two REs classified as ‘Endangered’ and seven REs classified as ‘Least concern’.

Table 5-2: State Regional Ecosystem mapping by VM Act Status

Land zone	RE Code	Description	Occurrence in Study area (ha)
Least Concern (Remnant)			
3 – Quaternary alluvial plains	11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	69.6
	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	34.8
5 – Cainozoic sandy plains and plateaus	11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	300.4
	11.5.1a	<i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer. Occurs on flat to gently undulating plains formed from weathered sandstones. Duplex soils with sandy surfaces.	60.6
	11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland to open forest on Cainozoic sand plains.	98.9
7 – Cainozoic duricrusts	11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	10.5
	11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust	7.0
Endangered (remnant)			
4 – Tertiary-early Quaternary clay plains	11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	4.2
9 – Fined grained sedimentary rocks	11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	19.3
Subtotal (remnant)			605.3
Non-remnant			815.5
Total			1420.9

Figure 5-5: State RE Mapping



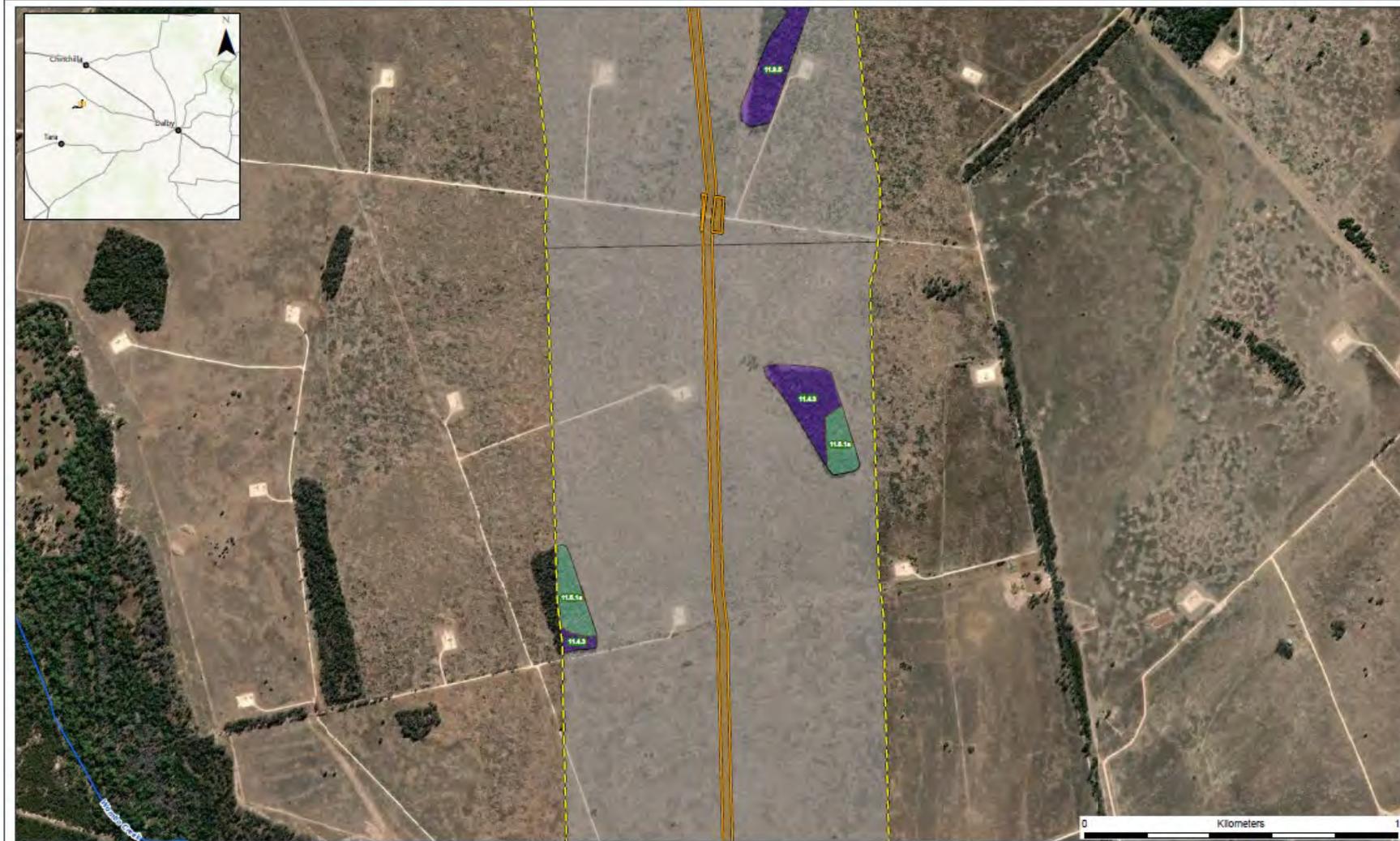


State RE Mapping (Page 2 of 4)

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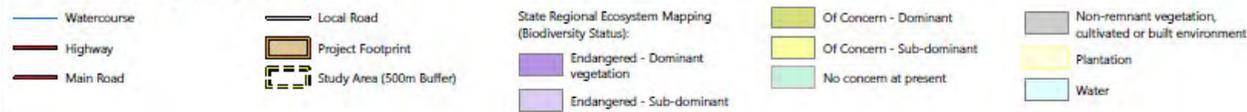
- | | | | | |
|-------------|--------------------------|---------------------------------------------------------|---------------------------|---------------------------------------------------------|
| Watercourse | Local Road | State Regional Ecosystem Mapping (Biodiversity Status): | Of Concern - Dominant | Non-remnant vegetation, cultivated or built environment |
| Highway | Project Footprint | Endangered - Dominant vegetation | Of Concern - Sub-dominant | Plantation |
| Main Road | Study Area (500m Buffer) | Endangered - Sub-dominant | No concern at present | Water |

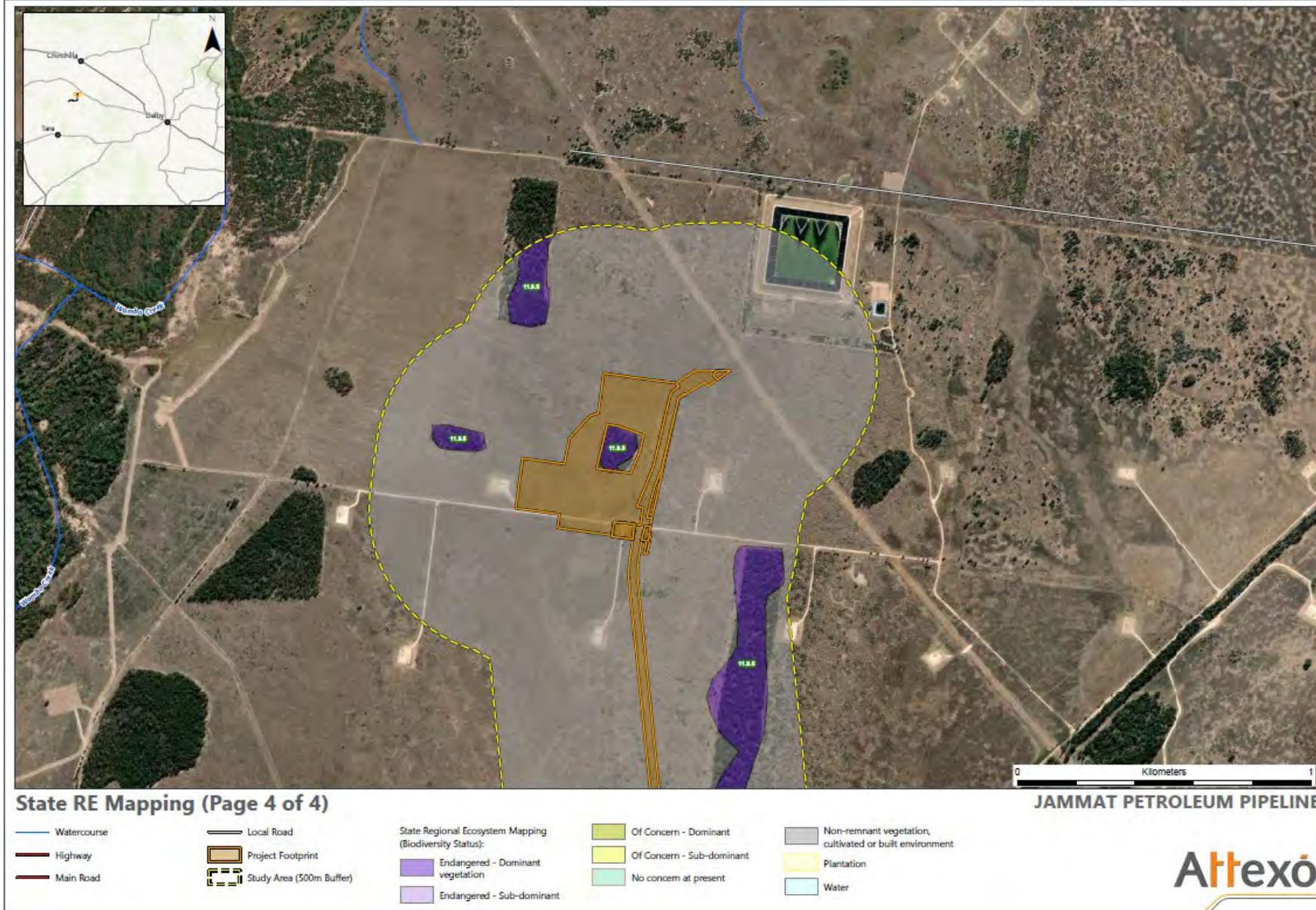




State RE Mapping (Page 3 of 4)

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5.2.1.1 Field-verified Regional Ecosystems

GTRE mapping prepared for the Study area has been based on the consolidated survey efforts undertaken across the Project footprint by CHEC Environmental and Arrow Ecologists from 2021 and 2024. These surveys are discussed in Appendix B and the GTRE mapping (by Biodiversity Status) has been shown on Figure 5-6.

Of the nine (9), REs originally mapped by the DoR for the Study area, seven were confirmed to be present within the Study area (Table 5-3). One RE 11.5.4 was not mapped by DoR and two REs which were mapped under DoR but were not found in the Study area during ecological surveys including, RE 11.9.5 (Endangered) and RE 11.9.7 (Of Concern). In total seven REs were confirmed, with six REs classified as 'Least Concern', one RE classified as 'Endangered', and five REs classified as regrowth vegetation.

Table 5-3: Ground-truthed Regional Ecosystems by Biodiversity Status

Land zone	RE Code	Description	Occurrence in Study area (ha)
Least Concern (Remnant)			
3 – Quaternary alluvial plains	11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium.	22.5
5 – Cainozoic sandy plains and plateaus	11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces.	115.1
	11.5.1a	<i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer. Occurs on flat to gently undulating plains formed from weathered sandstones. Duplex soils with sandy surfaces.	23.9
	11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> woodland. Occasional canopy species may include <i>A. floribunda</i> and <i>E. crebra</i> or <i>E. rhombica</i> . A low tree layer is usually present that includes species such as <i>Allocasuarina luehmannii</i> , <i>A. inophloia</i> and <i>Callitris endlicheri</i> . Occurs on Cainozoic plains with deep sandy soils.	24.0
	11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains.	289.1
Of Concern (Remnant)			
3 – Quaternary alluvial plains	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.	18.7
Endangered (Remnant)			
4 – Tertiary clay plains	11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	31.7
Subtotal remnant			525.0
Least Concern (Regrowth vegetation)			

Land zone	RE Code	Description	Occurrence in Study area (ha)
5 – Cainozoic sandy plains and plateaus	11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces.	24.3
	11.5.1a	<i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer. Occurs on flat to gently undulating plains formed from weathered sandstones. Duplex soils with sandy surfaces.	25.7
	11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> woodland. Occasional canopy species may include <i>A. floribunda</i> and <i>E. crebra</i> or <i>E. rhombica</i> . A low tree layer is usually present that includes species such as <i>Allocasuarina luehmannii</i> , <i>A. inophloia</i> and <i>Callitris endlicheri</i> . Occurs on Cainozoic plains with deep sandy soils.	2.4
	11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains.	11.4
Endangered (Regrowth vegetation)			
4 – Tertiary to early Quaternary clay plains	11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains.	0.2
Other regrowth vegetation			
Undifferentiated regrowth			0.5
Subtotal Regrowth vegetation			64.4
Non-remnant			33.9
Cleared			724.7
Pasture/grazing			71.2
Derived grassland			2.6
Total			1421.8

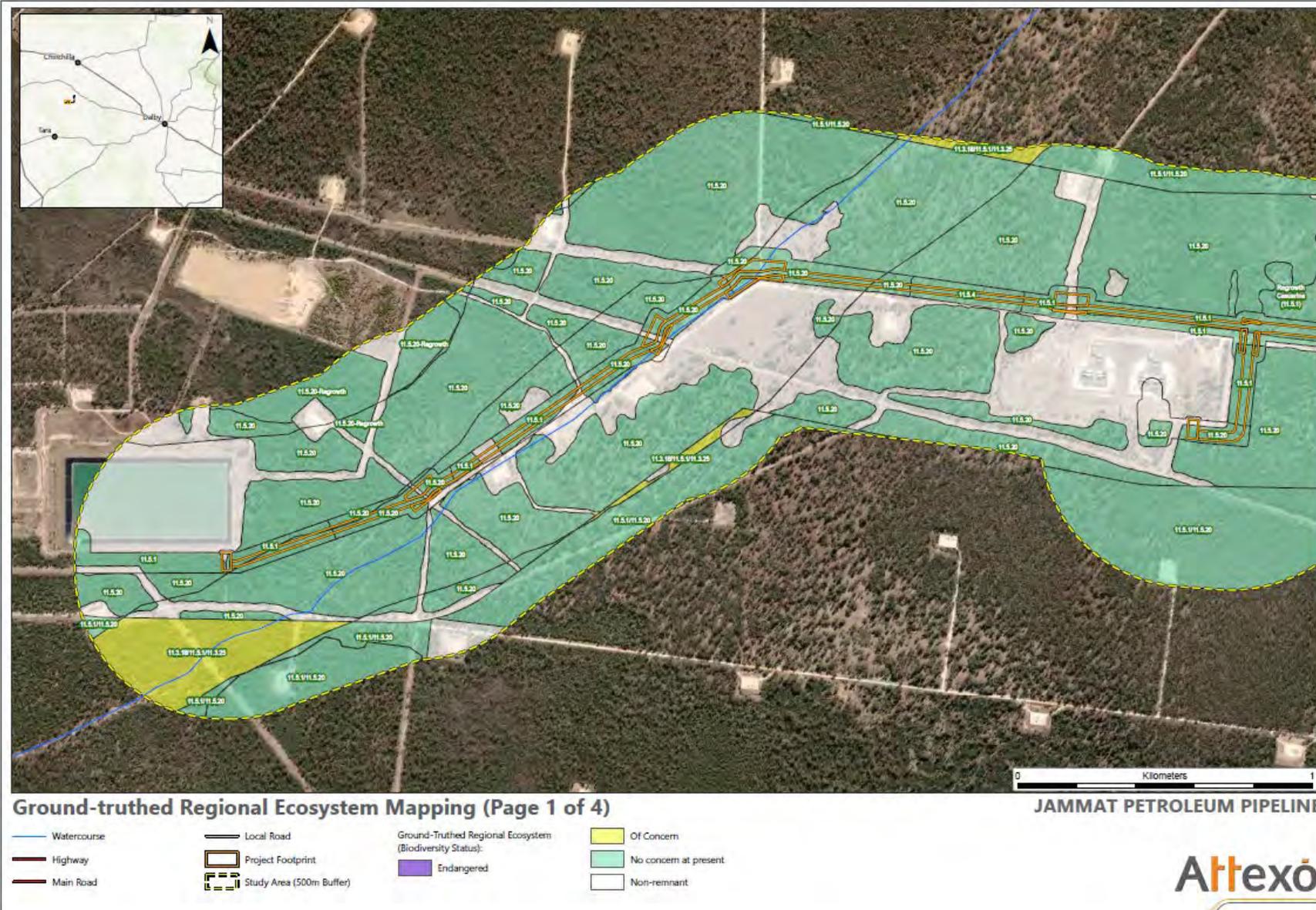
5.2.2 Conservation-significant flora

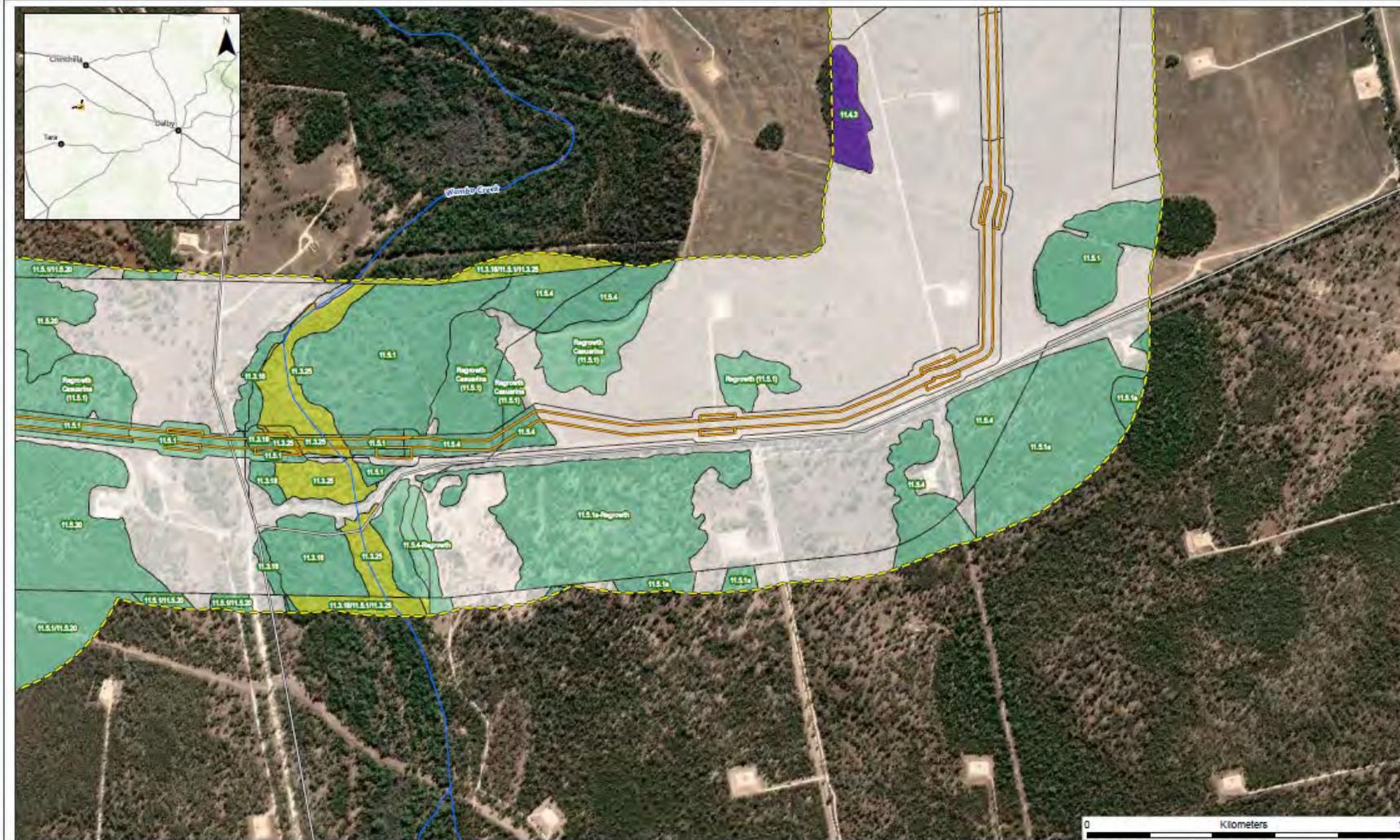
Ecological surveys of the Study area have been undertaken by CHEC Environmental in October 2024. No conservation significant flora species were identified. Refer to Appendix C for the PEC reports for the October 2024 ecological surveys. A map showing the location of all conservation significant flora records in the vicinity of the Study area is provided in Figure 5-7.

5.2.3 Protected plants trigger map

There are no 'high risk' areas shown on the Protected Plants Flora Survey Trigger Map within the Study area.

Figure 5-6: Ground-truthed Regional Ecosystem mapping





Ground-truthed Regional Ecosystem Mapping (Page 2 of 4)

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- | | | | |
|-------------|--------------------------|----------------------------------------------------------|-----------------------|
| Watercourse | Local Road | Ground-Truthed Regional Ecosystem (Biodiversity Status): | Of Concern |
| Highway | Project Footprint | | No concern at present |
| Main Road | Study Area (500m Buffer) | Endangered | Non-remnant |





Ground-truthed Regional Ecosystem Mapping (Page 3 of 4)

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- | | | | |
|-------------|--------------------------|----------------------------------------------------------|-----------------------|
| Watercourse | Local Road | Ground-Truthed Regional Ecosystem (Biodiversity Status): | Of Concern |
| Highway | Project Footprint | | No concern at present |
| Main Road | Study Area (500m Buffer) | Endangered | Non-remnant |



Ground-truthed Regional Ecosystem Mapping (Page 4 of 4)

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- | | | | |
|-------------|--------------------------|----------------------------------------------------------|-----------------------|
| Watercourse | Local Road | Ground-Truthed Regional Ecosystem (Biodiversity Status): | Of Concern |
| Highway | Project Footprint | | No concern at present |
| Main Road | Study Area (500m Buffer) | Endangered | Non-remnant |

Figure 5-7: Conservation significant flora species records



5.3 Description of environmental values – terrestrial fauna

5.3.1 Habitat types and condition

The Study area is dominated by eucalypt woodland habitats on depositional plains and low ridges west of Wambo Creek and gilgaied clay plains with isolated patches of Brigalow to the east. These eucalypt vegetation communities are found on soils of low fertility, with REs associated with land zone 5 forming the largest and most continuous tracts of vegetation within both the Study area and broader SGP. Most of these areas have been impacted by logging activities (either broadscale or selective). The northern portion of the Study area has been almost completely cleared to support pastoral activities, however several discrete patches of brigalow vegetation (RE 11.4.3) have been retained within these areas. Additionally, the Project is located within an area of existing CSG infrastructure.

The vegetation communities that have been ground-truthed across the Study area (Figure 5-6) represent the following broad habitat types:

- Eucalypt woodlands to open forests: Several eucalypt communities have been identified within the Study area, including RE 11.5.1, RE 11.5.1a, RE 11.5.4 and RE 11.5.20. This habitat type represents approximately 36.3% of the total Study area (Plate 1). Of these communities RE 11.5.20 and RE 11.5.1 are the most abundant communities and are dominated by grey box (*Eucalyptus moluccana*), narrow-leaved ironbark (*E. crebra*) and poplar box (*E. populnea*). Regrowth patches of these communities have also been incorporated into this habitat type.
- Riparian woodlands: Two eucalypt woodland communities were identified along mapped watercourses within the Study area, including RE 11.3.18 and RE 11.3.25. This habitat type represents approximately 2.9% of the total Study area (Plate 2). These communities are dominated by forest red gum (*E. tereticornis*) and poplar box. No regrowth communities were identified within the Study area.
- Acacia woodlands: Several isolated patches of RE 11.4.3 dominated by brigalow (*Acacia harpophylla*) have also been identified within the study area. These patches represent approximately 2.2% of the total Study area (Plate 3) and are restricted to the eastern northern portion of the Project.
- Cleared and/or non-remnant: The remaining areas within the Study area have been described as cleared and/or non-remnant. This habitat type represents approximately 58.5% of the total Study area (Plate 4). Whilst these areas contain no little to no vegetation, they do contain large areas of highly disturbed gilgai.



Plate 1: Example of the eucalypt woodland to open forest habitat type



Plate 2: Example riparian woodlands habitat type



Plate 3: Example Acacia woodland habitat type



Plate 4: Example cleared and/or non-remnant habitat type (with gilgai)

5.3.2 Watercourses

Major watercourses are important landscape elements which act as significant migratory and dispersal pathways for many fauna species, contain important habitat resources (including food, water, sheltering, roosting and nesting sites) as well as provide refugia during periods of drought. Unlike other parts of the Brigalow Belt bioregion where waterways often provide the only remaining landscape connectivity, the Study area retains a significant amount of native vegetation and landscape connectivity. Despite this, the major creek system (Wambo Creek) identified within the Study area does represent habitat that are often less impacted by historical clearing and are more likely to contain large trees due to their position in the landscape (Plate 5).

The drainage in the Study area generally flows in a northerly direction, eventually draining into the Condamine River. Whilst Wambo Creek is the only major creek system in the Study area, there are also several tributaries of Sixteen Mile Creek that occur in the eastern portion of the Study area. Whilst the portion of Wambo Creek that intersects with the Project area is a stream order 4 watercourse, it is also ephemeral and only likely to contain water following substantial rainfall events. This watercourse is buffered by riparian vegetation (RE 11.3.25). This watercourse is also mapped as a State significant terrestrial biodiversity corridor as shown in Figure 5-1.



Plate 5: Wambo Creek looking downstream of main channel from centre of RoW

5.3.3 Wetlands

Whilst there are no wetlands of high ecological significance mapped within the Study area.

5.3.4 State Forests

There are no state forests in the Study area.

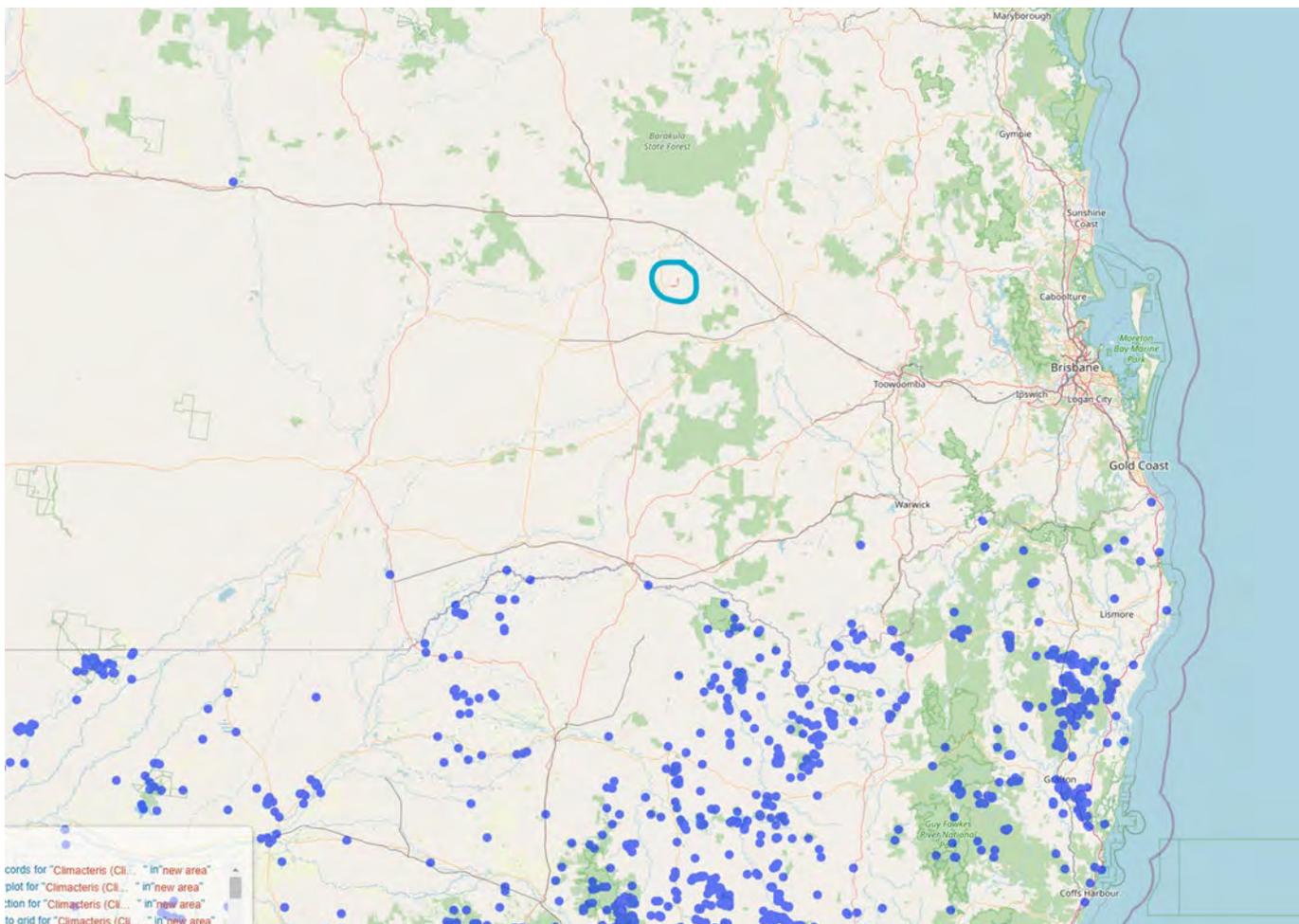
5.3.5 Conservation-significant fauna

Of the 34 species initially considered as part of the LoOM assessment as potentially occurring within the Study area, 10 species were ultimately identified as 'known to occur' or 'likely to occur' based on the proximity to nearby records and the availability of suitable microhabitat features within the Study area (refer to Appendix B for the individual PEC reports). The records of known or likely to occur species are shown on

Figure 5-8. Whilst the short-beaked echidna (*Tachyglossus aculeatus*) was not considered during these PEC assessments, Arrow have included this species in this preliminary shortlist based on their experience with similar Projects in the region.

Following a more detailed review of the review of (recently listed – March 2023) brown treecreeper (south-eastern) (*Climacteris picumnes victoriae*) and in undertaking an SRI assessment it was determined that the listed subspecies of brown treecreeper, *Climacteris picumnes victoriae*, is **Unlikely to Occur** in the Study area. The justification for this update is provided below:

- the Study area is located outside the distribution of this subspecies (refer to the map below with records of the listed subspecies). The south-eastern subspecies is the only one listed under the EPBC Act or NC Act and its distribution appears to be confined to the Queensland-New South Wales border (with the exception of a few extraneous and disjunct records). In contrast there are records of other brown treecreeper subspecies throughout Queensland and within the Study area (1 record was observed within the Study area). See below for distribution records for the listed subspecies of brown treecreeper, *Climacteris picumnes victoriae*.



The 'known to occur' and 'likely to occur' species have been summarised in Table 5-4, with nearby records and habitat mapping for this species been shown on Figure 5-9, Figure 5-10, Figure 5-11 and Figure 5-12. For the purposes of this report, whilst microhabitat data collected from the surrounding areas was used to make these determinations, habitat for these 'known to occur' and 'likely to occur' species has been mapped within the disturbance footprint and surrounds. Species that were assessed as 'unlikely to occur' or 'potentially occurring' within the Study area have not been considered further in this report and are

not a PEM (under the EO Act) for the Project. The following sections provide a broad overview of the ecology for these species.

Table 5-4: Summary of fauna species known or likely to occur in the Study area

Fauna Species	EPBC Act Status ¹	NC Act Status ²	Likelihood of Occurrence & Rationale
Bird Species			
diamond firetail (<i>Stagonopleura guttata</i>)	V	V	Likely to Occur. Nearby historical record was identified approximately 7 km to north-east. Study area intersects patch of suitable habitat for this species.
glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>)	V	V	Likely to Occur. Potential foraging resources (<i>Casuarina spp</i>) and large hollow bearing trees were observed within the Study area.
white-throated needletail (<i>Hirundapus caudacutus</i>)	V, Mi, Ma	V	Likely to Occur. As this is a flyover species, the entire Study area was identified as suitable habitat for this species.
Invertebrate Species			
brigalow woodland snail (<i>Adclarkia cameroni</i>)	E	E	Likely to Occur. Microhabitat features for this species including decaying logs, woody debris, leaf litter, and dense overstorey cover of shrubs and trees were observed within the Study area. These could provide suitable feeding and breeding habitat for this species.
Mammal Species			
Greater Glider (southern and central) (<i>Petauroides volans</i>)	E	E	Likely to Occur. Diverse and abundant food resources identified for this species within riparian vegetation along Wambo Creek.
Koala (<i>Phascolarctos cinereus</i>)	E	E	Likely to Occur. Suitable riparian vegetation (dominated by <i>Eucalyptus tereticornis</i>) was identified along Wambo Creek. This large tract of intact vegetation is located within 1 km of a permanent water source.
Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	-	SLC	Likely to Occur. Short-beaked echidnas can utilise a wide range of habitat types and are well known from the border SGP Project area.
Reptile Species			
Dunmall's snake (<i>Furina dunmalli</i>)	V	V	Likely to Occur. Microhabitat features for this species including soil cracks, woody debris, leaf litter, and dense overstorey cover of shrubs and trees were observed within the Study area.
Grey Snake (<i>Hemiaspis damelii</i>)	E	E	Likely to Occur. Microhabitat features for this species including, heavy clay soils with cracks in gilgai (within <1 km of permanent water), woody debris, leaf litter and dense overstorey cover of shrubs and trees were observed within the Study area.
Golden-tailed Gecko (<i>Strophurus taenicauda</i>)	-	NT	Known to Occur. Recent (>20 years) historical records have been identified near to the Study area. Suitable

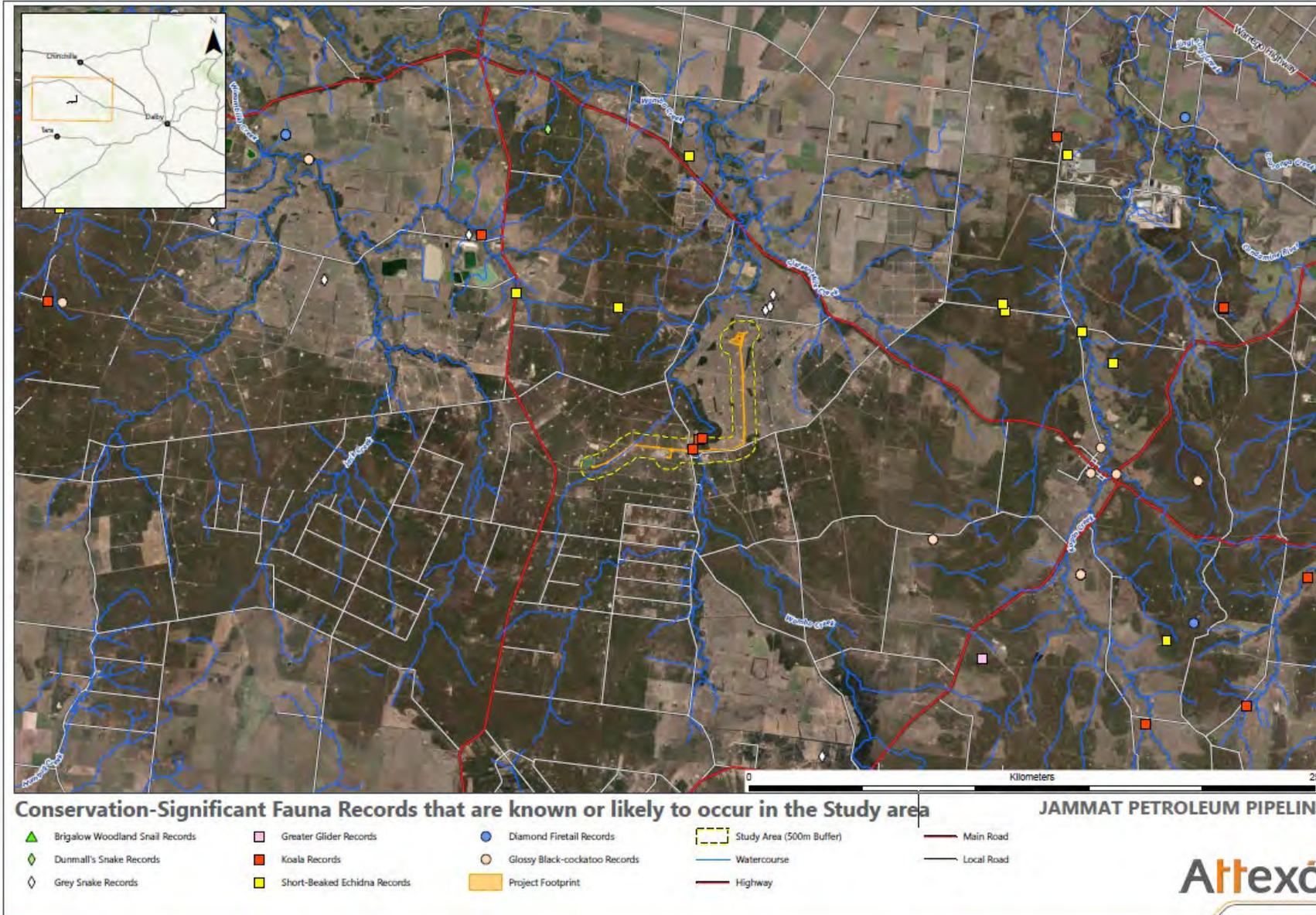


Fauna Species	EPBC Act Status ¹	NC Act Status ²	Likelihood of Occurrence & Rationale
			habitat (trees with loose/peeling bark) was common throughout the Study area.

¹ EPBC Act Status: E = Endangered, V = Vulnerable, Mi = Migratory, Ma = Marine

² NC Act Status: E = Endangered, V = Vulnerable, NT = Near Threatened, SLC = Special Least Concern

Figure 5-8: Conservation-significant fauna records that are known likely to occur in the Study area



5.3.5.1 Diamond Firetail (*Stagonopleura guttata*)

Diamond firetails occur on the south-east mainland of Australia from south-east Queensland to Eyre Peninsula, South Australia, and about 300 km inland from the sea (Appendix B). Their range once extended to north Queensland inland from Cardwell, but they now occur only in the very south of the state. They have also disappeared from many of the more settled parts of New South Wales, Australian Capital Territory and Victoria, and birds in South Australia appear to have been separated into three isolated subpopulations.

This species occurs in eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats, including farmland and grassland with scattered trees (Appendix B). They typically prefer areas with relatively low tree density, few large logs, and little litter cover but high grass cover. They occur in flocks of between 5 to 50 and occasionally more. Whilst they are thought to be sedentary, some populations move locally. They predominantly feed at ground level, on ripe and partly ripe grass seeds, herb seeds, green leaves and on insects. The nearest (dated) record to the Project is approximately 36 km to the south-east (Appendix B).

Most of the eucalypt woodland communities mapped within the Study area have been identified as suitable habitat for this species. Suitable habitat for this species has been shown on Figure 5-9.

5.3.5.2 Glossy Black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*)

South-eastern glossy black-cockatoos widespread and can be found from Mitchell, Queensland, through eastern New South Wales to East Gippsland, Victoria (Appendix B). Their distribution is continuous through the forested parts of the Great Dividing Range but becomes more scattered inland, to as far west as the Riverina in New South Wales.

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*. 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. Stands of *Allocasuarina* are not, therefore, of uniform value and the loss of individual stands or trees can have disproportionate impacts. Although an *Allocasuarina* species, *A. luehmannii*, has small seeds and is infrequently used (Appendix B). The nearest historical record of this species to the Study area is approximately 9.5 km to the south-east (Appendix B).

Within the Study area, suitable habitat for this species has been mapped within patches of RE 11.4.3 containing *belah* (*Casuarina cristata*) and is shown on Figure 5-9.

5.3.5.3 White-throated Needletail (*Hirundapus caudacutus*)

The White-throated Needletail is widespread in eastern and south-eastern Australia where it has been recorded in all coastal regions of QLD and NSW, extending inland to the western slopes of the Great Dividing Range and occasionally into the adjacent inland plains (Appendix B). The breeding distribution of this species is fragmented, with two subspecies occurring in different parts of Asia. The nominate subspecies (*H.c. nudipes*) breeds from south-western China to northern Pakistan and is largely resident. Individuals found in Australia all belong to the *H.c. caudacutus* subspecies which are non-breeding migrants to Australia.

In Australia, the White-throated Needletail is mostly aerial, from heights of less than 1 m to up to more than 1,000 m (Appendix B). They are known to forage over most habitat types however, they are most often recorded above wooded areas including open forest and rainforest. They have also been recorded

foraging above farmland, cleared pasture, plantations and remnant vegetation at the edge of paddocks. Whilst this species spends most of their time on the wing, they are known to roost in trees amongst dense foliage in the canopy or in hollows. During the non-breeding season in Australia, this species has been recorded eating a wide variety of insects. The nearest historical record was identified approximately 3 km to the north-west (Appendix B).

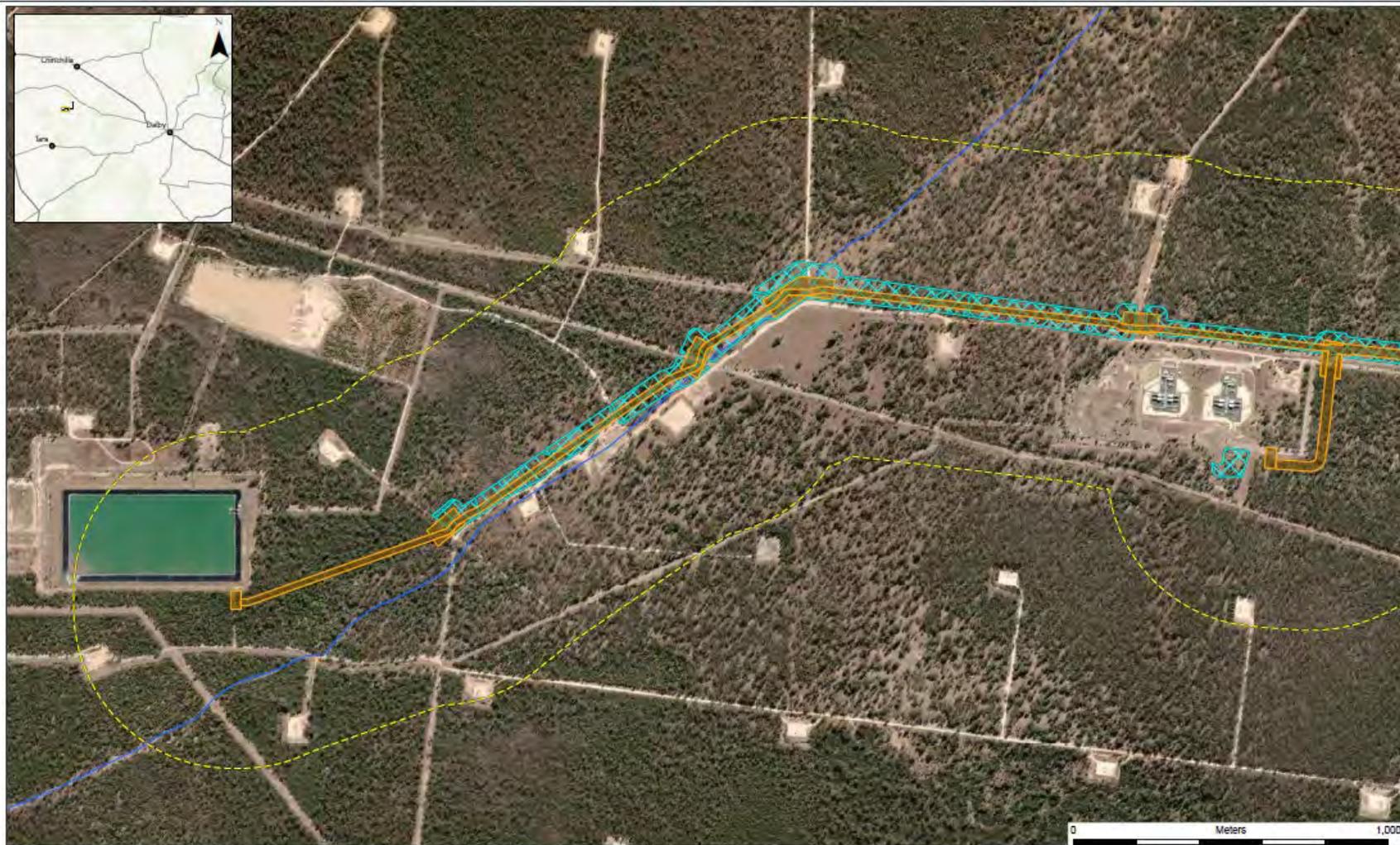
Most of the Study area has been identified as suitable habitat for this species, and as such habitat has not been mapped for this species.

5.3.5.4 Brigalow Woodland Snail (*Adclarkia cameroni*)

The Brigalow Woodland Snail is part of the family Camaenidae and is a medium-sized species characterised by a somewhat flattened shell, with rounded and tightly coiled whorls, the last of which is flared (Appendix B). This species is endemic to southeast Queensland, where it occurs in a small number of remnant and scattered *Acacia harpophylla* and eucalypt woodland patches (commonly along road verges and riparian corridors) along the Condamine River floodplain, especially in the area around Dalby and Chinchilla (Appendix B).

The current distribution of this species is severely fragmented. The Brigalow communities within the Condamine River floodplain (located to the north of the Study area) that were once contiguous throughout the species' historical distribution have been extensively cleared to support agricultural and pastoral activities (Appendix B). The current distribution of this species along the floodplain (from approximately 17 km south of Dalby to around Miles), reflects this broad scale clearing (Appendix B). The nearest recorded individual to the Study area is located approximately 1 km to the north-east. Suitable habitat for this species has been mapped within patches of RE 11.4.3 as shown on Figure 5-10.

Figure 5-9: Conservation-significant fauna records (birds)



Conservation-Significant Fauna Records (Birds) (Page 1 of 4)

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- Diamond Firetail Records
- Glossy Black-cockatoo Records
- Watercourse
- Highway
- Main Road
- Local Road
- Study Area (500m Buffer)
- Project Footprint
- Diamond Firetail Habitat
- Glossy Black Cockatoo Habitat

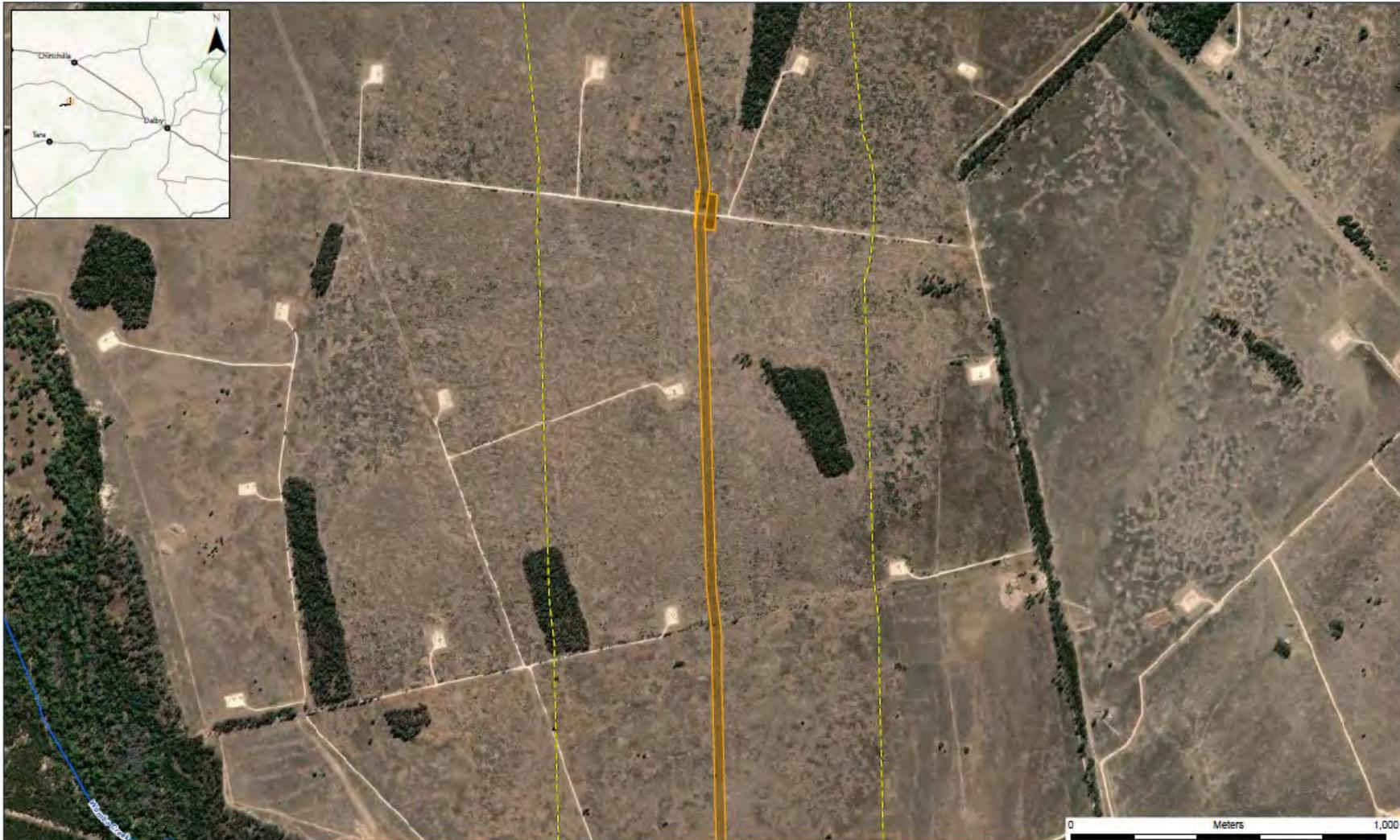


Conservation-Significant Fauna Records (Birds) (Page 2 of 4)

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|-------------------------------|--------------------------|-------------------------------|
| Diamond Firetail Records | Main Road | Diamond Firetail Habitat |
| Glossy Black-cockatoo Records | Local Road | Glossy Black Cockatoo Habitat |
| Watercourse | Study Area (500m Buffer) | |
| Highway | Project Footprint | |



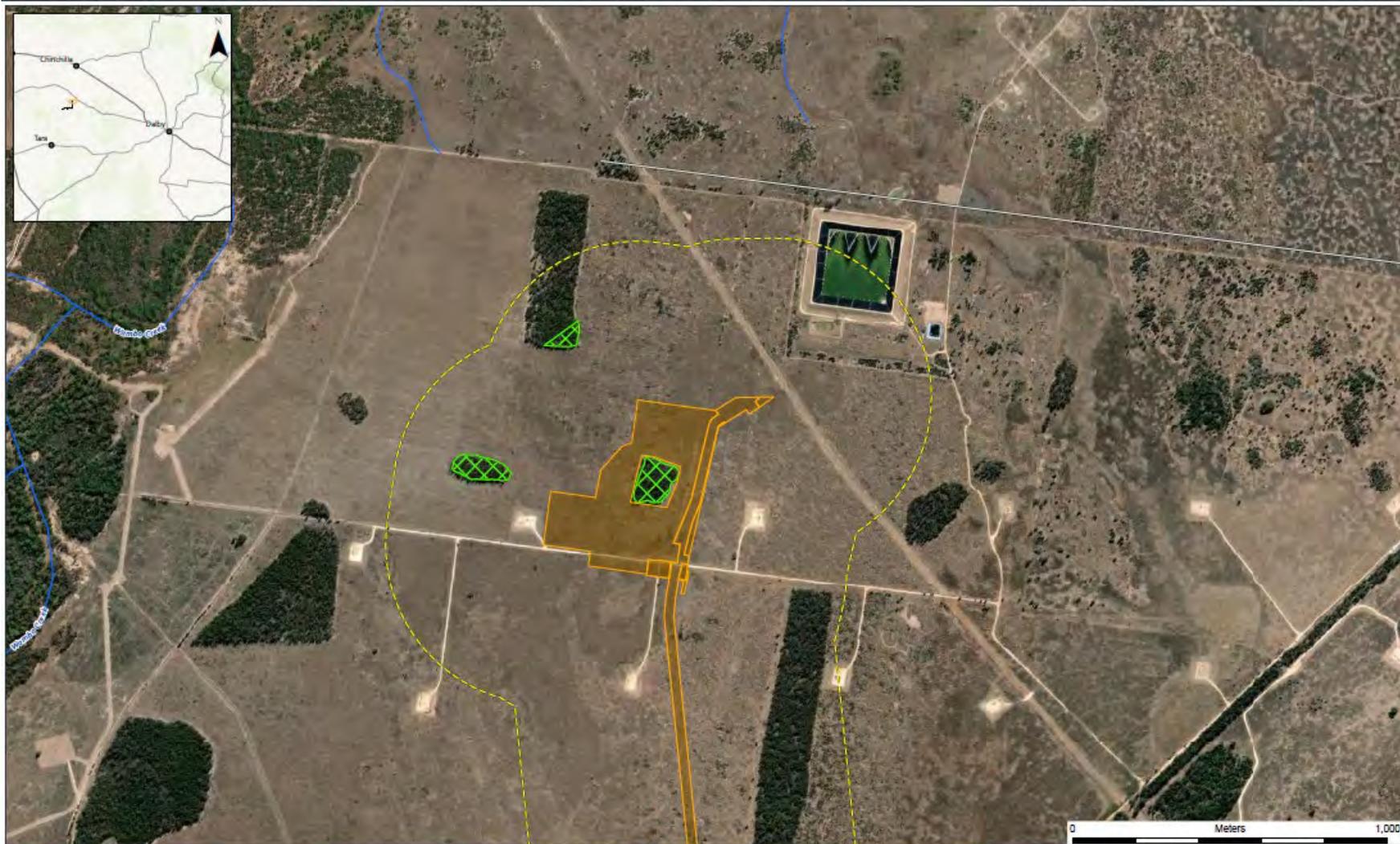


Conservation-Significant Fauna Records (Birds) (Page 3 of 4)

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- | | | |
|-------------------------------|--------------------------|-------------------------------|
| Diamond Firetail Records | Main Road | Diamond Firetail Habitat |
| Glossy Black-cockatoo Records | Local Road | Glossy Black Cockatoo Habitat |
| Watercourse | Study Area (500m Buffer) | |
| Highway | Project Footprint | |



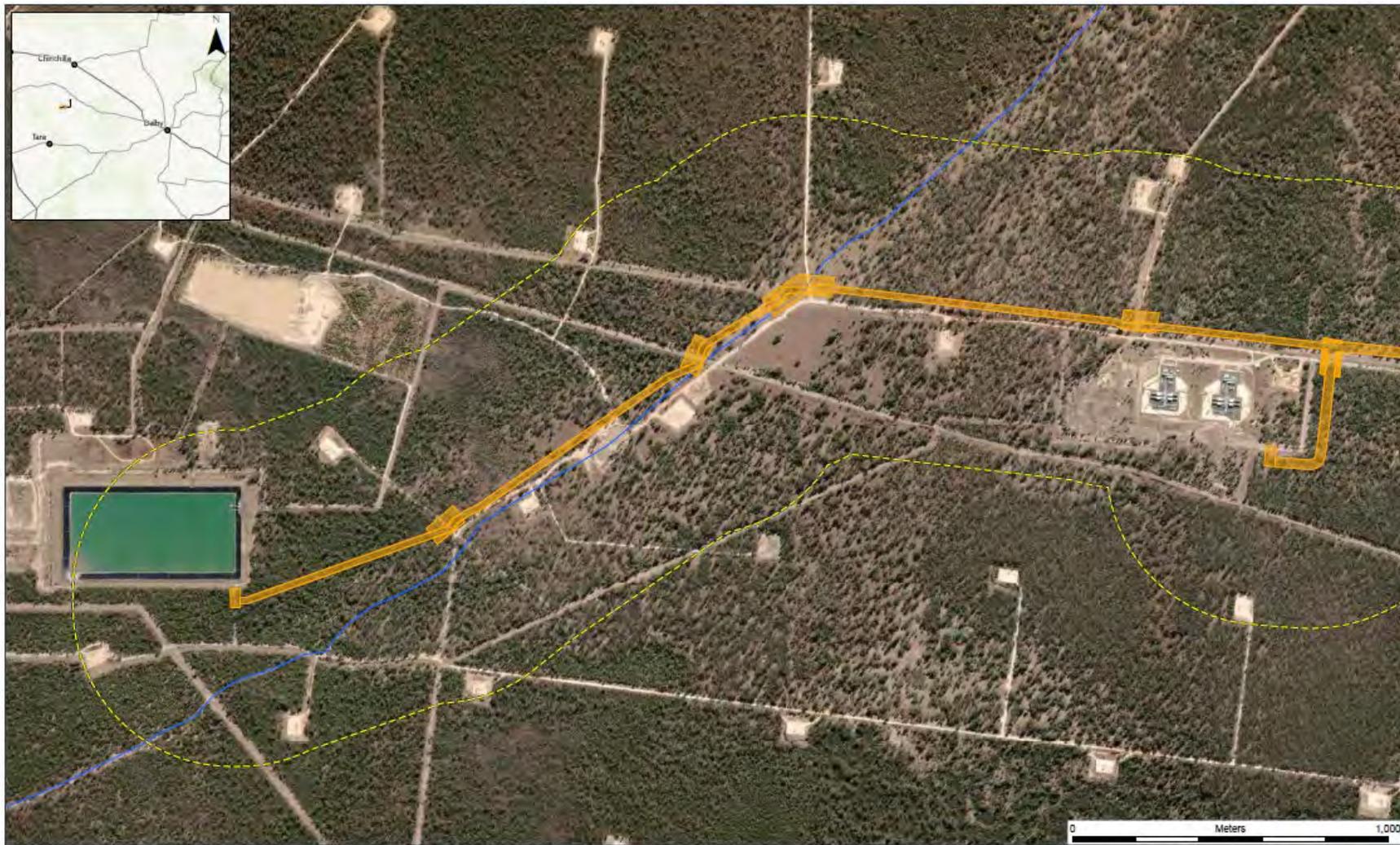


Conservation-Significant Fauna Records (Birds) (Page 4 of 4)

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- | | | |
|-------------------------------|--------------------------|-------------------------------|
| Diamond Firetail Records | Main Road | Diamond Firetail Habitat |
| Glossy Black-cockatoo Records | Local Road | Glossy Black Cockatoo Habitat |
| Watercourse | Study Area (500m Buffer) | |
| Highway | Project Footprint | |

Figure 5-10: Conservation-significant fauna records (invertebrates)



Conservation-Significant Fauna Records (Invertebrates) (Page 1 of 4)

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- Brigalow Woodland Snail Records
- Watercourse
- Highway
- Main Road
- Local Road
- Project Footprint
- Study Area (500m Buffer)
- Brigalow Woodland Snail Habitat

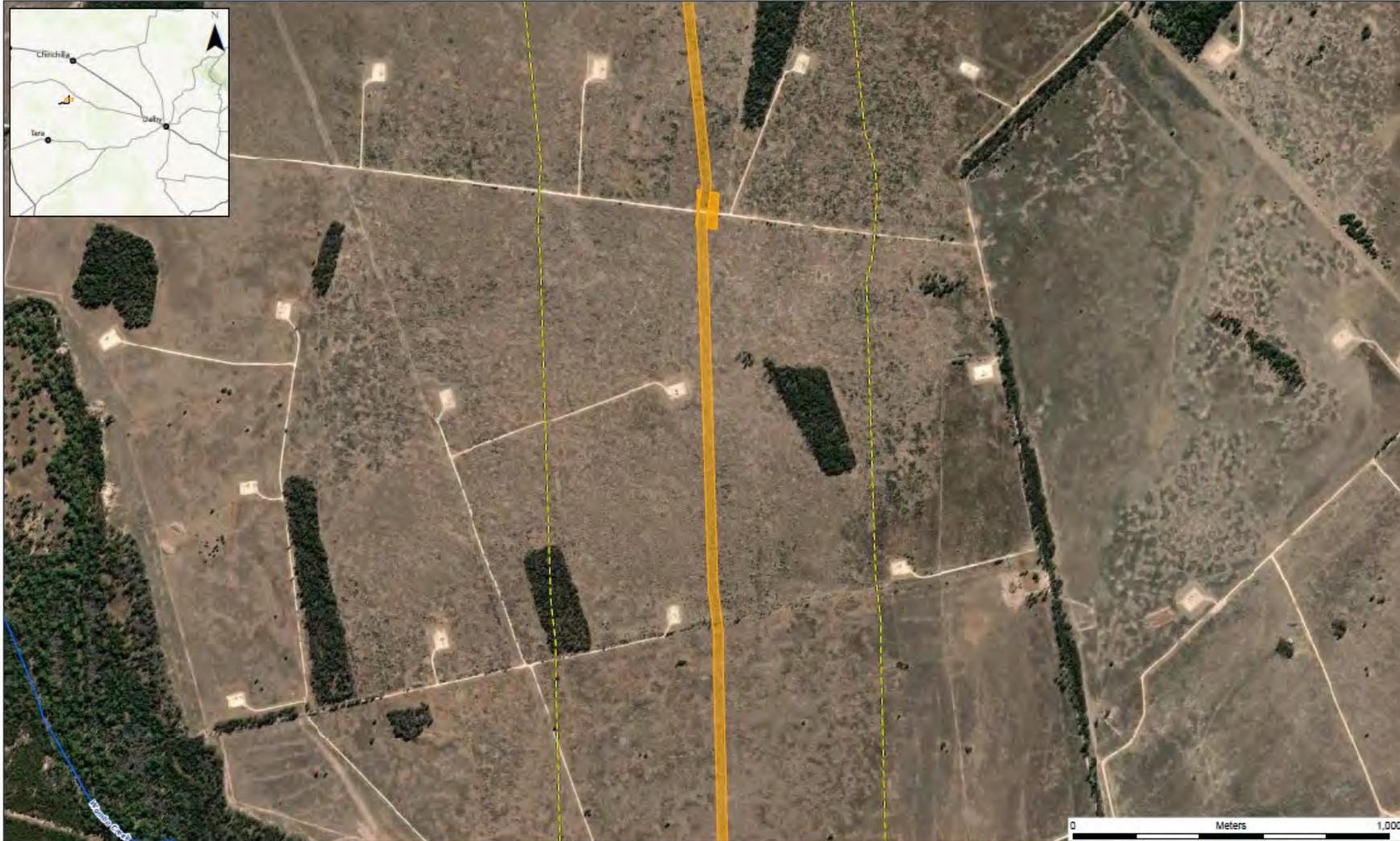


Conservation-Significant Fauna Records (Invertebrates) (Page 2 of 4)

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- Brigalow Woodland Snail Records
- Main Road
- Watercourse
- Local Road
- Highway
- Project Footprint
- Study Area (500m Buffer)
- Brigalow Woodland Snail Habitat





Conservation-Significant Fauna Records (Invertebrates) (Page 3 of 4)

JAMMAT PETROLEUM PIPELINE

- Brigalow Woodland Snail Records
- Main Road
- Local Road
- Highway
- Project Footprint
- Study Area (500m Buffer)
- Brigalow Woodland Snail Habitat





Conservation-Significant Fauna Records (Invertebrates) (Page 4 of 4)

JAMMAT PETROLEUM PIPELINE

- Brigalow Woodland Snail Records
- Main Road
- Study Area (500m Buffer)
- Watercourse
- Local Road
- Brigalow Woodland Snail Habitat
- Highway
- Project Footprint

5.3.5.5 Greater Glider (*Petauroides volans*)

The Greater Glider (southern and central) is the largest gliding possum in eastern Australia where it has a broad distribution from around Proserpine in Queensland, south through New South Wales and the Australian Capital Territory, to Wombat State Forest in central Victoria (Appendix B). This species occurs at elevational ranges from 0 – 1200 m ASL. This subspecies distribution appears to be restricted in the Australian Capital Territory, where the species is only known from the Lower Cotter Catchment and Namadgi National Park.

The Greater Glider is an arboreal nocturnal marsupial, predominantly solitary and largely restricted to eucalypt forests and woodlands of eastern Australia. It is typically found in highest abundance in taller, montane, moist eucalypt forests on fertile soils, with relatively old trees and abundant hollows (Appendix B). During the day this species shelters in tree hollows, with a particular preference for large hollows (diameter M10 cm) in large, old trees. Whilst both live and dead trees can be used for denning, the species prefers live hollow-bearing trees when adequate numbers are available. Multiple dens can be used by the same individual across their home range, which, in Queensland, can range between 4-20. Whilst no greater gliders have been observed within the Study area, historical records in the surrounding landscape suggest that local populations may be present. The nearest record of this species is approximately 14 km to the south-east (Appendix B).

Within the Study area, suitable habitat for this species has been identified along the riparian corridor of Wambo Creek as shown on Figure 5-11.

5.3.5.6 Koala (*Phascolarctos cinereus*)

Koalas are widespread across Queensland, occurring in patchy and often low-density populations across the different bioregions where they inhabit moist coastal forests, southern and central western sub-humid woodlands, and a number of eucalypt woodlands adjacent to waterbodies in the semi-arid western parts of the state (Appendix B).

Closer to the western extent of their distribution, Koalas are often associated with watercourses, though they are not restricted to them (Appendix B). They are not strongly territorial and home ranges will overlap. Home ranges vary in size from 1-2 ha in optimum habitat up to 135 ha in semi-arid regions. Koalas are surprisingly mobile and able to move large distances across artificial (cleared) land. There are no limitations on patch size, and they are also often seen in regrowth vegetation. The abundance of records in non-remnant habitats likely reflect these behaviours with individuals able to utilise isolated trees in an otherwise unsuitable landscape.

Koalas feed on eucalypt 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 on which they preferentially forage (Appendix B). Of these tree species, the following have been recorded in the broader 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*. Numerous historical koala records have been identified within the Study area, the most recent of which was recorded in 2018.

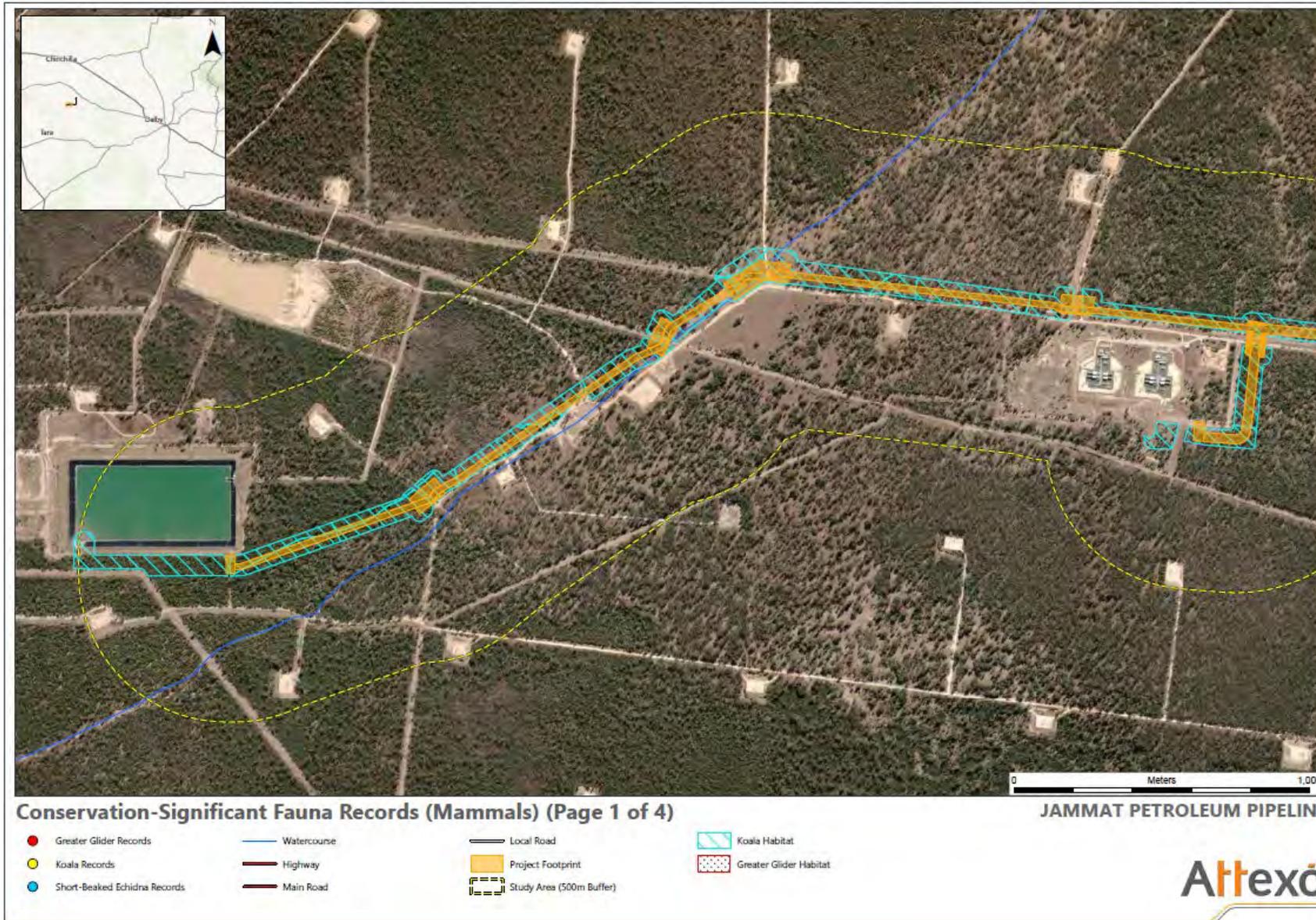
Within the Study area, most remnant and regrowth eucalypt woodlands have been identified as suitable habitat for this species. Habitat mapping for this species has been shown on Figure 5-11.

5.3.5.7 Short-beaked Echidna, (*Tachyglossus aculeatus*)

The short-beaked echidna can be found across most of Australia, where they live in forests and woodlands, heaths, grasslands and arid environments (Appendix B). Considering the broad range of

habitats that the Echidna could occupy, they could occur anywhere across the Study area. For the purposes of this assessment, habitat has been mapped by buffering known records by 1 km as set out in the DETSI *Method for mapping matters of state environmental significance, Version 7*. Whilst several records of the short-beaked echidna have been identified in the surrounding landscape, the nearest record is approximately 5 km to the north-west (Appendix B). Following the guidance outlined in *Method for mapping matters of state environmental significance, Version 7*, there is no mapped habitat for the short-beaked echidna within the Study area.

Figure 5-11: Conservation-significant fauna records (mammals)



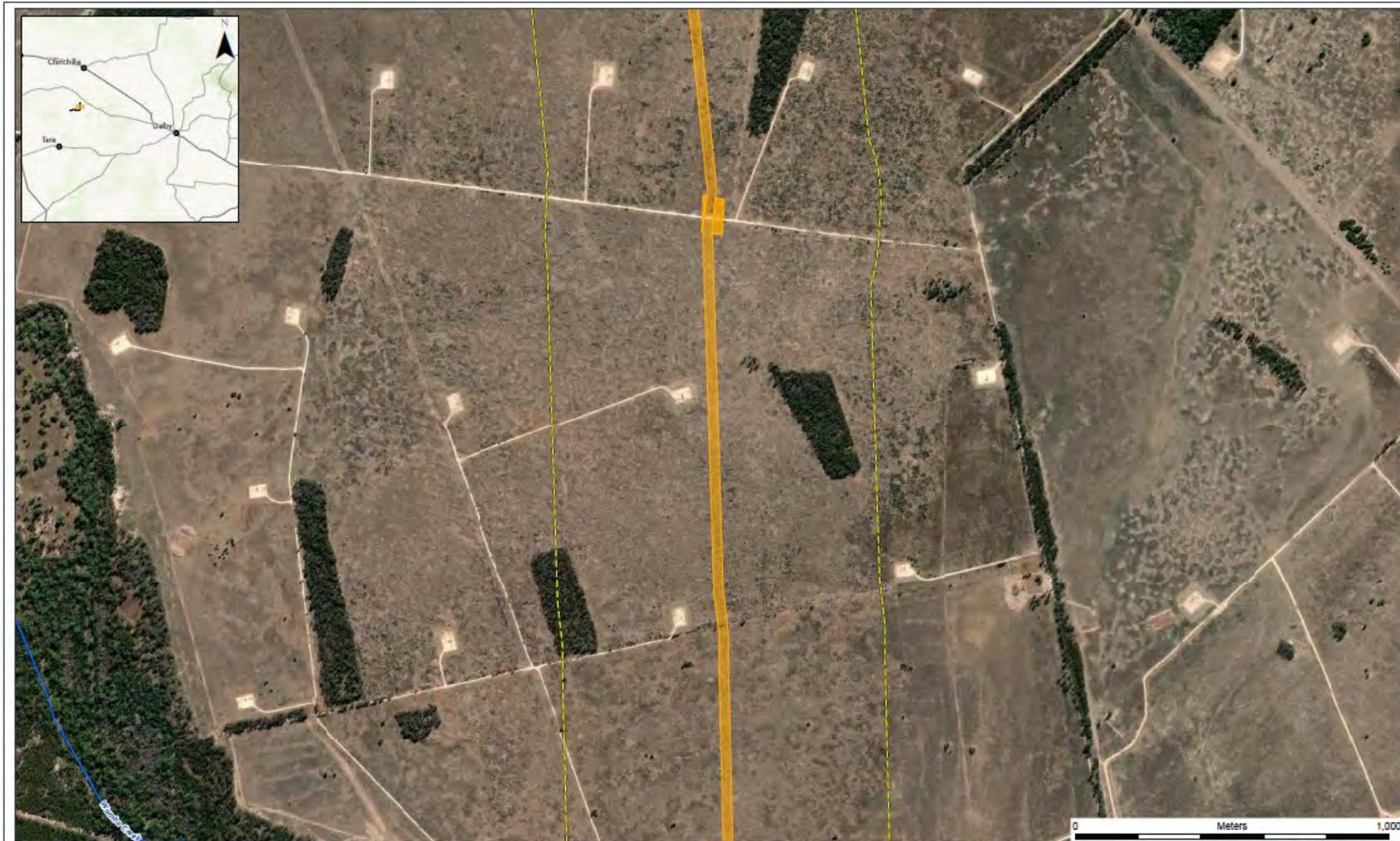


Conservation-Significant Fauna Records (Mammals) (Page 2 of 4)

JAMMAT PETROLEUM PIPELINE

- | | | | |
|------------------------------|-------------|--------------------------|------------------------|
| Greater Glider Records | Watercourse | Local Road | Koala Habitat |
| Koala Records | Highway | Project Footprint | Greater Glider Habitat |
| Short-Beaked Echidna Records | Main Road | Study Area (500m Buffer) | |





Conservation-Significant Fauna Records (Mammals) (Page 3 of 4)

JAMMAT PETROLEUM PIPELINE

- | | | | |
|--------------------------------|---------------|----------------------------|--------------------------|
| ● Greater Glider Records | — Watercourse | — Local Road | ▨ Koala Habitat |
| ● Koala Records | — Highway | ▨ Project Footprint | ▨ Greater Glider Habitat |
| ● Short-Beaked Echidna Records | — Main Road | ▨ Study Area (500m Buffer) | |





Conservation-Significant Fauna Records (Mammals) (Page 4 of 4)

JAMMAT PETROLEUM PIPELINE

- | | | | |
|--------------------------------|---------------|----------------------------|--------------------------|
| ● Greater Glider Records | — Watercourse | — Local Road | ▨ Koala Habitat |
| ● Koala Records | — Highway | ■ Project Footprint | ▨ Greater Glider Habitat |
| ● Short-Beaked Echidna Records | — Main Road | ▭ Study Area (500m Buffer) | |



5.3.5.8 Dunmall's snake (*Furina dunmalli*)

Dunmall's snake is found in central and south-central Queensland and may potentially extend into inland north-eastern New South Wales (Appendix B). In Queensland, its range extends from Yeppoon and the Expedition Range in the north, to Oakey, Glenmorgan and Inglewood in the south. Most locality records are from between 200-500 m in elevation.

This species is typically found in open forest, particularly brigalow (*Acacia harpophylla*) forests and woodlands growing on floodplains of deep-cracking black clay and clay loam soils. Very little is known about this species although it is thought to be uncommon within its limited range (Appendix B). Captive specimens indicate that it is a nocturnal species, sheltering under fallen timber and in deep soil cracks and other cavities. Its diet consists primarily of small skinks and geckos. The nearest Dunmall's snake record to the Study area is approximately 13 km to the north-west (Appendix B).

Within the Study area, suitable habitat for this species was identified within patches of mapped RE 11.4.3. Suitable habitat for this species has been shown on Figure 5-12.

5.3.5.9 Grey Snake (*Hemiaspis damelii*)

Grey snakes potentially occur from southern, inland New South Wales to south-eastern Queensland (Appendix B), however the conservation advice indicates that the occurrence in New South Wales is represented by heavily fragmented, isolated areas, rather than continuous distribution as indicated by the Cogger distribution map (Appendix B). In Queensland, grey snake distribution is more widespread, with a concentration of records of the species along the Macintyre and Condamine Rivers and associated floodplains of the southern Brigalow Belt from Goondiwindi and Dalby west to Glenmorgan on the Darling Downs and western Lockyer Valley. The species has been recorded at two locations within the Study area in the western portion of the Project, with suitable habitat modelled in multiple locations, associated mostly with water features along the length of the Study area.

Grey snakes occur in dry sclerophyll forests and woodlands throughout their range and are normally found under cover during the day but are only partly nocturnal (Appendix B). In Queensland, habitat is specifically in Brigalow (*Acacia harpophylla*) and Belah (*Casuarina cristata*) woodlands on heavy, dark brown to black cracking clay soils, particularly in association with water bodies, areas with small gullies and ditches, and floodplain environments. Logs, rocks and soil cracks provide important cover requirements for the species. Primary prey for this species is frogs, thus the floodplains and ephemeral water features that support the prey are important habitat for Grey Snake. The nearest grey snake record to the Study area is approximately 1 km to the north-east (Appendix B).

Suitable habitat for this species has been mapped within patches of RE 11.4.3 as shown on Figure 5-12.

5.3.6 Near Threatened fauna species

Whilst the Golden-tailed Gecko (*Strophurus taenicauda*) has been described as likely to occur within the Study area, habitat for near threatened species does not constitute an ESA, nor is it a PEM under the EO Act. The presence or potential presence of a near threatened species triggers requirements under the NC Act that are approved and managed separately to the EA. Therefore, the occurrence or potential occurrence of near threatened species or their habitat does not trigger any requirement to amend the EA however, the presence of these species is noted.

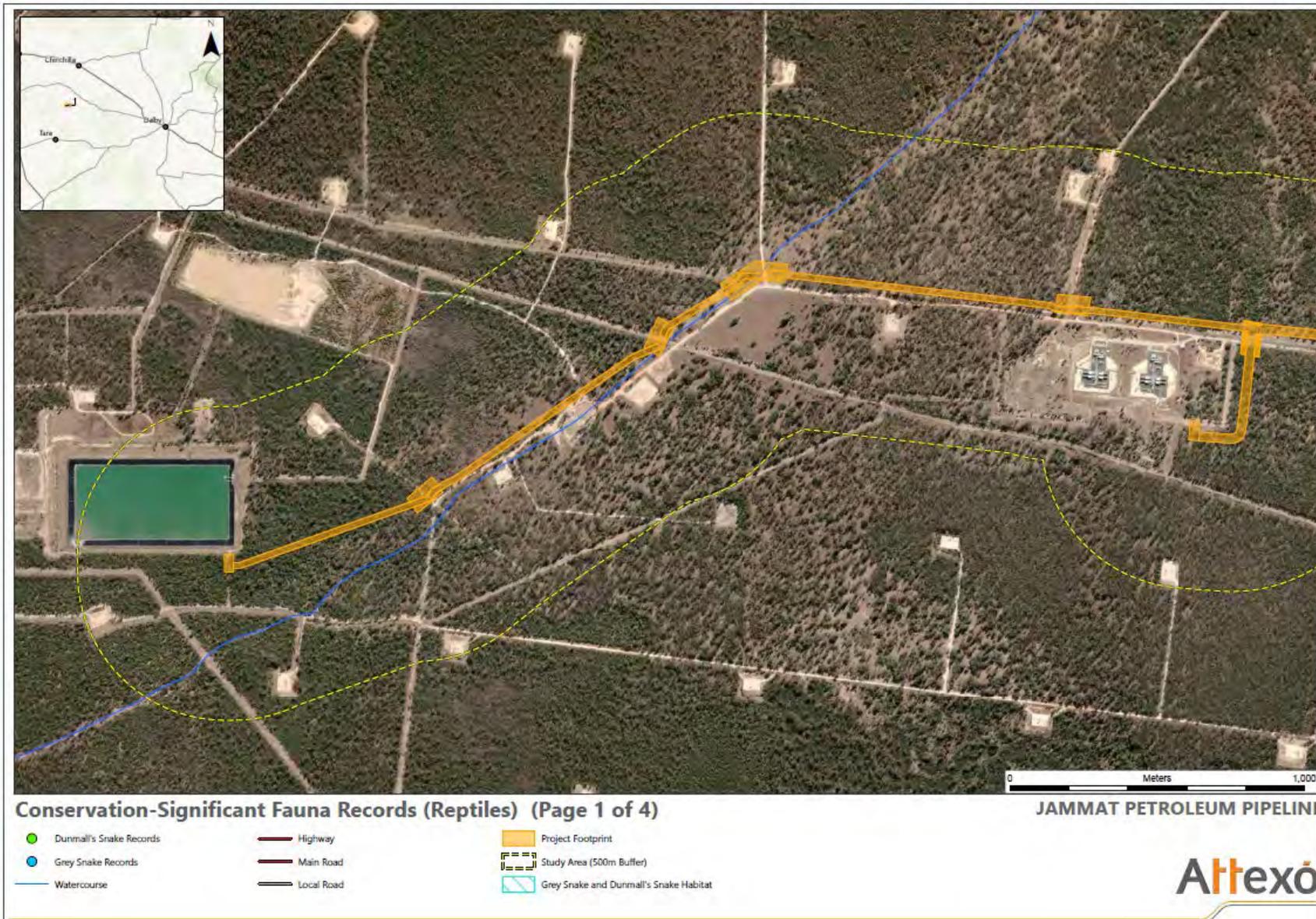
5.3.7 Essential habitat mapping

Mapped Essential habitat occurs within the Study area for the following species (refer to Figure 5-13):

- Pale imperial hairstreak, *Jalmenus eubulus*
- Golden-tailed Gecko, *Strophurus taenicauda*

As only essential habitat for critically endangered, endangered and vulnerable wildlife is considered as an ESA in this report, no further assessment is made of essential habitat mapping for Golden-tailed Gecko (refer Appendix B).

Figure 5-12: Conservation significant fauna records (reptiles)



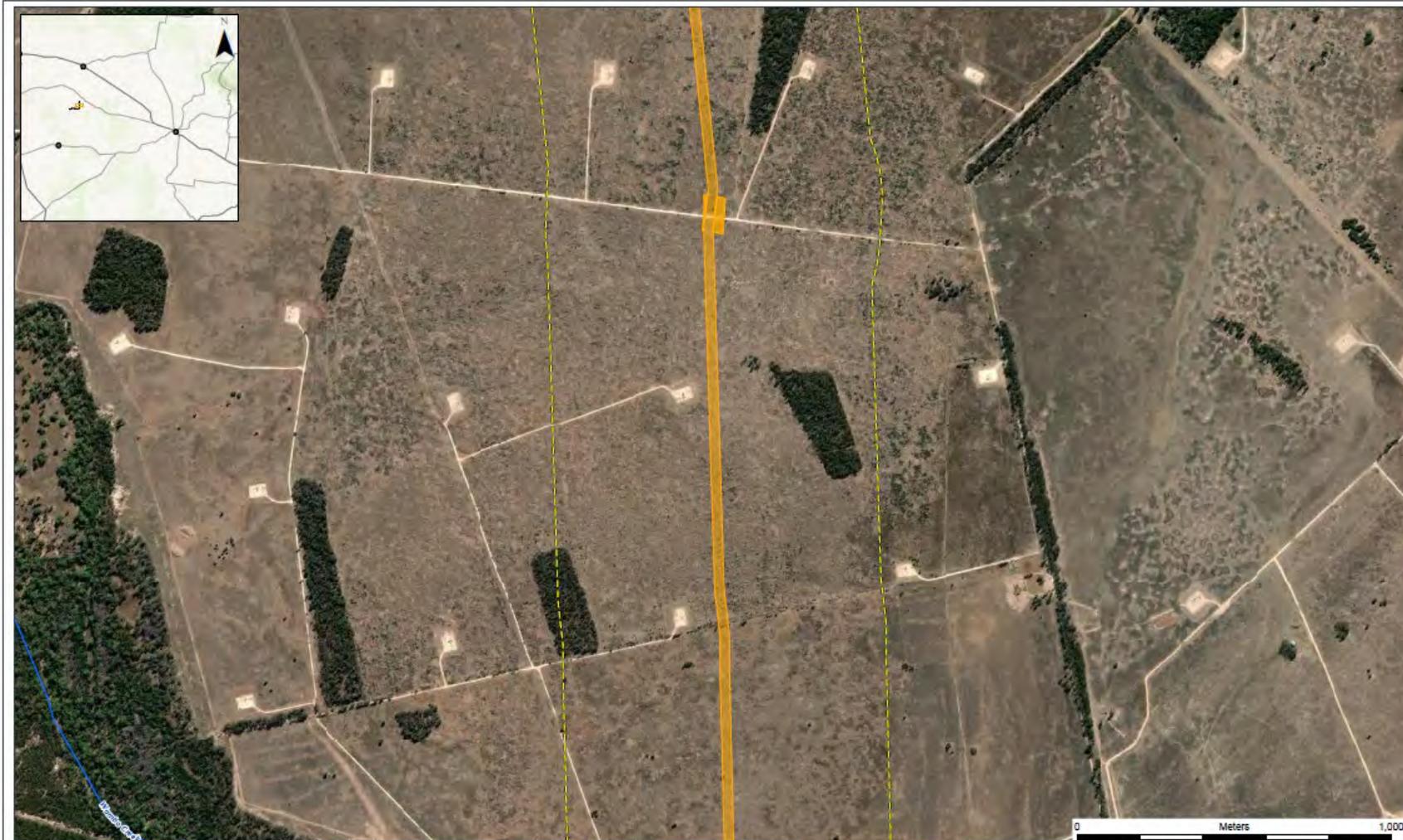


Conservation-Significant Fauna Records (Reptiles) (Page 2 of 4)

JAMMAT PETROLEUM PIPELINE

- Dunmall's Snake Records
- Grey Snake Records
- Watercourse
- Highway
- Main Road
- Local Road
- Project Footprint
- Study Area (500m Buffer)
- Grey Snake and Dunmall's Snake Habitat





Conservation-Significant Fauna Records (Reptiles) (Page 3 of 4)

JAMMAT PETROLEUM PIPELINE

- Dunmall's Snake Records
- Grey Snake Records
- Watercourse
- Highway
- Main Road
- Local Road
- Project Footprint
- Study Area (500m Buffer)
- Grey Snake and Dunmall's Snake Habitat



REVIEWED: JC

DRAWN: JT

SCALE (A3): 1:11,500

DATE: 17/02/2025

DWG No: ARR-002_144[A]

FIGURE 3.12



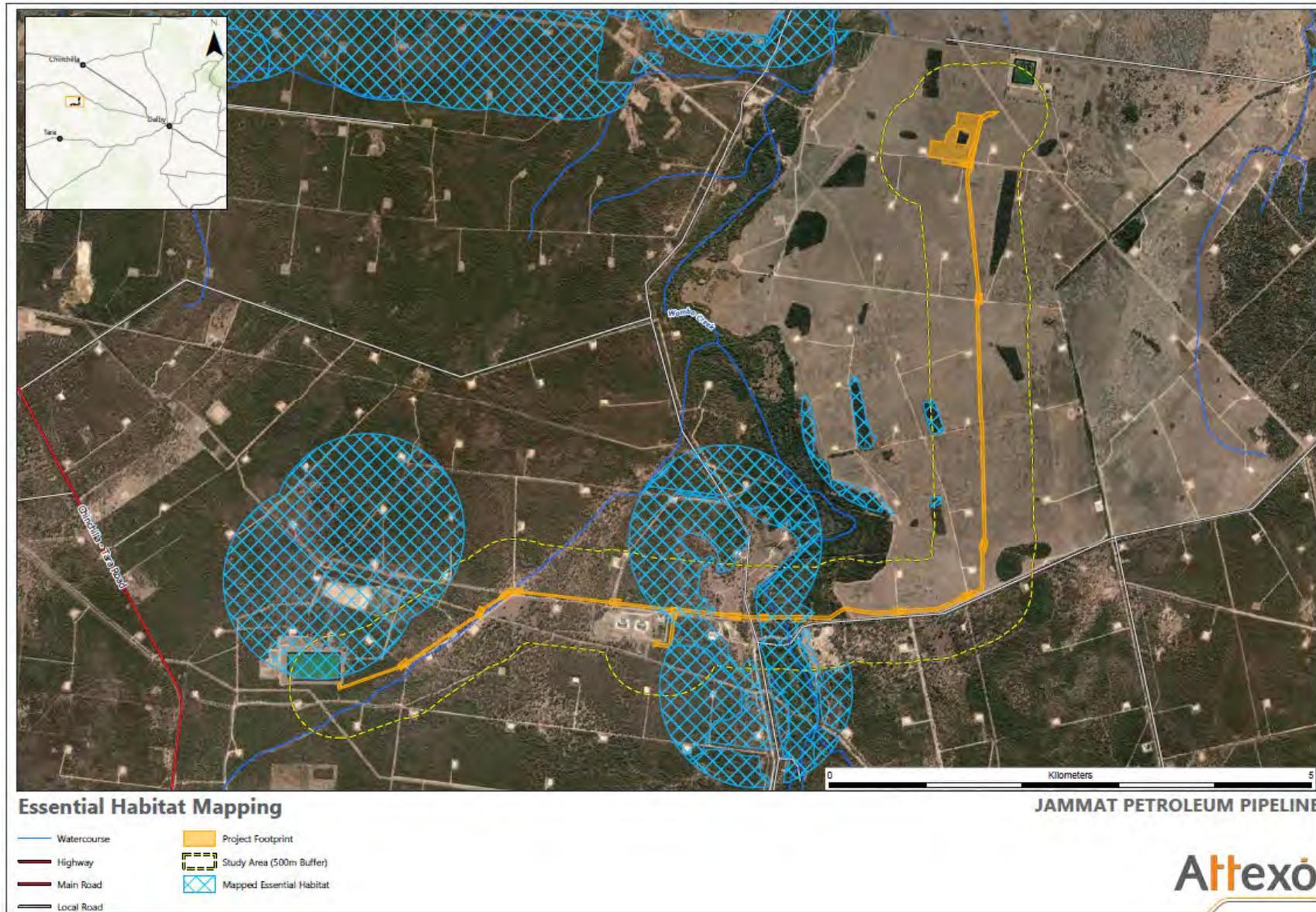
Conservation-Significant Fauna Records (Reptiles) (Page 4 of 4)

JAMMAT PETROLEUM PIPELINE

- | | | |
|-------------------------|------------|----------------------------------------|
| Dunmall's Snake Records | Highway | Project Footprint |
| Grey Snake Records | Main Road | Study Area (500m Buffer) |
| Watercourse | Local Road | Grey Snake and Dunmall's Snake Habitat |



Figure 5-13: Essential Habitat mapping



6 Impact Assessment

6.1 Planning and design

Coal seam gas developments apply an iterative process in terms of locating pipeline infrastructure to manage competing constraints associated with the RoW and location of surface infrastructure, including ecological values, landholder preferences, geological features, existing infrastructure, and access tracks. Planning and management of surface activities and ground disturbance is undertaken utilising a set of hierarchical management principles to avoid, minimise and mitigate impacts to environmental values.

These principles are:

- Avoid: Arrow Energy's first preference is to avoid PEMs, threatened ecological communities and the habitat of PEMs listed threatened species
- Minimise: where other competing constraints or the scale / location of PEMs communities or species habitat dictate that avoidance is not possible (e.g. where there is riparian vegetation that need to be crossed or large areas of suitable habitat for wide ranging species such as the Koala, Greater Glider or Painted Honeyeater), Arrow Energy's will preferentially locate infrastructure in a manner that minimises the impact to these values (e.g. cross the riparian vegetation at the narrowest or most degraded part or where practicable on the edge of suitable habitat for listed species so as not to bisect good quality habitat)
- Mitigate: implement mitigation measures to further minimise the direct and indirect impacts on ecological values
- Remediate and rehabilitate: actively remediate and rehabilitate impacted areas to promote and maintain long term recovery and
- Offset: Arrow Energy will offset unavoidable significant residual impacts to PEMs.

Project development has also considered the hierarchical management principles for primary and secondary protection zones of Category B and C ESAs as set out in conditions of the Jammatt PPL EA.

Proposed Project impacts have been compared against the standard criteria, standard conditions, and variation conditions within the Jammatt PPL EA to identify any impacts that are not consistent with approved conditions.

6.1.1 Co-location

The proposed pipeline alignment has been designed using the management hierarchy as described above. The pipeline is co-located adjacent to existing linear infrastructure as much as possible to avoid fragmenting vegetated areas which also allows for a narrower RoW during construction due to being able to use the existing tracks or RoWs for access. Many of the construction workspaces and activities such as laydowns, access tracks and extra workspaces use gas field infrastructure or have been located in areas previously disturbed as part of the development of the gas field and are already approved under existing EAs.

Refinement of the Jammatt alignment and design has minimised the Project's impact by co-locating with other pipelines and in or adjacent to previously disturbed areas. This has resulted in a comparatively small construction footprint for a pipeline project of this size.

6.1.2 Waterway crossing methodologies

A range of pipeline construction methods are available for watercourse crossings, including standard 'open cut' trenching, watercourse flow diversion and trenchless technology. A brief description of each and the associated advantages and disadvantages is provided below:

- Standard ‘open cut’ trenching involves in-stream construction of a trench using excavators or backhoes to stockpile trench spoil away from the streambed. The prefabricated pipe is placed across the waterway, lowered in and the trench and backfilled immediately. This method is often applied in dry or shallow low flow watercourses but may also be applied in sensitive watercourses where rapid construction is the best means of minimising environmental impacts.
- Watercourse flow diversion techniques involve construction of temporary dams up and downstream of a crossing and the diversion of water around the crossing site to create a dry construction area between the dams. This method is generally applied at crossings where water flow is required to be maintained for ecological, social or engineering reasons.
- Trenchless options, such as horizontal directional drilling (HDD) can cause less disruption to the surface environment and can be a viable alternative where there are significant surface constraints that exclude standard open cut trenching as a construction methodology. However, the cost of HDD is significantly higher compared to standard trenching and there are technical constraints and environmental risks (e.g. HDD failure, accidental release of drilling muds where geology is uncohesive, etc) that also need to be considered. A cleared area equivalent to the length of the HDD is also required to ‘string’ the pipe length (i.e. welding together all sections of the pipe that are then pulled through the HDD). Other technical considerations include are not limited to, ground conditions and depth of channels.

All crossings for the Project are proposed to be standard ‘open cut’ with a bed level access track where required. Refer to Section 6.5.5 for an assessment of impacts to fish passage.

6.2 Overview of impacts

6.2.1 Vegetation clearing

The most significant impact associated with the construction of the Jammatt Project is the direct loss vegetation through clearing of the RoW, which includes impacts on 17.9 ha of remnant vegetation and 0.2 ha of regrowth vegetation. Given the highly vegetated nature of much of the eastern end of Study area, clearing of remnant vegetation and associated habitat is an unavoidable aspect of the Project development. Despite this however, most of the clearing proposed is in widespread, least concern vegetation types (predominantly RE 11.5.1 and 11.5.20). Table 6-1 summarises the total area of remnant and regrowth vegetation proposed to be disturbed by the Project.

Table 6-1: Vegetation clearing for the pipeline footprint by RE type

RE Type	VM Act Class	Biodiversity Status	Impact area (ha)
Remnant			
11.3.18	Least concern	No concern at present	0.3
11.3.25	Least concern	Of concern	0.9
11.5.1	Least concern	No concern at present	8.6
11.5.20	Least concern	No concern at present	5.8
11.5.4	Least concern	No concern at present	2.2
Subtotal (remnant)			17.9
Regrowth			
Undifferentiated			0.2
Subtotal (regrowth)			0.2

RE Type	VM Act Class	Biodiversity Status	Impact area (ha)
Cleared	-	-	0.7
Non-remnant	-	-	37.0
Total Clearing			55.7

6.2.2 Habitat fragmentation and landscape connectivity

Habitat fragmentation occurs when continuous areas of habitat are subdivided into several smaller, separate components. This term encompasses two interrelated components: habitat loss (i.e. a reduction in the amount of habitat) and fragmentation (i.e. the breaking apart of habitat which increases ‘edge effects’). The impacts of habitat fragmentation are also scale-dependent and may differ depending on the species or community under consideration. For example, loss of small areas of habitat that do not present a significant barrier to movement by highly mobile species (e.g. birds of prey) may represent a much greater barrier to dispersal of less mobile or far-ranging species (e.g. amphibians or small reptiles). Habitat fragmentation and landscape connectivity impacts are assessed for individual species in Section 6.5.

To help determine whether the development of the Project will result in a SRI on connectivity (a recognised PEM under the EO Act), the Landscape Fragmentation and Connectivity (LFC) Tool was used. This tool performs a desktop assessment of development impacts on connectivity areas containing remnant vegetation to determine whether these developments are likely to result in a significant impact to regional and local vegetation connectivity. The analysis of the LFC on connectivity areas from the Project were identified as not significant, based on DETSI RE mapping and significant, based on Arrow’s GTRE mapping. Therefore, the impact on connectivity areas has been determined to be 17.9 ha. The LFC outputs have been attached in Appendix B.

Loss of connectivity at the patch scale largely depends on the species under consideration; impacts associated with linear infrastructure corridors and waterway crossings are considered in further detail for individual threatened species (refer Section 6.5).

6.2.3 Impacts to hollow-bearing trees

The Greater Glider and Glossy Black-cockatoo are two species assessed as known or likely to occur in the Study area which can be described as hollow-dependant species. The pipeline route / alignment has been designed to minimise impact to vegetation where possible and there is particular emphasis on minimising impacts to riparian vegetation through RoW minimisation and locating any temporary workspaces outside of these areas.

The importance of riparian vegetation along the major creek systems in the Study area is discussed in Section 5.3.2 and do represent habitats that are often less impacted by historical clearing and are more likely to contain large trees due to their position in the landscape.

Habitat trees with notes on their size and hollows has been captured during the ecological survey with 31 habitat trees identified within the Project footprint. Based on the PEC report (Appendix B) of the riparian vegetation associated with Wambo Creek there are 14 large mature trees that contain hollows within remnant RE 11.3.25. This data allows the identification of Glossy Black-cockatoo habitat which requires large hollows suitable for nesting and the Greater Glider requiring large trees >30 cm DBH for foraging and > 50 cm DBH for denning Appendix B.

During construction hollow bearing trees, beyond the essential clearing footprint, identified from ecological survey data are flagged for retention and exclusion zones established to avoid potential

impacts. Where required, clearing of hollows will be undertaken in accordance with the Arrow Energy Species Management Program (SMP) (Doc. No. ORG-ARW-HSM-PLA-00070) which authorises activities if it will impact on breeding places of protected animals, which includes relocation of hollows if breeding fauna are observed.

6.2.4 Indirect impacts

Indirect impacts on ecological values that may arise during the construction and ongoing operation of the Project include:

- Edge effects resulting from the creation of smaller patches of vegetation with a greater edge to surface ratio, including increased exposure to weed invasion, light and wind penetration (which can alter microclimate features) potentially resulting changes in community structure and composition over time;
- Dust generation during construction, which has the potential to smother plants, reducing photosynthesis and resulting in decreased vegetation health and condition;
- Increased noise from the vegetation clearing operations, the operation of machinery and vehicle traffic which may affect the behaviour of wildlife (typically limited to the construction period);
- Increased lighting during construction and operation, with the potential to disrupt the behaviour of nocturnal species, and
- Mortality resulting from vehicle collision.

Indirect impacts on the ecological values of the Project will be managed in accordance with Arrow's existing Environmental Management Framework.

6.3 **Impacts on State Forests**

There will be no impacts to State Forests.

6.4 **Impacts on terrestrial flora values**

6.4.1 Impacts on conservation significant flora species

No conservation significant flora species were identified during field surveys and will not be impacted by the Project.

6.4.2 Endangered REs by VM Class

No 'Endangered' REs by VM Status will be impacted by the Project. There is 31.7 ha of Endangered RE 11.4.3 within the study area that has been avoided.

6.4.3 Of Concern REs by VM Class

No 'Of concern' REs by VM Status were found to occur in the Study area. Impacts on RE 11.3.25 (listed as 'Of concern' by BD status) will be captured as an impact under the Environmentally Sensitive Area as they qualify as a Category C ESA (refer to Section 5.1.1).

6.4.4 Impacts on watercourse vegetation

As part of the ecological survey the high banks of watercourses associated with the Project were mapped. The Project footprint will impact 0.5 ha of RE 11.3.25 watercourse vegetation associated with the Wambo Creek crossing.

6.5 **Impacts on terrestrial fauna values**

The Project will have an impact on protected wildlife habitat for the species identified as 'known to occur' or 'likely to occur' as discussed in Section 5.3.5.2. Habitat mapping for these species have been provided in Figure 5-9 Figure 5-10 Figure 5-11 and Figure 5-12, and a summary of the Projects' impacts on habitat

for these species has been provided in Table 6-2. Whilst the Project will impact suitable habitat for the Golden-tailed Gecko (as mapped by Arrow), this species is listed as Near Threatened and does not constitute a PEM under the EO Act and has been excluded from this summary table.

Table 6-2: Summary of the Project impacts on protected wildlife habitat

Species	Area of impact (ha)
Habitat for animals listed as endangered wildlife under the NC Act	
Brigalow Woodland Snail, <i>Adclarkia cameroni</i>	1.3
Koala, <i>Phascolarctos cinereus</i> ¹	16.1
Greater Glider (southern and central), <i>Petauroides volans volans</i>	1.3
Grey Snake, <i>Hemiaspis damelii</i>	0
Habitat for animals listed as vulnerable wildlife under the NC Act	
Glossy Black-cockatoo (south-eastern), <i>Calyptorhynchus lathami lathami</i>	0.9
Diamond Firetail, <i>Stagonopleura guttata</i>	9.3
White-throated Needletail, <i>Hirundapus caudacutus</i>	0
Dunmall's Snake, <i>Furina dunmalli</i>	0
Habitat for animals listed as special least concern wildlife under the NC Act	
<i>Tachyglossus aculeatus</i> , Short-beaked Echidna	0

¹MNES species that have impacts approved under EPBC Approval (EPBC 2018/8223)

SRI Assessments have been undertaken for these species in accordance with the Significant Residual Impact Guidelines (SRI Guidelines) for endangered, vulnerable and special least concern wildlife habitat and have been provided in the following sections. Only those species that are assessed to have a likely SRI are considered to be a PEM and subsequently included in Appendix B.

The SRI Guidelines provide an explanation of some key terms used in these impact assessments, which include:

- Habitat: is the area occupied, or periodically or occasionally occupied, by any species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by the species during the different stages of their life cycles.
- Long-term decrease: and decline in a local population that is greater than which could be apparent without the action being present.
- Population: defined as an occurrence of the species in a particular area. In relation to endangered, vulnerable and special least concern species, occurrences include but are not limited to:
 - A geographically distinct regional population, or collection of local populations; or
 - A population, or collection of local populations, that occurs within a particular bioregion.

6.5.1 Impacts on habitat for endangered fauna species

6.5.1.1 **Brigalow Woodland Snail (*Adclarkia cameroni*)**

Construction of the Project will result in the direct loss of 1.3 ha of potentially suitable habitat for the brigalow woodland snail. An assessment undertaken in accordance with the SRI Guidelines for the Brigalow Woodland Snail has been provided in Table 6-3. The distribution of potentially suitable habitat for this species is presented in Figure 5-10.

Table 6-3: Significant Residual Impact Assessment for the Endangered Brigalow Woodland Snail

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to lead to a long-term decrease in the size of a population?</p>	<p>Unlikely</p> <p>Our limited understanding of brigalow woodland snail ecology makes determining population dynamics difficult. Whilst no historical records have been identified within the Study area, an adjacent record has been identified approximately 1 km to the north-east of the Project. This species has been described from and is known to occur along the Condamine River floodplain which is located to the north of the Project. Numerous additional historical records have been identified within 25 km of the Project. The occurrence of these records and the proximity of the Project to known populations suggests that a local population may occur within suitable brigalow habitat that has been identified within the Project area.</p> <p>Despite the occurrence of approximately 1.3 ha of suitable habitat, no local populations have been identified within the Study area, or within the portion of Wambo Creek that intersects with the Project area. This species has extremely limited dispersal capabilities and the construction of the Project is therefore considered unlikely to lead to a long-term decrease in the size of a population.</p>
<p>Are impacts to suitable habitat likely to reduce the extent of occurrence of the species?</p>	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. The estimated extent of occurrence for the brigalow woodland snail is approximately 27,924 km².</p> <p>The Project will require the removal of approximately 1.3 ha of suitable habitat for the brigalow woodland snail. Considering that the Project is located well within the known distribution of the Brigalow Woodland Snail and this region has already experienced localised habitat fragmentation, it is considered unlikely that the construction and ongoing operation of the Project will reduce the extent of occurrence for this species.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to fragment an existing population?</p>	<p>Unlikely</p> <p>The current distribution of the Brigalow Woodland Snail is already highly fragmented. Suitable habitat for this species along the Condamine River floodplain that was once contiguous, have been extensively cleared for agriculture and farming. For the purposes of this assessment, it has been assumed that each known record represents an isolated sub-population of the Brigalow Woodland Snail, as it is very unlikely that there is movement between these records.</p> <p>To facilitate the construction of the Project, approximately 1.3 ha of suitable habitat will be permanently removed, rendering it unsuitable as habitat for this species. Whilst suitable habitat for this species has been identified along Wambo Creek, the surrounding landscape is highly fragmented, and unlikely to provide additional dispersal opportunities.</p> <p>It is therefore considered unlikely that the removal this suitable habitat will contribute to the fragmentation experienced by local populations.</p>
<p>Are impacts to suitable habitat likely to result in genetically distinct populations forming as a result of habitat isolation?</p>	<p>Unlikely</p> <p>Population genetic studies are currently listed as one of the key research priorities for the Brigalow Woodland Snail suggesting that very little is known about the genetics of this species. For the purposes of this assessment, it has been assumed that each known record represents an isolated (potentially genetically distinct) sub-population of the Brigalow Woodland Snail, as it is very unlikely that there is movement between these records.</p> <p>Whilst the construction of the Project will result in the direct loss of 1.3 ha of suitable habitat for this species, no local records have been observed within this suitable habitat, or along the section of Wambo Creek that intersects within the Project area. Furthermore, the surrounding landscape is already highly fragmented, suggesting that dispersal outside of this riparian corridor is unlikely.</p> <p>It is therefore considered unlikely that the construction of the Project will result in genetically distinct populations forming as a result of habitat isolation.</p>
<p>Are impacts to suitable habitat likely to result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat?</p>	<p>Unlikely</p> <p>Several invasive species have been identified as conservation and management priorities for the Brigalow Woodland Snail, including Buffel Grass (<i>Cenchrus ciliaris</i>), Feral Pigs (<i>Sus scrofa</i>) as well as introduced rat and mice species. The occurrence of these pest and weed species has been well documented in the region surrounding the Project area.</p> <p>To help manage pest species across the Project, Arrow have developed an overarching pest management strategy and developed a Biosecurity Procedure for the broader SGP. This procedure will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint. This is supported by the Vehicle, Machinery, Equipment and Loads Hygiene Procedure to minimise the spread of Buffel Grass and other invasive species listed under the <i>Biosecurity Act 2014</i>.</p> <p>It is therefore considered unlikely that the Project will result in invasive species being established.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>There are no known diseases listed as threatening processes for the Brigalow Woodland Snail. It is considered unlikely that the construction and ongoing operation of the Project will introduce any that could cause potential populations to decline.</p>
<p>Are impacts to suitable habitat likely to interfere with the recovery of the species?</p>	<p>Likely</p> <p>The Conservation Advice for the Brigalow Woodland Snail, lists preventing clearing of brigalow habitat and in other areas where this species may occur within its range, retaining a buffer of native vegetation and leaf litter around records of the species and controlling Buffel Grass infestations as priority conservation and recovery objectives.</p> <p>Arrow have developed a WMP that has general vehicle hygiene requirements that will be followed during the construction and operational phases of the Project to help manage the spread or Buffel Grass.</p> <p>Despite this however, the Project will require the removal of 1.3 ha of suitable habitat for this species (riparian vegetation along Wambo Creek) which is likely to interfere with the recovery of this species, especially considering the Projects' location within the known distribution of the brigalow woodland snail.</p>
<p>Are impacts to suitable habitat likely to cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species?</p>	<p>Unlikely</p> <p>It is assumed that each known record, or group of records, represents an isolated sub-population of the Brigalow Woodland Snail, as it is very unlikely that there is movement between these records. Additionally, the areas identified as suitable habitat for brigalow woodland snail are regional ecosystems containing <i>Acacia harpophylla</i> (brigalow) which is a key requirement for the species, as described in the Conservation Advice.</p> <p>Given the limited understanding of this species' ecology, including breeding, feeding, and dispersal requirements, it is difficult to define ecologically significant locations for Brigalow Woodland Snail.</p> <p>Considering the absence of any local records of the Brigalow Woodland Snail within the study area however, it is unlikely that the Project will disrupt any ecologically significant locations for this species.</p>
<p>It is considered Likely that the Project will have a significant residual impact on the Brigalow Woodland Snail.</p>	

6.5.1.2 Greater Glider (central and southern) (*Petauroides volans sensu lato*)

Construction of the Project will result in the direct loss of 1.3 ha of potentially suitable habitat for the Greater Glider. An assessment undertaken in accordance with the SRI Guidelines for the Greater Glider has been provided in Table 6-4. Suitable habitat mapping for this species has been provided in Figure 5-11.

Table 6-4: Significant Residual Impact Assessment for the Endangered Greater Glider

SRI Criteria	Project Response
Are impacts to suitable habitat likely to lead to a long-term decrease in the size of a population?	<p>Unlikely</p> <p>Whilst no greater gliders have been observed within the Study area, historical records in the surrounding landscape suggest that local populations may be present. This species has a broad distribution through eastern Australia with local populations occurring along the Condamine River floodplain approximately 40 km to the north-west, to the south of Kogan approximately 14 km to the south-east and within Barakula State Forest approximately 65 km to the north.</p> <p>This species is largely restricted to eucalypt forests and woodlands, preferably taller montane moist eucalypt forests which provide suitable denning and foraging habitat. Whilst the northern portion of the Study area is located within predominantly cleared pastoral land, the southern portion of the Study area contains suitable habitat for this species.</p> <p>Whilst construction and ongoing operation of the Project will require the removal of 1.3 ha of suitable habitat, no residential populations have been identified. It is therefore considered unlikely that the Project will lead to a long-term decrease in the size of a local population.</p>
Are impacts to suitable habitat likely to reduce the extent of occurrence of the species?	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. The estimated extent of occurrence for the Greater Glider is approximately 752,962 km².</p> <p>Considering that the Project is situated well within the known distribution of the Greater Glider and this region is already experiencing localised habitat fragmentation, it is considered unlikely that the construction and ongoing operation of the Project will reduce the extent of occurrence for this species.</p>
Are impacts to suitable habitat likely to fragment an existing population?	<p>Unlikely</p> <p>Greater Gliders are known to be sensitive to habitat fragmentation. Although they have small home ranges, their low reproductive rate and sensitivity to disturbance means they tend to become locally extinct in small and fragmented habitat patches. Greater Gliders typically move through woodland and forest habitat by gliding from tree-to-tree without coming to ground. They are capable of maximum glide angle of between 31 to 40 degrees from horizontal. Therefore, if trees are less than 30 m high, Greater Gliders are unlikely to cross clearings greater than 50 m, and if trees were less than 20 m high, the animals would be unlikely to cross clearings > 30 m.</p> <p>The disturbance footprint of the Project will require the clearing of a ~30 m wide corridor, which should not affect the dispersal capabilities of any potentially occurring local greater glider populations. Additionally, tree hollows will be retained wherever possible to limit the Project’s impacts on habitat for this species. Additionally, to further reduce the effects of habitat fragmentation, the Project has been collocated with existing CSG infrastructure wherever possible, however the surrounding landscape is already highly fragmented.</p>

SRI Criteria	Project Response
	<p>Despite this however, the construction of the Project will result in new areas of disturbance that will contribute to the fragmented nature of the surrounding landscape.</p> <p>Whilst no local greater glider populations have been identified, the abundance of suitable habitat and occurrence of records in the broader landscape, suggests that a local population could occur. Considering the nature of the proposed infrastructure, it is unlikely that the construction and ongoing operation of the project will contribute significantly to the habitat fragmentation already present in the surrounding landscape.</p>
<p>Are impacts to suitable habitat likely to result in genetically distinct populations forming as a result of habitat isolation?</p>	<p>Unlikely</p> <p>The Greater Glider has been split into two genetically distinct populations: a southern & central population (<i>Petauroides volans volans</i> in Queensland) and a northern population (<i>P. v. minor</i>). The central & southern population and northern population are geographically distinct with the former occurring from Proserpine southwards throughout south-eastern Australia, and the latter occurring from Mt Windsor Tableland to Townsville. The Project is located well within the known distribution of the southern & central subspecies.</p> <p>Considering the nature of the proposed infrastructure, it is unlikely that the construction and ongoing operation of the project will contribute significantly to the habitat fragmentation which could result in the formation of genetically distinct populations.</p>
<p>Are impacts to suitable habitat likely to result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat?</p>	<p>Unlikely</p> <p>Predation by Feral Cats (<i>Felis catus</i>) and European Red Foxes (<i>Vulpes vulpes</i>) are listed as potential threatening processes for the Greater Glider. It is considered unlikely that the construction and ongoing operation of the Project will result in these species becoming established in the area or exacerbate an existing occurrence of these pest species.</p> <p>To help manage pest species across the Project, Arrow have developed a Biosecurity Procedure for the broader SGP. This procedure will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint.</p> <p>It is therefore considered unlikely that the Project will result in invasive species being established.</p>
<p>Are impacts to suitable habitat likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>There are no known diseases listed as threatening processes for the Greater Glider. It is considered unlikely that the construction and ongoing operation of the Project will introduce any diseases that could cause the population to decline.</p>
<p>Are impacts to suitable habitat likely to interfere with the recovery of the species?</p>	<p>Likely</p> <p>The conservation advice for the Greater Glider lists protecting areas of suitable habitat, restoring habitat and connectivity and minimising prescribed burning as priority conservation and recovery objectives.</p> <p>The implementation of bushfire mitigation strategies across the Project will be undertaken in accordance with those already established for the broader SGP. These have been designed to account for both underground and above-ground infrastructure so that bushfire risks are appropriately mitigated for the construction and operational phases of the Project.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species?</p>	<p>Despite this however, the Project will require the removal of 1.3 ha of potentially suitable habitat for the Greater Glider, which could interfere with the recovery of this species.</p> <hr/> <p>Unlikely</p> <p>Habitat mapping based on RE associations alone (without accounting for tree size and hollow availability) is likely to overestimate the extent of preferable habitat for the greater glider in the Study area. Observations made within these areas of suitable habitat have confirmed the presence of numerous hollow bearing trees which are a critical microhabitat feature required by this species. Approximately 14 large mature trees containing hollows were identified, which supports the habitat mapping for this species.</p> <p>Despite this however, no locally occurring records of the greater glider have been identified within the Project area suggesting that the construction and ongoing operation of the Project is unlikely to affect any current ecologically significant locations.</p>
<p>It is considered likely that the Project will have a significant residual impact on the Greater Glider.</p>	

6.5.1.3 Koala (*Phascolarctos cinereus*)

Construction of the Project will result in the direct loss of 16.1 ha of potentially suitable habitat for the Koala. An assessment undertaken in accordance with the SRI Guidelines for the Koala has been provided in Table 6-5. Suitable habitat mapping for this species can be found in Figure 5-11.

Table 6-5: Significant Residual Impact Assessment for the Endangered Koala

SRI Criteria	Project Response
Are impacts to suitable habitat likely to lead to a long-term decrease in the size of a local population?	<p>Unlikely</p> <p>Numerous records of a local koala population have been identified within the Study area, the most recent was recorded in 2018 . The presence of these records, and historical records in the broader landscape indicates the strong presence of a local population. Koalas are reported to utilise more than 400 different tree species for their food and habitat requirements resulting in all vegetated areas being mapped as potential habitat for this species. To facilitate the construction and ongoing operation of the Project, 16.1 ha of suitable habitat for the koala will be removed</p> <p>Unlike other forms of infrastructure focussed on a single site, the impacts of linear infrastructure on habitat are somewhat dispersed meaning that areas of suitable habitat remain in any given location along the corridor. Clearing will therefore be dispersed over the full length of the Project footprint with abundant suitable habitat remaining beyond the Project footprint.</p> <p>Considering that an abundance of suitable habitat will remain unaffected in the surrounding landscape, it is unlikely that the construction and ongoing operation of the Project will lead to a long-term decrease in the size of the local koala population.</p>
Are impacts to suitable habitat likely to reduce the extent of occurrence of the species?	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. The estimated extent of occurrence for the Koala is approximately 1,665,850 km².</p> <p>Whilst the Project will require the removal of approximately 16.1 ha of suitable habitat for this species, this impact only represents a fraction of the total habitat available to this species within the broader landscape. Considering that the Project is situated well within the known distribution of the Koala and this region is already experiencing localised habitat fragmentation, it is considered unlikely that the construction and ongoing operation of the Project will reduce the extent of occurrence for this species.</p>
Are impacts to suitable habitat likely to fragment an existing population?	<p>Unlikely</p> <p>Whilst koalas are known to be sensitive to habitat loss resulting from land clearing, they are capable of dispersing between areas of suitable habitat distance. In addition to regular movements across the ground between trees within their own home ranges, koalas, particularly subadult males but also females, are known to disperse across distances of 1 to 3 km but sometimes over 10 km.</p> <p>Establishment of the overall RoW for the Project and other co-located pipelines will result in the creation of a corridor which is approximately 70 m wide. This distance is navigable by individual Koalas and is not likely to fragment the local population.</p>
Are impacts to suitable habitat likely to result in genetically distinct populations forming as a	<p>Unlikely</p> <p>Conservation advice for the Koala has identified four spatially distinct, genetic koala management units, including:</p> <p>QLD and NSW populations north of the Clarence River Valley, NSW;</p>

SRI Criteria	Project Response
<p>result of habitat isolation?</p>	<p>South of the Clarence River Valley, NSW to north of the Sydney Basin; South of the Sydney Basin to approximately the NSW/VIC boarder, and VIC and SA populations</p> <p>Given the Project's location within the QLD and NSW Koala management unit, any localised habitat fragmentation is unlikely to result in a genetically distinct subpopulation from forming. Koalas are more than capable of traversing the ROW and associated infrastructure areas, indicating that this ROW is unlikely to fragment an existing population.</p> <p>It is therefore unlikely that the construction of the Project will result in genetically distinct populations from forming from habitat isolation.</p>
<p>Are impacts to suitable habitat likely to result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat?</p>	<p>Unlikely</p> <p>Predation by Feral Dogs (<i>Canis sp.</i>) is listed as a key threatening process for the Koala. It is considered unlikely that the construction and ongoing operation of the Project will result in this species becoming established in the area or exacerbate an existing occurrence of these pest species.</p> <p>To help manage pest species across the Project, Arrow have developed a PMP for the broader SGP. This PMP will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint.</p> <p>It is therefore considered unlikely that the Project will result in invasive species being established.</p>
<p>Are impacts to suitable habitat likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>The Koala retrovirus and Chlamydia (<i>Chlamydia pecorum</i>) are known to be present within Koala populations. They can be a major contributor to population decline and reduction in population viability.</p> <p>It is currently unknown whether these diseases are present within the local population of Koalas that have been identified within the Study area, but it is considered unlikely that the construction and ongoing operation of the Project will introduce these diseases to local populations, or exacerbate any preexisting diseases that may already be present.</p> <p>Whilst the prevalence of these diseases has been found to increase following localised habitat loss and fragmentation, the scale of the Projects' impacts on suitable habitat for this species is considered unlikely to trigger such outbreaks.</p> <p>It is therefore considered unlikely that the Project could introduce diseases that could cause populations to decline.</p>
<p>Are impacts to suitable habitat likely to interfere with the recovery of the species?</p>	<p>Likely</p> <p>Given the high-profile nature of the Koala there is an abundance of conservation advice and recovery objectives documented for this species. Both the National Recovery Plan for the Koala and the South-East Queensland Koala Conservation Strategy 2020-2025 lists ecosystem health and habitat protection as priority conservation objectives.</p> <p>Considering that the construction of the Project will require the removal of 16.1 ha of potentially suitable habitat for the Koala, it is therefore considered likely that this action could interfere with the recovery of the species.</p>
<p>Are impacts to suitable habitat likely to cause disruption to ecologically significant locations (breeding,</p>	<p>Likely</p> <p>Koalas are reported to utilise more than 400 different species of tree for their food and habitat requirements resulting in all vegetated areas within the Study area being mapped as potential habitat for this species. Breeding, feeding and resting</p>

SRI Criteria	Project Response
feeding, nesting, migration or resting sites) of a species?	<p>sites for Koalas are not location-specific and will be dispersed across habitat throughout the Study area, though there is some evidence that Koalas have a preference for individual trees in any given area of habitat.</p> <p>Considering that the development of the Project will result in the removal of 16.1 ha of potentially suitable habitat for the Koala, it is likely that the Project will disrupt ecologically significant locations for this species.</p>
It is considered likely that the Project will have a significant residual impact on the Koala.	

6.5.1.4 Grey Snake (*Hemiaspis damelii*)

Whilst suitable habitat has been identified for the grey snake within the broader Study area, the construction of the Project will not result in any direct impacts to suitable habitat for this species. Regardless of this, an assessment undertaken in accordance with the SRI Guidelines for the Grey Snake has been provided in Table 6-6. Suitable habitat mapping for this species can be found in Figure 5-12.

Table 6-6: Significant Residual Impact Assessment for the Endangered Grey Snake

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to lead to a long-term decrease in the size of a population?</p>	<p>Unlikely</p> <p>The presence of Grey Snake records in the region surrounding the Study area suggests that local population may occur within suitable habitat mapped in the broader Study area. The nearest record is approximately 1 km to the north-east. The construction and ongoing operation of the Project will not impact and suitable habitat for this species.</p> <p>Grey snakes are cryptic species that are typically only active for a few hours after sunset where they forage for prey (frogs) within soil cracks, in the open or beneath vegetation, typically during warmer weather and especially after heavy rain. Several areas of suitable habitat have been identified for this species within the Study area, all of which contained cracking soils or Gilgai’s which are key habitat features for this species. This suitable habitat was restricted to the northern portion of the Study area which contains isolated patches of vegetation surrounded by cleared pastoral land.</p> <p>Considering the cryptic nature of this species and the highly fragmented nature of suitable habitat within the Study area, it is considered unlikely that the construction and ongoing operation of the Project could lead to a long-term decrease in the size of a local population.</p>
<p>Are impacts to suitable habitat likely to reduce the extent of occurrence of the species?</p>	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. The estimated extent of occurrence for the grey snake is approximately 471,500 km².</p> <p>Whilst several patches of suitable habitat have been identified for this species within the broader Study area, these patches are completely isolated from other larger tracts of suitable habitat that have been identified in the broader landscape. Furthermore, the Project will not directly impact any mapped habitat for this species. Considering that the Project is situated well within the known distribution of the grey snake and this region is already experiencing localised habitat fragmentation, it is considered unlikely that the construction and ongoing operation of the Project will reduce the extent of occurrence for this species.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to fragment an existing population?</p>	<p>Unlikely</p> <p>The overall grey snake population is considered severely fragmented due to specific ecological constraints. Moreover, intra-population fragmentation is caused by agricultural practices removing suitable habitat. There is currently no information available about home range and dispersal ability of the grey snake, however based on the information available from other Australian elapids, it is inferred that the Grey Snake is likely to have little capacity to move between isolated populations.</p> <p>During the design stages of this Project, Arrow has also attempted to co-locate this pipeline with existing linear infrastructure to further reduce the effects of habitat fragmentation. Localised fragmentation may occur during construction activities, however once these areas have been constructed and rehabilitated, these areas are unlikely to represent ongoing physical barriers to the movement of local grey snake populations.</p> <p>It is therefore considered unlikely that the Project will fragment an existing population.</p>
<p>Are impacts to suitable habitat likely to result in genetically distinct populations forming as a result of habitat isolation?</p>	<p>Unlikely</p> <p>Although it is considered that there is considerably little gene flow among isolated and fragmented populations, localised intra-population dispersal may still occur. Project infrastructure is unlikely to physically inhibit the dispersal of locally fragmented populations. Given the Project's location within the QLD and NSW grey snake distribution, any localised habitat fragmentation is unlikely to result in a genetically distinct population from forming.</p>
<p>Are impacts to suitable habitat likely to result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat?</p>	<p>Unlikely</p> <p>Predation by Feral Cats (<i>Felis catus</i>) and European Red Foxes (<i>Vulpes vulpes</i>), and habitat destruction by Feral Pigs (<i>Sus scrofa</i>) are listed as potential threatening processes for the grey snake. It is considered unlikely that the construction and ongoing operation of the Project will result in these species' becoming established in the area or exacerbate an existing occurrence of these pest species.</p> <p>To help manage pest species across the Project, Arrow have developed a PMP for the broader SGP. This PMP will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint.</p> <p>It is therefore considered unlikely that the Project will result in invasive species being established.</p>
<p>Are impacts to suitable habitat likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>There are no known diseases listed as threatening processes for the grey snake. It is therefore considered unlikely that the construction and ongoing operation of the Project will introduce any diseases that could cause the population to decline.</p>
<p>Are impacts to suitable habitat likely to interfere with the recovery of the species?</p>	<p>Unlikely</p> <p>The conservation advice for the Grey Snake, lists protecting habitat from destruction and controlling invasive species as priority conservation and recovery objectives.</p> <p>Considering that the construction and ongoing operation of the Project will not require the removal of any suitable habitat for the grey snake, it is unlikely that this action will interfere with the recovery of the species.</p>
<p>Are impacts to suitable habitat likely to cause disruption to ecologically</p>	<p>Unlikely</p> <p>Whilst several nearby populations of grey snakes have been confirmed in proximity to the Study area, the presence of a local population has not been verified. Given</p>

SRI Criteria	Project Response
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significant locations (breeding, feeding, nesting, migration or resting sites) of a species?

that the occurrence of grey snakes is limited to specific microhabitats (i.e. cracking soils near alluvial systems), it is reasonable to assume that any suitable habitat mapped for this species could be utilised for breeding and/or foraging activities. While suitable habitat for this species has been mapped within the broader Study area, the construction and ongoing operation of the Project will not disturb these areas. The Project is therefore considered unlikely to impact any ecologically significant locations for this species.

It is considered **Unlikely** that the Project will have a significant residual impact on the Grey Snake.

6.5.2 Impacts on habitat for vulnerable fauna species

6.5.2.1 **Dunmall’s Snake (*Furina dunmalli*)**

Whilst suitable habitat has been identified for Dunmall’s snake within the broader Study area, the construction of the Project will not result in any direct impacts to suitable habitat for this species. Regardless of this, an assessment undertaken in accordance with the SRI Guidelines for Dunmall’s snake has been provided in Table 6-7. Suitable habitat mapping for this species can be found in Figure 5-12.

Table 6-7: Significant Residual Impact Assessment for the Vulnerable Dunmall’s snake

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to lead to a long-term decrease in the size of a population?</p>	<p>Unlikely</p> <p>The presence of Dunmall’s snakes in the region surrounding the Study area suggests that there may be sufficient suitable habitat to support a local population of this species. The nearest record is approximately 13 km to the north-west. The construction and ongoing operation of the Project will not impact and suitable habitat for this species.</p> <p>Whilst little is known about this cryptic species, captive specimens have indicated that they are nocturnal and are likely to shelter under fallen timber and in deep soil cracks and other cavities. Their diet is thought to consist primarily small skinks and geckos. Patches of RE 11.4.3 (dominated by <i>Acacia harpophylla</i>) within the Study area have been identified as suitable habitat for this species. This suitable habitat was restricted to the northern portion of the Study area which contains isolated patches of vegetation surrounded by cleared pastoral land.</p> <p>Considering the cryptic nature of this species, the absence of records from the Study area and the highly fragmented nature of suitable habitat, it is considered unlikely that the construction and ongoing operation of the Project could lead to a long-term decrease in the size of a local population.</p>
<p>Are impacts to suitable habitat likely to reduce the extent of occurrence of the species?</p>	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. Whilst the extent of occurrence for this species has not been formally calculated as part of its conservation advice, it is estimated to be approximately 169,262 km² using the built-in ALA tool.</p> <p>Whilst several patches of suitable habitat have been identified for this species within the broader Study area, these patches are completely isolated from other larger tracts of suitable habitat that have been identified in the broader landscape. Furthermore, the Project will not directly impact any mapped habitat for this species. Considering that the Project is situated well within the known distribution of the grey snake and this region is already experiencing localised habitat fragmentation, it is considered unlikely that the construction and ongoing operation of the Project will reduce the extent of occurrence for this species.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to fragment an existing population?</p>	<p>Unlikely</p> <p>The broader distribution of Dunmall’s snakes across its known range has been severely fragmented by broadscale land clearing and habitat modification. Habitat preferred by this species continues to be extensively modified through clearing for agriculture or pasture, overgrazing by stock and urban development. There is currently no information available about home range and dispersal capabilities of the Dunmall’s snake, however based on the information available from other Australian elapids, it is inferred that this species is likely to have little capacity to move between isolated populations.</p> <p>During the design stages of this Project, Arrow has also attempted to co-locate this pipeline with existing linear infrastructure to further reduce the effects of habitat fragmentation. Localised fragmentation may occur during construction activities, however once these areas have been constructed and rehabilitated, these areas are unlikely to represent ongoing physical barriers to the movement of local Dunmall’s snake populations.</p> <p>It is therefore considered unlikely that the Project will fragment an existing population.</p>
<p>Are impacts to suitable habitat likely to result in genetically distinct populations forming as a result of habitat isolation?</p>	<p>Unlikely</p> <p>Although it is considered that there is considerably little gene flow among isolated and fragmented populations, localised intra-population dispersal may still occur. Project infrastructure is unlikely to physically inhibit the dispersal of locally fragmented populations. Given the Project’s location within the QLD and NSW Grey Snake distribution, any localised habitat fragmentation is unlikely to result in a genetically distinct population from forming.</p>
<p>Are impacts to suitable habitat likely to result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species’ habitat?</p>	<p>Unlikely</p> <p>Predation by feral animals has been listed as a threatening process for the Dunmall’s snake. It is considered unlikely that the construction and ongoing operation of the Project will result in feral species becoming established in the Study area or exacerbate an existing occurrence of these pest species.</p> <p>To help manage pest species across the Project, Arrow have developed a PMP for the broader SGP. This PMP will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint.</p> <p>It is therefore considered unlikely that the Project will result in invasive species being established.</p>
<p>Are impacts to suitable habitat likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>There are no known diseases listed as potential threatening processes for the Dunmall’s snake. It is therefore considered unlikely that the construction and ongoing operation of the Project will introduce any diseases that could cause the population to decline.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to interfere with the recovery of the species?</p>	<p>Unlikely</p> <p>The conservation advice for the Dunmall’s snake, lists several local priority actions to support the recovery of this species including:</p> <ul style="list-style-type: none"> Minimise adverse impacts from land use (in the form of habitat loss, disturbance and modification) at known sites Ensure land owners/managers use appropriate management regimes and stocking density to reduce trampling by livestock Continue baiting and population control measures for feral animals. <p>Considering that the construction and ongoing operation of the Project will not require the removal of any suitable habitat for Dunmall’s snake, it is unlikely that this action will interfere with the recovery of the species.</p>
<p>Are impacts to suitable habitat likely to cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species?</p>	<p>Unlikely</p> <p>Whilst a nearby population of Dunmall’s snake have been confirmed in proximity to the Study area, the presence of a local population has not been verified. Given that the occurrence of this species is limited to suitable habitat with specific microhabitat features (i.e. fallen timber and in deep soil cracks and other cavities), it is reasonable to assume that any suitable habitat mapped for this species could be utilised for breeding and/or foraging activities.</p> <p>While suitable habitat for this species has been mapped within the broader Study area, the construction and ongoing operation of the Project will not disturb these areas. The Project is therefore considered unlikely to impact any ecologically significant locations for this species.</p>
<p>It is considered Unlikely that the Project will have a significant residual impact on the Dunmall’s snake.</p>	

6.5.2.2 Glossy Black-cockatoo (*Calyptorhynchus lathami lathami*)

Construction of the Project will result in the direct loss of 0.9 ha of potentially suitable habitat for the Glossy Black-cockatoo. An assessment undertaken in accordance with the SRI Guideline for the Glossy Black-cockatoo has been provided in Table 6-8. Suitable habitat mapping for this species can be found in Figure 5-9.

Table 6-8: Significant Residual Impact Assessment for the Vulnerable Glossy Black-cockatoo

SRI Criteria	Project Response
Are impacts to suitable habitat likely to lead to a long-term decrease in the size of a local population?	<p>Unlikely</p> <p>No glossy black-cockatoo records have been observed within the Study area, however, the occurrence of numerous records in the region surrounding the project suggests that local populations may utilise nearby suitable habitat. The nearest historical record of this species is approximately 9.5 km to the south-east.</p> <p>Whilst the construction and ongoing operation of the Project will require the removal of approximately 0.9 ha of suitable habitat for this species, they are highly dispersive and any individuals using the Study area are likely to occupy a far greater home range. It is unlikely that any population would rely heavily on the limited suitable habitat identified within the Project footprint for the entirety of its resource needs.</p> <p>It is therefore unlikely that the Project will lead to a long-term decrease in the size of a local population.</p>
Are impacts to suitable habitat likely to reduce the extent of occurrence of the species?	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. The estimated extent of occurrence for the glossy black-cockatoo is approximately 470,000 km².</p> <p>Whilst the Project will require the removal of approximately 0.9 ha of suitable habitat for this species, they are highly dispersive and any individuals using the Study area are likely to occupy a far greater range. It is unlikely that any population would rely heavily on suitable habitat within the Project footprint for the entirety of its resource needs. Project impacts are therefore considered unlikely to reduce the extent of occurrence for this species.</p>
Are impacts to suitable habitat likely to fragment an existing population?	<p>Unlikely</p> <p>Glossy black-cockatoos’ are known to be susceptible to habitat fragmentation, however they are also highly mobile and capable of traveling considerable distances to isolated fragments in search of food. The region surrounding the Project is already highly fragmented from pastoral activities and existing CSG infrastructure.</p> <p>Given the Projects location within a large tract of contiguous vegetation, and its proximity to several State Forests, it is unlikely that the removal of 0.9 ha of suitable habitat for this species could result in substantial habitat fragmentation for this species. It is therefore considered unlikely that the project will fragment an existing population.</p>
Are impacts to suitable habitat likely to result in genetically distinct populations forming as a result of habitat isolation?	<p>Unlikely</p> <p>Glossy black-cockatoos have already been broken up into three genetically distinct subspecies: <i>C. l. lathami</i> (south-eastern), <i>C. l. halmaturinus</i> (King Island), and <i>C. l. erebus</i> (northern). The location of the Project is situated within the core range of the south-eastern subspecies. Additionally, the high mobility of this species suggests that the construction of Project is unlikely to present a significant barrier to this species’ movement.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat?</p>	<p>It is therefore unlikely that the construction of the Project will result in genetically distinct populations from forming from habitat isolation.</p> <p>Unlikely</p> <p>Localised fragmentation and the removal of HBT may increase predation of nestlings or result in higher competition for hollows by 'edge' species such as the common brushtail possum. The Project is not expected to introduce and new invasive species to the Study area, nor are any established invasive species such as cats, foxes and invasive weeds, likely to pose a threat to resource accessibility. Regardless of this, Arrow have developed a PMP for the broader SGP. This WPMP will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint. This WPMP will also include hygiene procedure to minimise the spread of Buffel Grass and other invasive species listed under the Biosecurity Act 2014.</p> <p>It is therefore considered unlikely that the Project will result in invasive species being established.</p>
<p>Are impacts to suitable habitat likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>Psittacine Beak and Feather Disease (PBFD) is a potentially fatal disease caused by psittacine circovirus, typically transferred between adults, nestlings and contaminated nest hollows. Although glossy black-cockatoos are susceptible to PBFD, the threat level is relatively low compared to other threats. While the loss of nest hollows can lead to greater competition, and thus an increased likelihood of transmission, impacts to suitable habitat for this species (0.9 ha) are relatively small and unlikely to result in a significant loss of hollows or impinge on connectivity with surrounding habitat and hollows.</p> <p>It is considered unlikely that the construction and ongoing operation of the Project will introduce any diseases that could cause the local population to decline.</p>
<p>Are impacts to suitable habitat likely to interfere with the recovery of the species?</p>	<p>Likely</p> <p>The Conservation Advice for glossy black-cockatoo lists protecting, restoring and enhancing the quality of known suitable habitat, maintaining connectivity, increasing hollow availability and appropriate fire regimes as priority conservation and recovery objectives for this species.</p> <p>Arrow will implement bushfire mitigation strategies across the Project in accordance with those already established for the broader SGP. These have been designed to account for both buried infrastructure and exposed vents/drains so that during the construction and operational phases of the Project, bushfire risks are mitigated.</p> <p>Whilst the Project will require the removal of 0.9 ha of suitable habitat for this species, when compared to the abundance of suitable habitat remaining within the surrounding region, this impact only represents a small loss of habitat. To reduce and mitigate this impact Arrow have attempted to collocate this pipeline with existing linear infrastructure to further reduce the effects of habitat fragmentation.</p> <p>Therefore, whilst the Project is likely to interfere with the recovery of the glossy black-cockatoo, these impacts are not considered to be significant for the broader population.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species?</p>	<p>Possible</p> <p>The glossy black-cockatoo rely on nine species of she-oaks (<i>Allocasuarina spp.</i> and <i>Casuarina spp.</i>) for feeding. In south-east Queensland, they show preference for Black Sheoak (<i>A. littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) for foraging resources and they prefer Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) for nesting hollows.</p> <p>Whilst the Project will require the removal of 0.9 ha of suitable habitat for the glossy black-cockatoo, this species has not been recorded within the Study area, and the nearest record is approximately 9.5 km to the south-east. This suggests that there are no active ecological significant locations within the Project area, however they cannot be discounted entirely.</p> <p>Therefore, whilst the Project may interfere with ecologically significant locations for the glossy black-cockatoo, these impacts are not considered to be significant for the broader population.</p>
<p>It is considered Likely that the Project will have a significant residual impact on the Glossy Black-cockatoo.</p>	

6.5.2.3 Diamond Firetail (*Stagonopleura guttata*)

Construction of the Project will result in the direct loss of 9.3 ha of potentially suitable habitat for the diamond firetail. An assessment undertaken in accordance with the SRI Guideline for the diamond firetail has been provided in Table 6-9. Suitable habitat mapping for this species can be found in Figure 5-9.

Table 6-9: Significant Residual Impact Assessment for the Vulnerable diamond firetail

SRI Criteria	Project Response
Are impacts to suitable habitat likely to lead to a long-term decrease in the size of a local population?	<p>Unlikely</p> <p>Whilst no diamond firetails have been observed within the Study area, there are historical records in the vicinity of the Project, indicating that a local population may be present. The nearest (dated) record to the Project is approximately 36 km to the south-east.</p> <p>Diamond firetails are thought to be sedentary, through some populations have been recorded locally suggesting that this species may be less susceptible to localised fragmentation. Whilst the construction and ongoing operation of the Project will require the removal of approximately 9.3 ha of suitable habitat, the absence of local records from within the Study area and the linear nature of the proposed disturbance suggests that this impact is unlikely to result in a long-term decrease in the size of a potentially occurring local population</p>
Are impacts to suitable habitat likely to reduce the extent of occurrence of the species?	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. The estimated extent of occurrence for the diamond firetail is approximately 1,500,000 km².</p> <p>Whilst the Project will require the removal of approximately 9.3 ha of suitable habitat for this species, they are able to use a wide range of habitats for foraging and nesting, and an abundance of suitable habitat will remain within the Project area and broader landscape. It is unlikely that local population would rely solely on the suitable habitat identified within the Project footprint for the entirety of its resource needs. Project impacts are therefore considered unlikely to reduce the extent of occurrence for this species.</p>
Are impacts to suitable habitat likely to fragment an existing population?	<p>Unlikely</p> <p>Some diamond firetail populations have been recorded dispersing locally, suggesting that this species may be less susceptible to localised fragmentation. The landscape surrounding the Study area, whilst containing large tracts of intact remnant vegetation, has been subjected to ongoing historical disturbance to support pastoral activities and existing CSG infrastructure.</p> <p>Given the linear nature of the proposed disturbance and the absence of records within the Study area, it is considered unlikely that the construction and ongoing development of the Project is likely to effectively fragment an existing population.</p>
Are impacts to suitable habitat likely to result in genetically distinct populations forming as a result of habitat isolation?	<p>Unlikely</p> <p>There are currently no known subspecies of diamond firetail, and all individuals are considered to belong to the same genetic population. Some diamond firetail populations have been recorded dispersing locally, suggesting that this species may be less susceptible to localised fragmentation.</p> <p>Given the linear nature of the proposed disturbance, and their ability to disperse locally, it is considered unlikely that the construction and ongoing operation of the Project could lead to a genetically distinct population forming as a result of habitat fragmentation.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat?</p>	<p>Unlikely</p> <p>Habitat degradation from European rabbits (<i>Oryctolagus cuniculus</i>) and exotic weeds are listed as threatening processes for the diamond firetail. It is considered unlikely that the construction and ongoing operation of the Project will result in these feral species becoming established in the Study area or exacerbate an existing occurrence of these pest species.</p> <p>To help manage pest species across the Project, Arrow have developed a PMP for the broader SGP. This PMP will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint.</p> <p>It is therefore considered unlikely that the Project will result in invasive species being established.</p>
<p>Are impacts to suitable habitat likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>There are no known diseases listed as threatening processes for the diamond firetail. It is considered unlikely that the construction and ongoing operation of the Project will introduce any that could cause potential populations to decline.</p>
<p>Are impacts to suitable habitat likely to interfere with the recovery of the species?</p>	<p>Likely</p> <p>The conservation advice for the diamond firetail lists retaining and protecting woodland, open forest, grassland and mallee habitat from clearing and fragmentation as a key conservation objective for this species.</p> <p>Considering that the construction of the Project will require the removal of 9.3 ha of potentially suitable habitat for the diamond firetail, it is therefore considered likely that this action could interfere with the recovery of the species.</p>
<p>Are impacts to suitable habitat likely to cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species?</p>	<p>Possible</p> <p>Diamond firetails are known to utilise a wide range of habitat types including eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats, including farmland and grassland with scattered trees. Their ability to utilise such a wide range of habitats suggests that any suitable habitat identified for this species, could constitute an ecologically significant location.</p> <p>Despite the occurrence of 9.3 ha of suitable habitat for the diamond firetail, this species has not been recorded within the Study area, and the nearest (dated) record is approximately 36 km to the south-east. This suggests that there are no active ecological significant locations within the Project area, however they cannot be discounted entirely.</p> <p>Therefore, whilst the Project may interfere with ecologically significant locations for the diamond firetail, these impacts are not considered to be significant for the broader population.</p>
<p>It is considered Likely that the Project will have a significant residual impact on the Glossy Black-cockatoo.</p>	

6.5.2.4 White-throated Needletail (*Hirundapus caudacutus*)

To determine whether the Project will have a significant residual impact on this species, an assessment of potential impacts against the Significant Residual Impact Guidelines for this vulnerable species has been undertaken, the results of which are provided in Table 6-10.

Table 6-10: Assessment of significant residual impacts for the Vulnerable white-throated needletail

SRI Criteria	Project Response
<p>Is the action likely to lead to a long-term decrease in the size of a local population?</p>	<p>Unlikely</p> <p>The occurrence of historical records adjacent to the Study area indicates that the broader SGP Project is utilised by a portion of the global population of white-throated needletails during their non-breeding season. The nearest record is approximately 3 km to the north-west. Whilst the development of the Project will require the removal vegetation within the Project footprint, these terrestrial impacts are unlikely to affect the availability of aerial foraging habitat for this species.</p> <p>When roosting, white-throated needletails prefer dense roosting habitat. The structural category of REs as listed in the Regional Ecosystem Description Database (REDD) provides a useful proxy, with ‘dense’ REs indicating potential roosting habitat. A review of the ground-truthed REs within the Project footprint indicated that there is unlikely to be any suitable roosting habitat for this species.</p> <p>It is therefore considered unlikely that development of the Project will lead to a long-term decrease in the size of a local population.</p>
<p>Is the action likely to reduce the extent of occurrence of the species?</p>	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. The extent of occurrence for the White-throated Needle encompasses the entirety of Australia which is approximately 7.7 million km².</p> <p>Whilst the construction and ongoing operation of the Project will require the removal of vegetation within the Project footprint, these terrestrial impacts are unlikely to affect the availability of aerial foraging habitat for this species. Additionally, no suitable roosting habitat has been identified within the Study area.</p> <p>It is therefore considered unlikely that the Projects’ terrestrial impacts will reduce the extent of occurrence for this species.</p>
<p>Is the action likely to fragment an existing population?</p>	<p>Unlikely</p> <p>The landscape within the Study area has already been partly fragmented from by pastoral activities and existing CSG infrastructure. Based on available aerial imagery, this fragmentation dates back to at least the early 1950s. Considering the aerial nature of this species, terrestrial fragmentation is unlikely to affect the dispersal capabilities of this species as they move through the surrounding landscape.</p> <p>Whilst the construction and ongoing operation of the Project will contribute to the general terrestrial fragmentation of the surrounding landscape, no suitable roosting habitat for this species has been observed within the Study area. It is therefore considered unlikely that the construction and ongoing operation of the Project will fragment an existing population of White-throated Needletails.</p>
<p>Is the action likely to result in genetically distinct</p>	<p>Unlikely</p>

SRI Criteria	Project Response
<p>populations forming as a result of habitat isolation?</p>	<p>There are currently two recognised subspecies of White-throated Needletail (<i>H.c. nudipes</i> and <i>H.c. caudactus</i>). <i>H.c caudactus</i> is the only subspecies known to overwinter in Australia. Whilst extensive genetic studies have not yet been conducted on this species, it is believed that all individuals found in Australia belong to a single genetic population. Furthermore, no suitable roosting habitat for this species has been mapped within the Study area and terrestrial fragmentation resulting from the Project is unlikely to isolate any locally occurring populations.</p> <p>It is therefore considered unlikely that the construction and ongoing operation of the Project will result in genetically distinct populations forming.</p>
<p>Is the action likely to result in invasive species that are harmful to the endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat?</p>	<p>Unlikely</p> <p>Whilst numerous invasive flora and fauna species have been observed across the broader SGP Project, there are currently no invasive species listed as threatening processes for the White-throated Needletail.</p> <p>Regardless of this, to help manage pest species across the Project, Arrow have developed an overarching pest management strategy and Pest Management Plan (PMP) for the broader SGP. This PMP will help to ensure that appropriate management strategies are implemented to control pest species that could occur within the Project footprint, including the Black Rat.</p> <p>It is therefore considered unlikely that the construction and ongoing operation of the Project will result in any invasive species becoming established.</p>
<p>Is the action likely to introduce disease that may cause the population to decline?</p>	<p>Unlikely</p> <p>The conservation advice does not list any diseases as threatening processes for the White-throated Needletail. It is therefore considered unlikely that the construction and ongoing operation of the Project will introduce any diseases that could cause this species to decline.</p>
<p>Is the action likely to interfere with the recovery of the species?</p>	<p>Unlikely</p> <p>There are currently no recovery or management objectives listed for the White-throated Needletail in the conservation advice. Considering the aerial nature of this species, and the fact that they are a non-breeding migrant to Australia, it is conceivable that the protection of suitable roosting sites may become a recovery objective for this species. Given their aerial nature and ability to forage above most vegetated areas, it is unlikely that impacts to foraging habitat is likely to become a recovery objective for this species.</p> <p>No suitable roosting habitat for this species has been mapped within the Study area. Whilst the development of the Project will require the removal of terrestrial vegetation, these impacts are unlikely to impact the aerial foraging habitat above these communities.</p> <p>It is therefore considered unlikely that the construction and ongoing operation of the Project will interfere with the recovery of this species.</p>

SRI Criteria	Project Response
<p>Is the action likely to cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species?</p>	<p>Unlikely</p> <p>Considering the abundance of historical records adjacent to the Project, the Study area can be considered an ecologically significant location for the White-throated Needletail as it supports and abundance foraging opportunities for this species. Given their aerial nature, terrestrial impacts to vegetation communities are unlikely to affect the foraging opportunities for this species. Furthermore, no suitable roosting habitat has been identified within the Study area.</p> <p>It is therefore considered unlikely that impacts to support the construction and ongoing operation of the Project will disrupt an ecologically significant location for the White-throated Needletail.</p>
<p>It is therefore considered unlikely that the Project will have a significant residual impact on the White-throated Needletail.</p>	

6.5.3 Impacts on habitat for Special Least Concern species

6.5.3.1 **Short-beaked Echidna (*Tachyglossus aculeatus*)**

Construction of the Project will not result in any direct loss of potentially suitable habitat for the short-beaked echidna. An assessment undertaken in accordance with the SRI Guidelines for the short-beaked echidna has been provided in Table 6-11. The distribution of potentially suitable habitat for this species is presented in Figure 5-11.

Table 6-11: Significant Residual Impact Assessment for the Special Least Concern short-beaked echidna

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to result in a long-term decrease in the size of a local population?</p>	<p>Unlikely</p> <p>The presence and abundance of short-beaked echidna records in the region surrounding the Study area suggests that there is sufficient suitable habitat to support a local population of this species. The nearest record is approximately 5 km to the north-west. Whilst the construction of the Project will not result in any direct loss of potentially suitable habitat for this species, they are capable of utilising a broad range of habitats including forests and woodlands, heaths, grasslands and arid environments, suggesting that there is an abundance of suitable habitat in the surrounding landscape.</p> <p>Whilst designing the Project, Arrow have attempted to co-locate this linear infrastructure with other linear infrastructure and avoid vegetated areas wherever possible and to avoid further fragmentation of non-remnant habitat. Given the scale and type of disturbance associated with linear infrastructure, the construction and ongoing operation of the Project is not likely to permanently displace echidnas from the Study area.</p> <p>It is therefore unlikely that the Project will lead to a long-term decrease in the size of a local population.</p>
<p>Are impacts to suitable habitat likely to result in a reduced extent of occurrence for the species?</p>	<p>Unlikely</p> <p>The extent of occurrence is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy. Whilst a formal assessment of the short-beaked echidna’s extent of occurrence hasn’t been undertaken, the EOO tool embedded in the Atlas of Living Australia (ALA) indicates that the extent of occurrence for this species is will cover the entire Australian landmass.</p> <p>The Project will not result in any direct loss of potentially suitable habitat for the short-beaked echidna. The Project impacts on 17.9 ha of remnant vegetation and 0.2 ha of regrowth vegetation and this only represents only a fraction of the suitable habitat identified in the Study area. Considering the distribution of this species throughout Australia and the localised habitat fragmentation already present within the broader Study area, it is considered unlikely that the construction and ongoing operation of the Project will reduce the extent of occurrence for this species.</p>

SRI Criteria	Project Response
<p>Are impacts to suitable habitat likely to result in fragmentation of an existing population?</p>	<p>Unlikely</p> <p>The short-beaked echidna forages at ground level and it may travel considerable distances through fragmented landscapes in search of food. Arrow co-located the Project RoW with other linear infrastructure to minimise the impact of the overall construction RoW wherever possible. Given the scale and type of impact required for this Project (i.e. linear infrastructure 18-29 m wide), development at this location is not likely to impact dispersal of the echidna. Whilst dispersal opportunities may be impacted during the construction of the project (i.e. trenching and storage of infrastructure above ground), once constructed the project is not likely to physically inhibit the dispersal of the echidna throughout the Study area.</p> <p>It is therefore considered unlikely that the Project will fragment an existing population.</p>
<p>Are impacts to suitable habitat likely to result in genetically distinct populations forming as a result of habitat isolation?</p>	<p>Unlikely</p> <p>The short-beaked echidna is a very widespread species, colonising most of the Australian mainland. The development and ongoing operation of the Project does not completely dissect or isolate a population or populations, nor will it physically inhibit echidnas from travelling between fragmented areas of suitable habitat. It is unlikely that impacts to suitable habitat will isolate populations of the Short-beaked Echidna to the extent that genetically distinct populations will be formed.</p>
<p>Are impacts to suitable habitat likely to result in disruption to ecologically significant locations (breeding, feeding or nesting sites) or a species?</p>	<p>Unlikely</p> <p>The Short-beaked Echidna is widespread and occupies a variety of vegetation types, allowing it to remain fairly non-specialised. A key requirement for this species is the availability of day shelters. Day shelters can consist of a variety of habitat structures, such as hollow logs, rabbit burrows, depressions in the ground under fallen trees or leaf litter, and various crevices and cavities. Re-use of day shelters has also been observed, indicating site recognition of particularly good shelters.</p> <p>Suitable habitat for the short-beaked echidna has been identified in accordance with the <i>Method for mapping matters of state environmental significance, Version 7</i>. Whilst this habitat mapping is likely an underestimation of the actual extent of useable habitat for the species, it has been adopted for the purposes of this impact assessment. Based upon this approach, no suitable habitat for the echidna has been mapped within the Study area.</p> <p>Considering the construction of the Project will not result in any direct loss of potentially suitable habitat for the short-beaked echidna, it is unlikely that the Project will disrupt any ecologically significant locations for this species.</p>
<p>It is considered Unlikely that the Project will have a significant residual impact on the Short-beaked Echidna.</p>	

6.5.4 Impacts on mapped essential habitat

There are no impacts to 'essential habitat' on the Queensland Government Essential Habitat Map in accordance with section 20AC of the *Vegetation Management Act 1999* for a species of wildlife listed as critically endangered, endangered, vulnerable under the *Nature Conservation Act 1992*. Whilst some essential habitat mapping was initially identified across the Projects' disturbance footprint, this habitat was mapped for Near Threatened species under the NC Act, which does not constitute a PEM in this assessment.

6.5.5 Impacts to fish passage

The construction of the Project will involve crossing one Green (low impact) and one Purple (major impact) waterway crossings. Crossing methodologies for the pipe installations are discussed in Section 6.1.2.

The two creek crossings associated with the Project will be bed level crossings that will comply with the 'Accepted development requirements for operational work that is constructing or raising waterway barrier works' (Appendix B). There will be no culvert crossings or other structures placed in the waterways. Pipe crossing works and the use of bed-level crossings will be undertaken in accordance with the accepted development requirements (ADR) of the waterway barrier (WWB) self-assessable code or the temporary WWB code.

To assess the potential impacts to fish passage, waterways have been grouped based on their level of risk for impacts to fish passage. There is one low waterway (green) with bed level crossings on 1st order drainage features that is an open depression with no defined bed or banks and does not contain water outside of irregular flow events. It is considered to be low risk waterway and an SRI assessment is presented in Table 6-12.

Wambo Creek has defined bed and banks that frequently contain water and is considered to be higher risk waterway and an SRI assessment is presented in Table 6-12. An assessment of the potential fish passage area impacted by the Project on Wambo Creek is estimated to be 0.1 ha (40 m W x 20 m L) (Plate 6 and Plate 7).



Plate 6: Facing north on western outer bank of Wambo Creek



Plate 7: Facing upstream on eastern outer bank of Wambo Creek

An assessment undertaken in accordance with the SRI Guidelines for impacts to fish passage has been provided in Table 6-12. A conservative assessment has been undertaken based on the proposed works. An action is likely to have a significant impact on a waterway providing for fish passage if there is a real possibility that it will cause an impact on any of the criteria in the table below.

Table 6-12: Significant Residual Impact Assessment for impacts to fish passage

SRI Criteria	Low risk waterway (1 st order drainage feature)	Higher risk waterway (Wambo Creek)
Result in the mortality or injury of fish	Unlikely These waterways are generally dry except during high flow events and construction will not occur during these times.	Possible Waterways contain water more often and dewatering during construction maybe required.
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	Unlikely The construction will preferentially be undertaken during no/low flow periods, the area affected by construction is small and standing water in these waterways are uncommon.	Unlikely The construction will preferentially be undertaken during no/low flow periods, the area affected by construction is small.
Reduce the extent, frequency or duration of fish passage previously found at a site	Unlikely The crossing will be a bed-level crossing that will be constructed in accordance with the WWB ADR.	Unlikely The crossing will be a bed-level crossing that will be constructed in accordance with the WWB ADR.

SRI Criteria	Low risk waterway (1 st order drainage feature)	Higher risk waterway (Wambo Creek)
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	<p>Unlikely</p> <p>No significant habitat is present in these waterways and the profiles and substrates are reinstated to their original location.</p>	<p>Possible</p> <p>Temporary impacts to fish habitat may occur. The works are only for a small area of potential habitat and the profiles and substrates are reinstated to their original location.</p>
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	<p>Unlikely</p> <p>The crossing will be a bed-level crossing that will be constructed in accordance with the WWB ADR.</p>	<p>Unlikely</p> <p>The crossing will be a bed-level crossing that will be constructed in accordance with the WWB ADR.</p>
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	<p>Unlikely</p> <p>The construction will preferentially be undertaken during low flow periods, the area affected by construction is small and standing water in these waterways are uncommon.</p>	<p>Unlikely</p> <p>The construction will preferentially be undertaken during low flow periods, the area affected by construction is small and will be undertaken in accordance with the WWB ADR.</p>
	<p>It is considered Unlikely that the Project will have a significant residual impact on fish passage for this waterway.</p>	<p>It is considered Possible that the Project will have a significant residual impact on fish passage for this waterway.</p>

7 Conclusion

The amendment application relates to EA0002166 Jammatt PPL2047. The subject of the application is the inclusions of an authorised activity table, authorisation of ESA disturbance and inclusion of PEMS. The application had previously been assessed and approved by DES in 2020 and as such this application seeks to include the ESA and PEMS authorisations. In addition to the ESA and PEMS, the EA seeks to authorise an additional IPF at the same location of the existing authorised facility to cater for future expansion.

Arrow assessed the environmental impacts of the proposed activity and actively sought to avoid or minimise adverse impacts to the greatest practicable extent which has led to a reduction in the RoW width from 40m to 30m (20m RoW for the remaining 3km of produced water) where possible.

The information provided supports Arrow's understanding that the application is properly classified a minor amendment (threshold), for the purpose of section 228 of the EP Act. Arrow believes that the proposed amendment does not trigger the thresholds/criteria for a major amendment based on the DETSI Major and Minor amendments guideline ESR/2015/1684 Version 11.00, in that the application does not increase the level of environmental harm caused by the proposed relevant activity since the application seeks to reduce the width of the RoW from 40m to 30m (20m RoW for the remaining 3km of produced water) whilst seeking the inclusion of relevant PEMS and ESA authorisations.