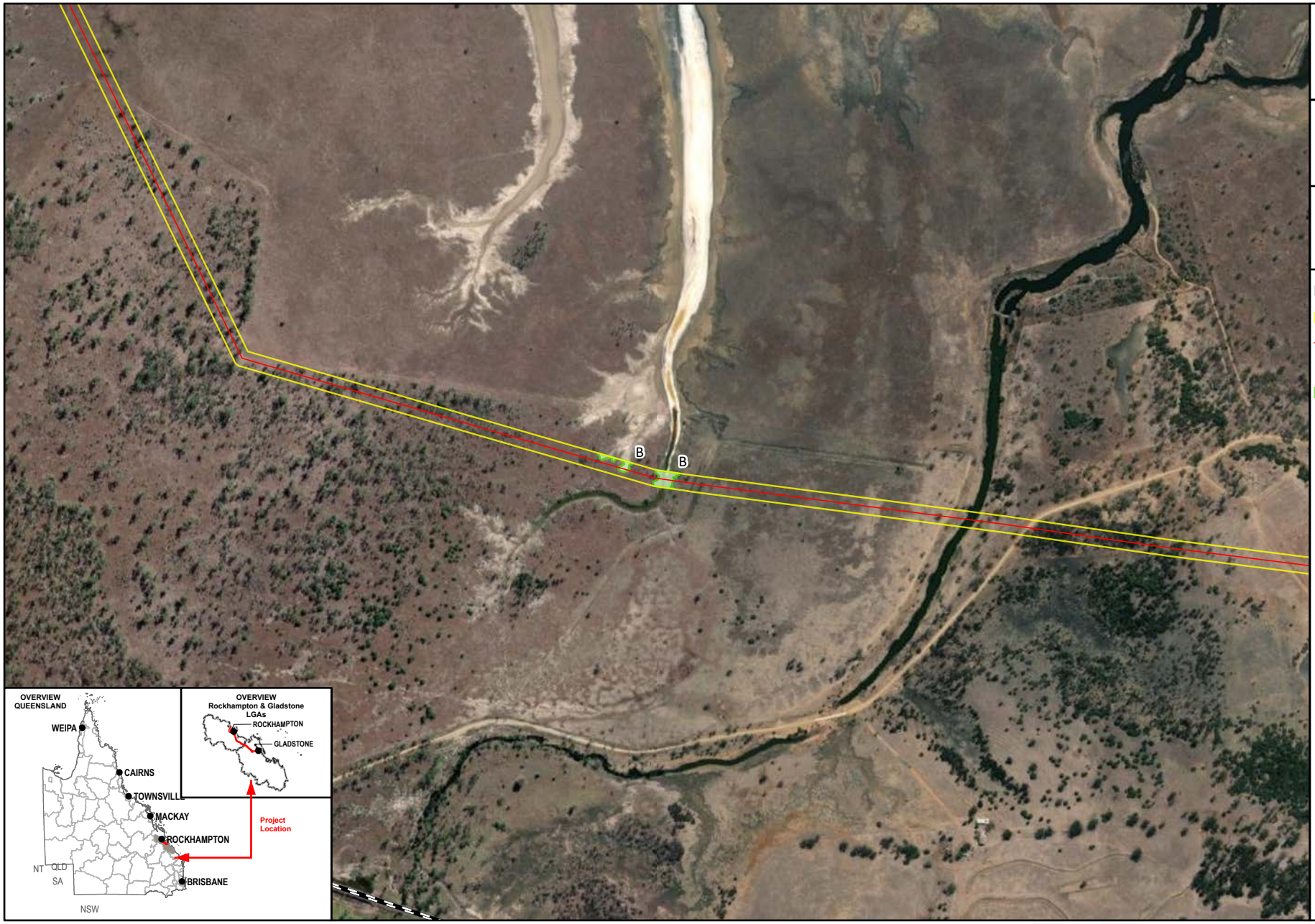

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Legend

- Study Area
- SGIC SDA Pipeline Alignment
- Railways
- Marine Plants Sites

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-4c Marine Plant Extents Within the SGIC SDA Study Area

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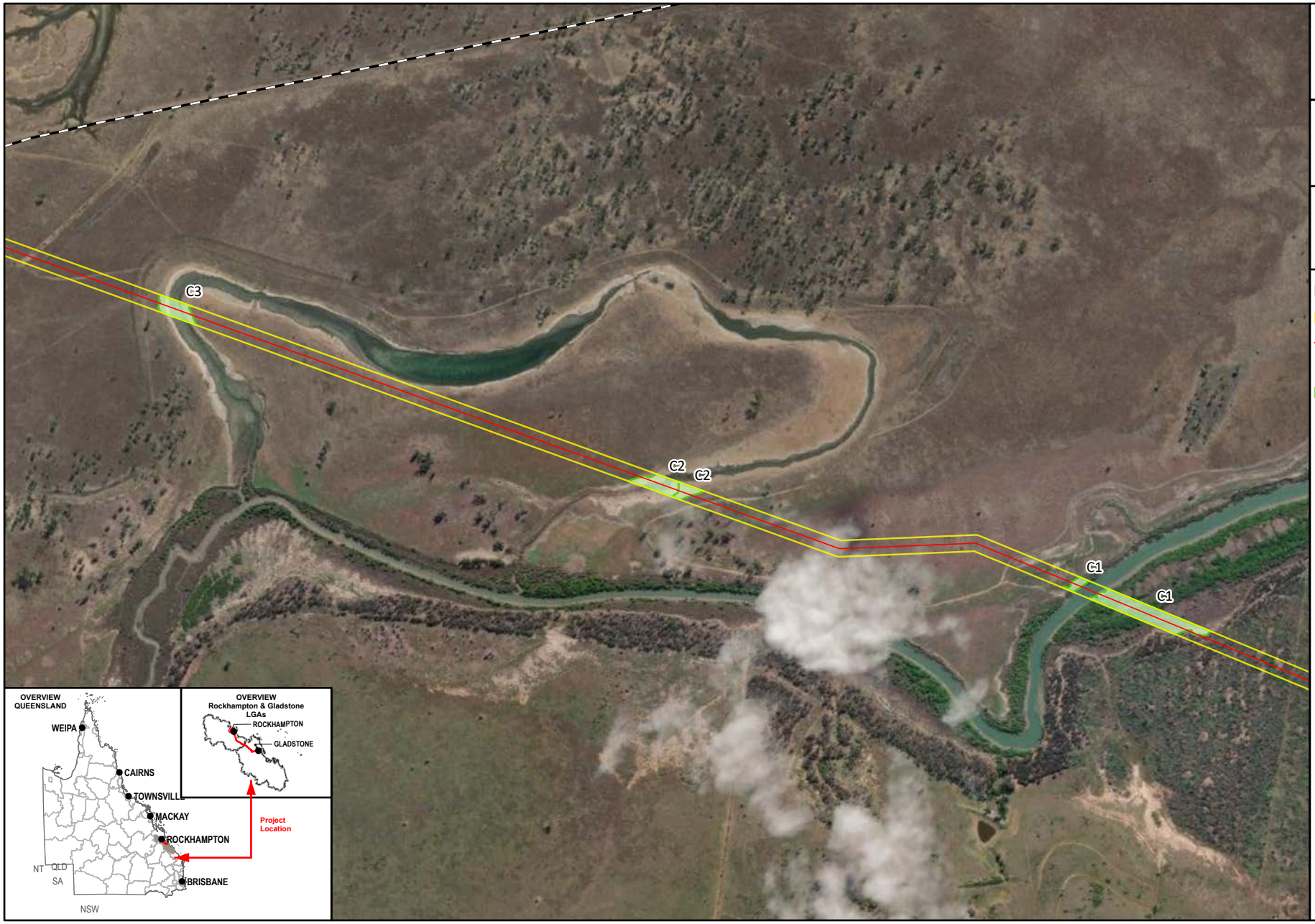

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Legend

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Data Sources:
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Figure 4-4c Marine Plant Extents Within the SGIC SDA Study Area

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4.4 Terrestrial fauna

4.4.1 Desktop assessment results

4.4.1.1 Threatened fauna species

The EPBC Act PMST database identified 36 threatened fauna species that have the potential to occur within the desktop search extent (10 km buffer). State based searches (i.e. WildNet, Species Profile Search and Biomaps) identified 29 threatened fauna species that have been historically recorded within the desktop search extent. Note that marine species have been addressed in Section 4.6.

In aggregate, the searches identified 41 State and/or Federal threatened fauna species that are either predicted to occur or have been confirmed as occurring, within the desktop search extent. This comprised 24 birds, nine mammals, seven reptiles and one insect. Some historical records identified within the desktop search extent are classified and therefore the exact location of these records within the search extent are unknown. The PMST and WildNet desktop search results are provided in Appendix A and summarised in Table 4-9 .

Table 4-9 also identifies threatened fauna species that were identified as controlling provisions at the time of the EPBC approval.

Table 4-9 Threatened fauna species identified within the desktop search extent and/or predicted to occur (PMST)

Scientific name	Common name	Status		Source	WN Records	Nearest record to ROW	EPBC Approval
		EPBC Act	NC Act				
Birds							
Botaurus poiciloptilus	Australasian bittern	E	E	PMST	-	-	
Calidris canutus	Red knot	E, Mig	E	PMST	-	-	
Calidris ferruginea	Curlew sandpiper	CE, Mig	CE	WN; PMST	13	1.7 km	
Charadrius leschenaultii	Greater sand plover	V, Mig	V	PMST	-	-	
Charadrius mongolus	Lesser sand plover	E, Mig	E	WN	1	*	
Cyclopsitta diophthalma coxeni	Coxen's fig-parrot	E	E	PMST	-	-	
Epthianura crocea macgregori	Yellow chat (Dawson)	CE	E	WN; PMST	157	580 m	✓
Erythrotriorchis radiatus	Red goshawk	V	E	WN; PMST	2	5.0 km	✓
Falco hypoleucos	Grey falcon	V	V	WN; PMST	1	3.0 km	
Fregetta grallaria grallaria	White-bellied storm-petrel	V	LC	PMST	-	-	
Geophaps scripta scripta	Squatter pigeon (southern)	V	V	WN; PMST	59	1.1 km	✓
Hirundapus caudacutus	White-throated needletail	V, Mig	V	WN; PMST	2	9.3 km	
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	V	V	WN; PMST	6	1.6 km	
Lophochroa leadbeateri	Major Mitchell's cockatoo	NL	V	WN	1	*	
Macronectes giganteus	Southern giant petrel	E, Mig	E	PMST	-	-	

Scientific name	Common name	Status		Source	WN Records	Nearest record to ROW	EPBC Approval
		EPBC Act	NC Act				
Neochmia ruficauda ruficauda	Star finch (eastern, southern)	E	E	WN; PMST	1	5.4 km	
Ninox strenua	Powerful owl	NL	V	WN	7	6.7 km	
Numenius madagascariensis	Eastern curlew	CE	E	WN; PMST	9	1.7 km	
Pachyptila turtur subantarctica	Fairy prion (southern)	V	LC	PMST	-	-	
Poephila cincta cincta	Black-throated finch (southern)	E	E	WN; PMST	4	2.0 km	
Pterodroma neglecta neglecta	Kermadec petrel (western)	V	LC	PMST	-	-	
Rostratula australis	Australian painted snipe	E	E	WN; PMST	6	*	✓
Thalassarche impavida	Campbell albatross	V, Mig	SL	PMST	-	-	
Turnix melanogaster	Black-breasted button-quail	V	V	WN; PMST	2	1.9 km	
Mammals							
Chalinolobus dwyeri	Large-eared pied bat	V	V	PMST	-	-	
Dasyurus hallucatus	Northern quoll	E	LC	WN; PMST	7	795 m	
Macroderma gigas	Ghost bat	V	E	WN; PMST	1	*	
Nyctophilus corbeni	Corben's long-eared bat	V	V	PMST	-	-	
Petauroides volans	Greater glider (southern and central)	E	E	WN; PMST	14	4.9 km	
Petaurus australis australis	Yellow-bellied glider (south-eastern)	V	V	WN; PMST	10	10 km	
Phascolarctos cinereus	Koala	E	E	WN; PMST	14	930 m	
Pteropus poliocephalus	Grey-headed flying-fox	V	LC	WN; PMST	4	3.3 km	✓
Xeromys myoides	Water mouse	V	V	PMST	-	*	
Reptiles							
Acanthophis antarcticus	Common death adder	NL	V	WN	1	*	
Delma torquata	Collared delma	V	V	WN; PMST	1	4.8 km	✓
Denisonia maculata	Ornamental snake	V	V	WN; PMST	24	5.2 km	✓
Egernia rugosa	Yakka skink	V	V	WN; PMST	2	5.0 km	✓
Elseya albagula	White-throated snapping turtle	CE	CE	WN; PMST	3	860 m	
Furina dunmalli	Dunmall's snake	V	V	WN; PMST	1	*	

Scientific name	Common name	Status		Source	WN Records	Nearest record to ROW	EPBC Approval
		EPBC Act	NC Act				
Hemiaspis damelii	Grey snake	NL	E	WN	22	2.7 km	
Insects							
Jalmenus eubulus	Pale imperial hairstreak	NL	V	WN	2	*	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed;

WN – WildNet; PMST – Protected Matters Search Tool.

* – location of historical record classified

4.4.1.2 Migratory species

The desktop searches (i.e. PMST, WildNet, Species Profile Search and Biomaps) identified 45 migratory species that have the potential to occur within the desktop search extent. The PMST and WildNet desktop search results are provided in Appendix A and summarised in Table 4-10. Migratory species listed as threatened under the EPBC Act and NC Act have also been included in Table 4-10.

At the time of the EPBC Referral and EPBC approval, migratory species were not identified as controlling provisions.

Table 4-10 Migratory species identified within the desktop search extent

Scientific name	Common name	Status		Source	Records
		EPBC Act	NC Act		
Birds					
Actitis hypoleucos	Common sandpiper	Mig	SL	PMST	-
Anous stolidus	Common noddy	Mig	SL	PMST	-
Apus pacificus	Fork-tailed swift	Mig	SL	WN; PMST	2
Arenaria interpres	Ruddy turnstone	Mig	SL	WN	1
Calidris acuminata	Sharp-tailed sandpiper	Mig	SL	WN; PMST	43
Calidris canutus	Red knot	E, Mig	E	PMST	-
Calidris ferruginea	Curlew sandpiper	CE, Mig	CE	WN; PMST	13
Calidris melanotos	Pectoral sandpiper	Mig	SL	PMST	-
Calidris ruficollis	Red-necked stint	Mig	SL	WN	6
Calonectris leucomelas	Streaked shearwater	Mig	SL	PMST	-
Charadrius dubius	Little ringed plover	Mig	SL	WN	1
Charadrius mongolus	Lesser sand plover	E, Mig	E	WN	1
Charadrius leschenaultii	Greater sand plover	V, Mig	V	PMST	-
Chlidonias leucopterus	White-winged black tern	Mig	SL	WN	1
Cuculus optatus	Oriental cuckoo	Mig	SL	WN; PMST	1
Fregata ariel	Lesser frigatebird	Mig	SL	PMST	-
Fregata minor	Great frigatebird	Mig	SL	PMST	-
Gallinago hardwickii	Latham's snipe	Mig	SL	WN; PMST	45
Gelochelidon nilotica	Gull-billed tern	Mig	SL	WN	19
Hirundapus caudacutus	White-throated needletail	V, Mig	V	WN; PMST	2
Hydroprogne caspia	Caspian tern	Mig	SL	WN	41

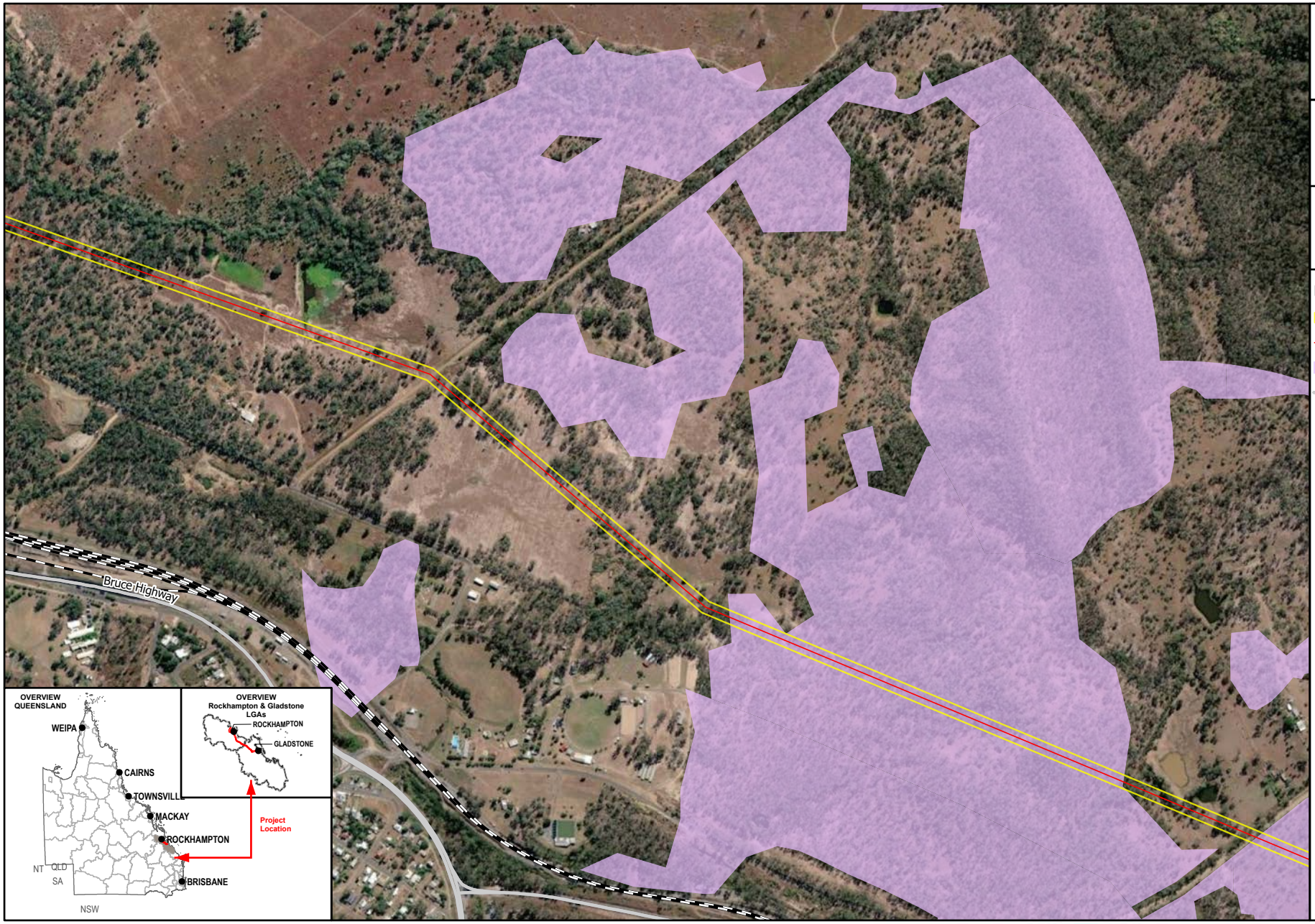
Scientific name	Common name	Status		Source	Records
		EPBC Act	NC Act		
Limnodromus semipalmatus	Asian dowitcher	Mig	SL	PMST	-
Limosa lapponica	Bar-tailed godwit	Mig	SL	PMST	-
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	V, Mig	V	WN; PMST	6
Limosa limosa	Black-tailed godwit	Mig	SL	WN	23
Macronectes giganteus	Southern giant petrel	E, Mig	E	PMST	-
Monarcha melanopsis	Black-faced monarch	Mig	SL	WN; PMST	8
Monarcha trivirgatus	Spectacled monarch	Mig	SL	WN; PMST	11
Myiagra cyanoleuca	Satin flycatcher	Mig	SL	WN; PMST	6
Numenius madagascariensis	Eastern curlew	CE, Mig	E	WN; PMST	9
Numenius minutus	Little curlew	Mig	SL	WN	2
Numenius phaeopus	Whimbrel	Mig	SL	WN	4
Pandion haliaetus	Osprey	Mig	SL	WN; PMST	9
Phaethon lepturus	White-tailed tropicbird	Mig	SL	PMST	-
Plegadis falcinellus	Glossy ibis	Mig	SL	WN	69
Pluvialis fulva	Pacific golden plover	Mig	SL	WN	3
Rhipidura rufifrons	Rufous fantail	Mig	SL	WN; PMST	16
Sternula albifrons	Little tern	Mig	SL	WN; PMST	3
Thalasseus bergii	Crested tern	Mig	SL	WN	1
Thalassarche impavida	Campbell albatross	V, Mig	LC	PMST	-
Tringa incana	Wandering tattler	Mig	SL	WN	1
Tringa nebularia	Common greenshank	Mig	SL	WN; PMST	20
Tringa stagnatilis	Marsh sandpiper	Mig	SL	WN	60
Xenus cinereus	Terek sandpiper	Mig	SL	WN	1
Reptiles					
Crocodylus porosus	Estuarine crocodile	Mig	V	WN; PSMT	2
Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed; WN – WildNet; PMST – Protected Matters Search Tool.					

4.4.1.3 Essential habitat

The SGIC SDA pipeline alignment intersects multiple areas of mapped essential habitat for conservation significant species listed under the NC Act as shown in Figure 4-5. These areas include essential habitat for the curlew sandpiper (*Calidris ferruginea*), lesser sand plover (*Charadrius mongolus*), ornamental snake (*Denisonia maculata*), yellow chat (Dawson) (*Epthianura crocea macgregori*), squatter pigeon (southern) (*Geophaps scripta scripta*), Australian painted snipe (*Rostratula australis*), powerful owl (*Ninox strenua*) and koala (*Phascolarctos cinereus*).

4.4.1.4 State and regional wildlife corridors

The SGIC SDA pipeline alignment crosses two state riparian corridors which follows Raglan Creek near Raglan and Scrubby Creek near Rockhampton (Figure 4-5). The SGIC SDA pipeline alignment also intersects nine regional terrestrial corridors which follow waterways, including Twelve Mile Creek, Inkerman Creek, Station Creek, Gavial Creek, and an unnamed waterway (Figure 4-5).



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Legend

- Study Area
- SGIC Pipeline Alignment
- Essential Habitat
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-5a
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent

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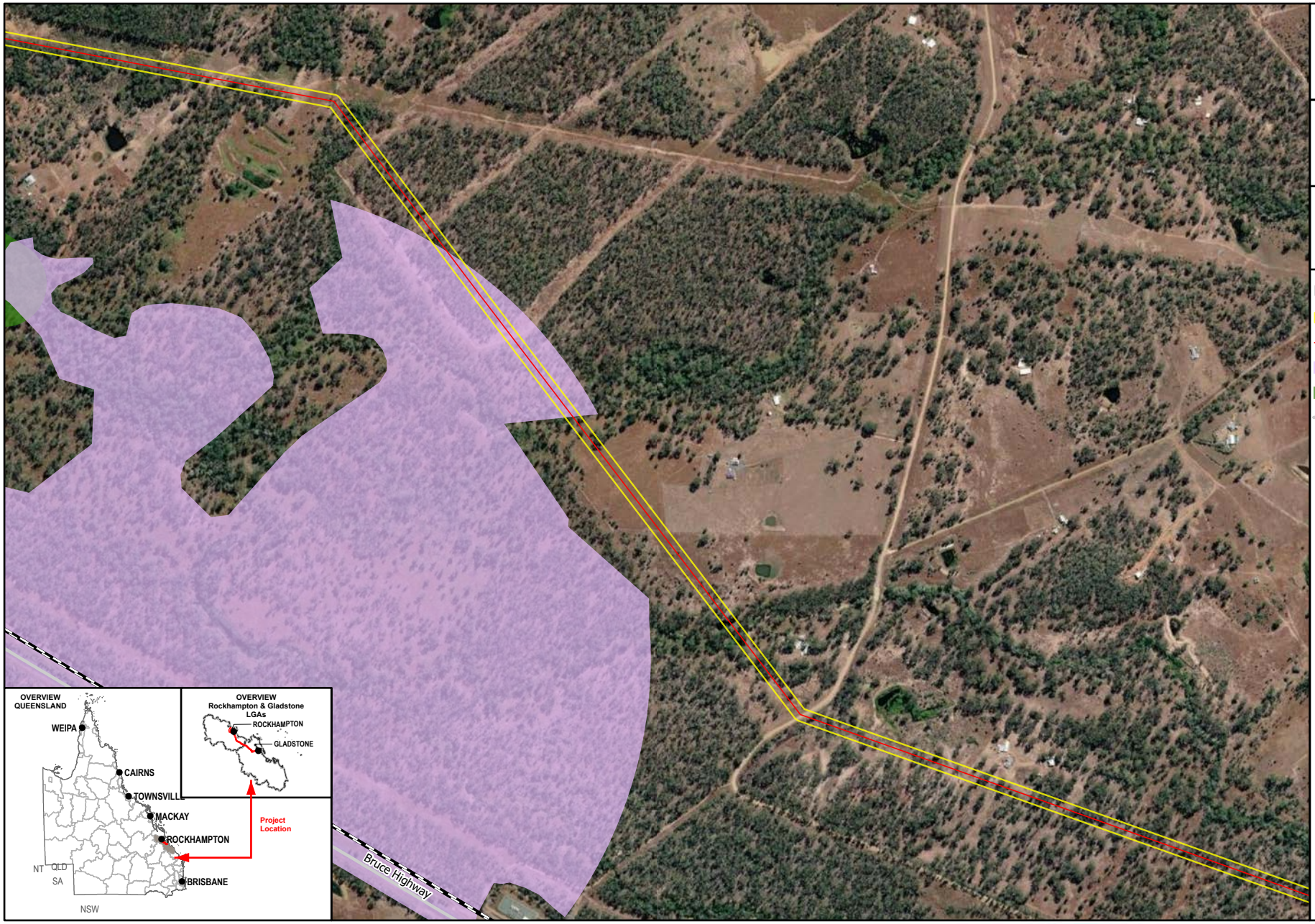

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Legend

- Study Area
- SGIC Pipeline Alignment
- Essential Habitat
- Regional Wildlife Corriors
- Main Roads
- Railways

Data Sources:
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Figure 4-5b
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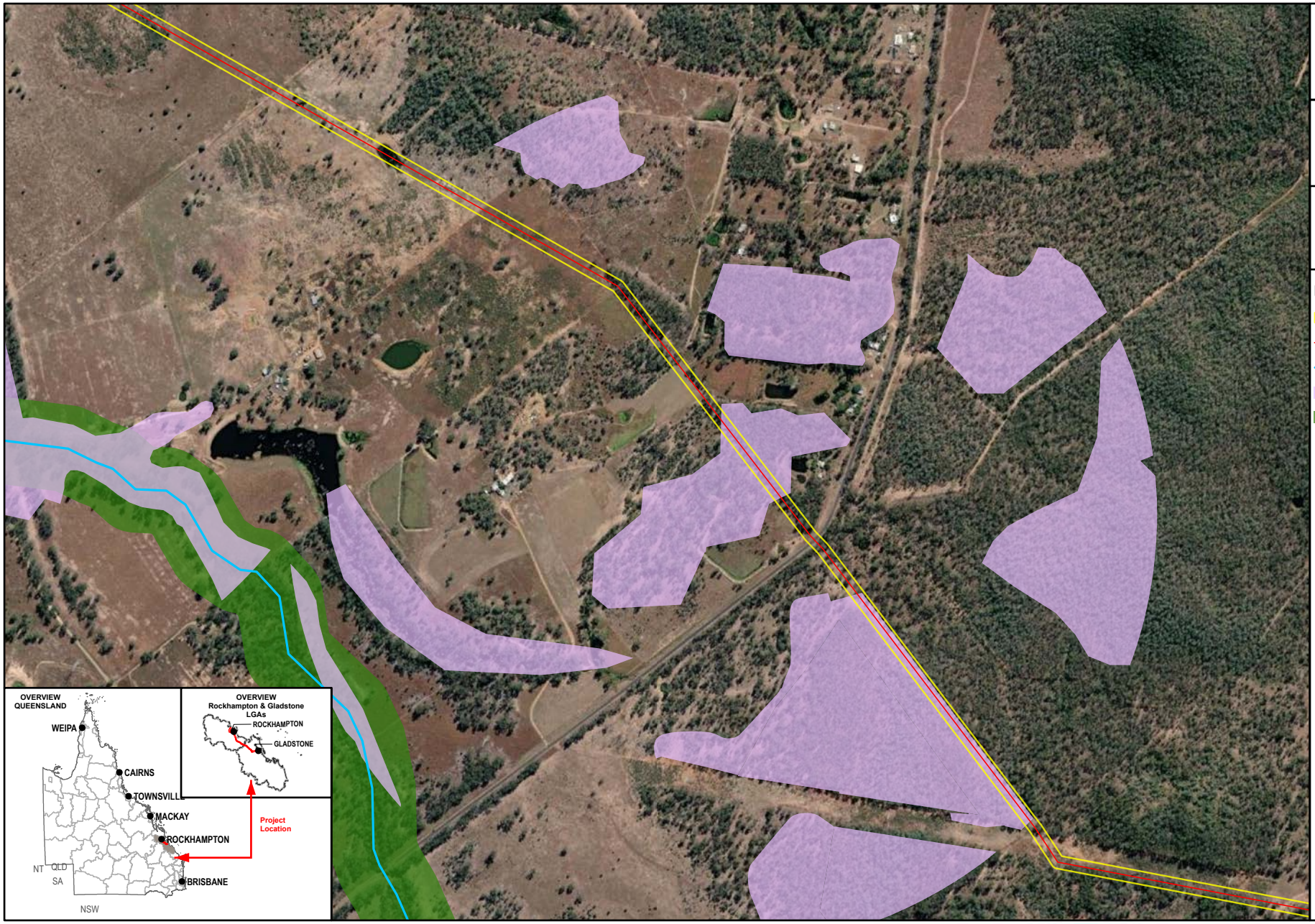

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Legend

- Study Area
- SGIC Pipeline Alignment
- Riparian Corridor Centrelines
- Essential Habitat
- Regional Wildlife Corriors

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Figure 4-5c
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent

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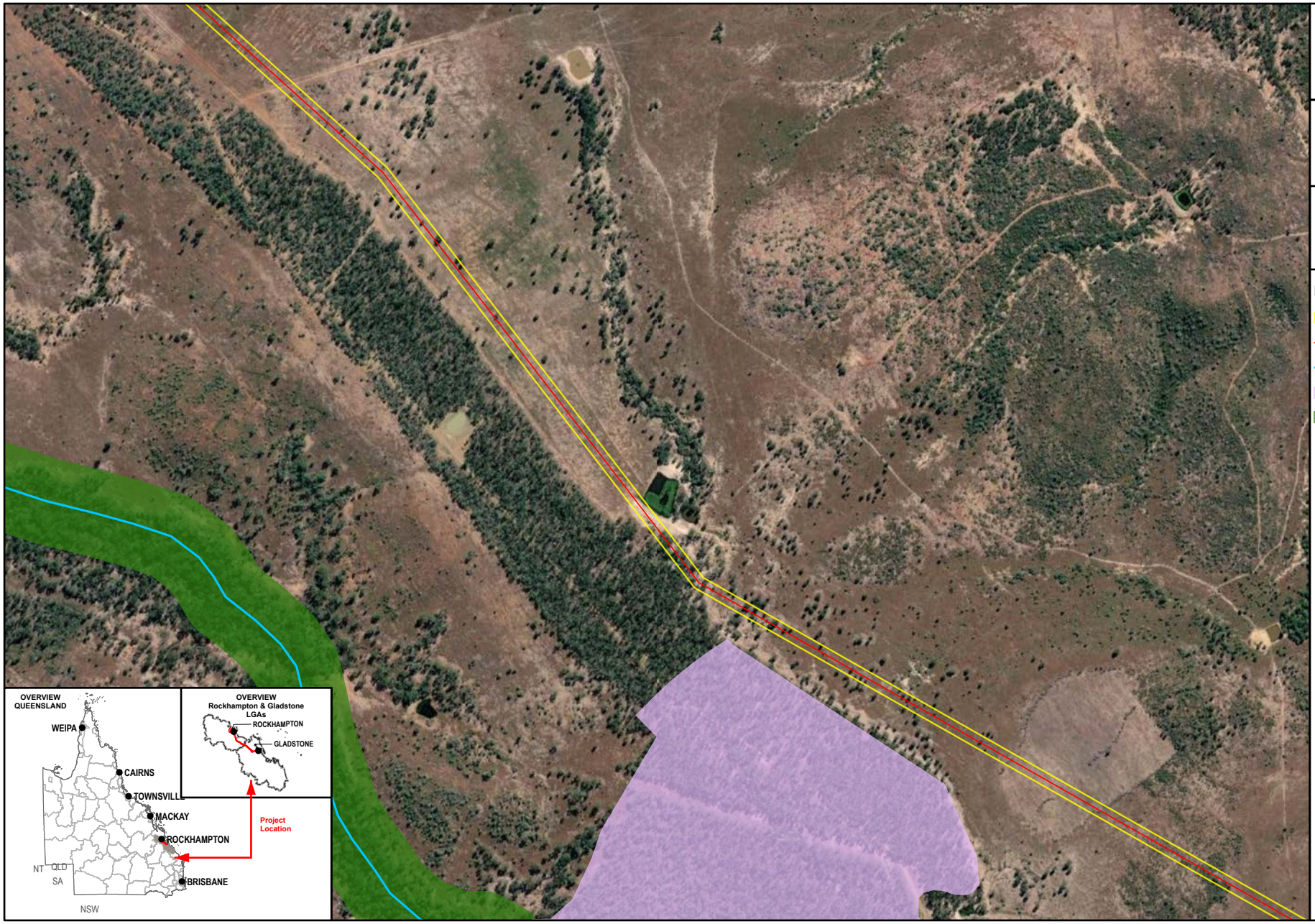

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Legend

- Study Area
- SGIC Pipeline Alignment
- Riparian Corridor Centrelines
- Essential Habitat
- Regional Wildlife Corriors

Data Sources:
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Fitzroy to Gladstone Pipeline
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Figure 4-5d
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent

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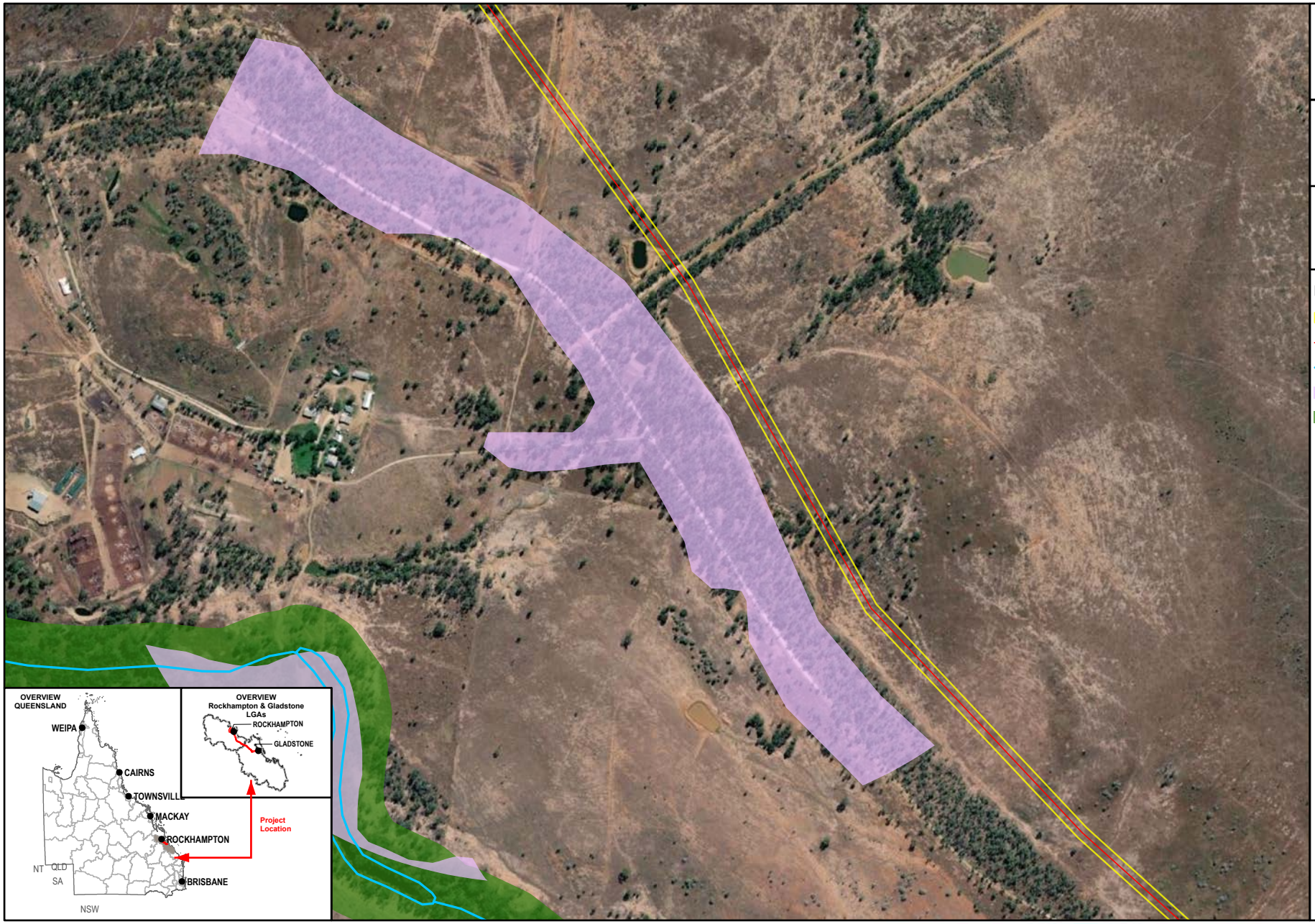

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Legend

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- Essential Habitat
- Regional Wildlife Corriors

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-5e
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent

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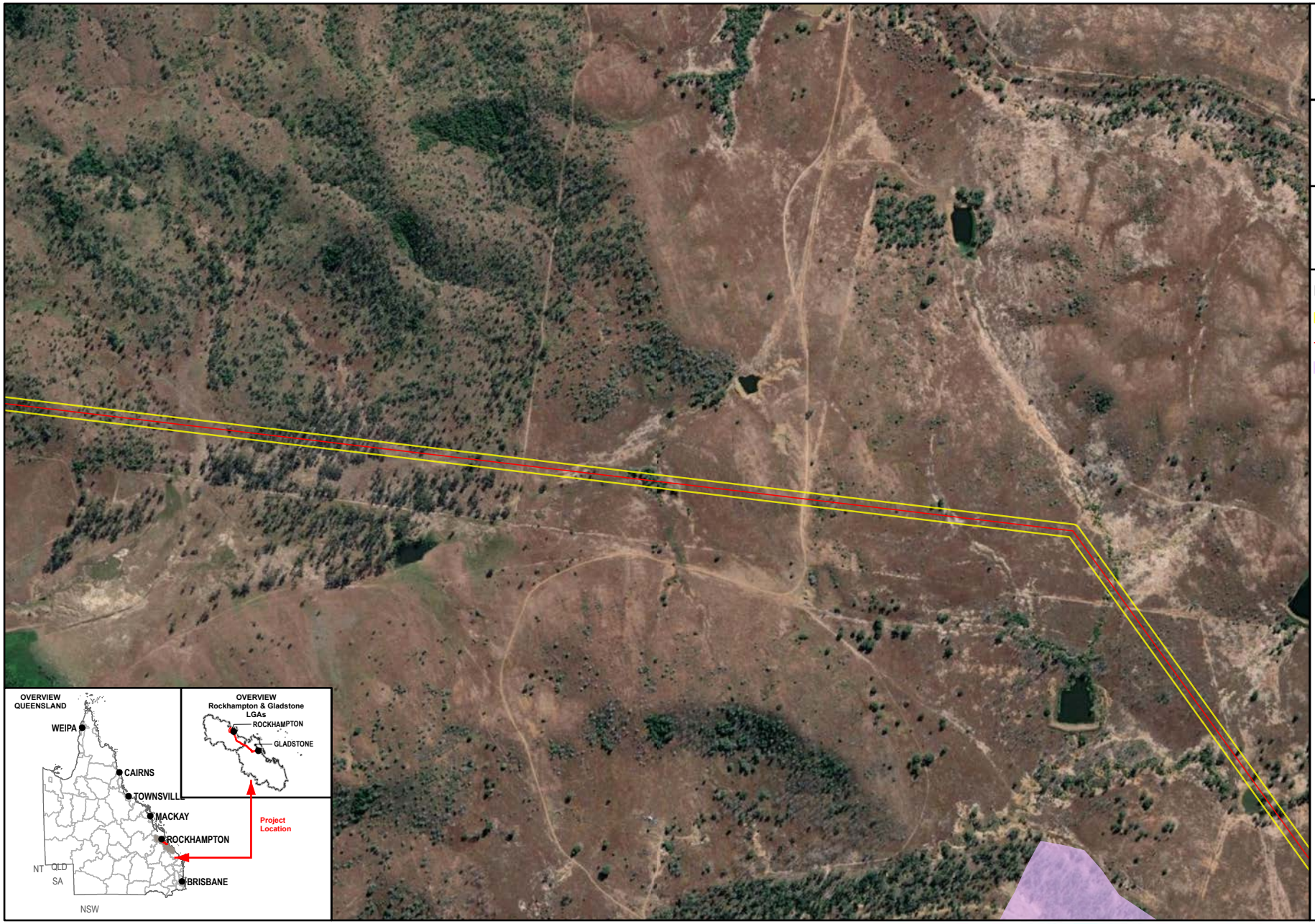

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Figure 4-5f
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent

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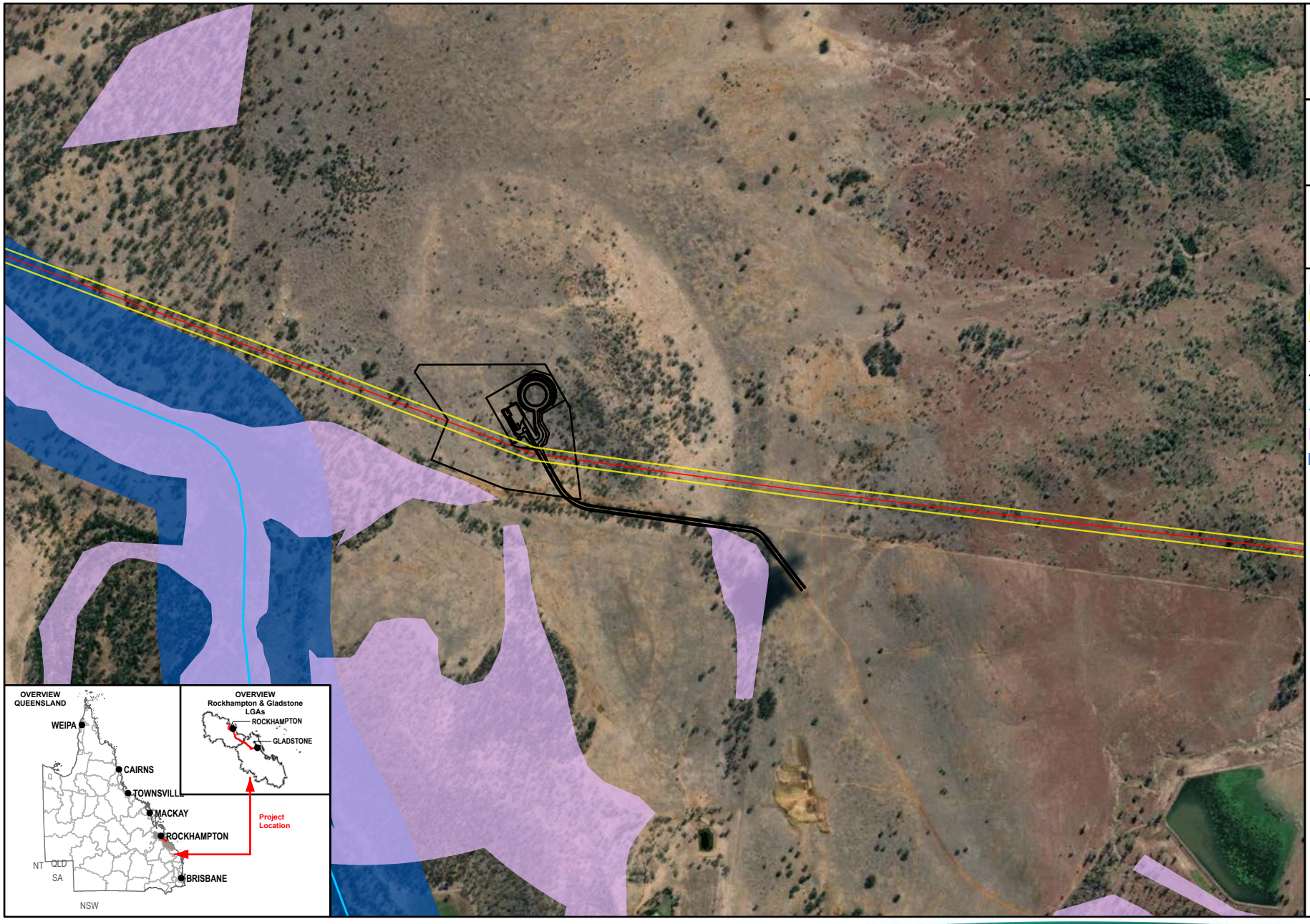

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- Study Area
- SGIC Pipeline Alignment
- Raglan Pump Station and Reservoir Layout
- Riparian Corridor Centrelines
- Essential Habitat
- State Wildlife Corriors

Data Sources:
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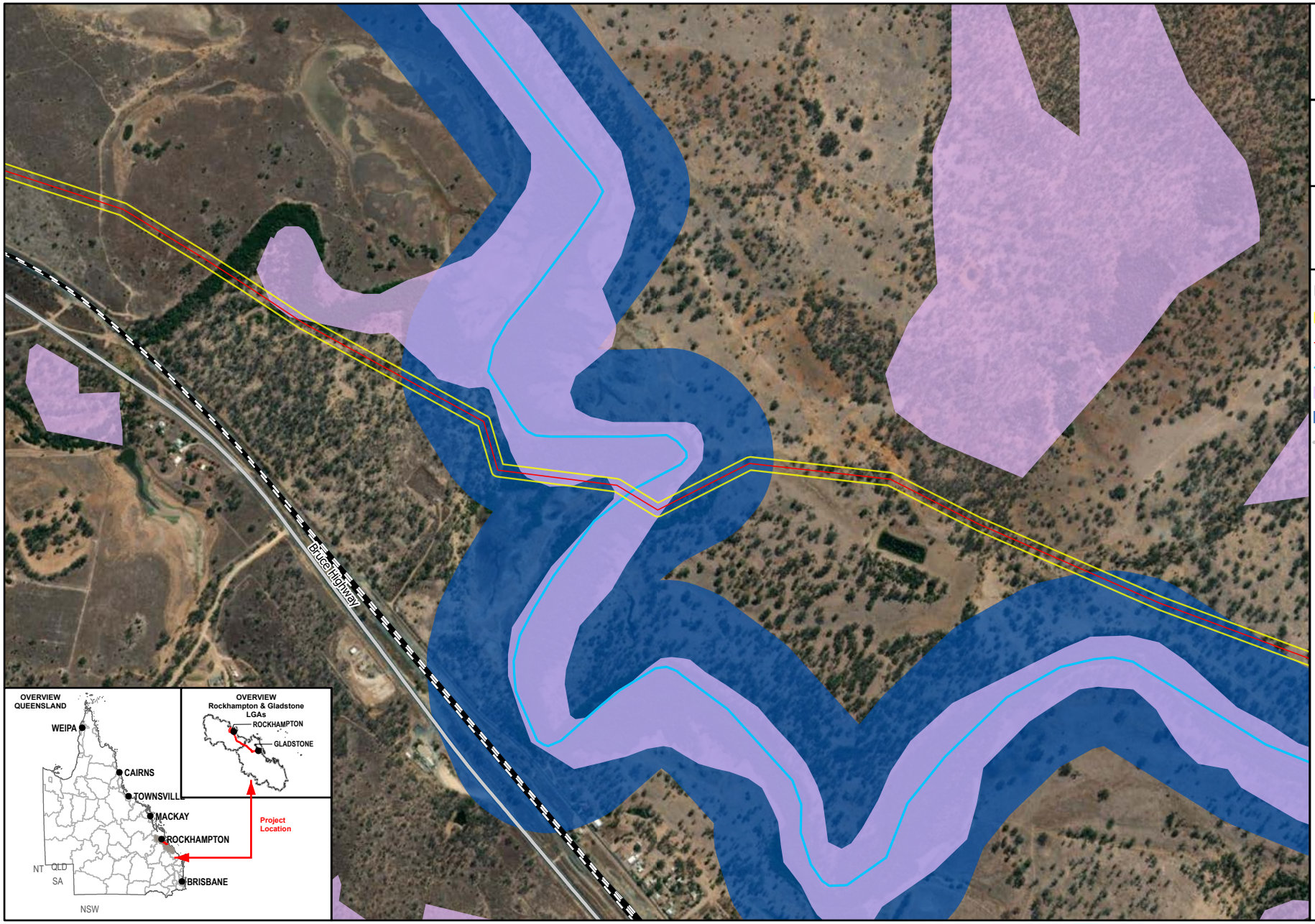
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-5g
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent
000-G-MAP-2414 Version:3 Date:2022/09/19



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Legend

- Study Area
- SGIC Pipeline Alignment
- Riparian Corridor Centrelines
- Essential Habitat
- State Wildlife Corriors
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-5h
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent
000-G-MAP-2414 Version:3 Date:2022/09/19

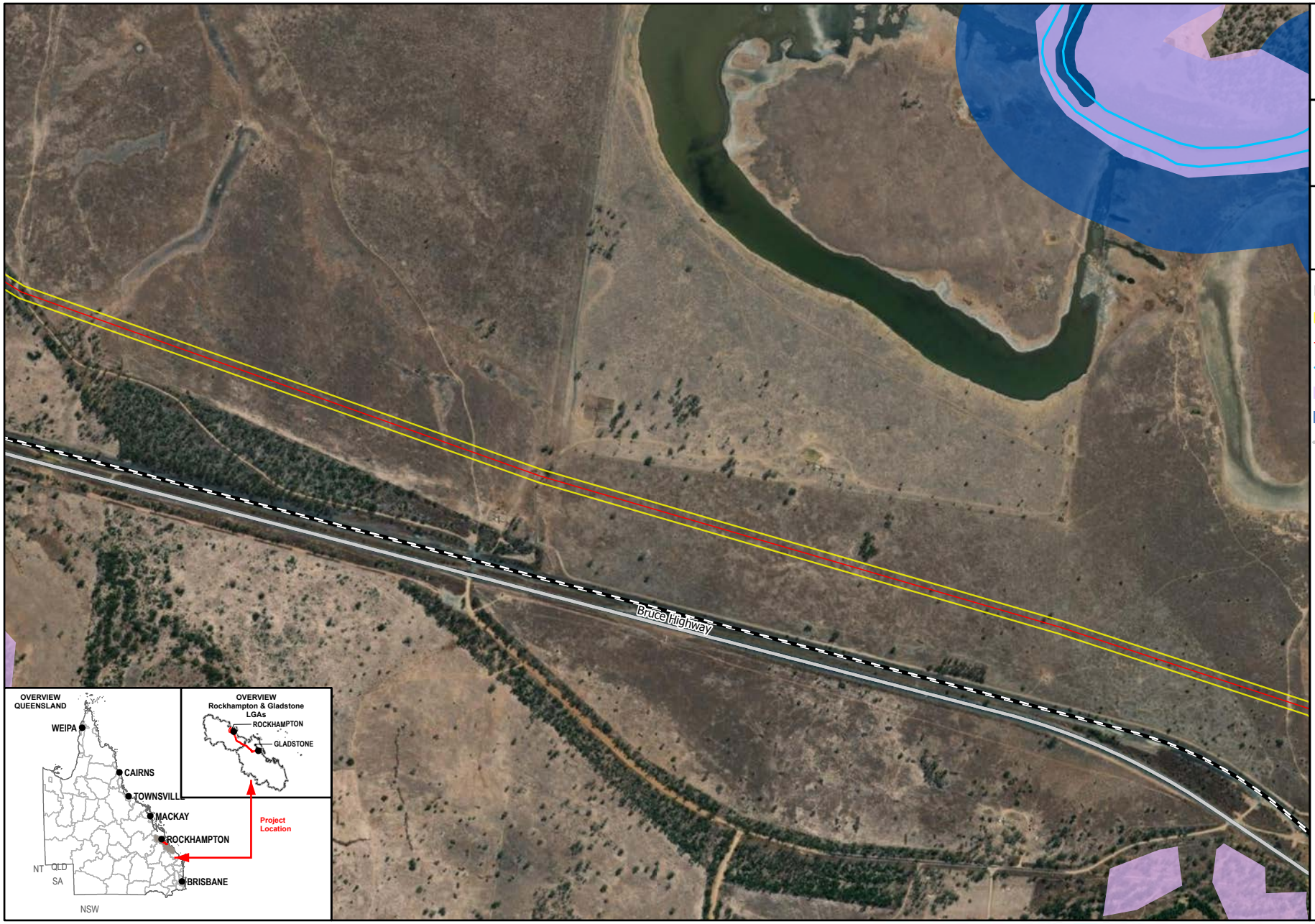

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Figure 4-5i
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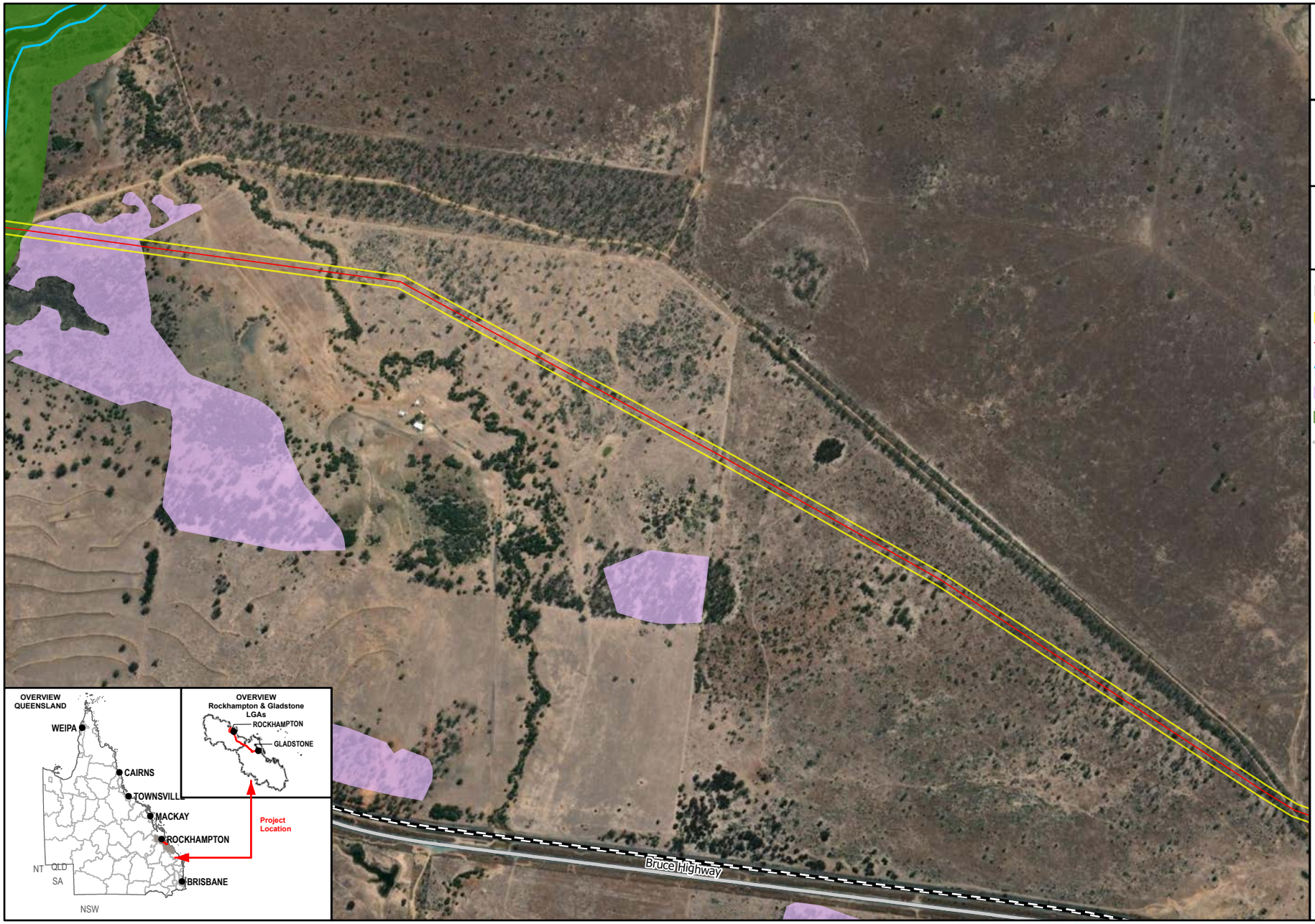

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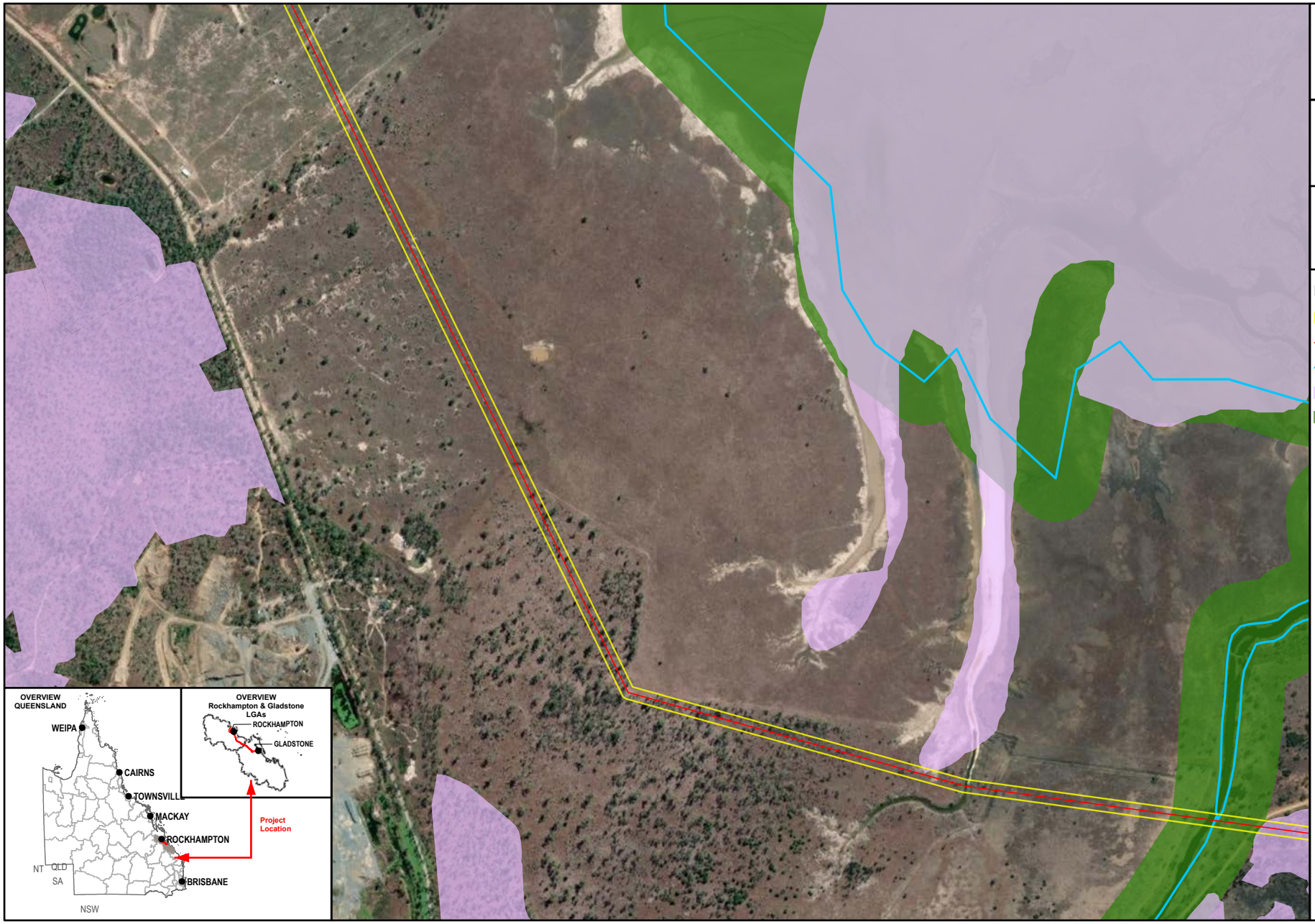

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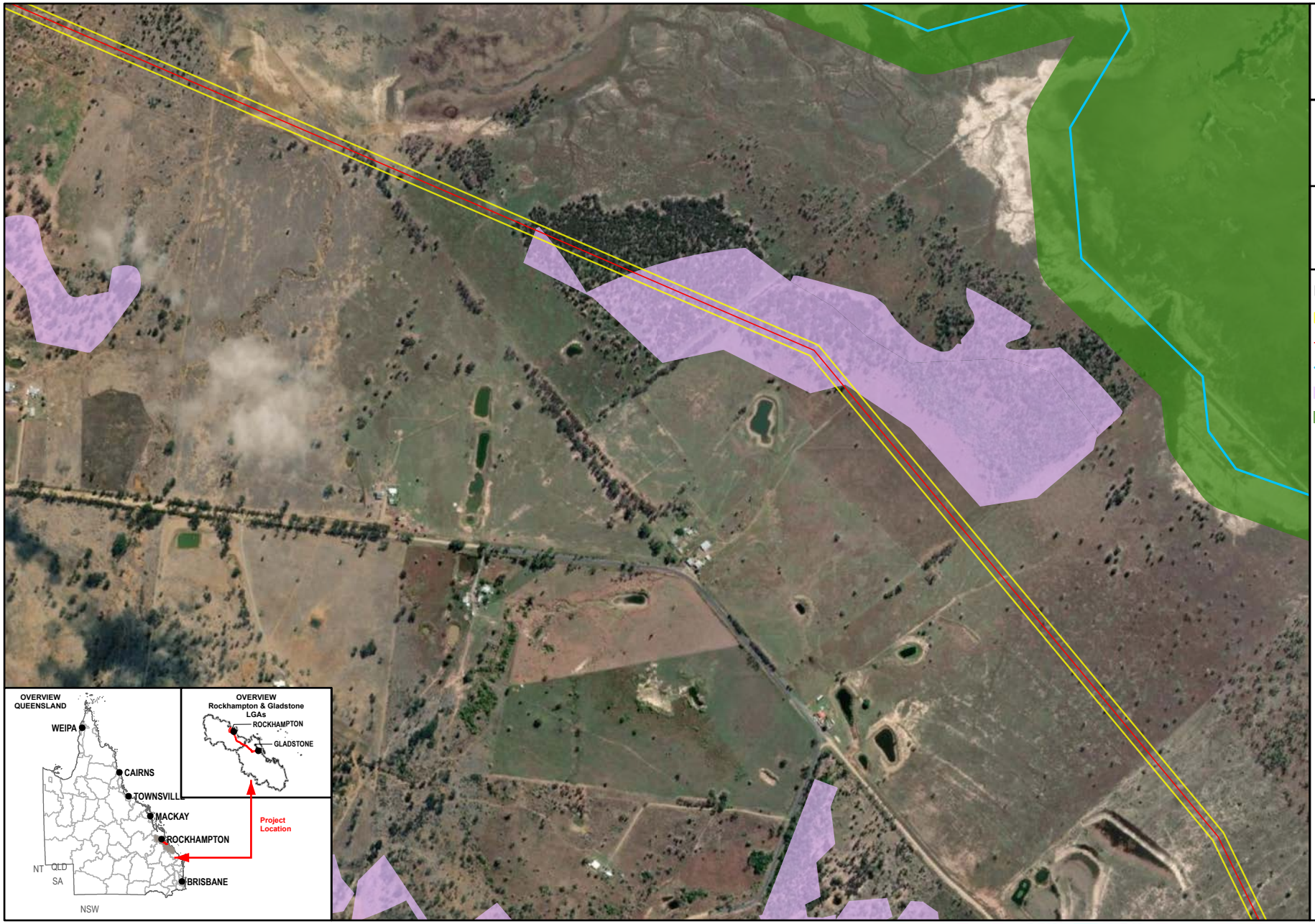

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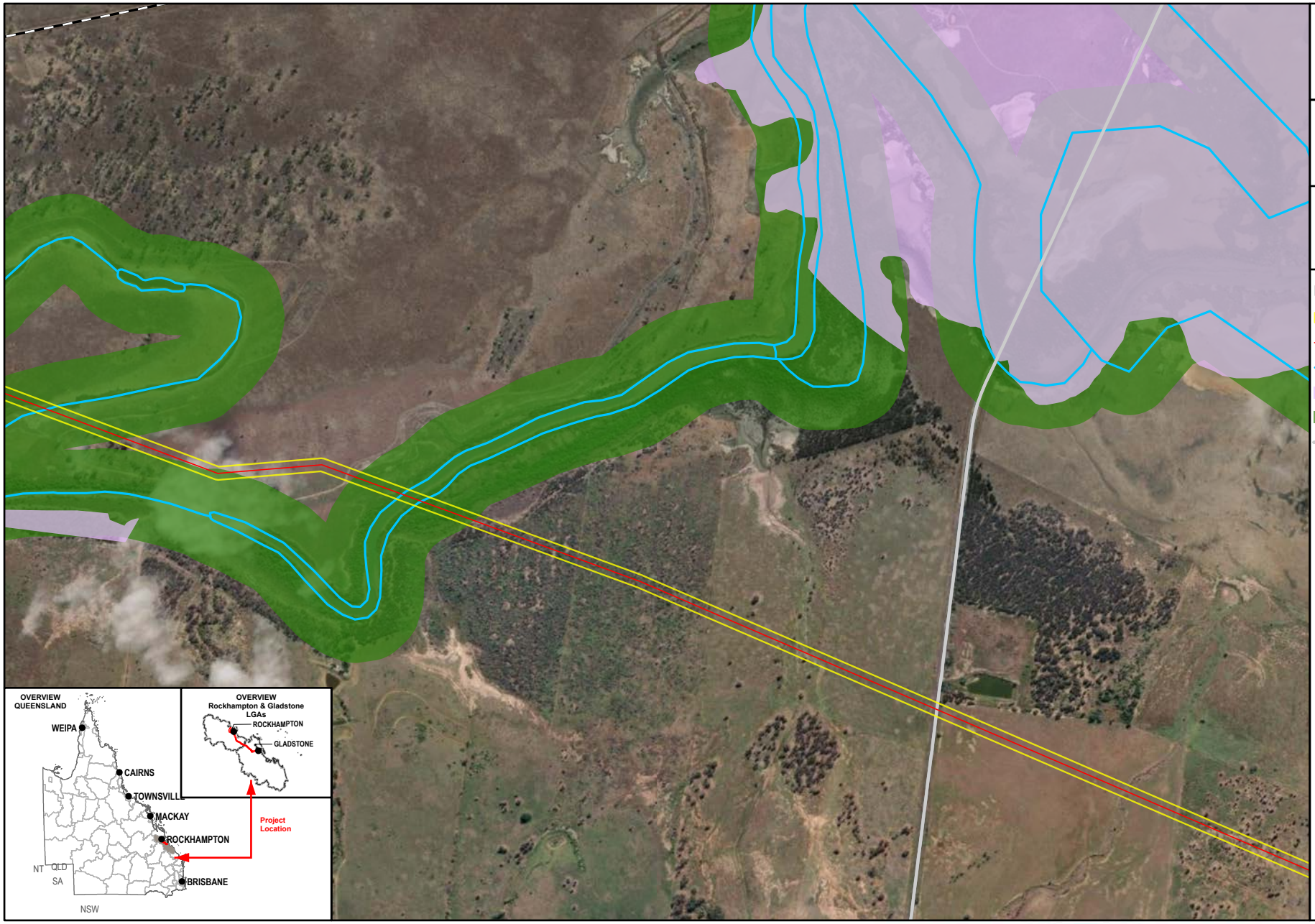

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Figure 4-5m
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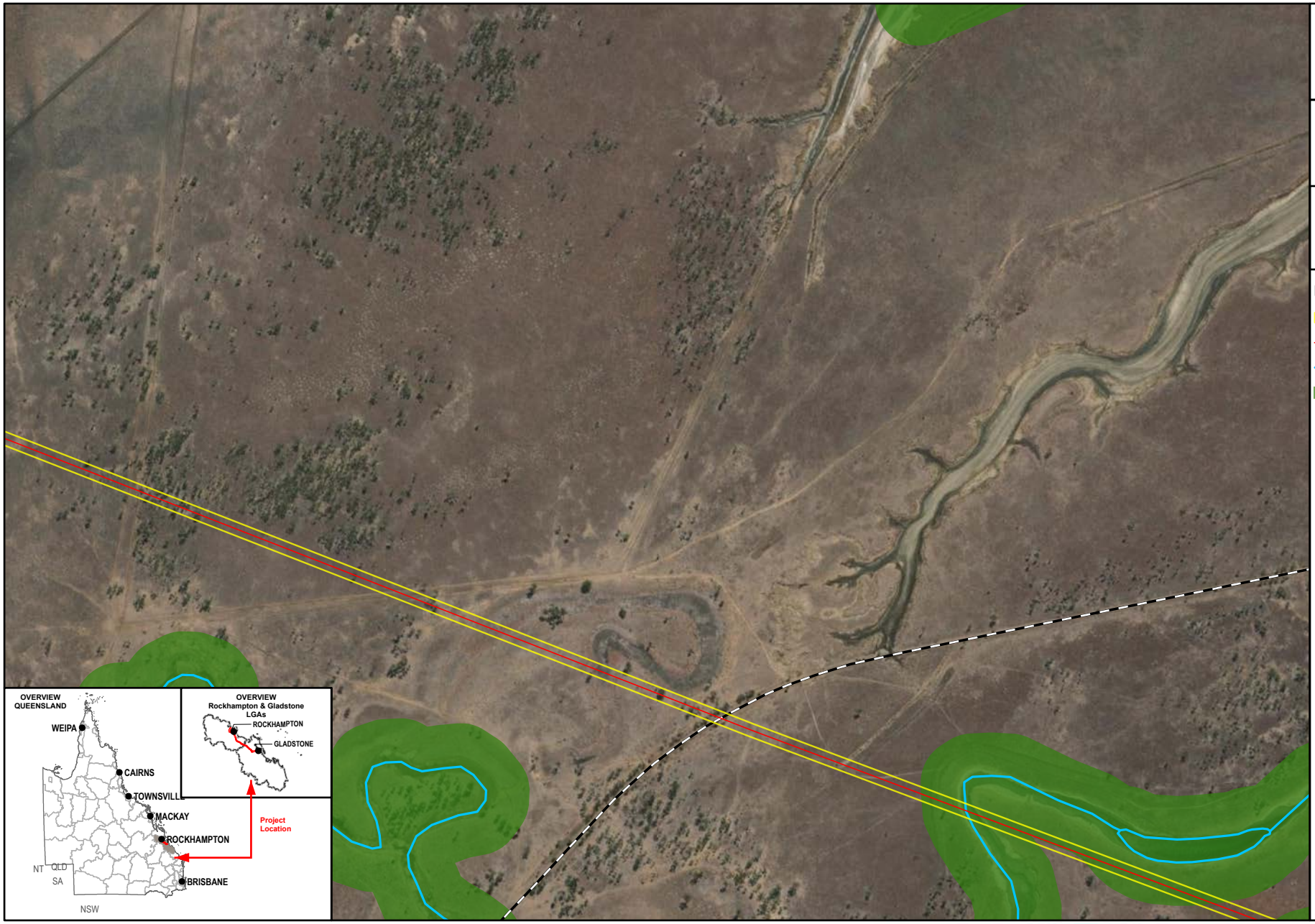

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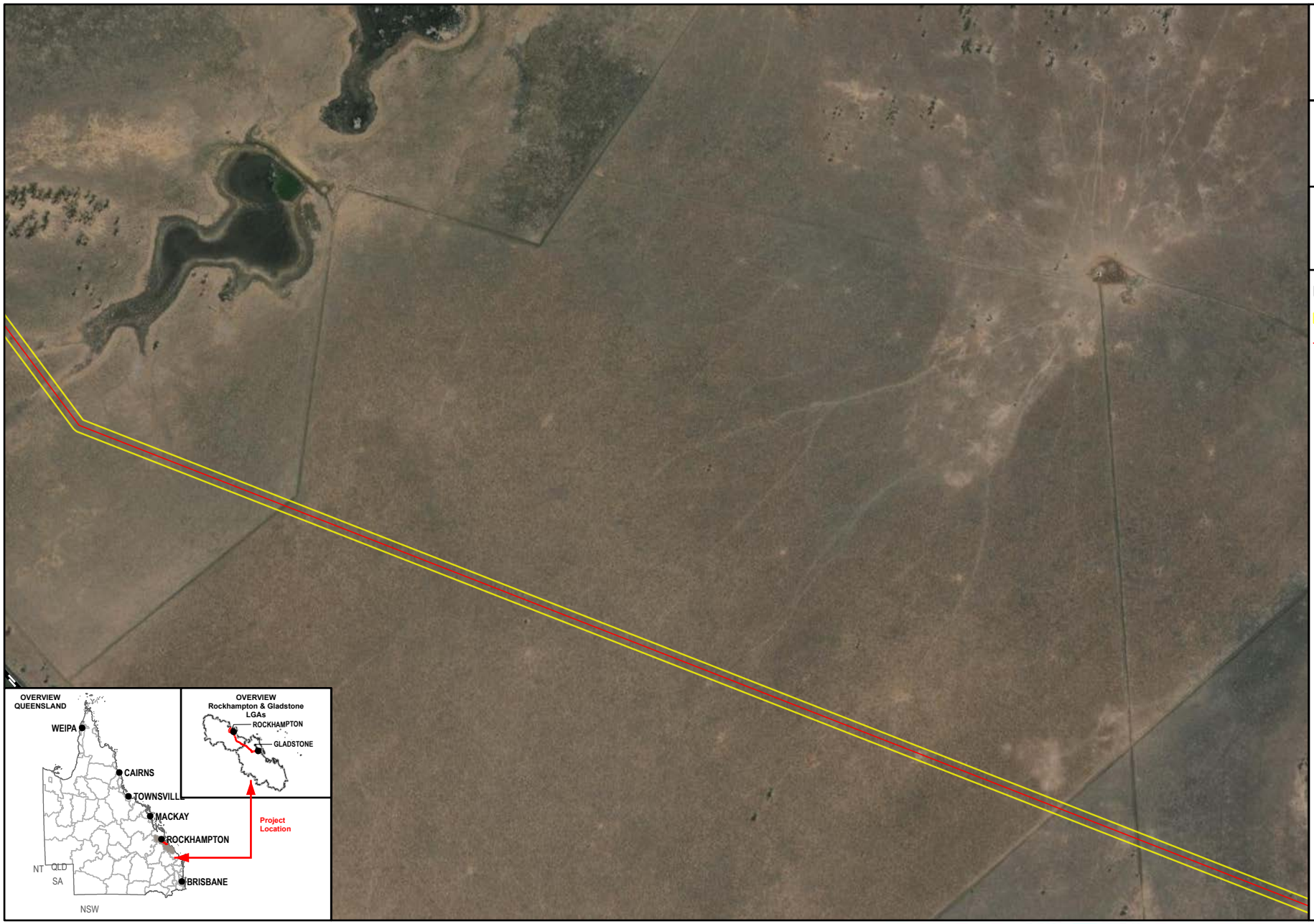

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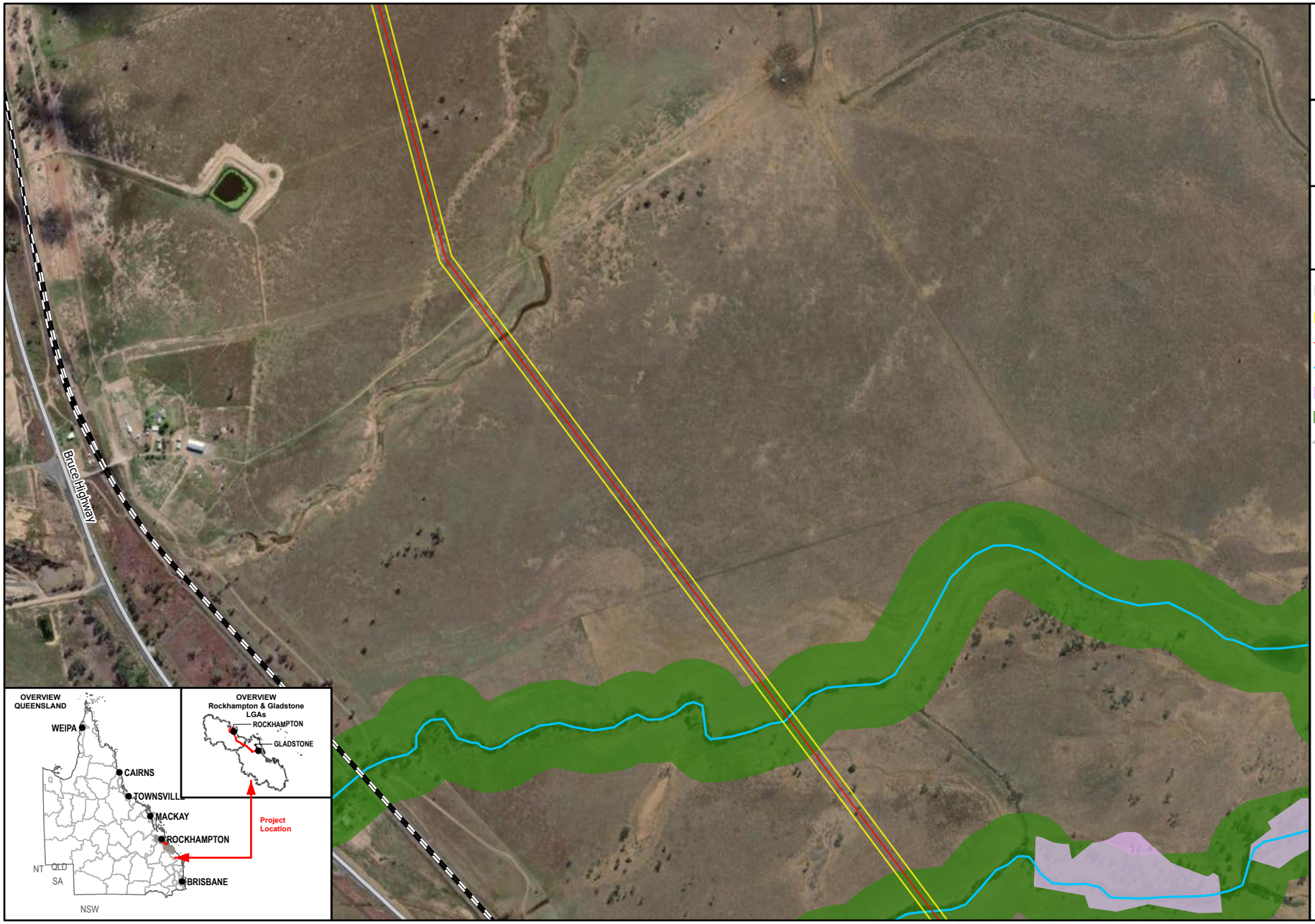

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Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent

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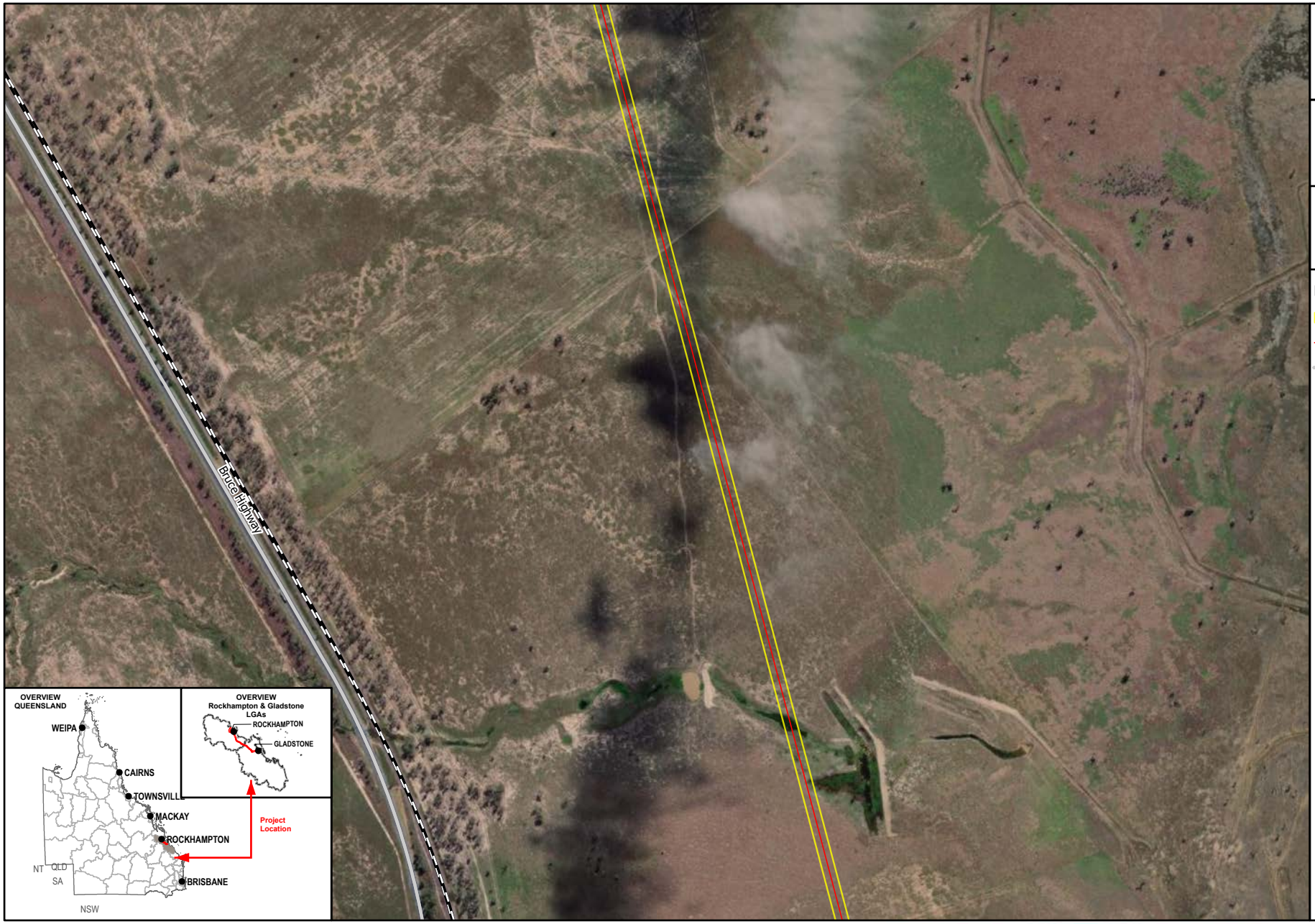

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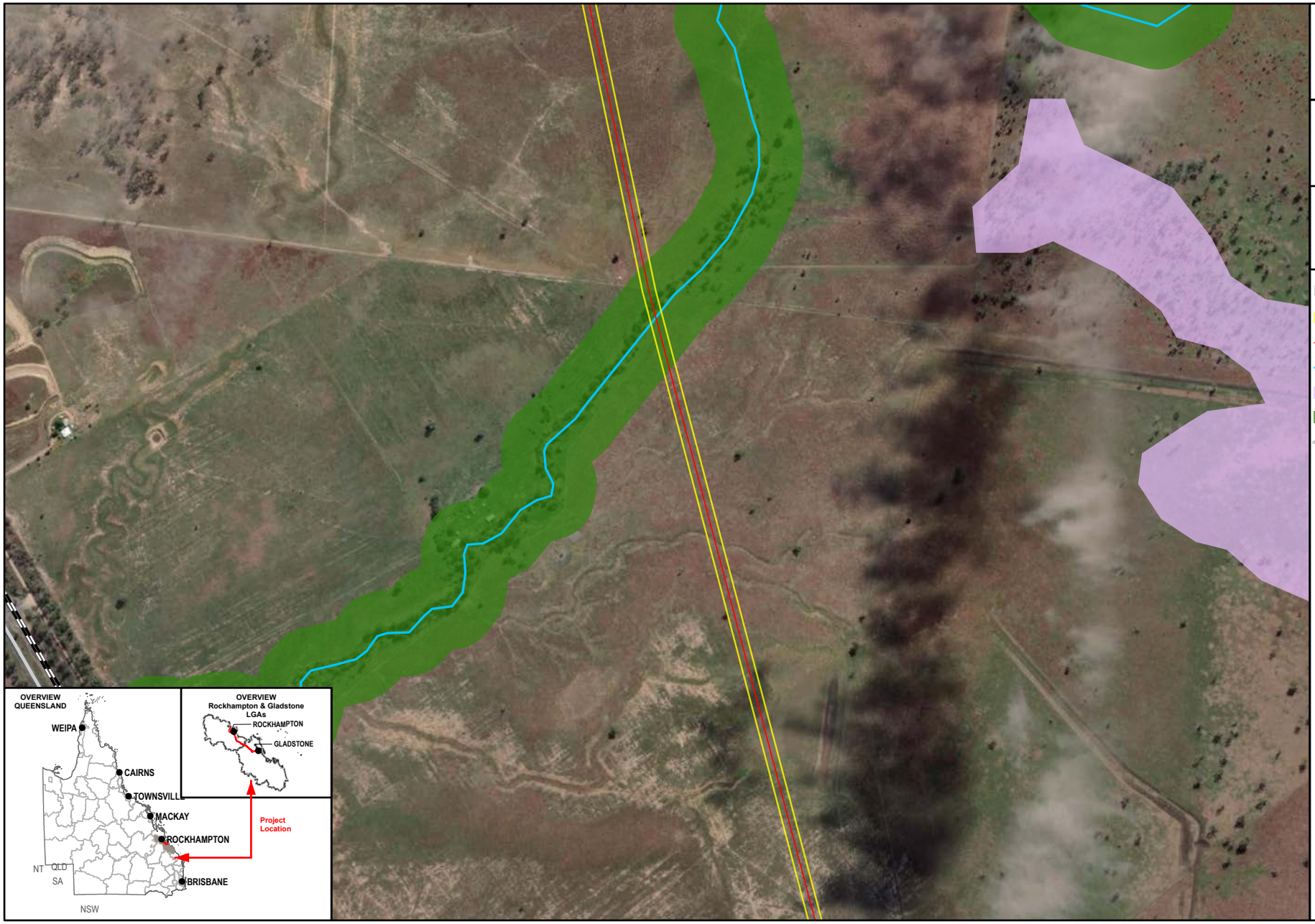

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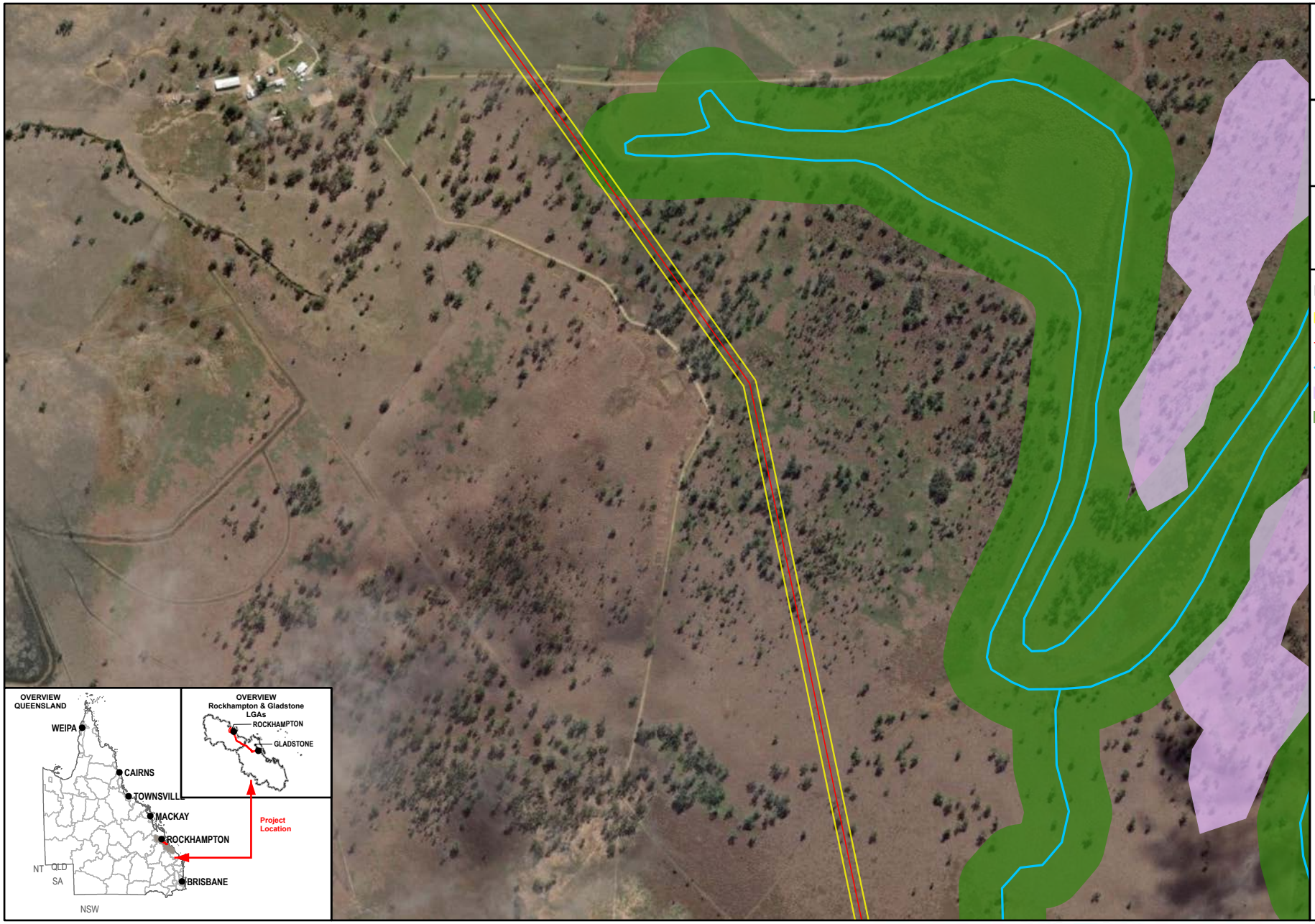

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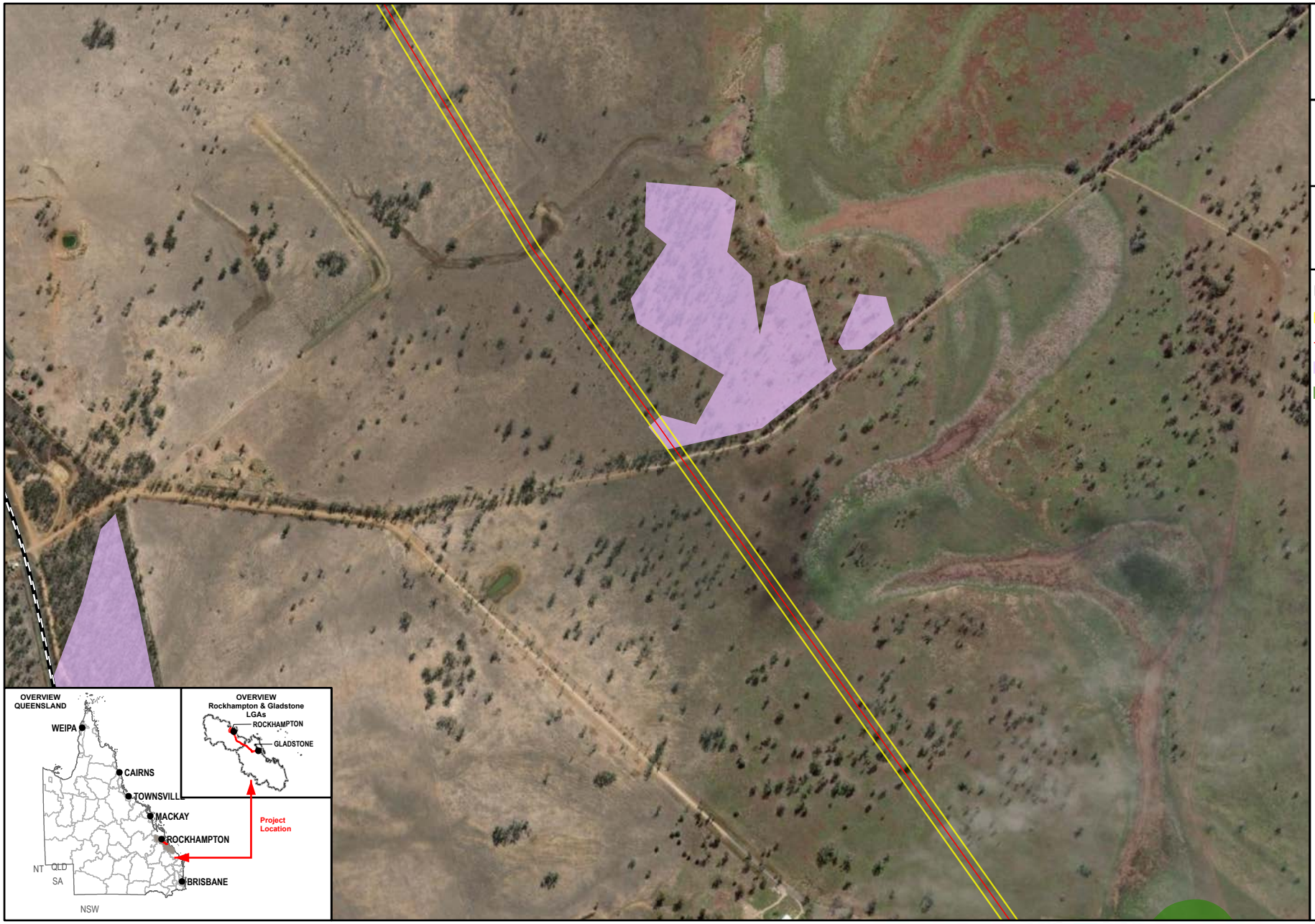

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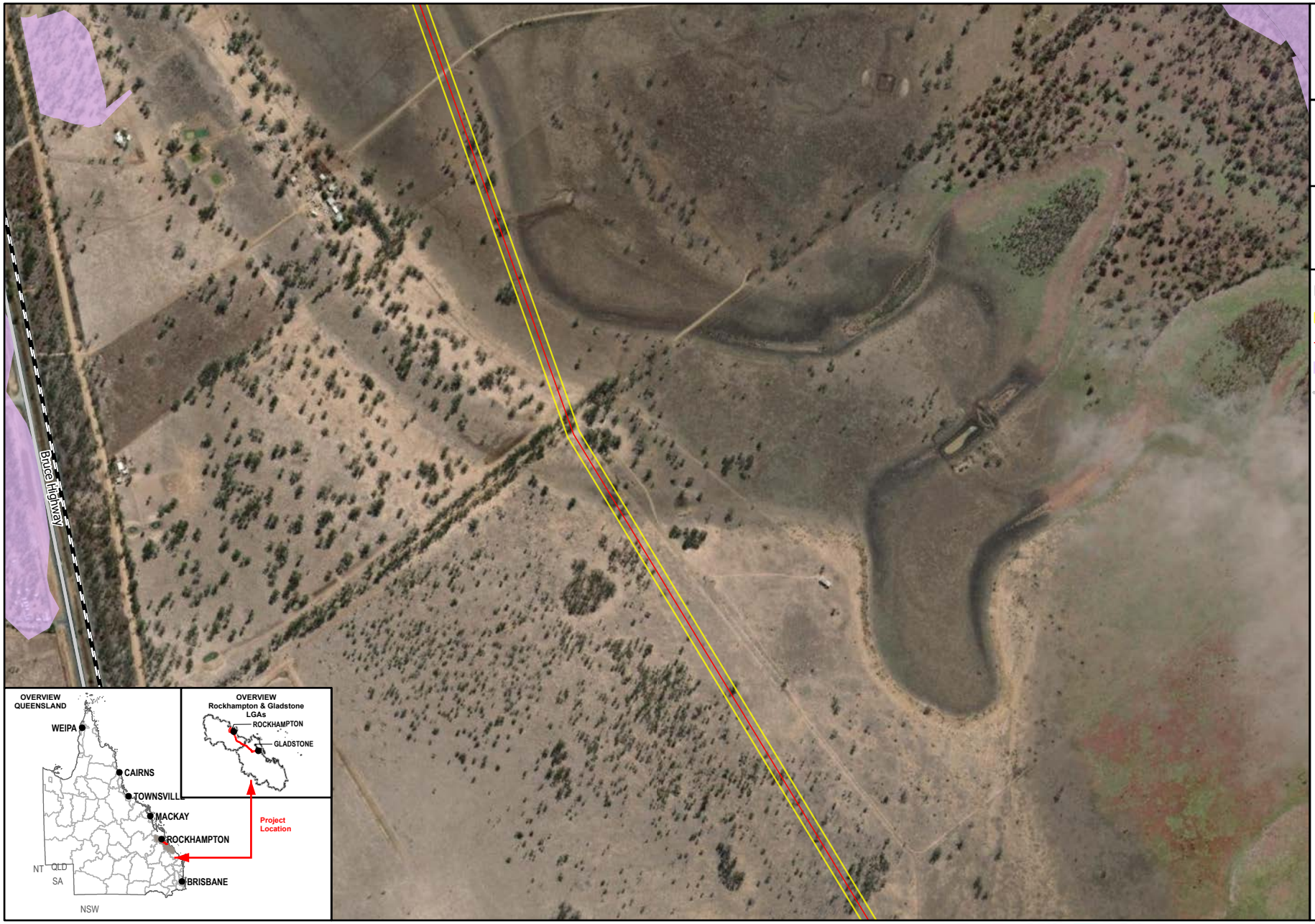

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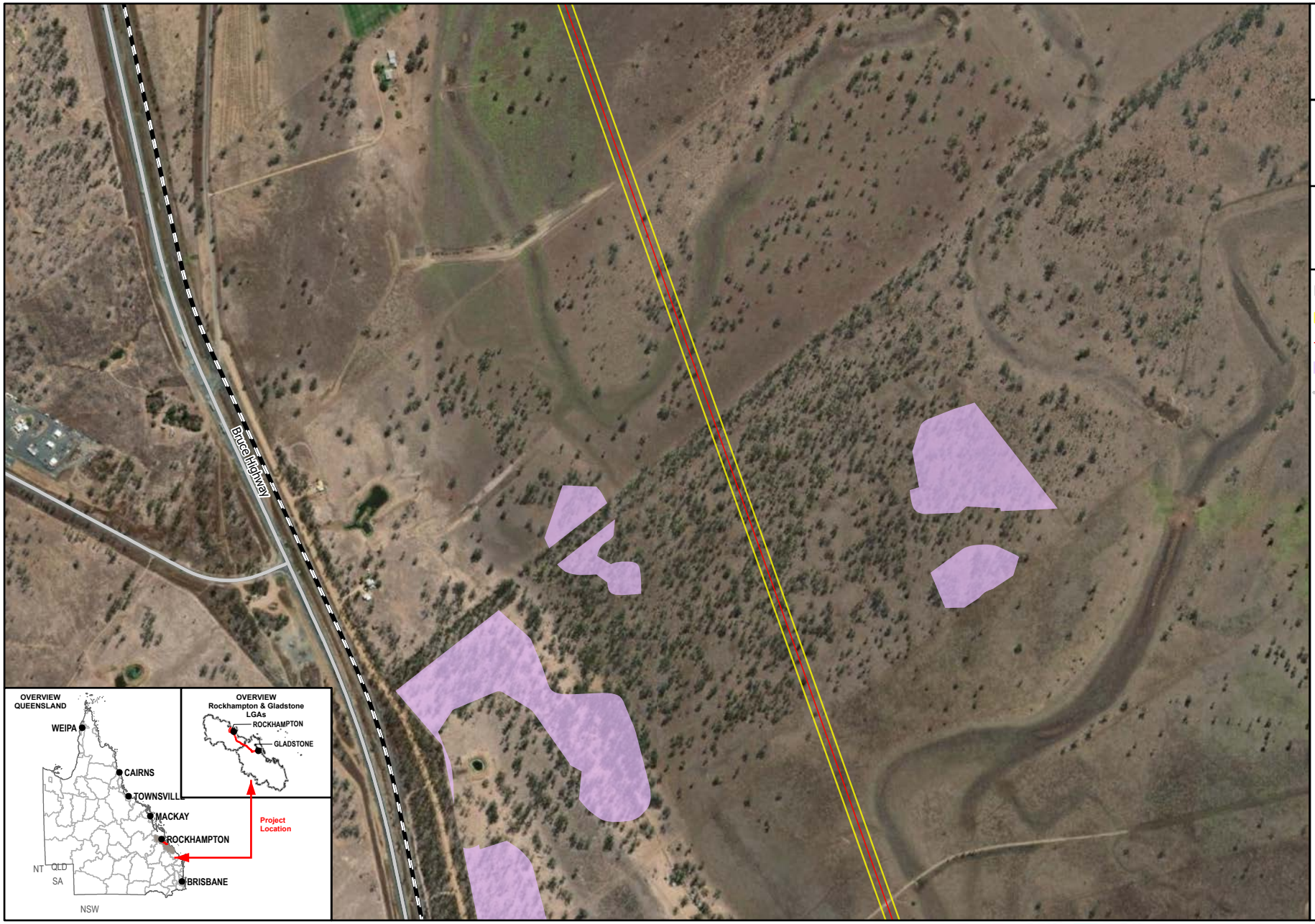

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- Main Roads
- Railways

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Figure 4-5w
Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent
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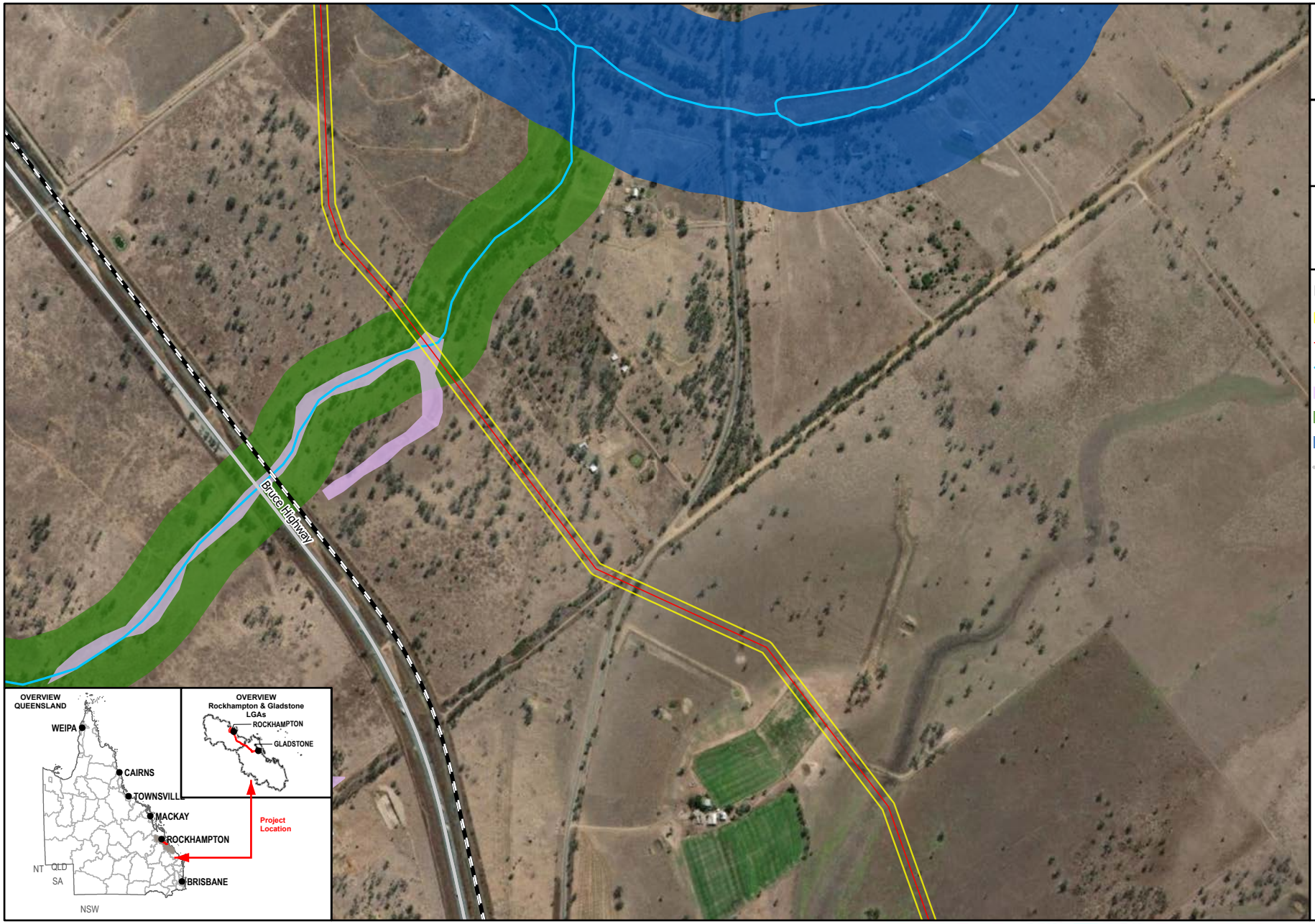

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Legend

- Study Area
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- Riparian Corridor Centrelines
- Essential Habitat
- Regional Wildlife Corriors
- State Wildlife Corriors
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- Railways

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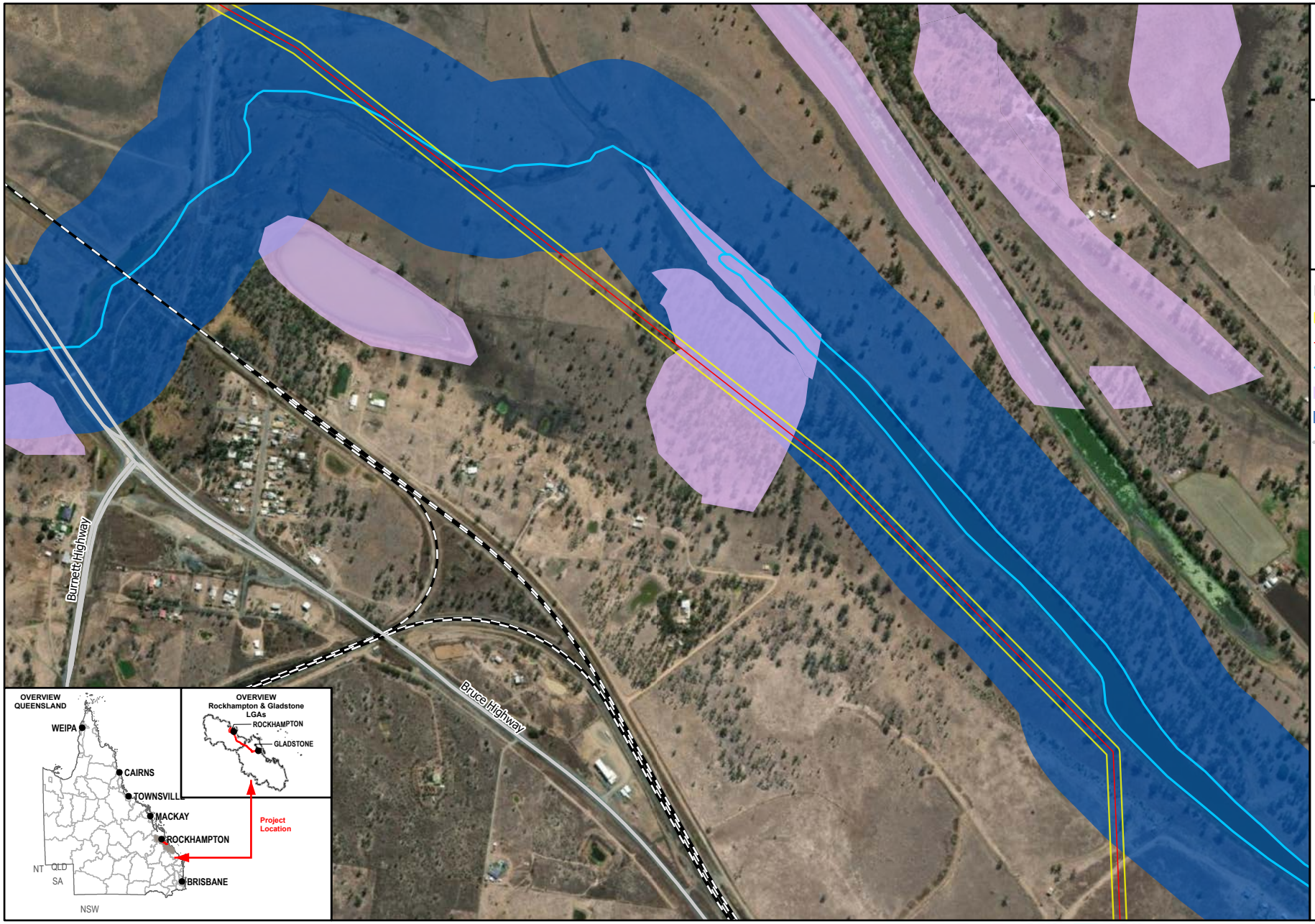

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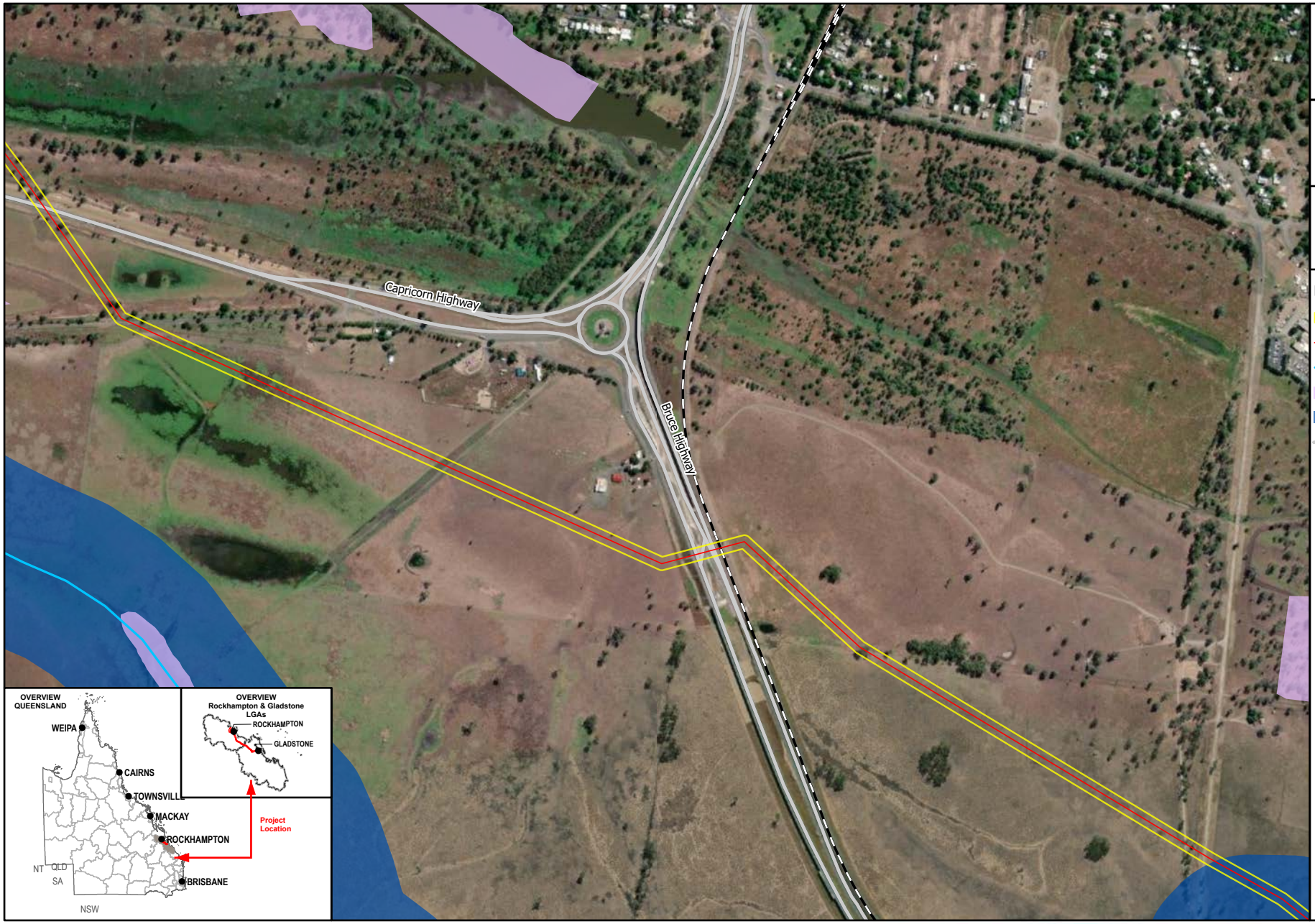

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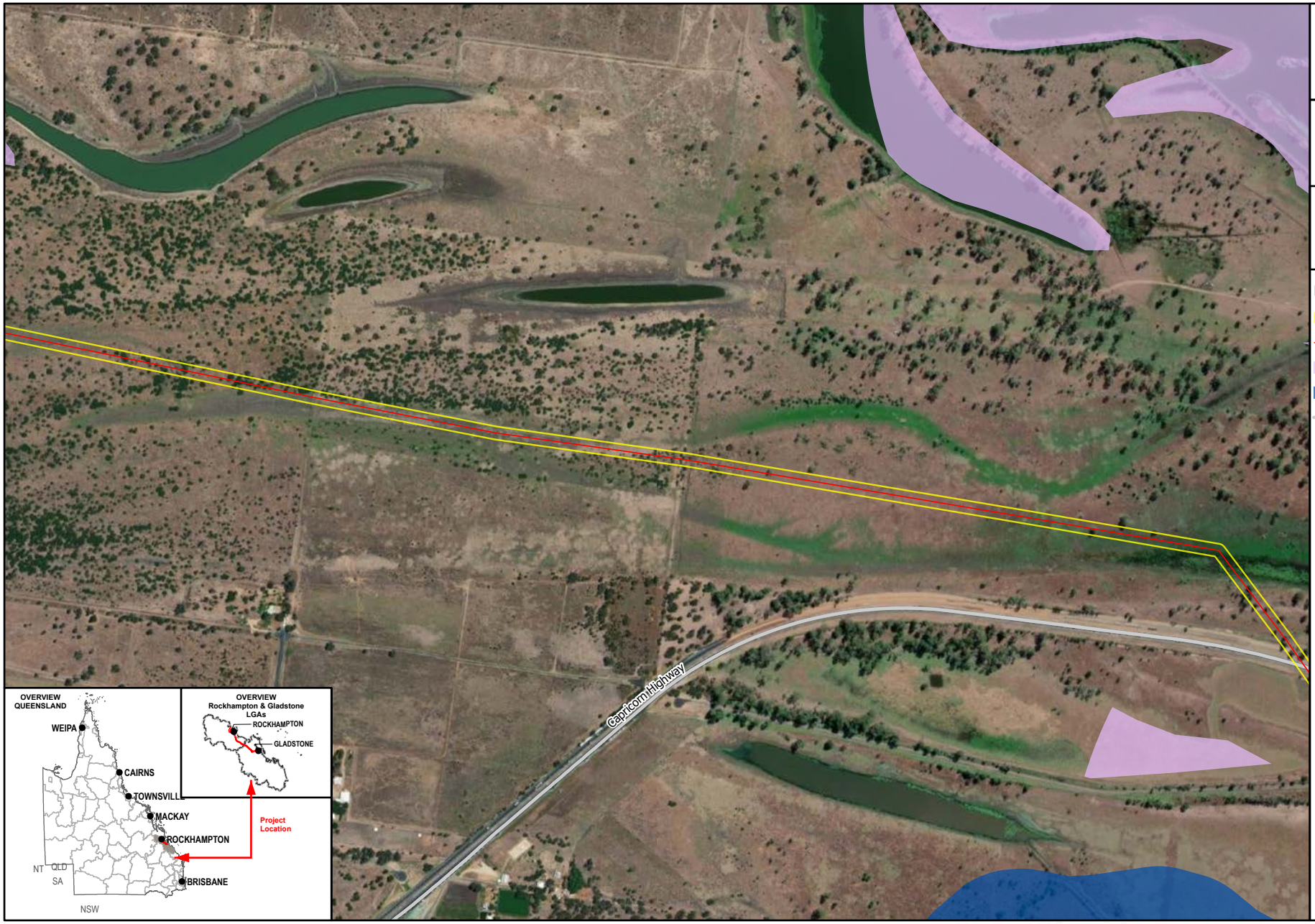

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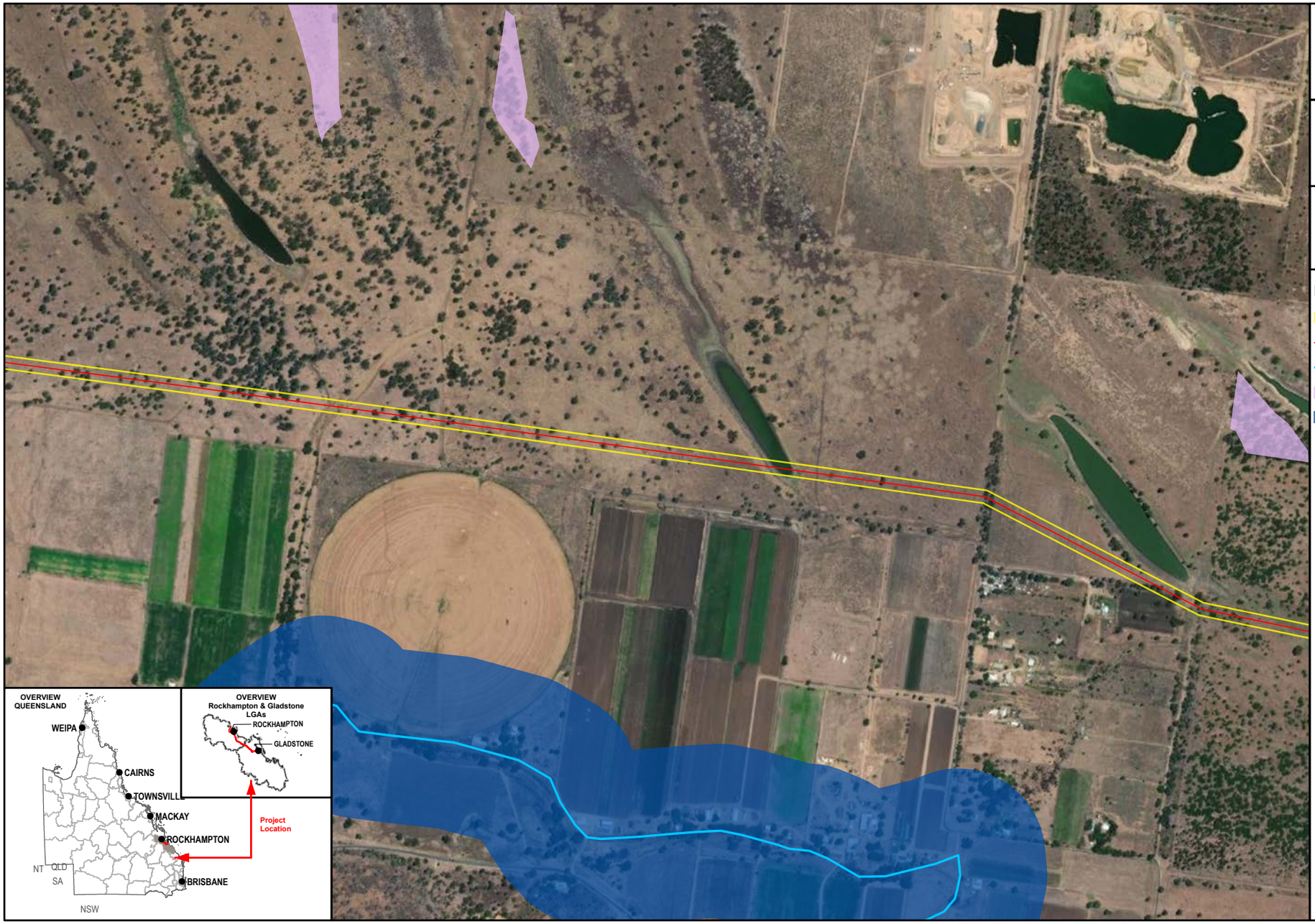

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Figure 4-5b1

Essential Habitat and Wildlife Corridors Within the SGIC SDA Desktop Search Extent

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4.4.2 Field survey results

4.4.2.1 Terrestrial fauna survey results

Survey methods undertaken within the SGIC SDA study area are listed below. Details of each survey method is provided in Table 2-5.

– Habitat assessments
– Bird surveys
– Active searches
– Anabat detectors
– Remote cameras
– Large tree density assessments
– Hollow-bearing tree counts
– Nocturnal searches and spotlighting
– Opportunistic searches

4.4.2.2 Terrestrial fauna communities

A total of 98 terrestrial fauna species were recorded during the ecological surveys within the SGIC SDA study area. This comprised of 71 species of birds, 20 species of mammals, three species of reptiles and four species of amphibians. A description of each of the fauna groups is provided below. A list of fauna species encountered in the field survey is provided in Appendix H.

Birds

One conservation significant bird species, namely the squatter pigeon (southern), was confirmed present within the SGIC SDA study area during the 2022 field surveys. More information on this species is provided in Section 7.2.2.5. The yellow chat (Dawson) was confirmed present during the Arup (2008) field surveys and potentially suitable habitat was recorded within the SGIC SDA study area. More information on this species is provided in Section 7.2.2.4. The curlew sandpiper (Section 7.2.2.2), white-throated needletail (Section7.2.2.7), powerful owl (Section 7.2.2.8) and Australian painted sipe (7.2.2.13) are considered likely to occur.

At total of 71 bird species were recorded during the field surveys within the SGIC SDA study area. Riparian corridors and woodland ecosystems supported the greatest avian diversity. Woodland environments supported an array of honeyeaters, kookaburras, parrots, lorikeets and friarbirds. Riparian habitats supported rainbow bee-eater, striated pardalote (*Pardalotus striatus*), silvereye (*Zosterops lateralis*) and spangled drongo (*Dicrurus bracteatus*).

Freshwater waterbodies and wetlands provide drinking sites utilised by a range of woodland birds and habitat for wetland birds including the plumed whistling-duck (*Dendrocygna eytoni*), pacific black duck (*Anas superciliosa*), eastern great egret (*Ardea intermedia*), black swan (*Cygnus atratus*) and brolga (*Grus rubicunda*).

Open areas provide foraging habitat for raptors including the wedge-tailed eagle (*Aquila audax*), nankeen kestrel (*Falco cenchroides*), black kite (*Milvus migrans*) and whistling kite (*Haliastur sphenurus*), while the white-bellied sea eagle (*Haliaeetus leucogaster*) was recorded along the watercourses. While distinctly less frequent bird species associated with grasslands were also identified. These species included the Australasian pipit (*Anthus novaeseelandiae*), Australian bustard (*Ardeotis australis*) and golden-headed cisticola (*Cisticola exilis*).

Mammals

No conservation significant mammal species were recorded within the SGIC SDA study area during the 2022 field surveys. The koala was confirmed present during the Arup (2008) field surveys and potentially suitable habitat was recorded within the SGIC SDA study area during the 2022 field surveys. More information on this species is provide in Section 7.2.2.11. The greater glider (southern and central) (Section 7.2.2.9), yellow-bellied glider (south-eastern) (Section 7.2.2.10) and grey-headed flying-fox (Section 7.2.2.12) are considered likely to occur.

A total of 20 mammal species were identified during the field surveys within the SGIC SDA study area. Four introduced mammal species were recorded during the field surveys, two of which were captured on the remote cameras, including the wild dog (*Canis lupus familiaris*) and European fox (*Vulpes vulpes*). A total of 11 bat species were identified during microbat call analysis, including the yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*), little bent-wing bat (*Miniopterus australis*) and Northern freetail bat (*Chaerephon jobensis*).

Reptiles

No conservation significant terrestrial reptile species were recorded within the SGIC SDA study area during the 2022 field surveys. The ornamental snake was confirmed present during the Arup (2008) field surveys and potentially suitable habitat as recorded within the SGIC SDA study area. More information on this species is provided in Section 7.2.2.3. The grey snake (Section 7.2.2.6) is considered like to occur.

Only three reptile species were documented during field surveys within the SGIC SDA study area. Reptile species were predominantly recorded within the relatively more complex ground-level microhabitats of woodland habitat types. The species observed included the dubious dtella (*Gehyra dubia*), Bynoe's gecko (*Heteronotia beinoei*) and eastern bearded dragon (*Pogona barbata*). While not frequently observed, fringing riparian habitat would also host reptile species as these habitats provide essential vegetated corridors for species movements across the landscape.

Amphibians

No conservation significant frog species were recorded within the SGIC SDA study area during the2022 field surveys. No conservation significant frogs are considered likely to occur.

Three amphibian species were documented within the SGIC SDA study area. Amphibian species observed during field surveys included the green tree frog (*Litoria caerulea*), eastern sedge frog (*Litoria fallax*), desert tree frog (*Litoria rubella*) and cane toad (*Rhinella marina*). Amphibian species were generally observed in woodland habitats (mature eucalypt woodland and mixed *Eucalyptus/Corymbia* woodland), that supported dense ground-level microhabitats, including woody debris and leaf litter, but were also documented within fringing riparian habitats.

4.4.2.3 Conservation significant fauna species

One conservation significant fauna species, namely the squatter pigeon (southern), was confirmed present during the 2022 field surveys, and three conservation significant fauna species, namely the ornamental snake, yellow-chat (Dawson) and koala were confirmed present during the Arup (2008) field surveys (Table 4-11). Survey effort undertaken for threatened fauna species within the study area is outlined in Table 2-6.

Table 4-11 Conservation significant fauna species recorded within the SGIC SDA study area

Scientific name	Common name	Status		Details
		EPBC Act	NC Act	
Denisonia maculata	Ornamental snake	V	V	Two individuals were confirmed present on the southern extent of Casuarina Road during the Arup (2008) field surveys. The 2022 field surveys undertook nocturnal searches and spotlighting along Casuarina Road. No individuals were recorded; however, suitable habitat was identified within the SGIC SDA study area.
Epthianura crocea macgregori	Yellow chat (Dawson)	CE	E	Four individuals were confirmed present during the yellow chat (Dawson) field survey program (Arup 2008). Species were recorded from two locations along Twelve Mile Creek, just north of the SGIC SDA pipeline alignment. The 2022 field surveys were undertaken along Twelve Mile Creek and Inkerman Creek within the SGIC SDA study area. No individuals were recorded; however, suitable habitat was identified within the SGIC SDA study area along or in close proximity to both creeks.

Scientific name	Common name	Status		Details
		EPBC Act	NC Act	
Geophaps scripta scripta	Squatter pigeon (southern)	V	V	14 individuals were confirmed present within the SGIC SDA study area during the 2022 field surveys. The species was also recorded during the Arup (2008) field surveys.
Phascolarctos cinereus	Koala	E	E	Tree trunk scratches and scats were identified at one location adjacent to Boat Landing Creek during the Arup (2008) field surveys. During the 2022 field surveys, a habitat assessment and SAT survey was undertaken approximately 450 m north of the location of confirmed koala traces. No individuals were recorded; however, suitable habitat was identified throughout vegetated areas retaining koala food and shelter trees within the SGIC SDA study area.
Key to table: CE – critically endangered; E – endangered; V – vulnerable.				

4.4.2.4 Essential habitat

Based on the field verified REs within the SGIC SDA study area, the mapped essential habitat for conservation significant species, identified in Section 4.4.1.3, did not change.

4.4.2.5 Habitat types

Historically, the landscape has been impacted by decades of disturbance from cattle grazing, vegetation clearing and intrusion by invasive weeds. These processes have altered local ecosystem composition and processes, reducing in places the density of native vegetation and habitat for conservation significant species. Despite this, sizeable remnants of natural habitat have been retained.

Eight broad habitat types were identified within the SGIC SDA study area during the field survey, including:

– Mature eucalypt woodland
– Mixed *Eucalyptus/Corymbia* woodland
– Regrowth and/or scattered *Eucalyptus/Corymbia/Acacia* trees
– Brigalow (*Acacia harpophylla*) woodland
– Estuarine environments
– Fringing riparian vegetation
– Freshwater waterbodies and seasonal wetlands
– Cleared and highly modified landscapes.

Broad habitat types were defined and broadly mapped throughout the study area based on habitat assessments, DoR and field verified RE mapping, and aerial imagery. These habitat types were validated, and mapping refined, through the ecological field surveys. A representative photograph and description of each of these habitat types is provided in Table 4-12, together with identification of which habitat types provide potential habitat for fauna that are MNES and MSES. Habitat types identified within the study area are mapped in Figure 4-6.

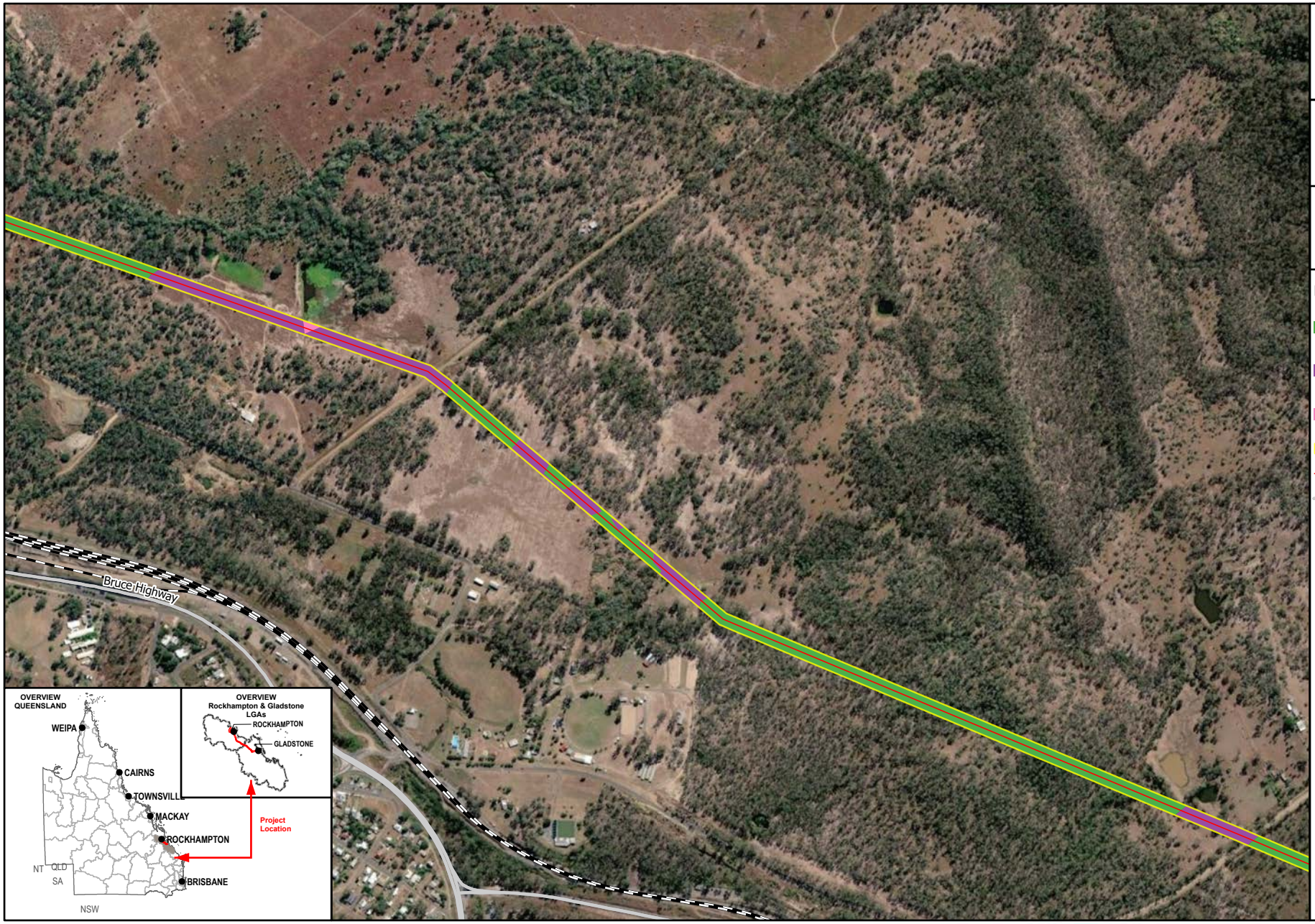
Table 4-12 Habitat types recorded within the SGIC SDA study area

Habitat type	General characteristics and ecological values
Mature eucalypt open woodland 	– Mature *Eucalyptus* species provides blossom and nesting opportunities for honeyeaters, flower peckers and parrots, and foraging habitat for flying-foxes. – Hollow-bearing trees are moderately dense, retaining small to medium sized hollows. Very few large hollows (> 30 cm) were observed. – Relatively complex ground-level microhabitats, with a high density of woody debris and leaf litter, and some ground logs. These microhabitats provide shelter and foraging microhabitat for ground-dwelling mammals, reptiles and amphibians. – Sparse, low ground cover, dominated by native grasses. Grasses provided food resources for some granivorous birds and herbivorous mammals.
	MNES and MSES species: – Potential foraging habitat for the squatter pigeon (southern) within 1 km (for breeding) and 3 km (for foraging) of a suitable, permanent or seasonal waterbody. – Potential foraging and denning habitat for the greater glider (southern and central) and yellow-bellied glider (south-eastern). – Potential foraging habitat for the powerful owl, koala and grey-headed flying-fox. – Potential foraging and breeding habitat for the ornamental snake (only woodland habitats retaining *Eucalyptus coolabah*).
Mixed *Eucalyptus/Corymbia* open woodland 	– Eucalypts provide blossoms and nesting opportunities for honeyeaters, and foraging habitat for flying-foxes. – Variety of koala food trees present, including *Eucalyptus tereticornis*¸ *E. crebra*, *E. coolabah, E. moluccana*, *E. exserta*, *Corymbia tessellaris*, *C. citriodora C. erythrophloia*, *C. intermedia* and *Lophostemon suaveolens.* – Low density of hollow-bearing trees present. Hollows are relatively small, providing suitable habitat for hollow-nesting birds (i.e. parrots and lorikeets), small mammals (i.e. gliders) and arboreal reptiles and amphibians. – Ground-level microhabitats varied throughout vegetated areas. Moderately dense to sparse ground logs, woody debris, rocks and leaf litter were present, providing shelter and foraging habitat for small to medium sized mammals, reptiles and amphibians. – Decorticating bark provide refuge for microbats, reptiles and amphibians. – Groundcover densities varied throughout vegetated areas. A mixture of native and introduced grasses were present.
	MNES and MSES species: – Potential foraging habitat for the squatter pigeon (southern) within 1 km (for breeding) and 3 km (for foraging) of a suitable, permanent or seasonal waterbody. – Potential foraging habitat for the greater glider (southern and central) and yellow-bellied glider (south-eastern). – Potential foraging habitat for the koala and grey-headed flying-fox.

Habitat type	General characteristics and ecological values
Regrowth and/or scattered *Eucalyptus/Corymbia/Acacia* trees 	– Characterised by the low density of mature and regrowth vegetation and is dominated by introduced pasture grasses. – Scattered koala food trees present, including *Eucalyptus tereticornis*, *E. crebra* and *Corymbia* species. – Low density of hollow-bearing tree resulting in limited roosting sites for microbat species, nesting sites for hollow-nesting bird species, and denning sites for arboreal mammals. Mature E. tereticornis trees retain large (>30 cm) hollows on alluvial plains adjacent to waterways. – Introduced grass species provide food resources for some grassland birds, and herbivorous mammals such as macropods. – The open landscape provides foraging habitat for raptors and snakes. – In most areas, the ground-layer has been heavily altered by cattle grazing and trampling, and intensive cultivation. These alterations have reduced the presence of suitable microhabitats for a range of fauna species.
	MNES and MSES species: – Potential foraging habitat for the squatter pigeon (southern) within 1 km (for breeding) and 3 km (for foraging) of a suitable, permanent or seasonal waterbody. – Potential foraging habitat for the koala (where paddock trees retained).
Brigalow (*Acacia harpophylla*) woodland 	– Regrowth areas contained moderately dense canopy cover of *Acacia harpophylla*. Structural complexity within this habitat was low. – Remnant areas contained moderately dense canopy cover layer of *A. harpophylla*. Dead stags retaining small hollows were generally sparse, providing refuge for microbats and arboreal reptile species. – The mid-storey was generally sparse containing various shrub species and juvenile *A. harpophylla*, providing shelter and nesting habitat for a variety of bird species. – Complex ground-level microhabitats, with a high density of woody debris, logs, root cavities and burrows and native and exotic grasses providing shelter and foraging habitat for small ground-dwelling mammals and reptiles. – Decorticating bark was sparse in remnant patches, providing some shelter for microbats and arboreal reptile species. – In some areas, gilgai depressions with deep soil cracks were present. Gilgais provide suitable habitat for a variety of reptile species, some of which are threatened including the ornamental snake, Dunmall's snake and yakka skink.
	MNES and MSES species: – Potential foraging and breeding habitat for the ornamental snake and grey snake.

Habitat type	General characteristics and ecological values
Estuarine environments 	– Mudflats provide important foraging habitat for migratory wading bird species, as they travel between northern and southern hemisphere. These birds forage on crabs, molluscs and other marine invertebrates in the intertidal mudflats. – Mangroves, saltmarshes and mudflats provide important foraging and breeding habitat for local bird species. – When inundated, mangroves and saltmarshes provide breeding and foraging habitat, and are an important nursery ground for juvenile fish and other marine organisms such as crabs and prawns. – Mudflats support a diverse benthic (bottom-dwelling) community, including worms, crabs and yabbies. This, in turn, provides food for fish species such as flathead and whiting.
	MNES and MSES species: – Potential foraging habitat for the curlew sandpiper and other migratory shorebird species. – Potential foraging and breeding habitat for the yellow chat (Dawson).
Fringing riparian vegetation 	– Fringing riparian vegetation along ephemeral waterways were dominated by *Melaleuca* spp., with *Eucalyptus* and *Corymbia* sp. – *Melaleuca*, *Eucalyptus* and *Corymbia* species provide foraging opportunities for honeyeaters and flying-foxes. – Ground-level microhabitats, including coarse woody debris and dense ground cover, provide shelter and foraging habitat for a variety of reptile and frog species. – Instream complexity with undercut banks, root balls, trailing vegetation and shallow water edges. – An important movement corridor for native mammals, birds, reptiles and amphibians, and are important foraging routes and flyways for microbats.
	MNES and MSES species: – Potential foraging and breeding habitat for the squatter pigeon (southern) (confirmed present). – Potential foraging and denning habitat for the greater glider (southern and central) and yellow-bellied glider (south-eastern). – Potential foraging and roosting habitat for the powerful owl. – Potential foraging habitat for the koala, grey-headed flying-fox and migratory bird species.

Habitat type	General characteristics and ecological values
Freshwater waterbodies and seasonal wetlands 	– Levees have been built on open floodplains to retain flood water. When these areas are inundated with water, these waterbodies may provide suitable foraging habitat for waterbirds. – Floodplains have largely been modified with pastural grasses. – Permanent to semi-permanent waterbodies (i.e. billabongs and dams) occur within the landscape. These waterbodies provide foraging, breeding and nesting habitat for a range of waterbirds. – Within the context of the local environment, permanent waterbodies provide an important reliable source of drinking water for birds, macropods, reptiles and amphibians. These features are particularly important during times of drought. – Waterbodies support local food webs. A local abundance of invertebrates provides prey items for microbats and amphibians. In turn, these attract predators including snakes, waterbirds, and raptors. – Canopy and/or shrub layer was either very sparse or absent. – Some waterbodies retained sedges, rushes and grasses, as well as dead stags within small (<10 cm) hollows, ground logs and woody debris. – Low density of deep cracking clays present.
	MNES and MSES species: – Potential foraging habitat for the curlew sandpiper, Australian painted snipe and other migratory bird species. – Potential foraging and breeding habitat for the squatter pigeon (southern).
Cleared and highly modified landscapes 	– Characterised by the absence or very low density of mature and regrowth vegetation and is dominated by introduced pasture grasses. – Very low density of koala food trees present (< 1 tree per ha), including *Eucalyptus, Corymbia* and *Acacia* species. – Introduced grass species provide food resources for some grassland birds, and herbivorous mammals such as macropods. – The open landscape provides foraging habitat for raptors and snakes. – Ground-level microhabitats have been historically cleared and lack structural complexity. – In most areas, the ground-layer has been heavily altered by cattle grazing and trampling, and intensive cultivation. These alterations have reduced the presence of suitable microhabitats for a range of fauna species.
	MNES and MSES species: No suitable habitat for conservation significant fauna species.



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Freshwater Waterbodies and Seasonal Wetlands
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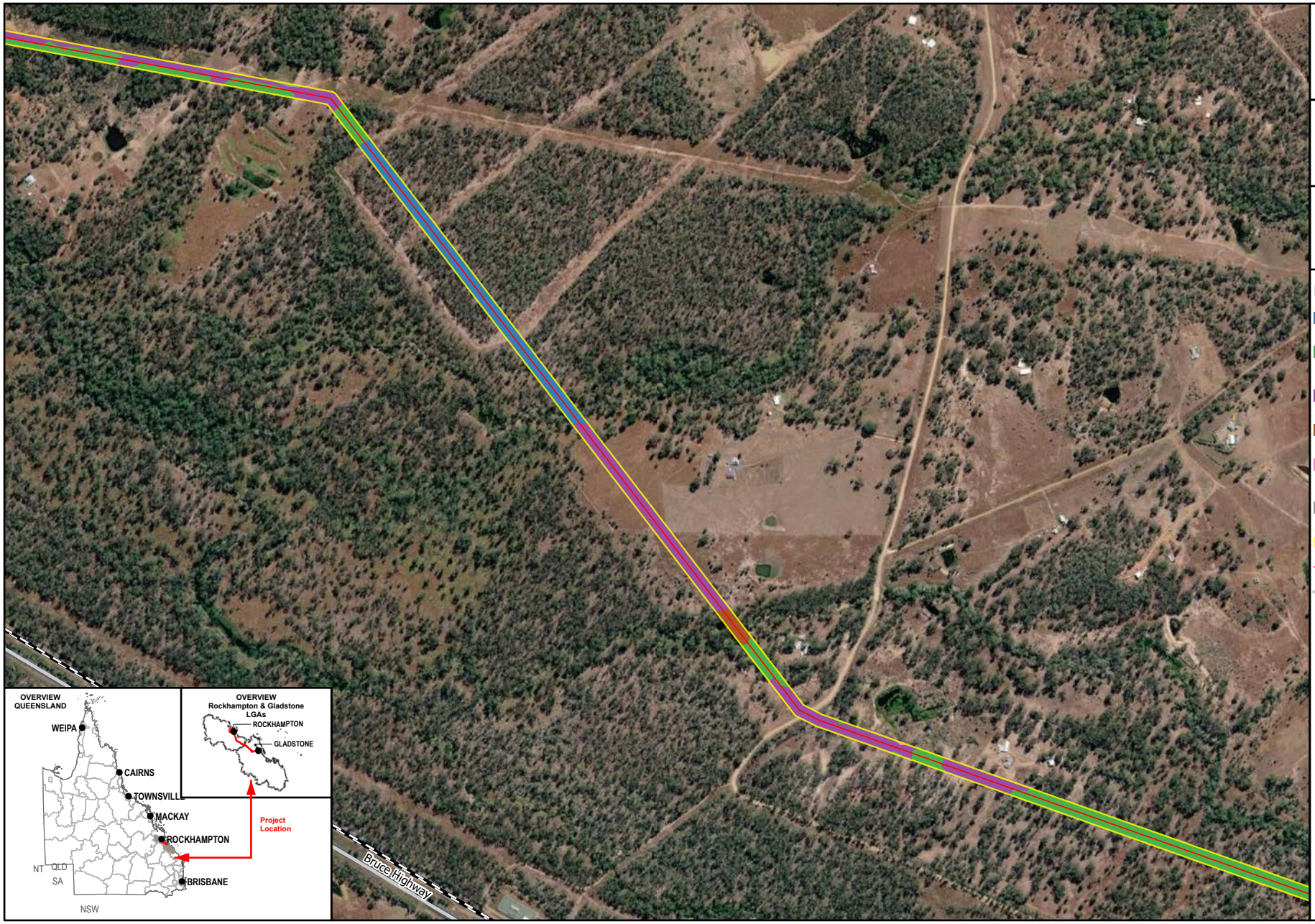
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6a
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Queensland Government

SMEC
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Legend

- Mature Eucalypt Woodland
- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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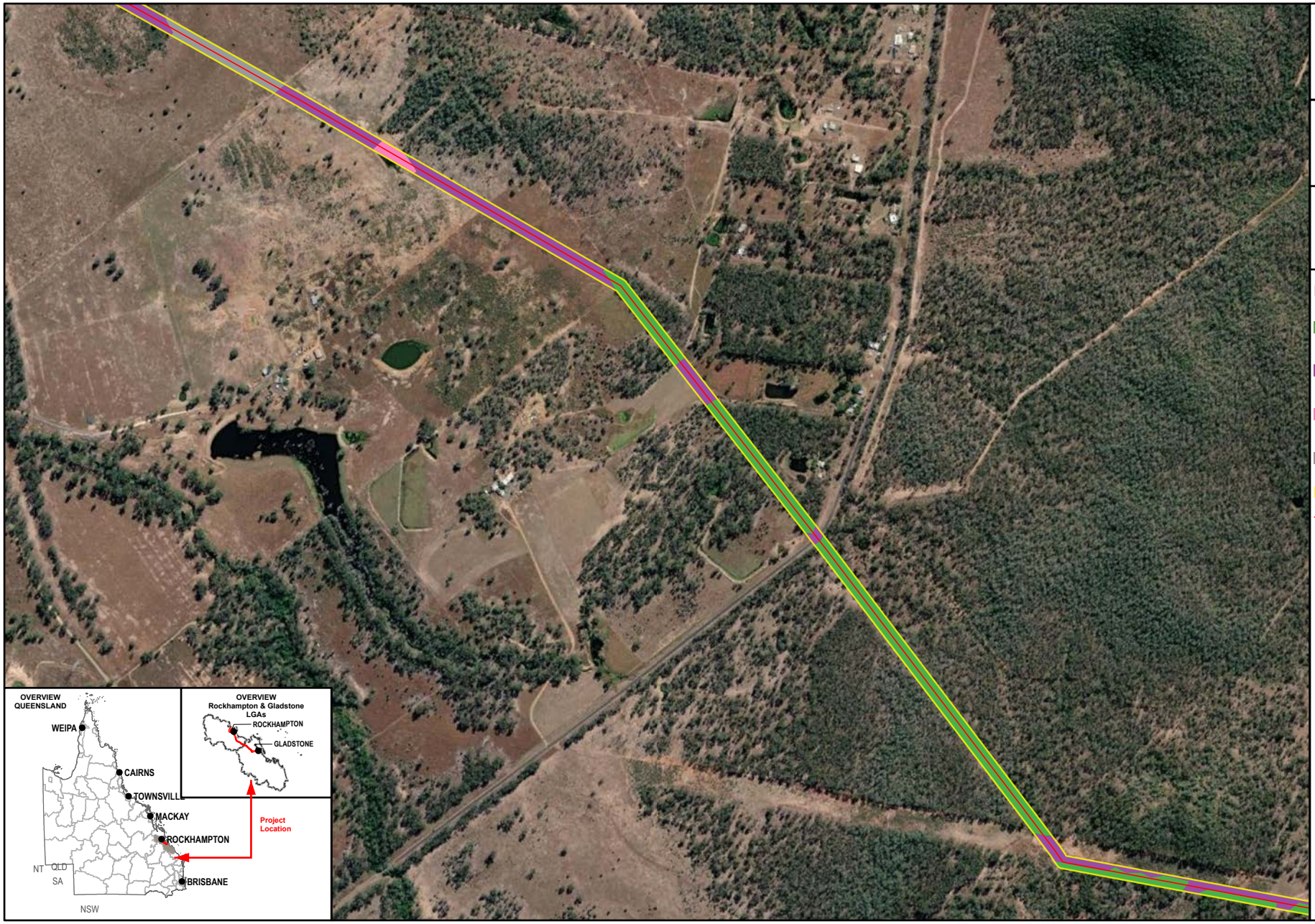
Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report

Figure 4-6b
Habitat Types Identified Within the SGIC SDA Study Area

000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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(Datum GDA2020)

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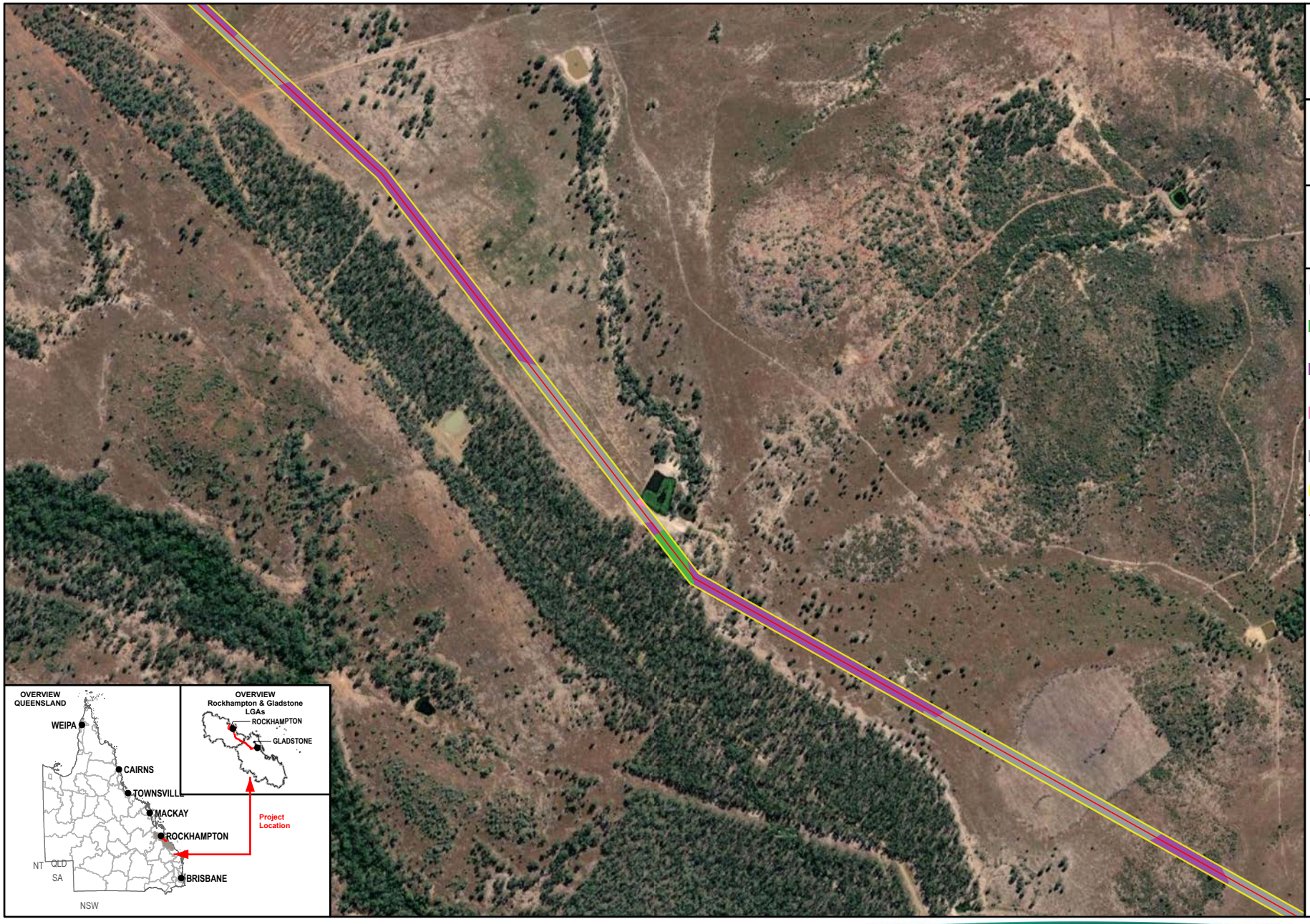
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6c
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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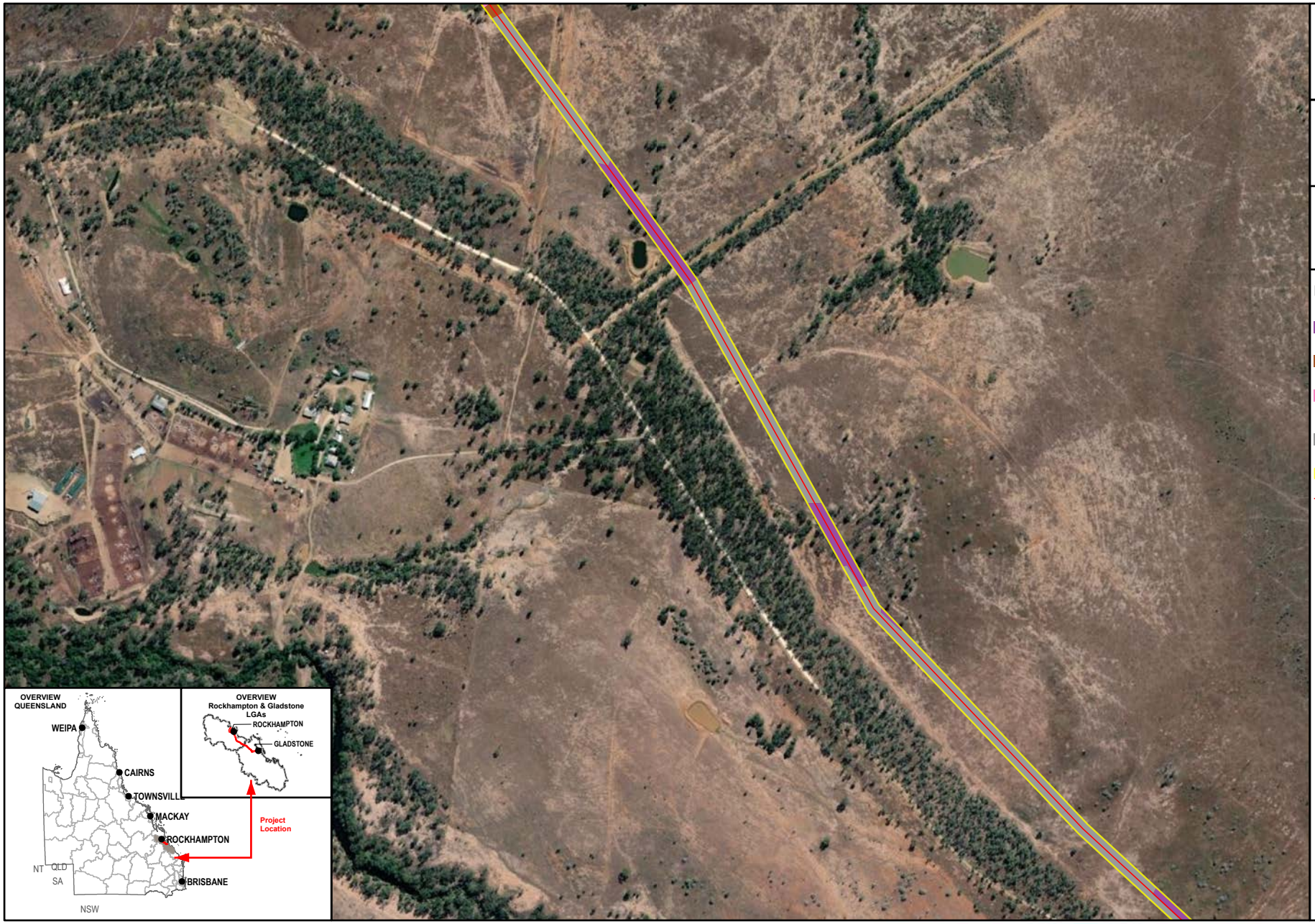
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6d
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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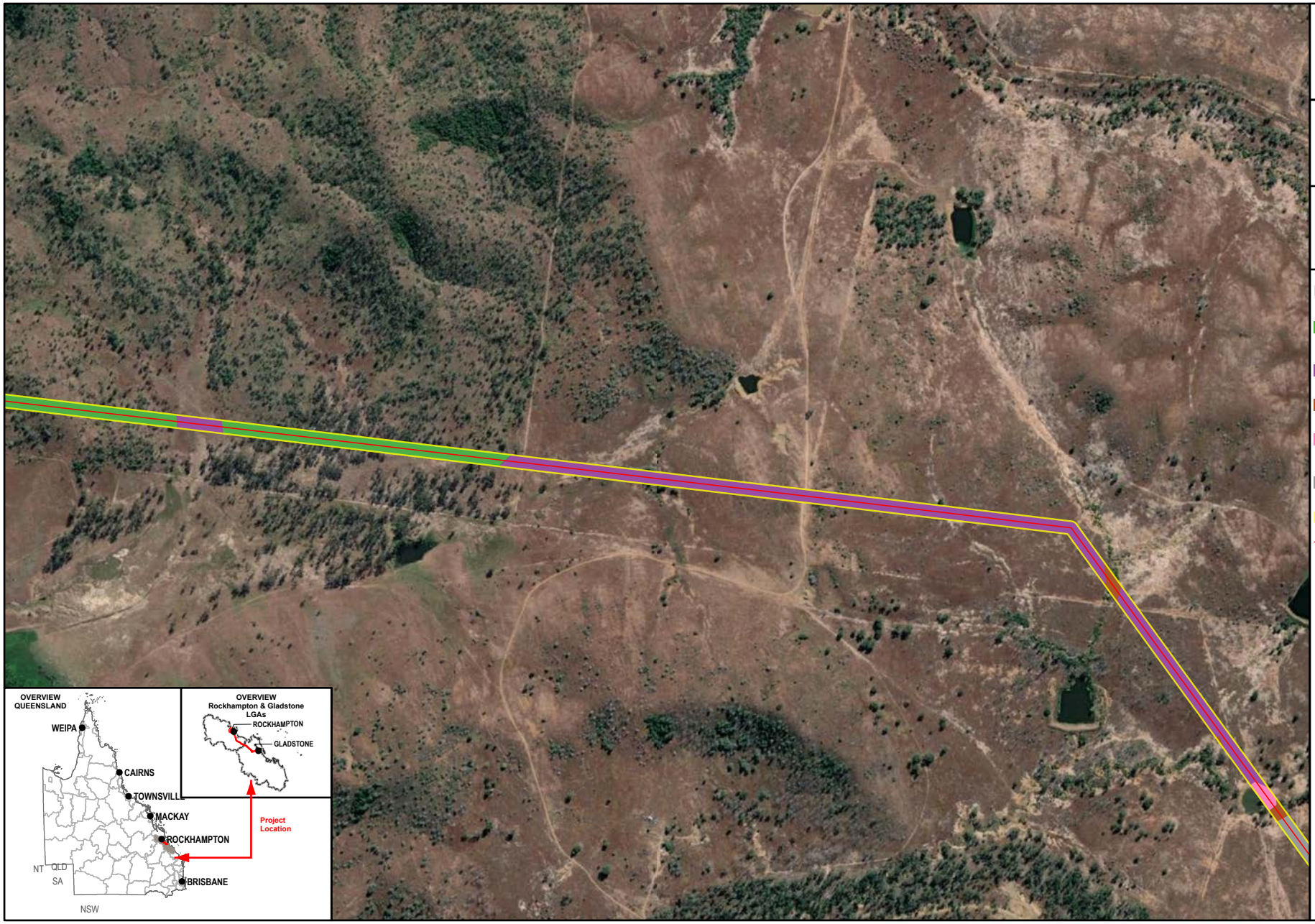
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6e
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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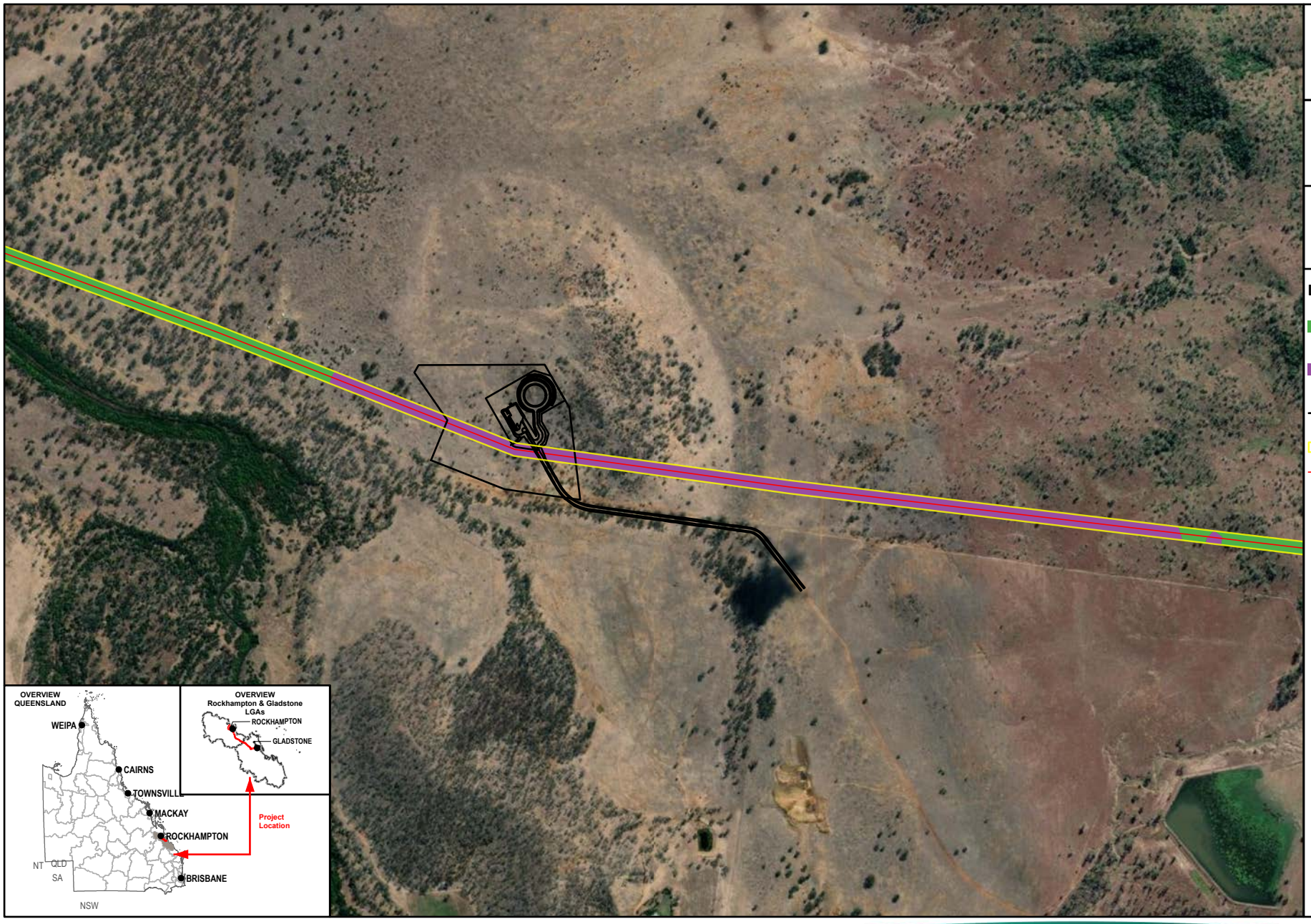
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6f
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Raglan Pump Station and Reservoir Layout
- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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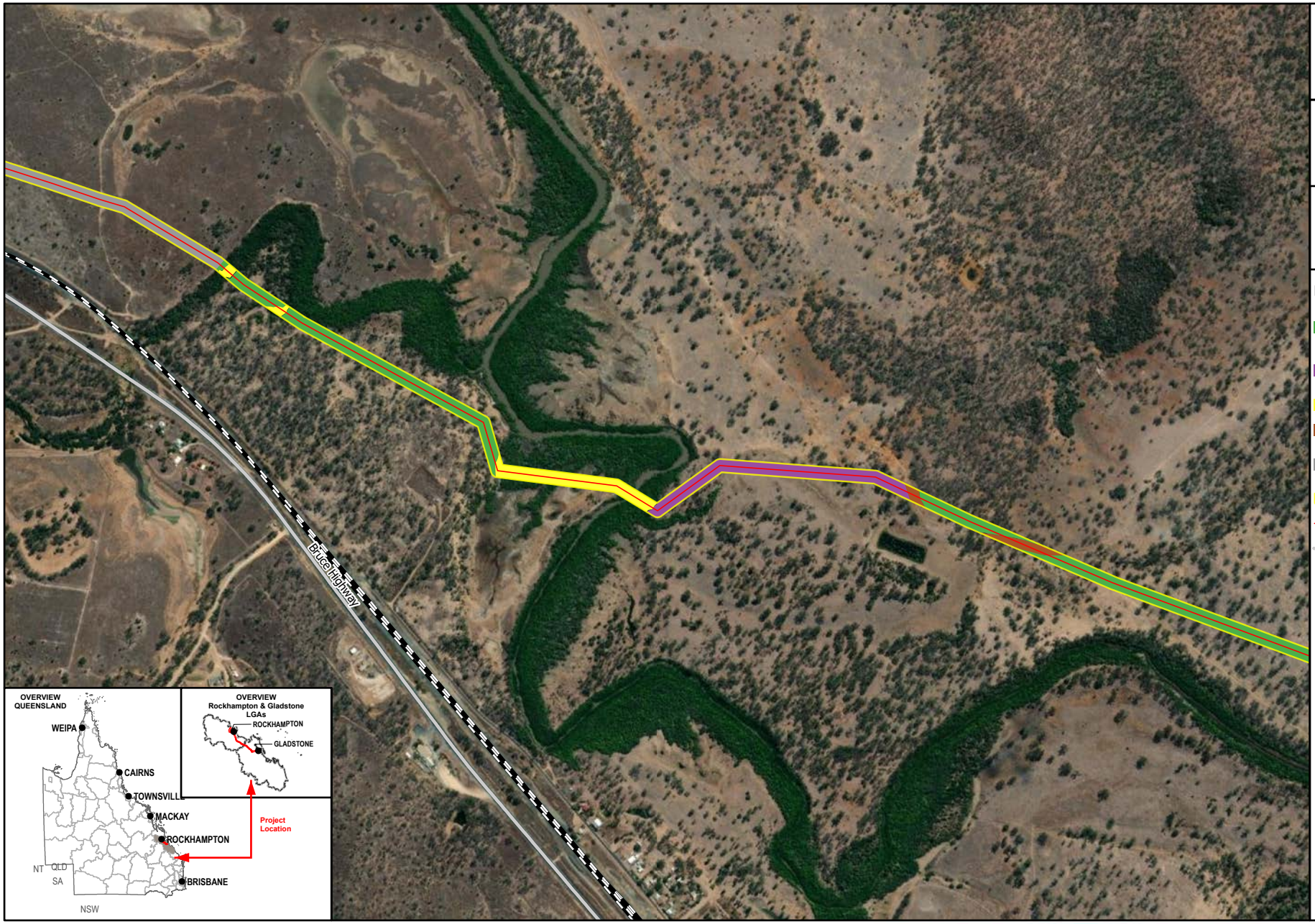
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6g
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Estuarine Environments
- Fringing Riparian Vegetation
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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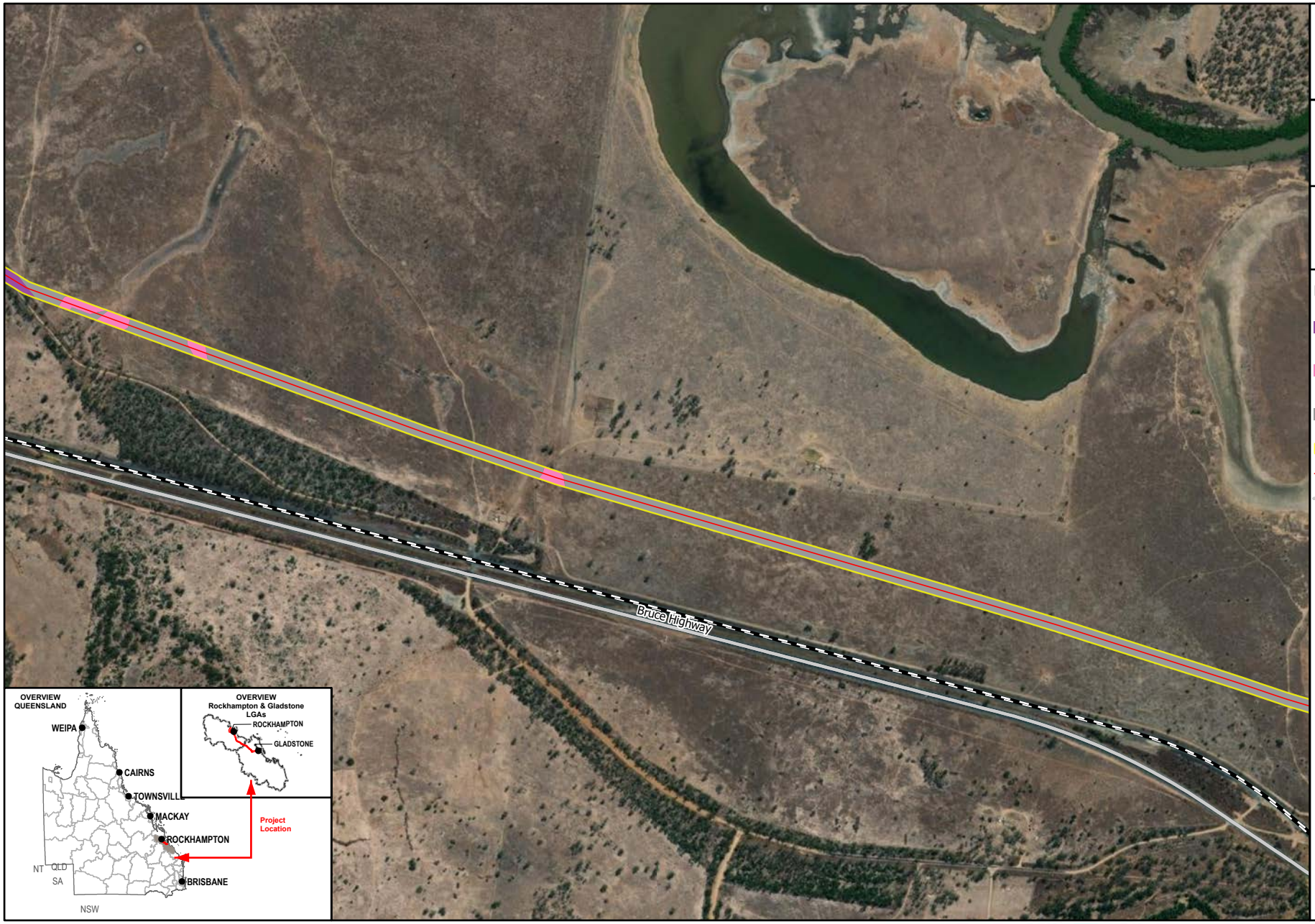
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6h
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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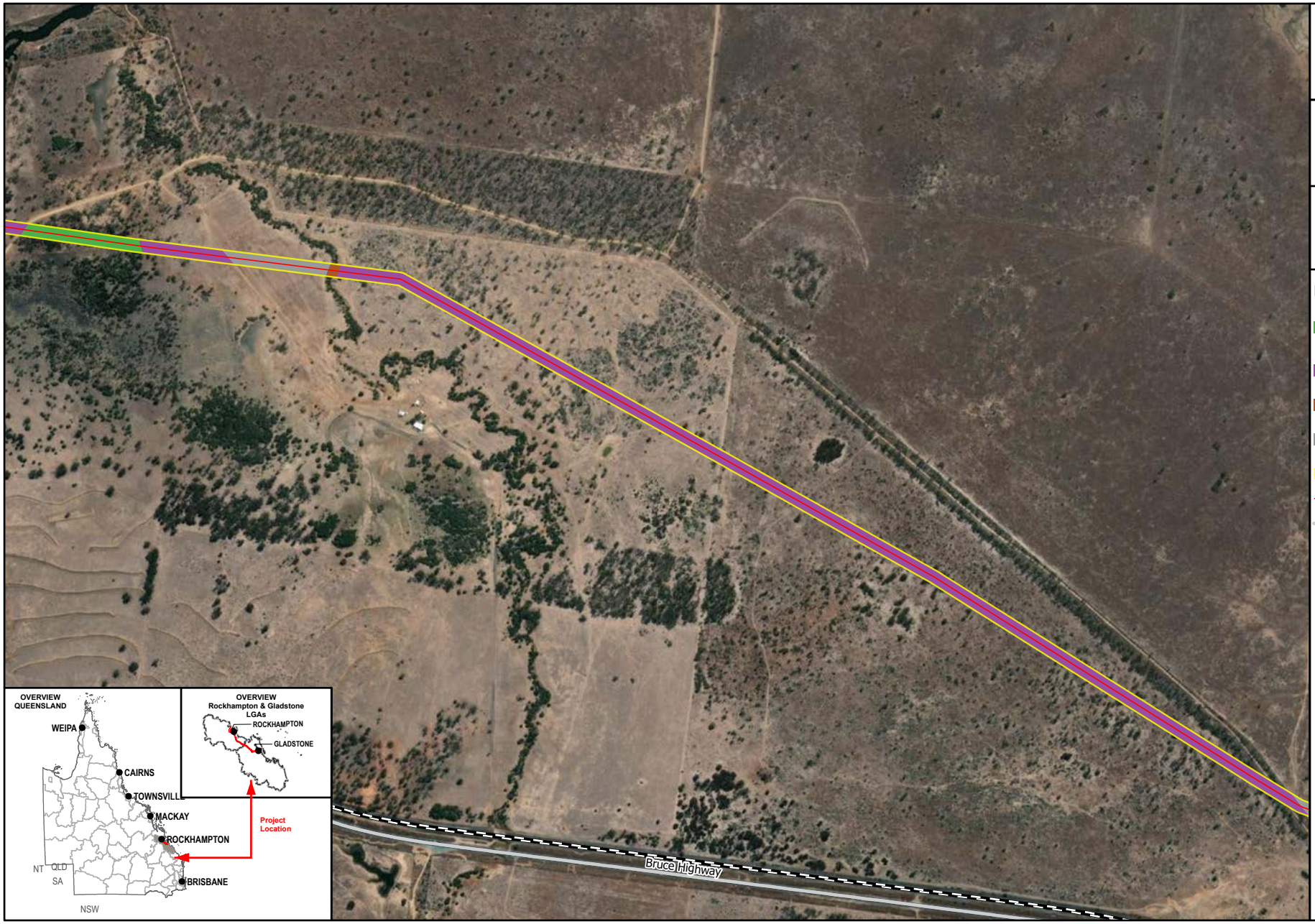
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6i
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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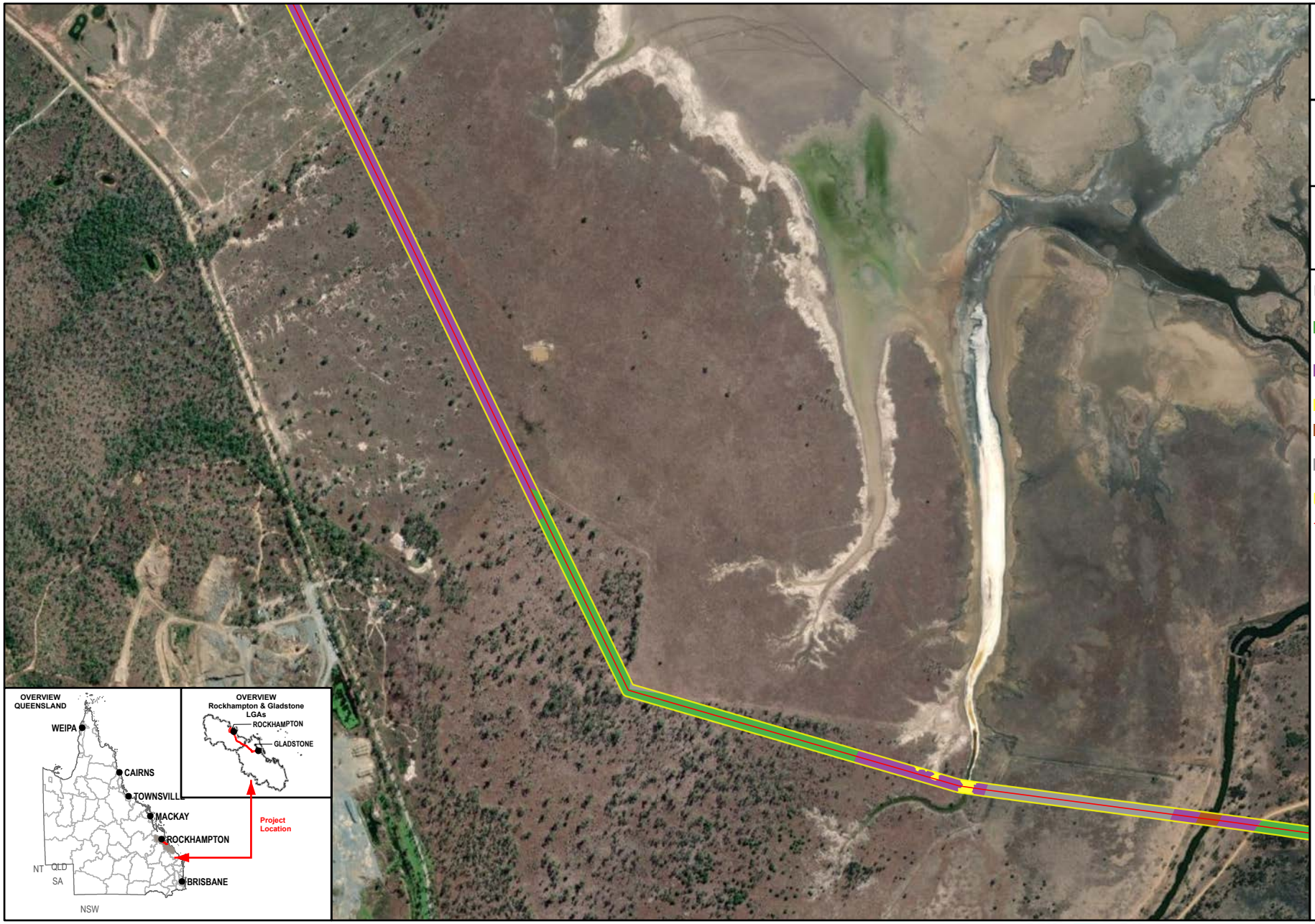
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6j
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Estuarine Environments
- Fringing Riparian Vegetation
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
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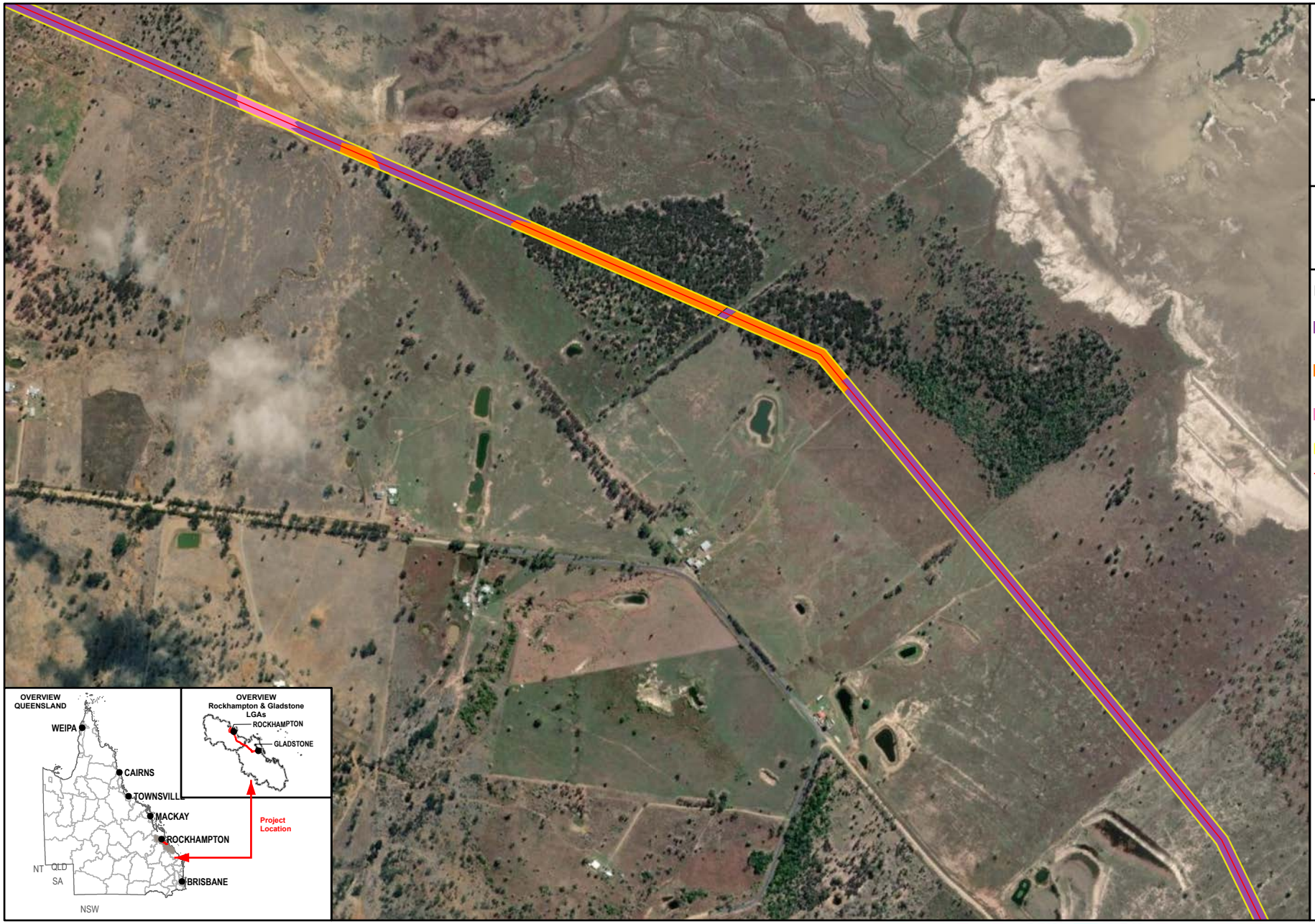
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6k
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Brigalow (Acacia harpophylla) Woodland
- Freshwater Waterbodies and Seasonal Wetlands
- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
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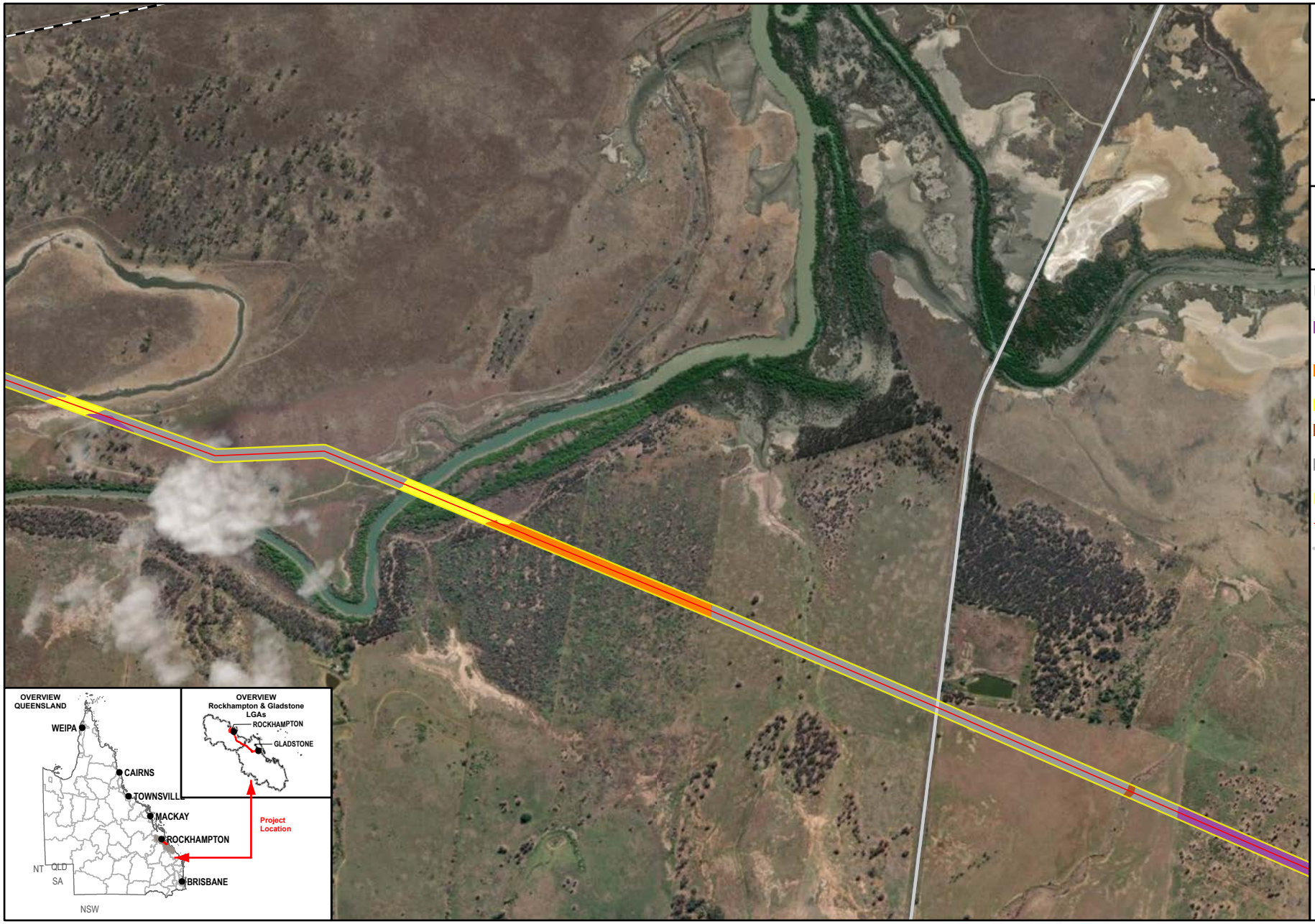
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6l
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Brigalow (Acacia harpophylla) Woodland
- Estuarine Environments
- Fringing Riparian Vegetation
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-6m
Habitat Types Identified Within the SGIC SDA Study Area
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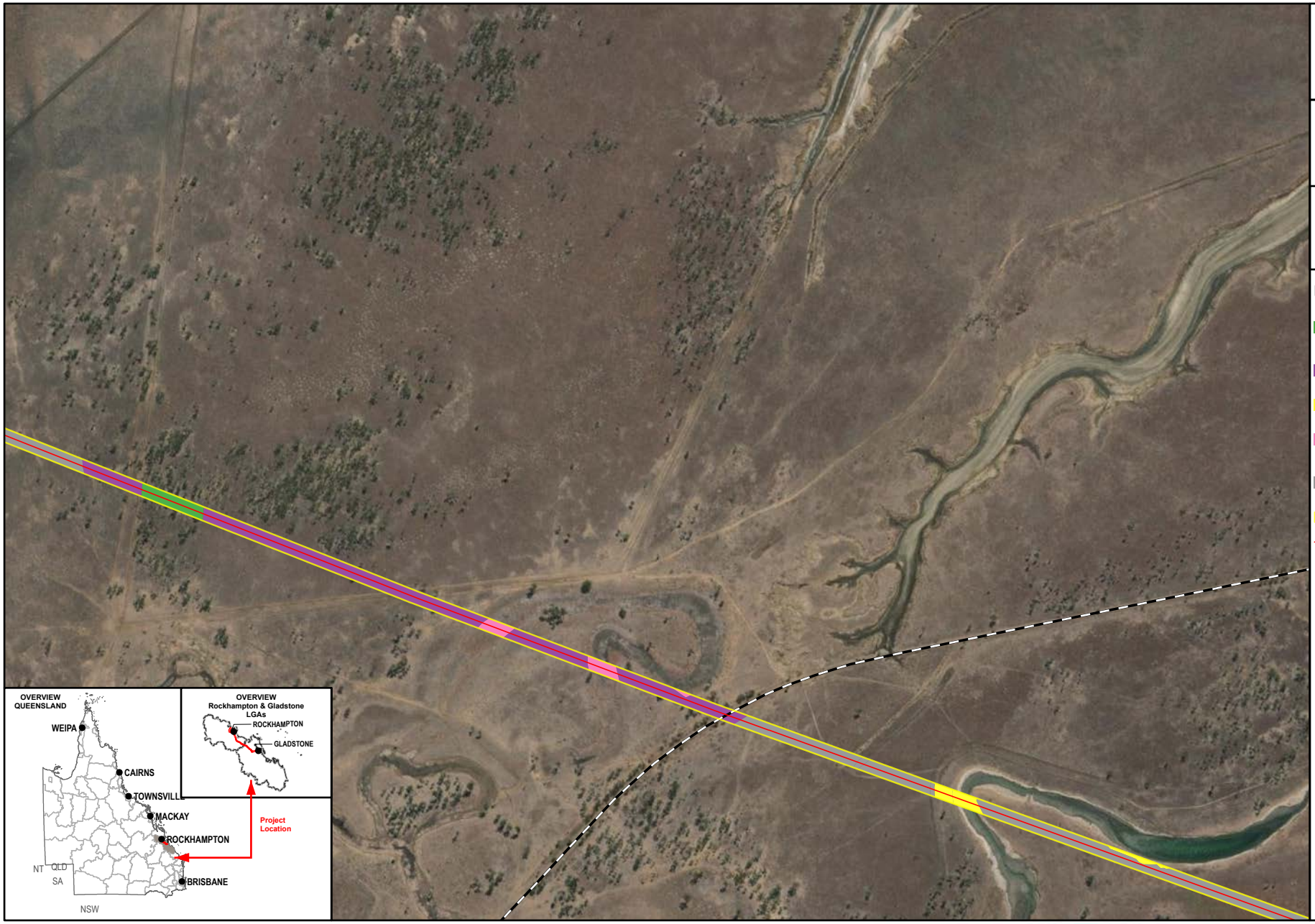

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Legend

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Estuarine Environments
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment
- Railways

Data Sources:
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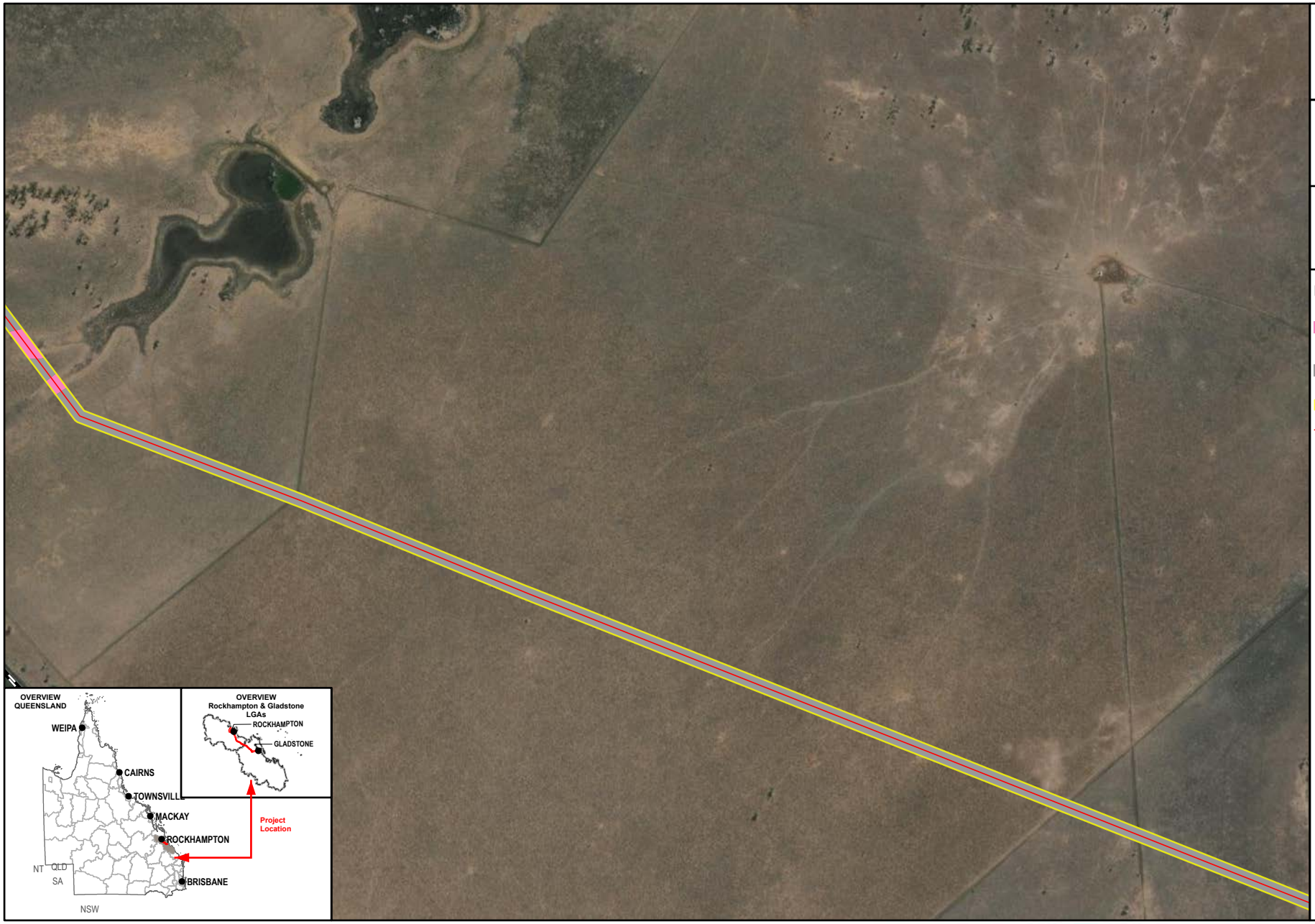
Figure 4-6n
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12



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Legend

- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
- SGIC SDA Pipeline Alignment
- Railways

Data Sources:
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Figure 4-6o
Habitat Types Identified Within the SGIC SDA Study Area
000-G-MAP-2415 Version:3 Date:2022/09/12

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Legend

- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Study Area
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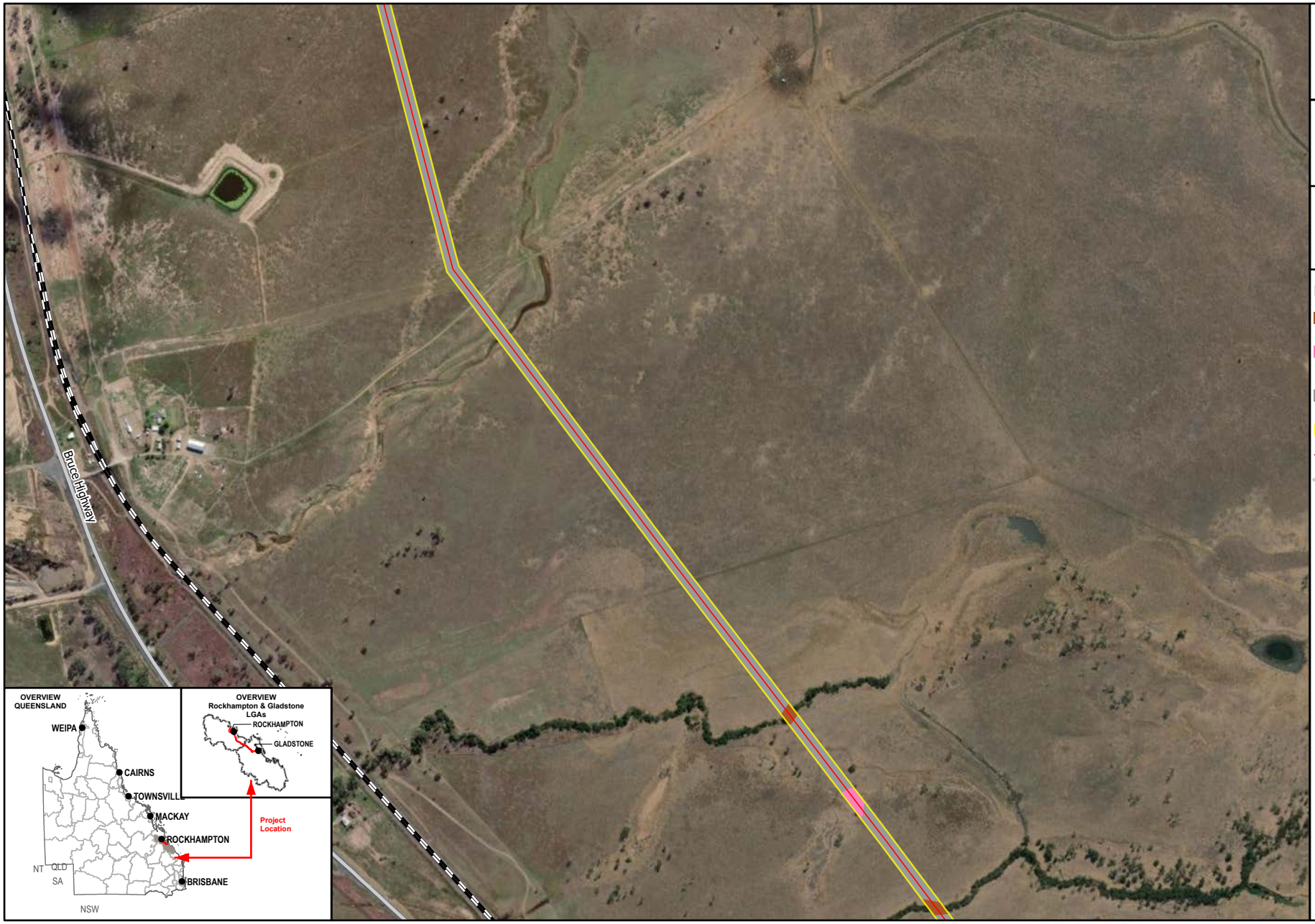

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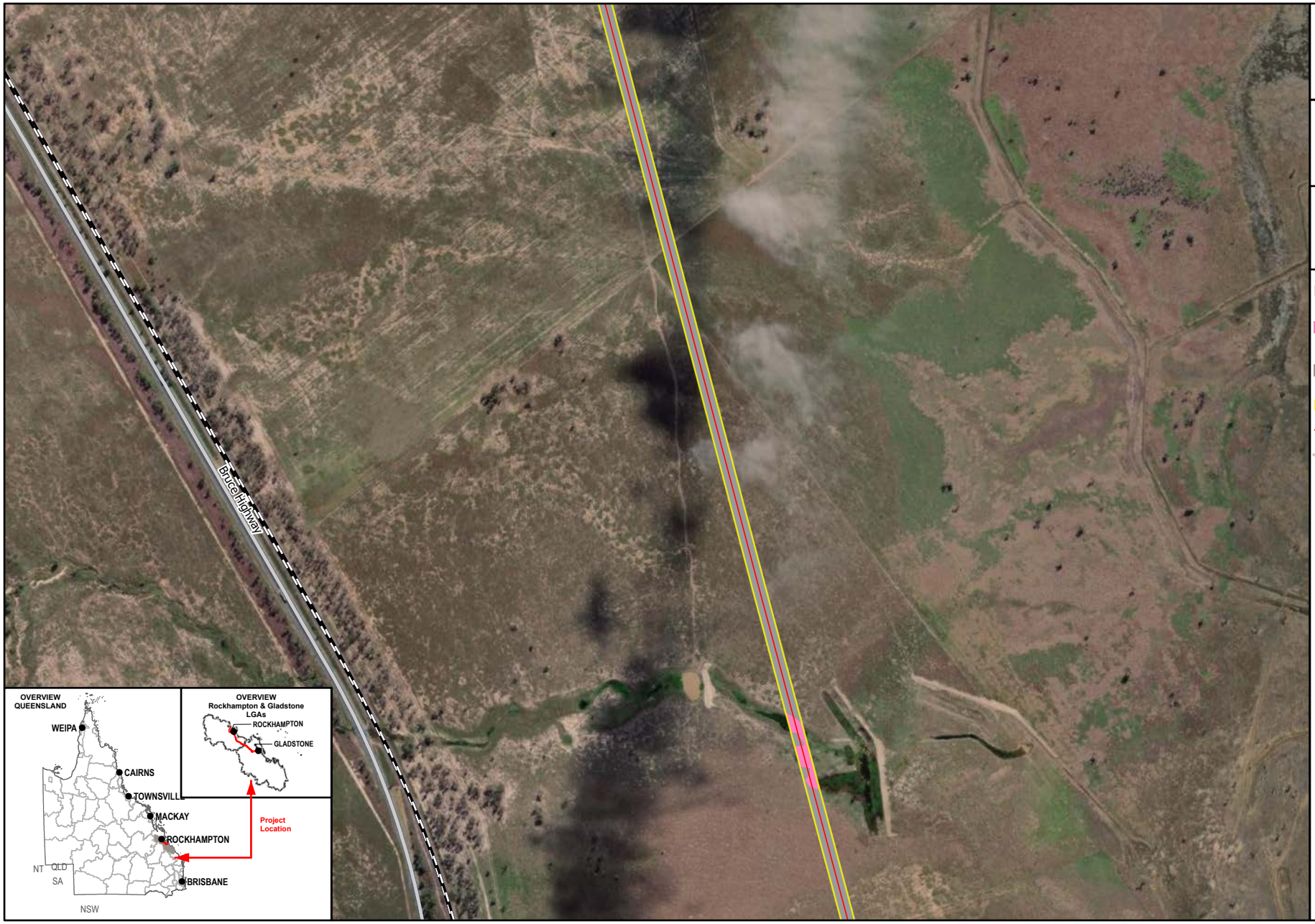

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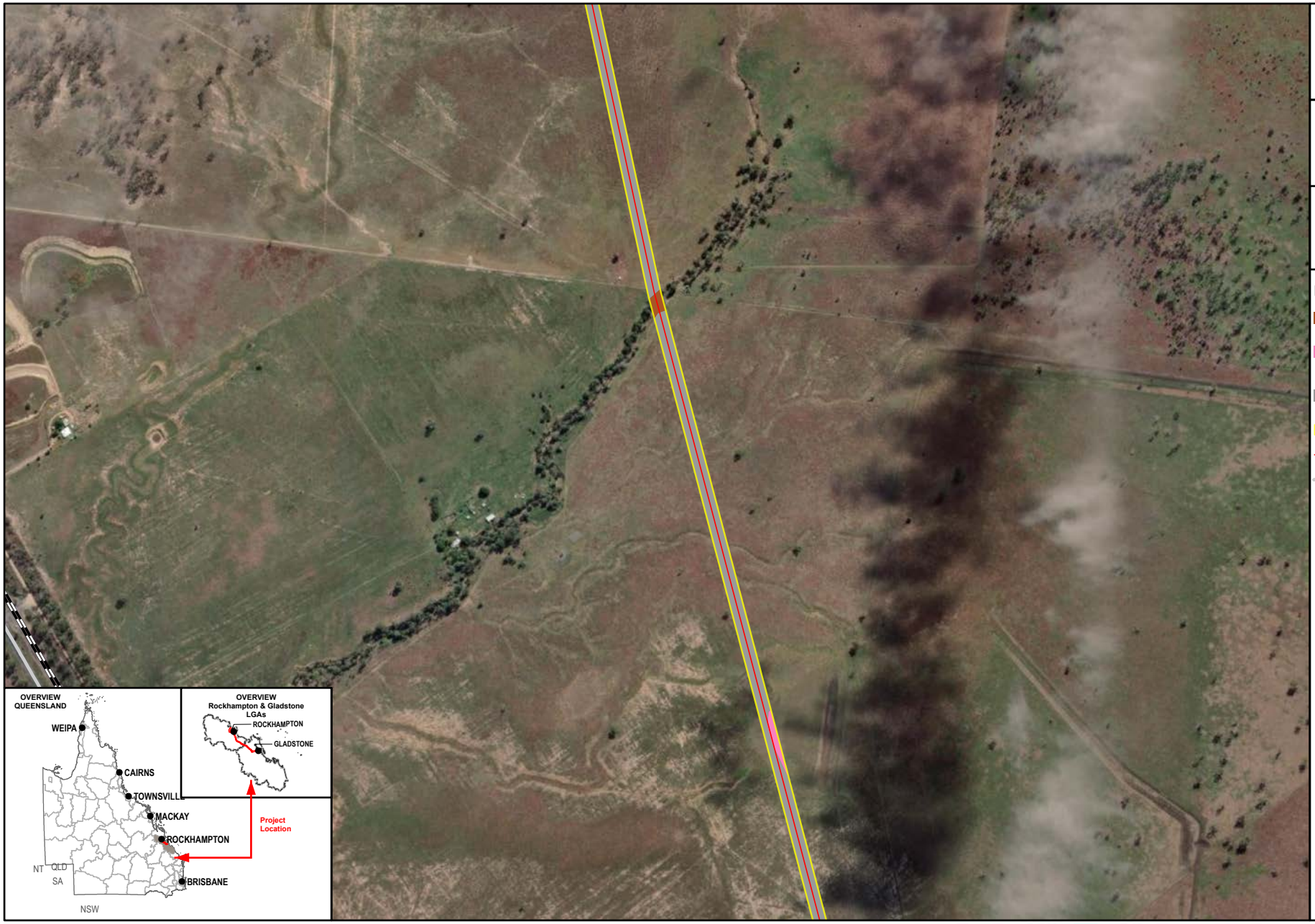

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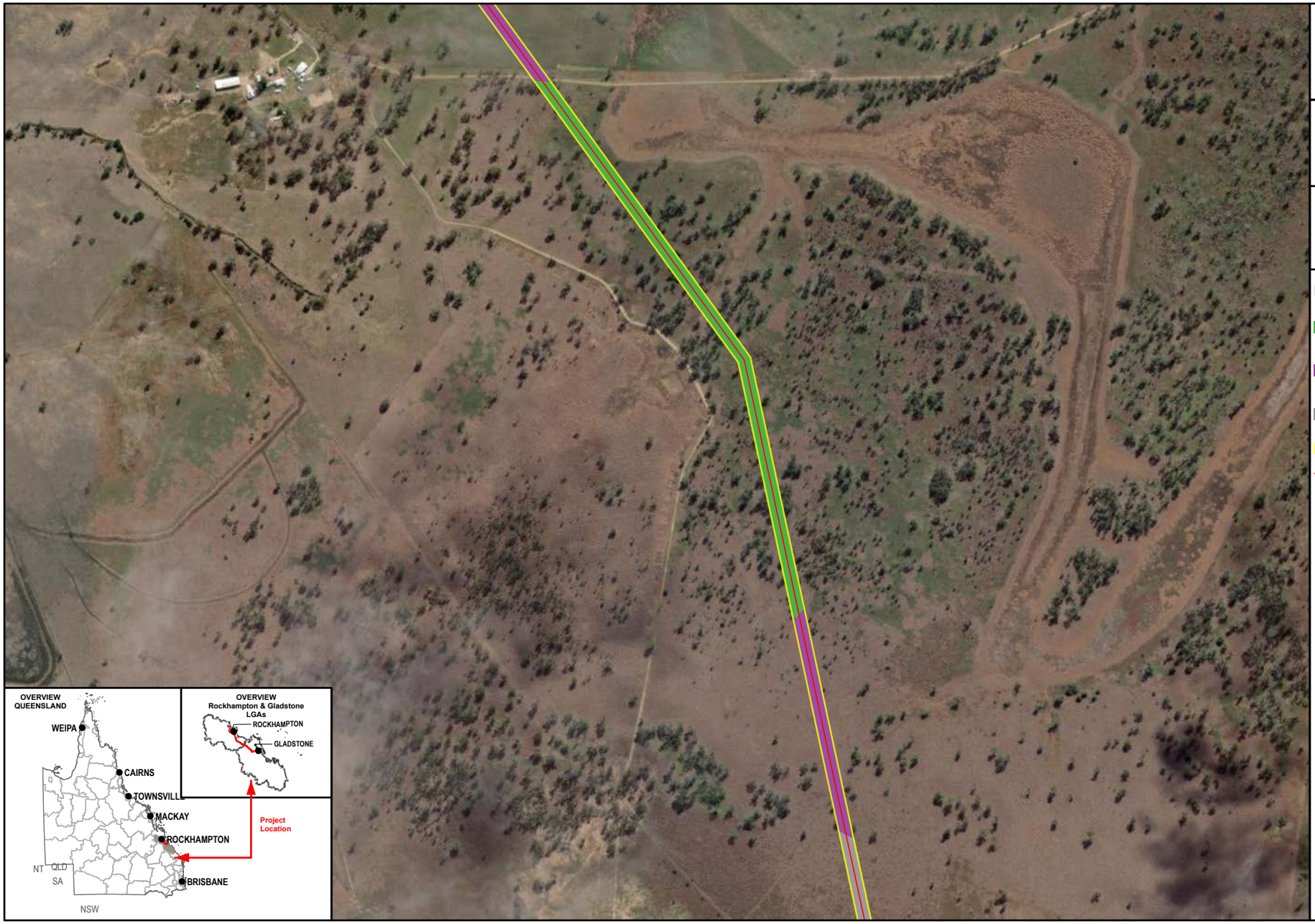

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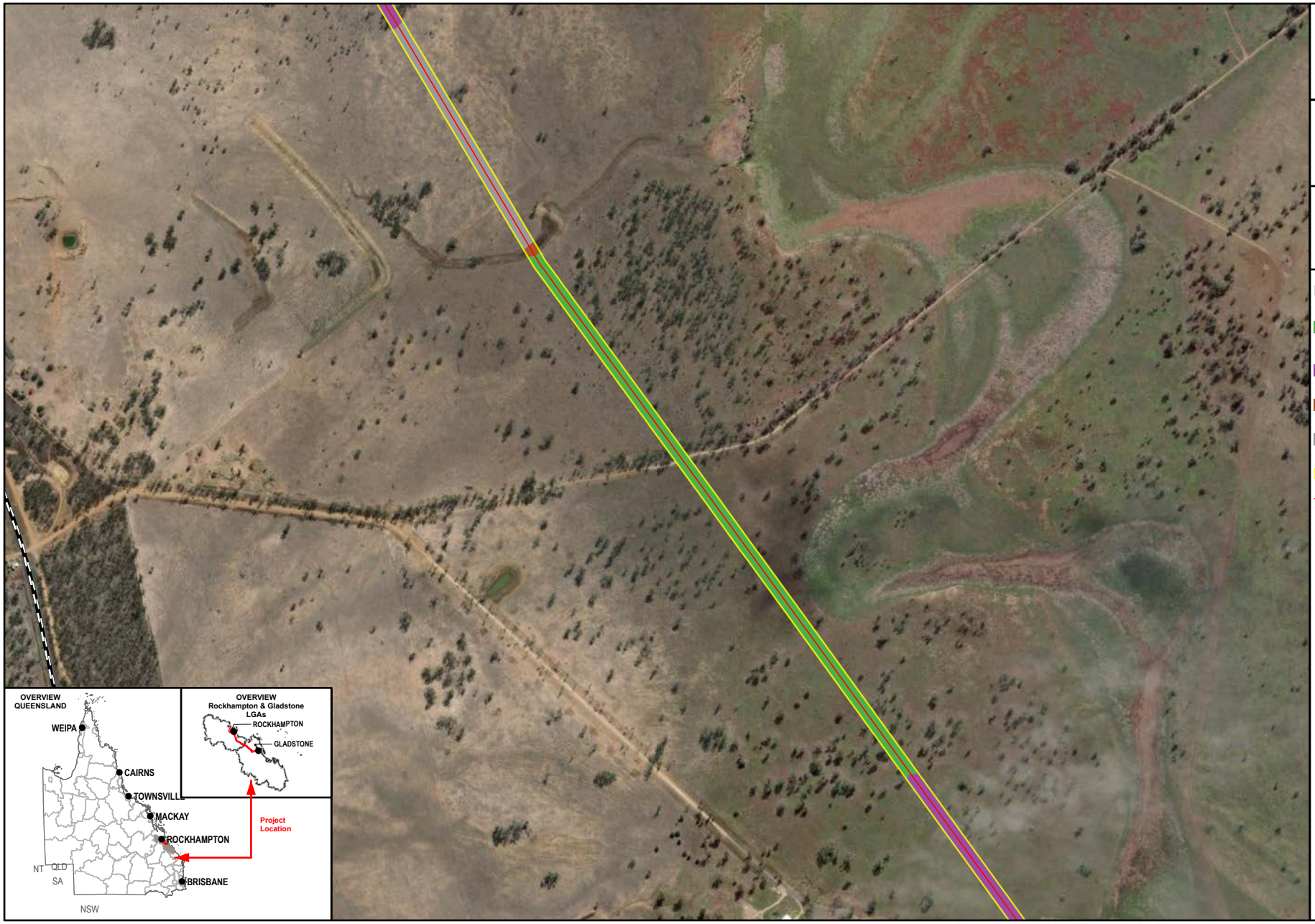

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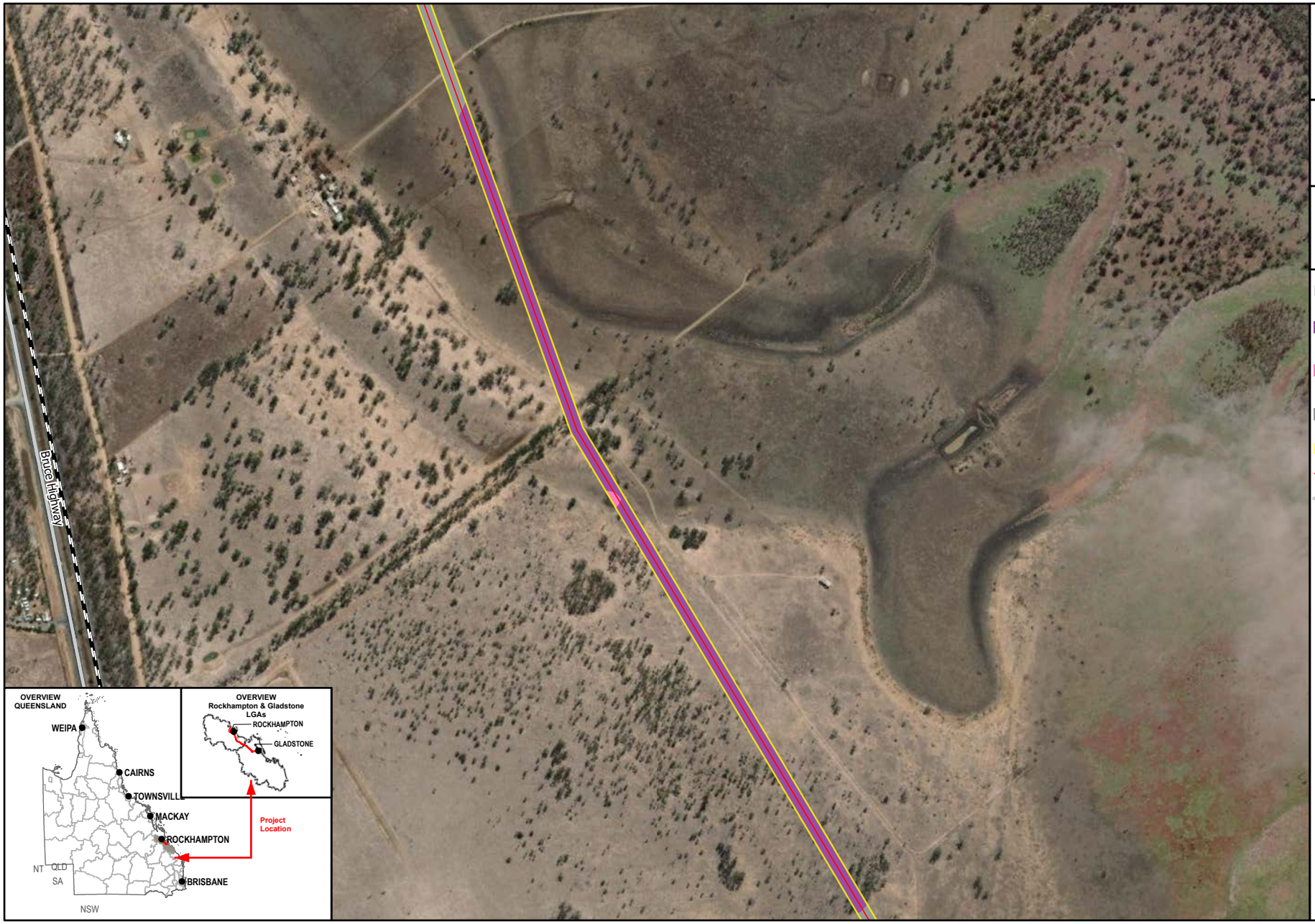

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Figure 4-6v
Habitat Types Identified Within the SGIC SDA Study Area
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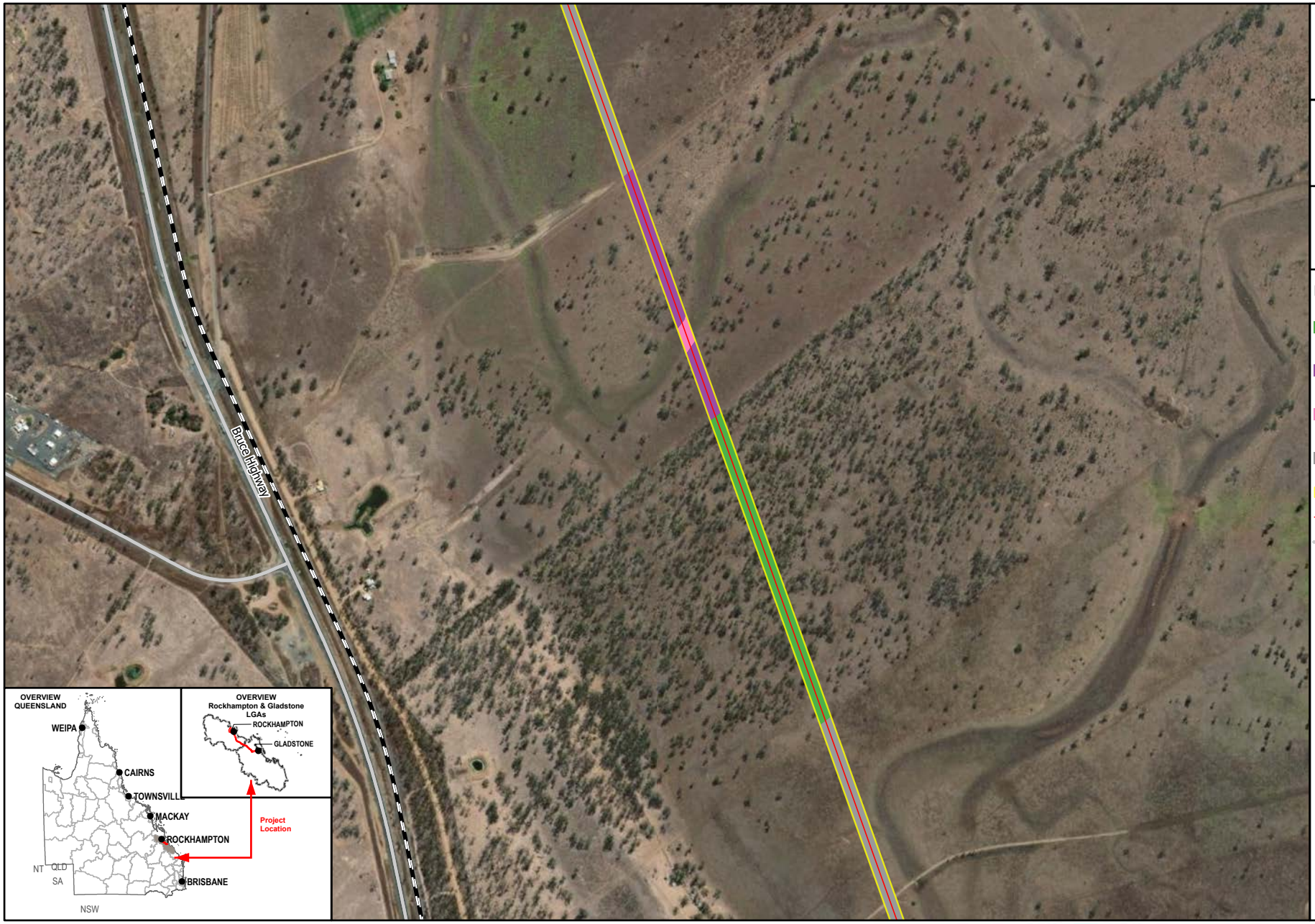

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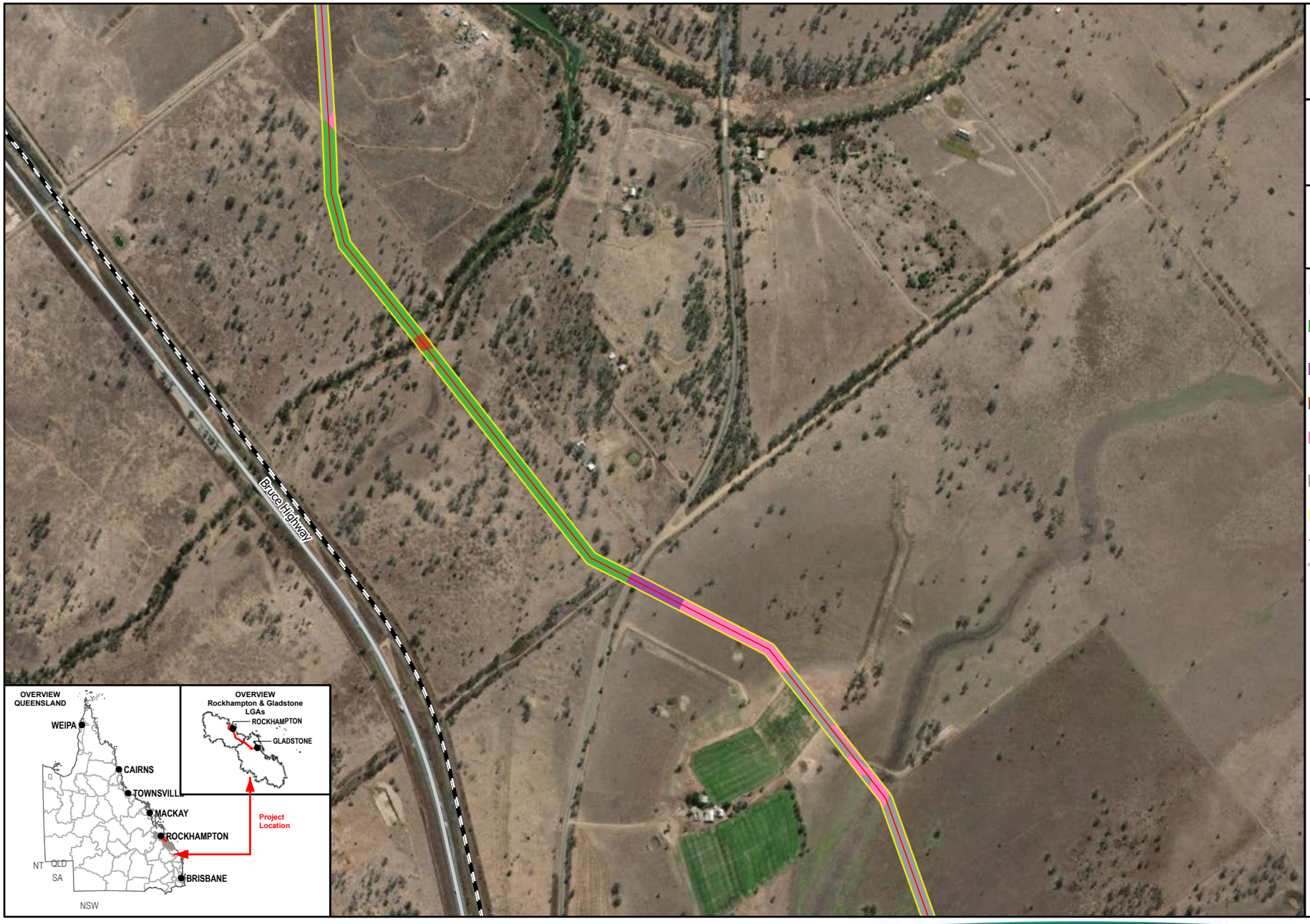

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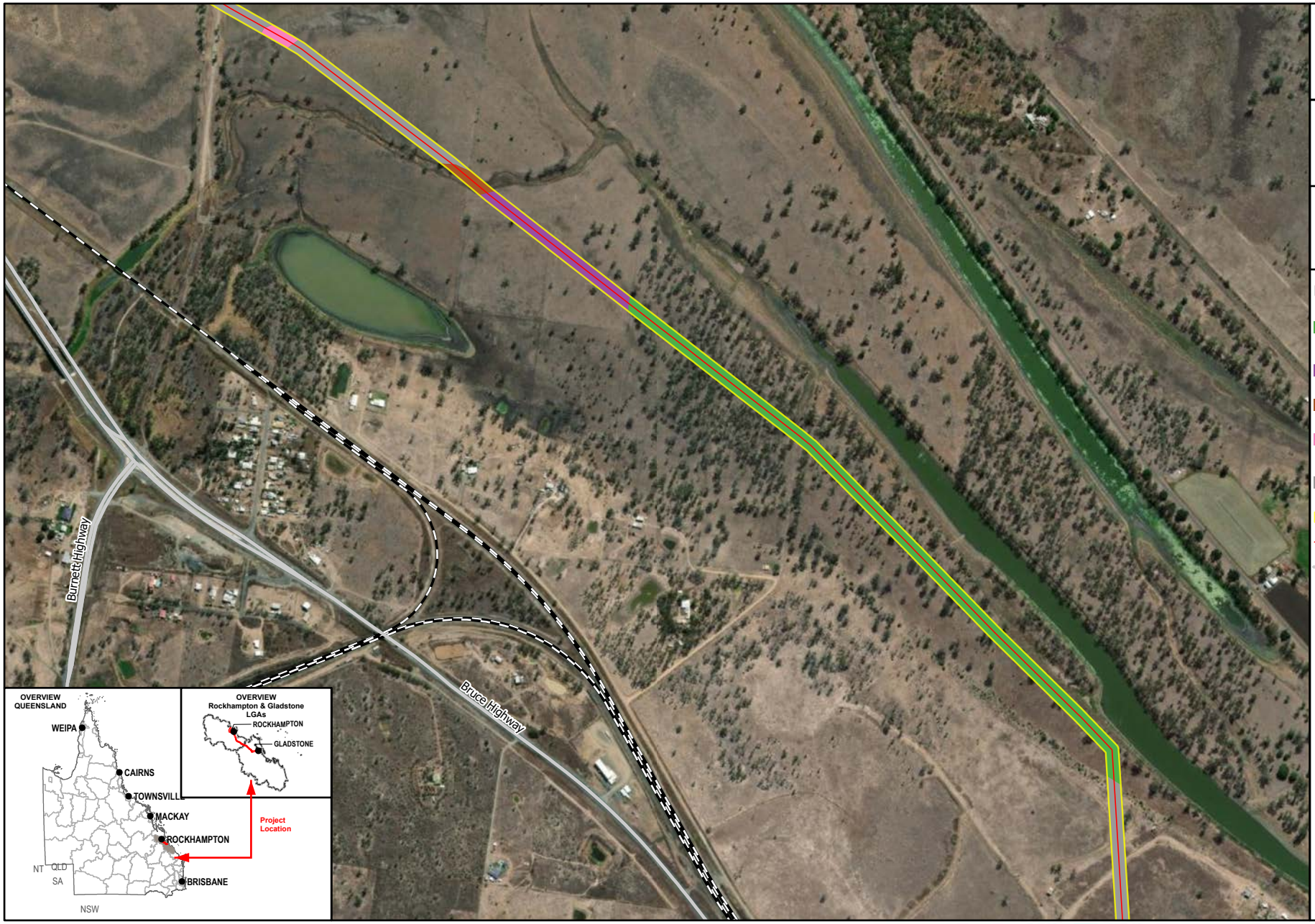

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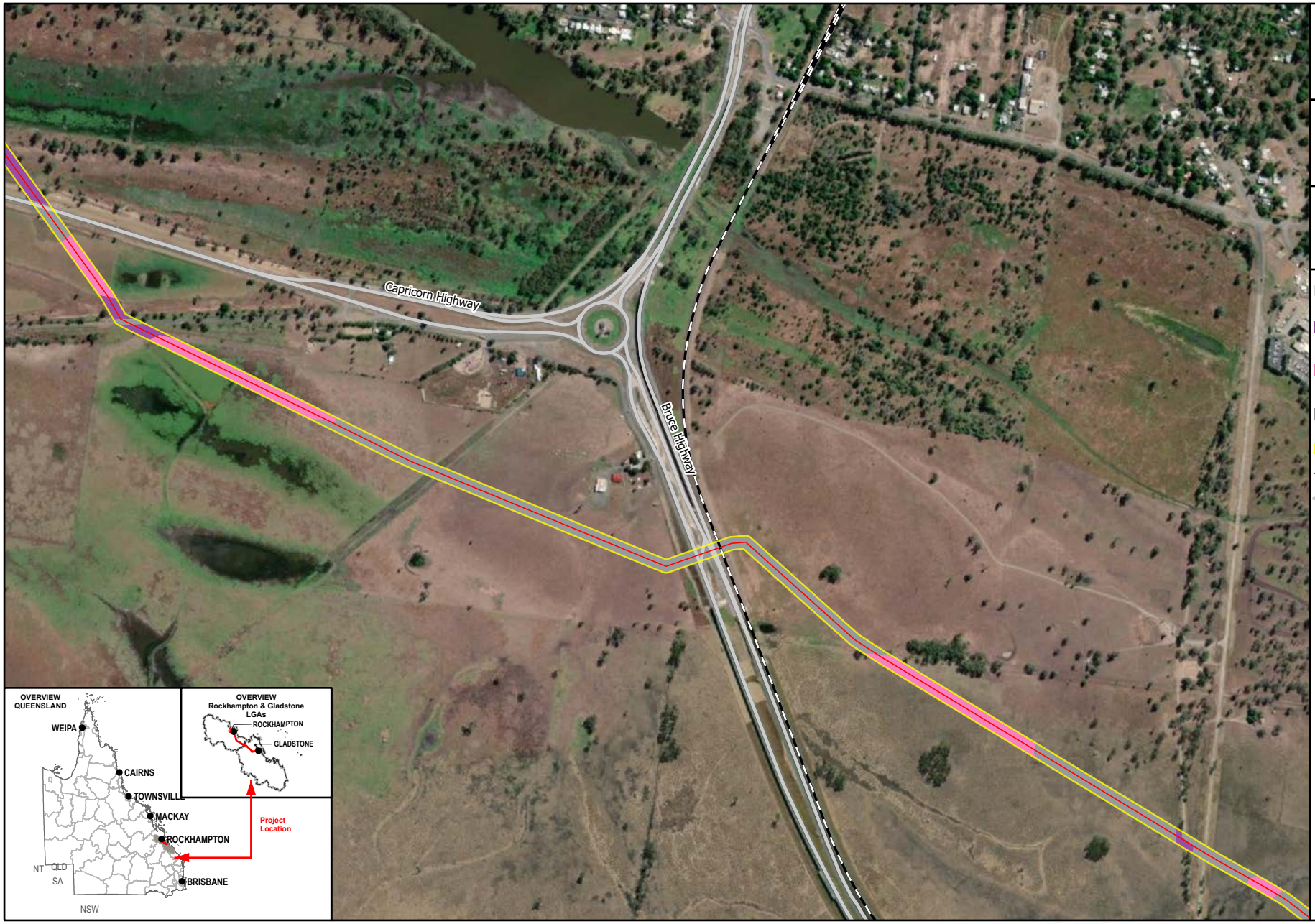

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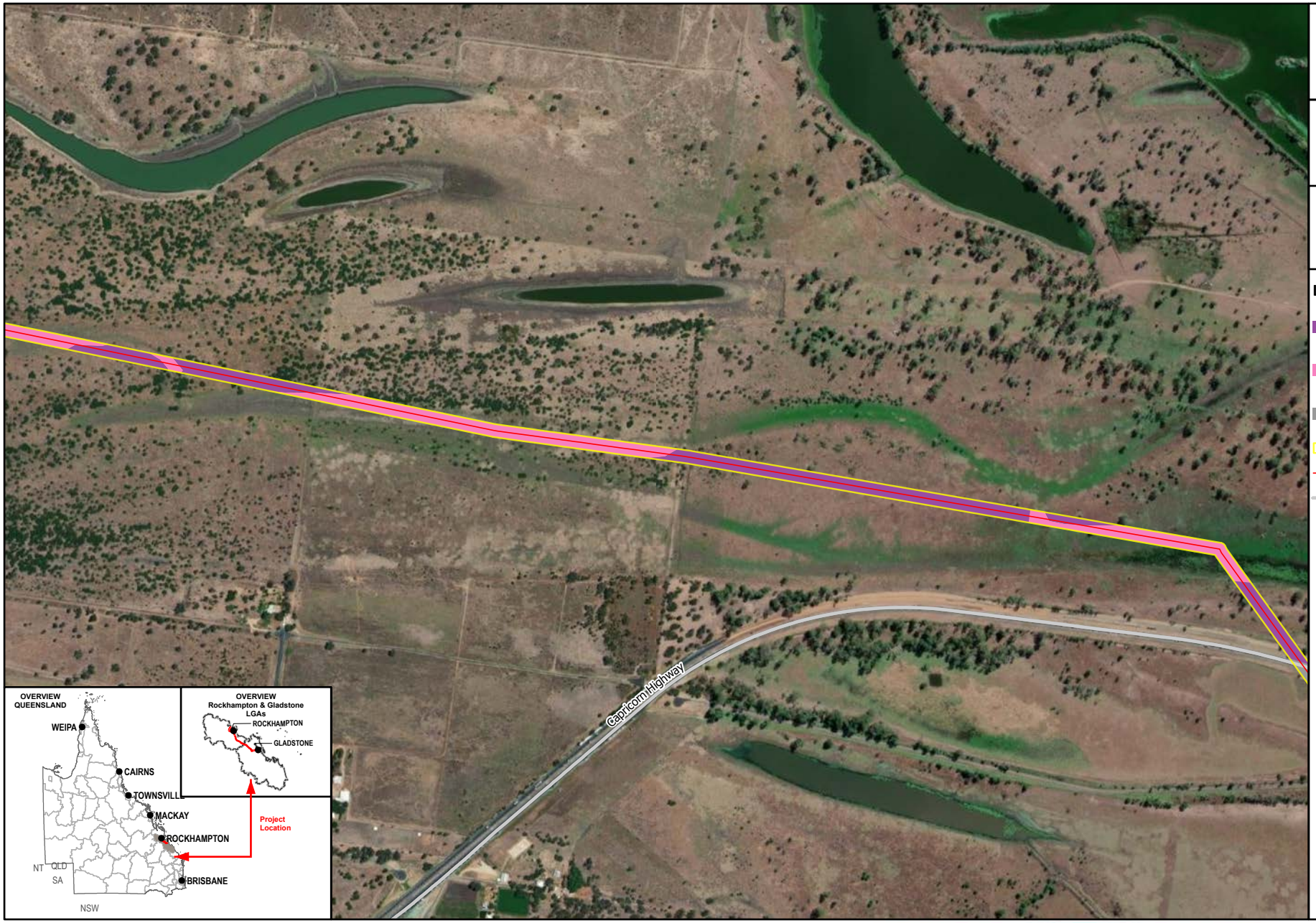

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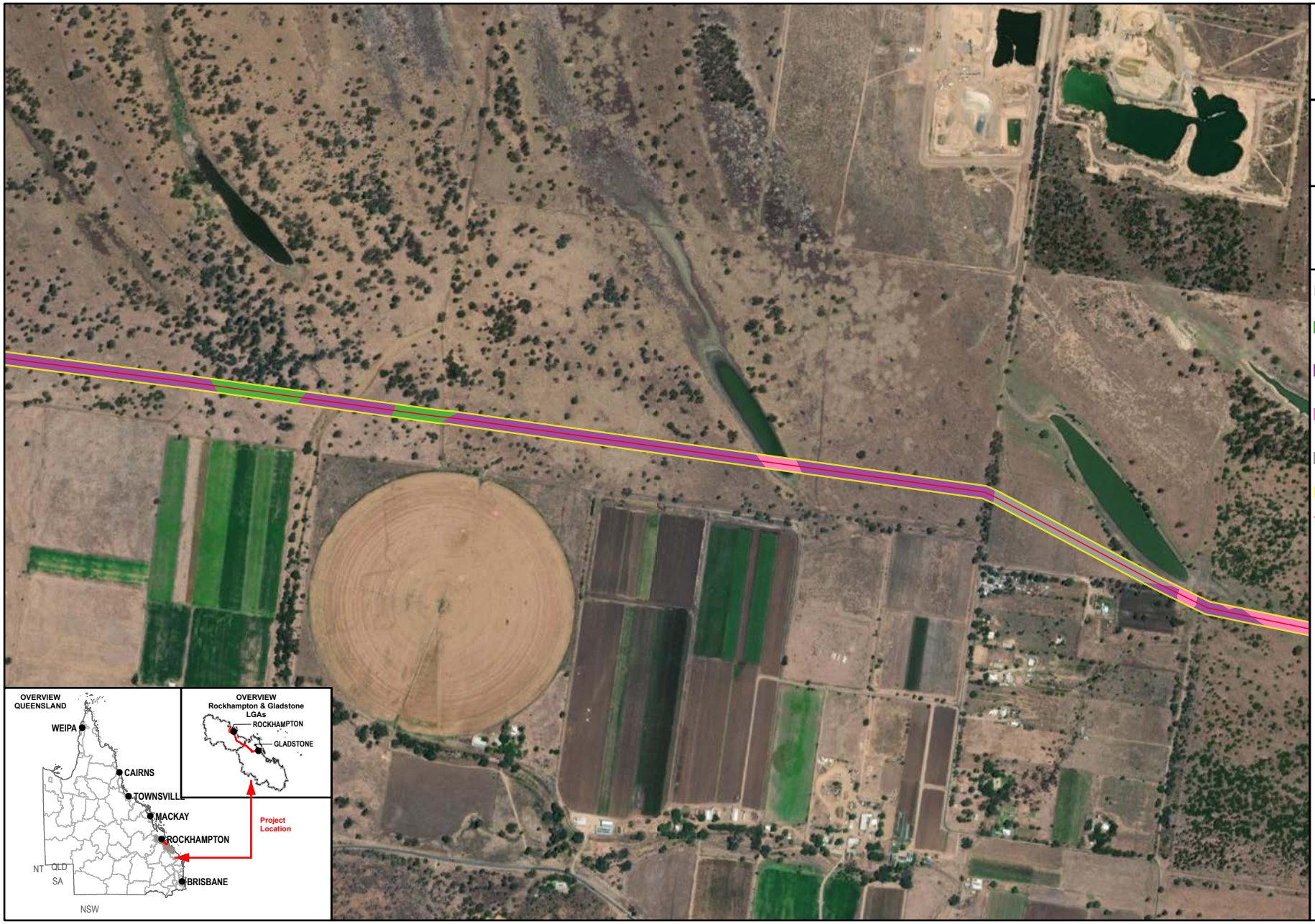

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4.5 Biosecurity matters

4.5.1 Field survey results

4.5.1.1 Introduced flora species

Weed species were commonly observed throughout the SGIC SDA study area. WoNS and restricted invasive weeds (listed under the Biosecurity Act) recorded in the Northern Section study area are listed in Table 4-13. All restricted invasive plants recorded are Category 3 restricted matters.

Table 4-13 Weed species identified within the SGIC SDA study area

Species name	Common name	WoNS	State declaration Biosecurity Act
Parthenium hysterophorus	Parthenium	X	Category 3
Lantana camara	Lantana	X	Category 3
Opuntia stricta	Common pest pear	X	Category 3
Opuntia tomentosa	Velvety tree pear	X	Category 3
Sporobolus pyramidalis	Giant rat's tail grass		Category 3
Cryptostegia grandiflora	Rubber vine	X	Category 3
Cascabela thevetia syn. *Thevetia peruviana*	Yellow oleander		Category 3
Baccharis halimifolia	Groundsel bush		Category 3
Harrisia martinii	Harrisia cactus		Category 3

4.5.1.2 Introduced fauna species

Six introduced fauna species were identified within the SGIC SDA study area (Table 4-14), including four mammal species declared as restricted invasive animals under the Queensland's *Biosecurity Act 2014* (DAF 2017). Baited remote cameras detected the presence of the wild dog and European red fox during the field surveys within the SGIC SDA study area and are shown below in Plate 4-3.

Table 4-14 Introduced fauna species recorded within the SGIC SDA study area

Species name	Common name	State declaration Biosecurity Act
Canis lupus familiaris	Wild dog	Category 3, 4 and 6
Oryctolagus cuniculus	European rabbit	Category 3, 4 and 6
Rhinella marina	Cane toad	-
Sturnus tristis	Common Myna	-
Sus scrofa	Feral pig	Category 3, 4 and 6
Vulpes vulpes	European red fox	Category 3, 4 and 6

Plate 4-3 Wild dog (left) and European red fox (right)

4.6 Aquatic environment

4.6.1 Desktop assessment results

4.6.1.1 Threatened aquatic species

The EPBC Act PMST database identified 13 threatened aquatic species that have the potential to occur within the desktop search extent. State based searches (i.e. WildNet, Species Profile Search and Biomaps) identified seven threatened aquatic species that have been historically recorded within the desktop search extent.

The PMST and WildNet desktop search results are provided in Appendix A and summarised in Table 4-15. This table also identifies threatened aquatic species that were identified as controlling provisions under the EPBC approval.

Combined, all searches identified 15 threatened aquatic species within the desktop search extent. Six marine turtle species (*Caretta caretta, Chelonia mydas, Dermochelys coriacea, Eretmochelys imbricata, Lepidochelys olivacea, Natator depressus*), two freshwater turtle species (*Elseya albagula, Rheodytes leukops)*, dugong (*Dugong dugon)*, estuarine crocodile (*Crocodylus porosus)*, platypus (*Ornithorhynchus anatinus*), two sawfish species (*Pristis zijsron*, *Anoxypristis cuspidate)* and two riverine dolphin species (*Orcaella heinsohni, Sousa sahulensis),* listed in Table 4-15, have the potential to occur within the study area.

The green sawfish has no previous occurrences within study area. The species have been recorded in inshore coastal environments and estuarine creeks, but not into freshwaters (COA 2015). The species distribution occurs across northern Australia to the Whitsundays, its most current southern distribution (COA 2015). Although the species may occur further south, it is considered locally extinct throughout much of its former range. It is therefore unlikely that the green sawfish will occur within the SGIC SDA.

No previous occurrence records for the narrow sawfish occurs within the SGIC SDA (ALA 2022). The species is distributed across the Indo-Pacific, including across northern Australia and as far south in Queensland as off the coast of MacKay (Florida Museum 2022) and is therefore unlikely to occur within the waterways within the SGIC SDA.

Dugong are known to occur across northern Australia and as far south on the east coast as Moreton Bay and are known to congregate near accessible seagrass meadows within wide shallow bays, wide mangrove channels, and in the lee of large inshore islands (DCCEEW 2022f). Previous occurrence records of the species have occurred at the mouth of the Fitzroy River, but not in any of the tidal reaches within the SGIC SDA (ALA 2022). The turbidity of the water within the upper tidal reaches of Raglan Creek at site 2 and at Inkerman Creek at site 4 would not allow growth of large seagrass meadows within these reaches, there was also no evidence of seagrass at these sites. The habitat conditions within the tidal reaches of Raglan Creek and Inkerman Creek are not suitable for the species, and due to the sites occurring in the upper tidal reaches, the species is therefore unlikely to occur within the SGIC SDA.

The two dolphin species, dugong, and marine turtle species are discussed further in Section 4.6.2.5.

Table 4-15 Threatened aquatic species identified within the SGIC SDA desktop search extent

Scientific name	Common name	Status		Source	WN Records	Nearest Record to ROW	EPBC Approval
		EPBC Act	NC Act				
Reptiles							
Caretta caretta	Loggerhead turtle	E, Mig	E	WN, PMST	1	21.78 km	
Chelonia mydas	Green turtle	V, Mig	V	WN, PMST	14	21.75 km	
Crocodylus porosus	Estuarine crocodile	Mig	V	WN, PMST	1	7.5 km	
Dermochelys coriacea	Leatherback turtle	E, Mig	E	PMST	-	50.76 km	

Scientific name	Common name	Status		Source	WN Records	Nearest Record to ROW	EPBC Approval
		EPBC Act	NC Act				
Elseya albagula	White-throated snapping turtle	CE	CE	WN, PMST	3	904 m	
Eretmochelys imbricata	Hawksbill turtle	V, Mig	E	PMST	-	52.13 km	
Lepidochelys olivacea	Olive Ridley turtle	E, Mig	E	PMST	-	>180 km	
Natator depressus	Flatback turtle	V, Mig	V	PMST	-	30.67 km	
Rheodytes leukops	Fitzroy River turtle	V	V	PMST	-	9.63 km	✓
Sharks							
Anoxypristis cuspidata	Narrow sawfish	V, Mig	NL	PMST		30.72 km	
Pristis zijsron	Green sawfish	V, Mig	NL	PMST		>1,000 km	
Mammals							
Dugong dugon	Dugong	Mig	V	WN, PMST	2	17.40 km	
Orcaella heinsohni	Australian snubfin dolphin	NL	V	WN	1	26.0 km	
Ornithorhynchus anatinus	Platypus	-	SL	WN	4	3.15 km	
Sousa sahulensis	Australian humpback dolphin	Mig	V	PMST	-	25.52 km	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed.

WN – WildNet; PMST – Protected Matters Search Tool.

4.6.1.2 Great Barrier Reef Marine Park

The SGIC section of the pipeline intersects several waterways within the Fitzroy River sub- catchment. The closest of these waterways to the GBR, Inkerman Creek, feeds into Casuarina Creek approximately 37 km upstream from GBR coastal zone. The GBR is listed as a World Heritage Area, National Heritage Property, Marine Park and nationally important wetland. The GBR supports a large number of conservation significant species including marine megafauna, shorebirds, sharks and marine fish species. It contains approximately ten per cent of the coral reef ecosystems in the world and supports an enormous amount of biodiversity. The SGIC SDA pipeline alignment will have no direct impacts upon the GBR, and mitigation measures (see Section 6) enacted to minimise potential indirect risks to the GBR.

4.6.1.3 Wetlands

One Nationally Important Wetland (Fitzroy River Floodplain) listed under the Australian Directory of Important Wetlands intersects the SGIC SDA, approximately 6 km south of Rockhampton. Two additional National Important Wetlands (Fitzroy River Delta, Great Barrier Reef Marine Park) are located downstream of the SGIC SDA pipeline alignment as outlined in Table 4-16 and shown in Figure 4-7. The SGIC SDA pipeline alignment with have no direct impacts upon these wetlands. The SGIC SDA pipeline alignment intersects with three MSES listed wetlands which are mapped as high ecological significance wetlands and wetland protection areas as shown in Figure 4-7. No Ramsar wetlands occur within or adjacent to the study area. The nearest Ramsar site is located at Shoalwater and Corio Bays approximately 48 km north-east of the study area.

Table 4-16 Nationally Important Wetlands within and in relation to the SGIC SDA pipeline alignment

Wetland ID	Wetland name	Location
QLD013	Fitzroy River Floodplain	SGIC SDA pipeline alignment

Wetland ID	Wetland name	Location
QLD012	Fitzroy River Delta	1.2 km downstream of the SGIC SDA pipeline alignment at Twelve Mile Creek
QLD100	Great Barrier Reef Marine Park	55 km downstream of the SGIC SDA pipeline alignment at Gavial Creek

4.6.1.4 Waterways and fish habitat

A total of 47 mapped waterways under the WWBW layer, including the tidal spatial layer, are intersected by the SGIC SDA pipeline alignment (Table 4-17; Figure 4-8).

The risk ratings assist with the determination of DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), based on the shape and location of the waterway in the catchment, as well as the characteristics of species that reside within them (DAF 2021). Waterways with a rating of major or high-risk to fish passage generally contain larger biomasses of fish populations and contain species that are more likely to have weaker swimming abilities (DAF 2021). Low or moderate risk waterways for fish passage are often in the upper reaches of a catchment and have steeper slopes and would generally have a lower biomass of fish populations than downstream reaches (DAF 2021).

Table 4-17 Summary of all waterway crossings in the SGIC SDA pipeline alignment

Waterway barrier works risk rating	Number of waterways intersected
Purple (major)	9
Red (high)	4
Amber (moderate)	15
Green (low)	16
Tidal	3

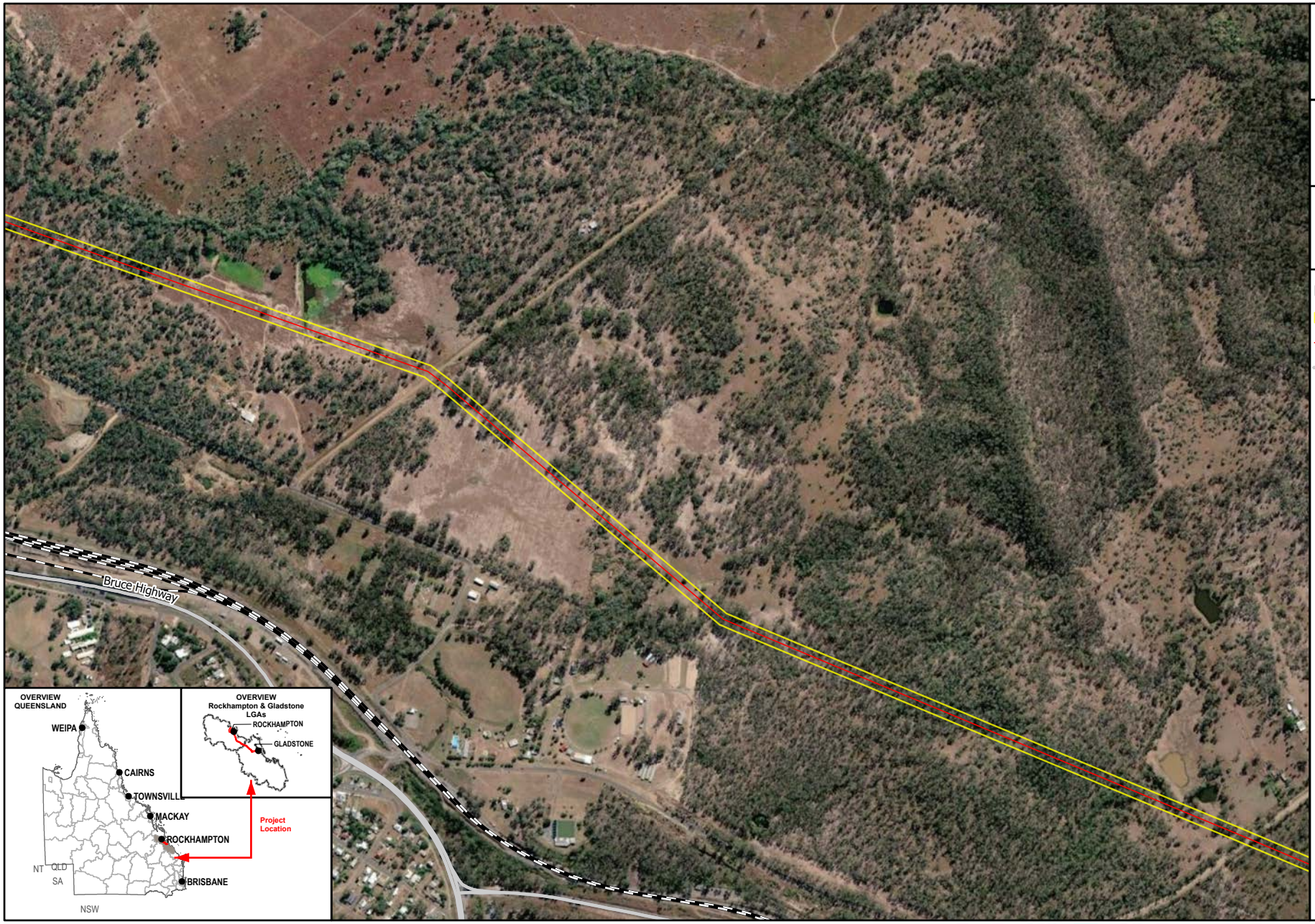
Majority of the waterways are mapped as moderate (15) and low (16). The nine major (purple) waterways in the WWBW layers within the SGIC SDA pipeline alignment include:

– Scrubby Creek
– Gavial Creek
– Bobs Creek
– Station Creek
– Oaky Creek
– Anabranch of Inkerman Creek (intersects SGIC SDA pipeline alignment twice)
– Twelve Mile Creek
– Horigan Creek.

The three tidal waterways in the WWBW layer within the SGIC SDA pipeline alignment include:

– Inkerman Creek
– Horigan Creek
– Raglan Creek.

No mapped fish habitat areas intersect the SGIC SDA pipeline alignment. Two kilometres downstream of the pipeline crossing at Raglan Creek is a mapped fish habitat area (management A) that extends beyond the mouth of the Fitzroy River and upstream towards Rockhampton (Figure 4-8).



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Legend

- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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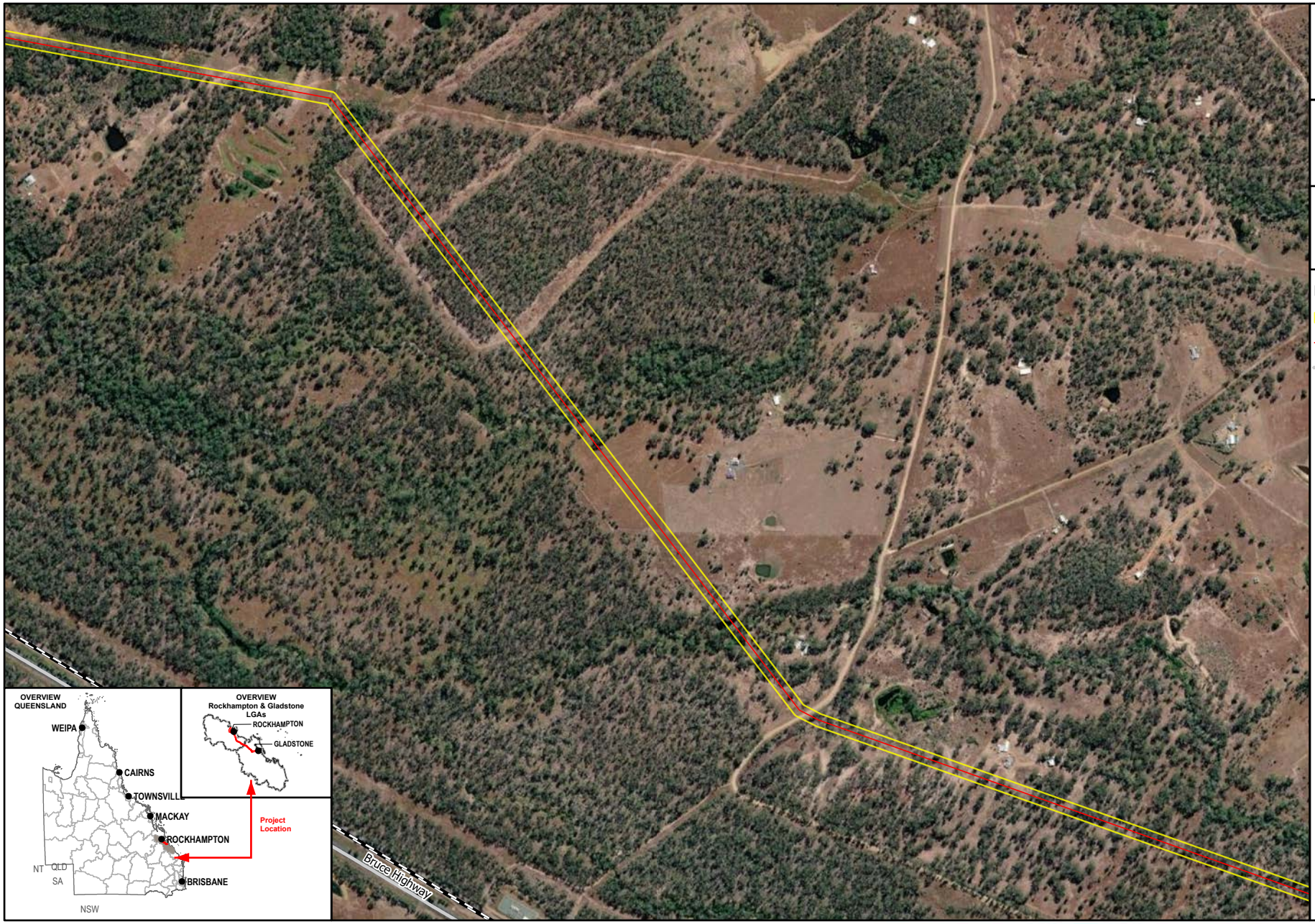
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7a
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7b
Mapped Wetlands Within the SGIC SDA Desktop Search Area

000-G-MAP-2416 Version:3 Date:2022/09/12

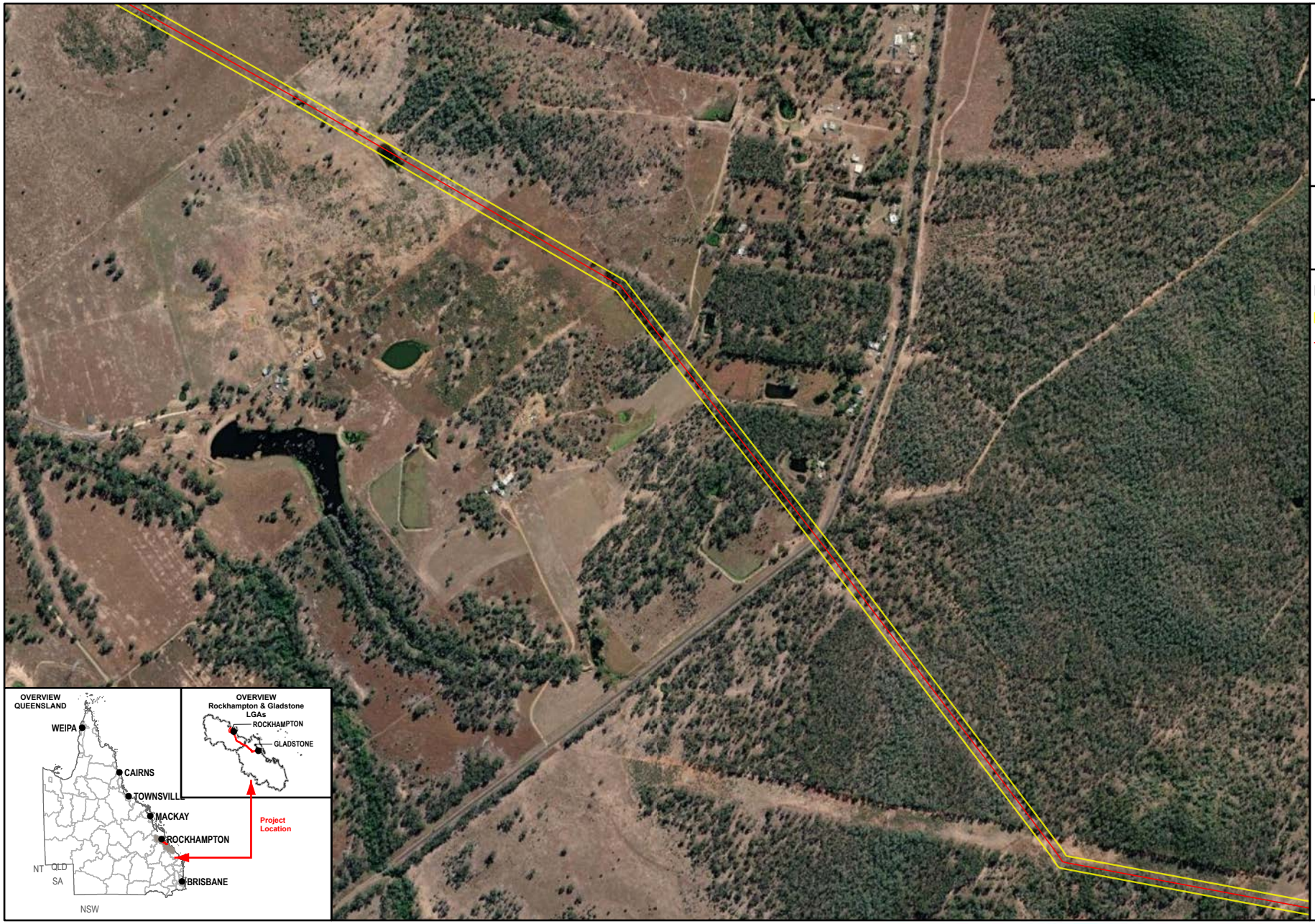

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Figure 4-7c
Mapped Wetlands Within the SGIC SDA Desktop Search Area

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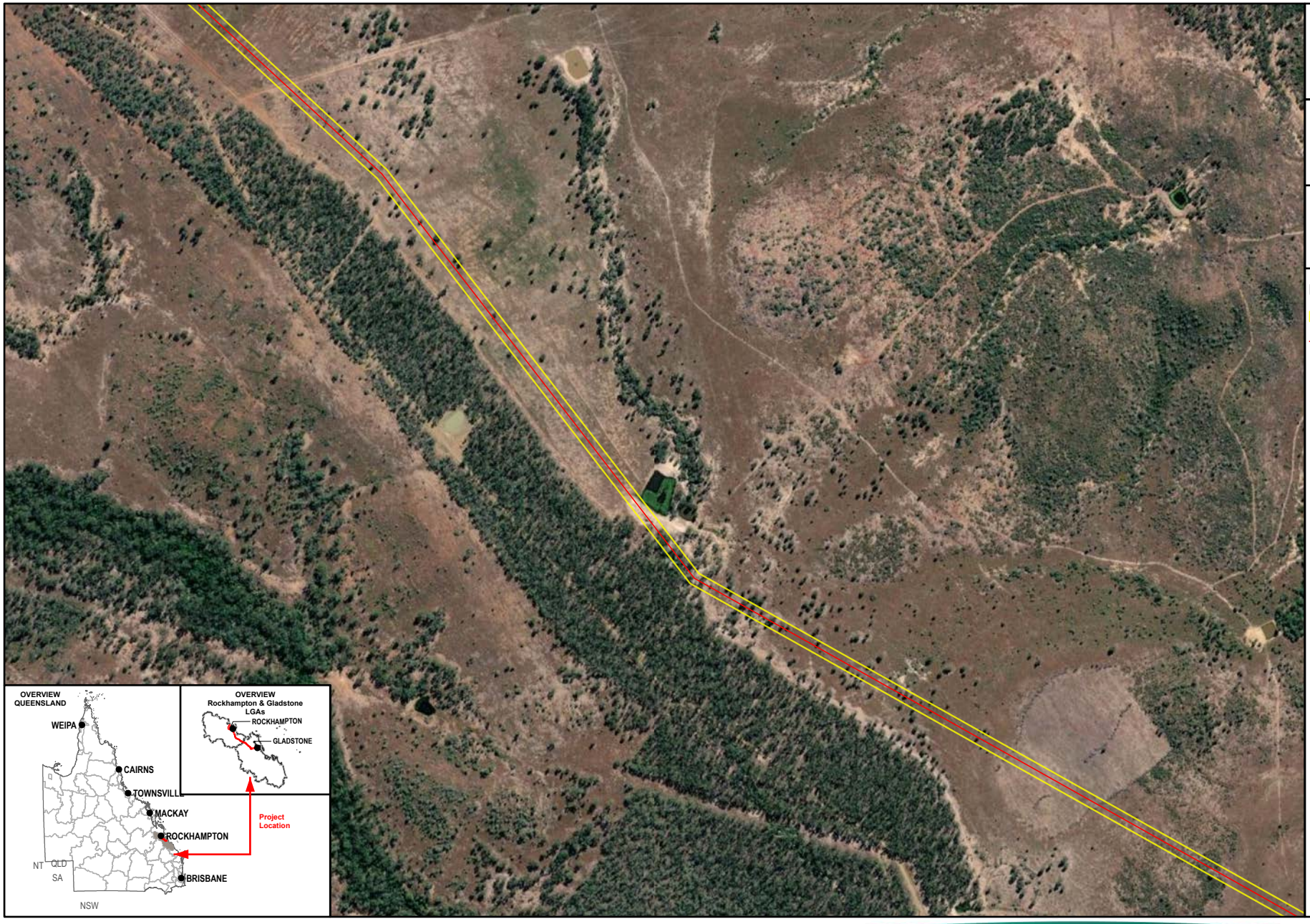

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- Study Area
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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7d
Mapped Wetlands Within the SGIC SDA Desktop Search Area
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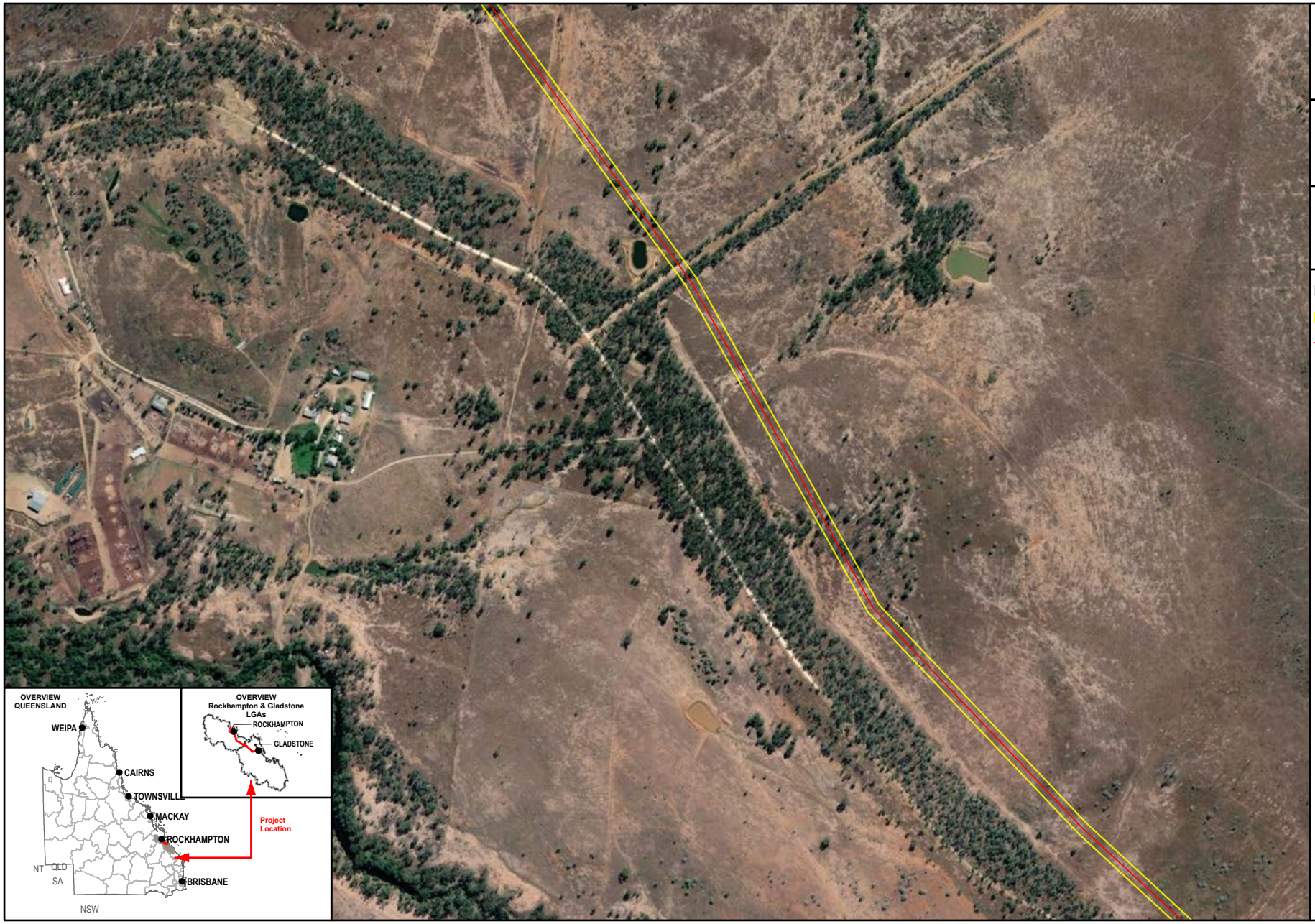

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- Study Area
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Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7e
Mapped Wetlands Within the SGIC SDA Desktop Search Area

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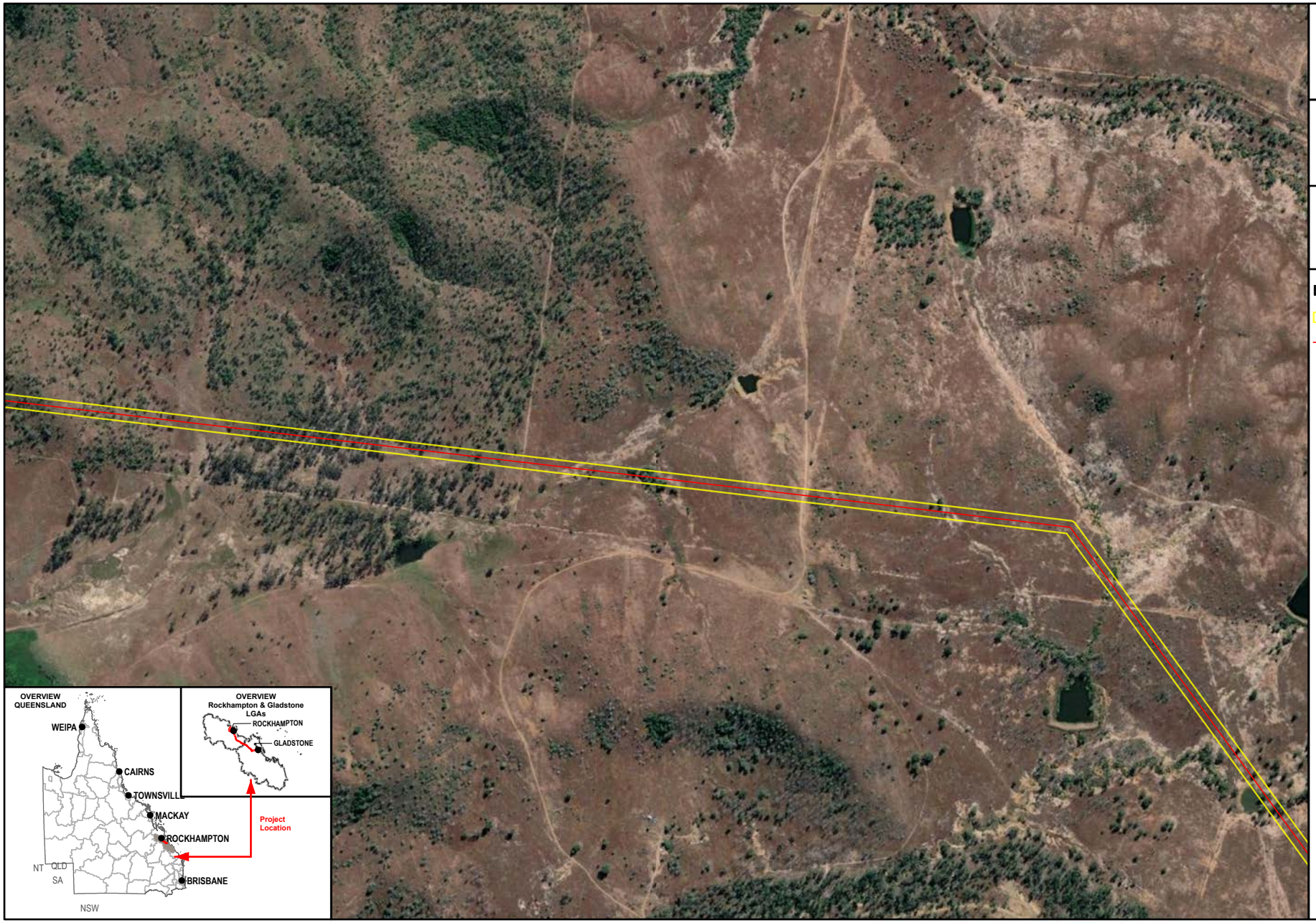

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- Study Area
- SGIC SDA Pipeline Alignment

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Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7f
Mapped Wetlands Within the SGIC SDA Desktop Search Area

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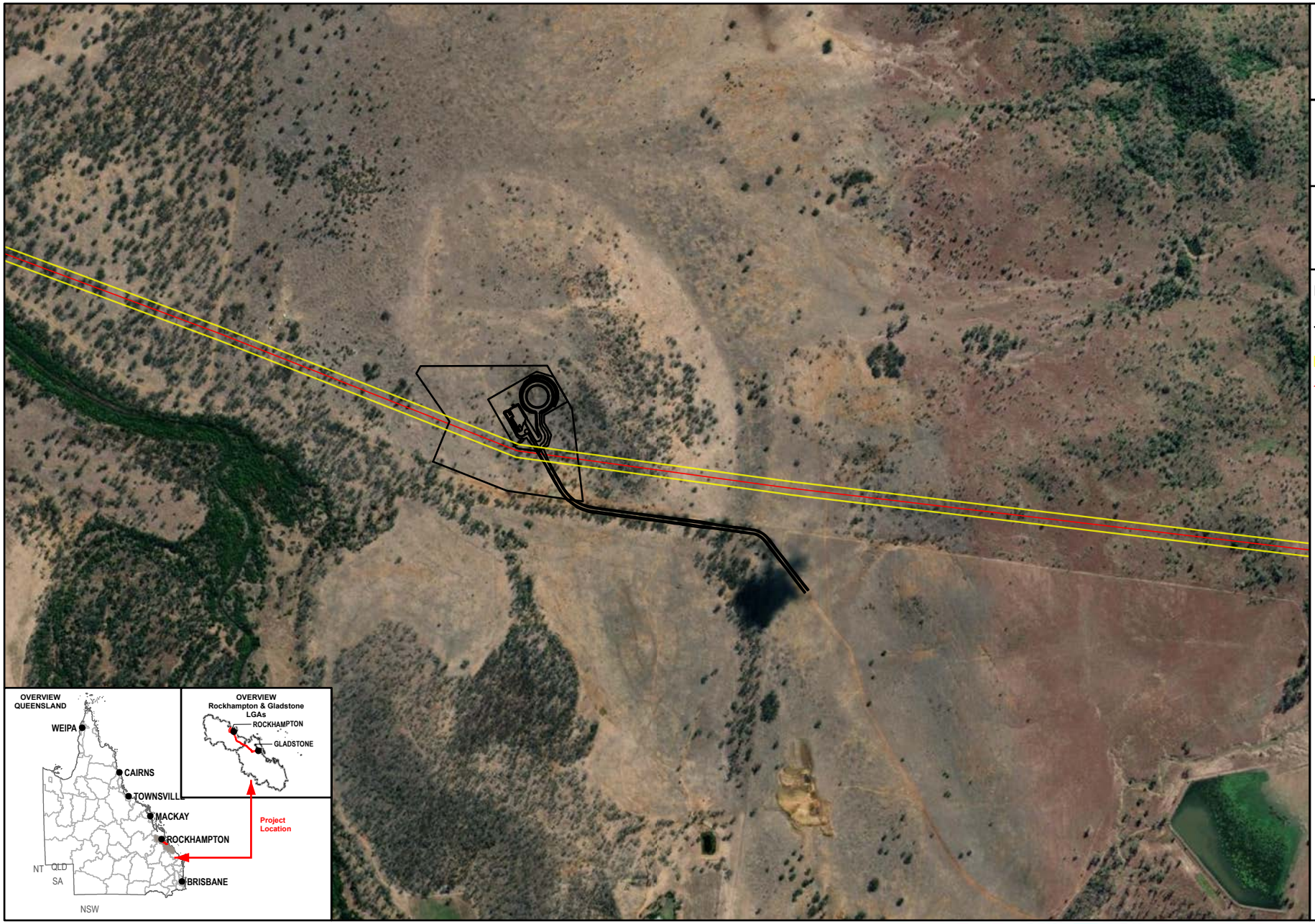

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- Raglan Pump Station and Reservoir Layout
- Study Area
- SGIC SDA Pipeline Alignment

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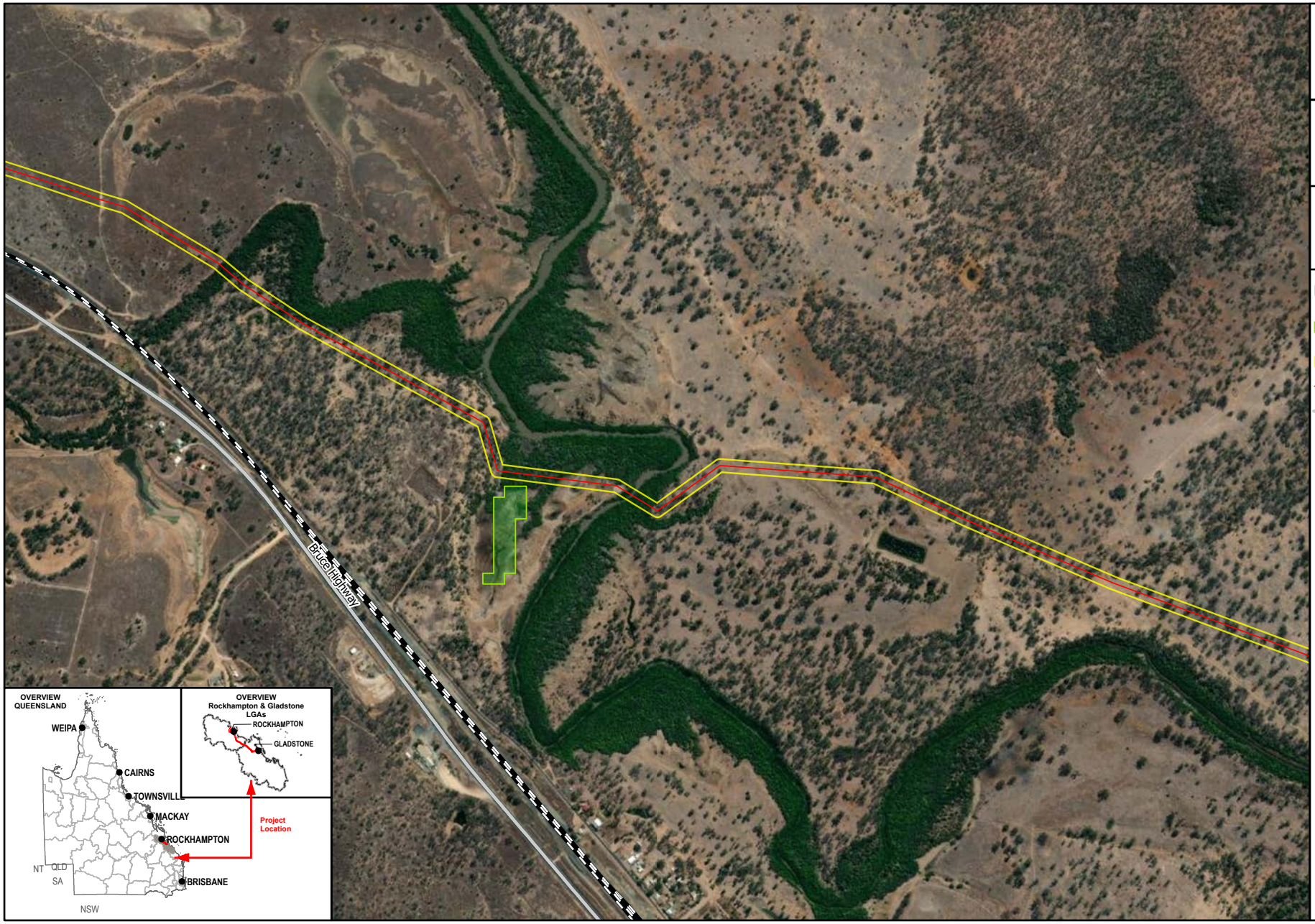
Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7g
Mapped Wetlands Within the SGIC SDA Desktop Search Area

000-G-MAP-2416 Version:3 Date:2022/09/12



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- MSES High Ecological Significance Wetlands
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- Main Roads
- Railways

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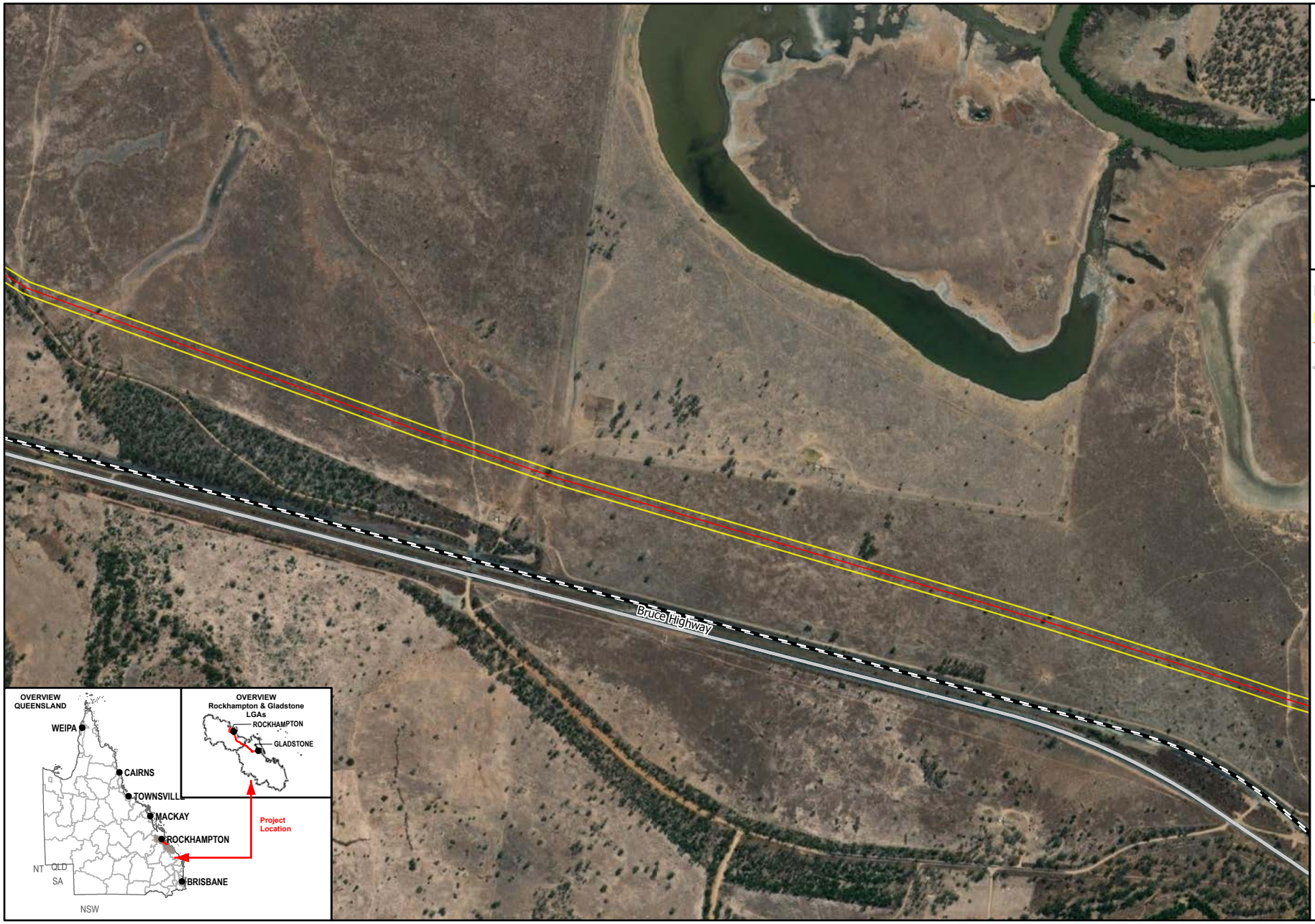
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7h
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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Legend

- Study Area
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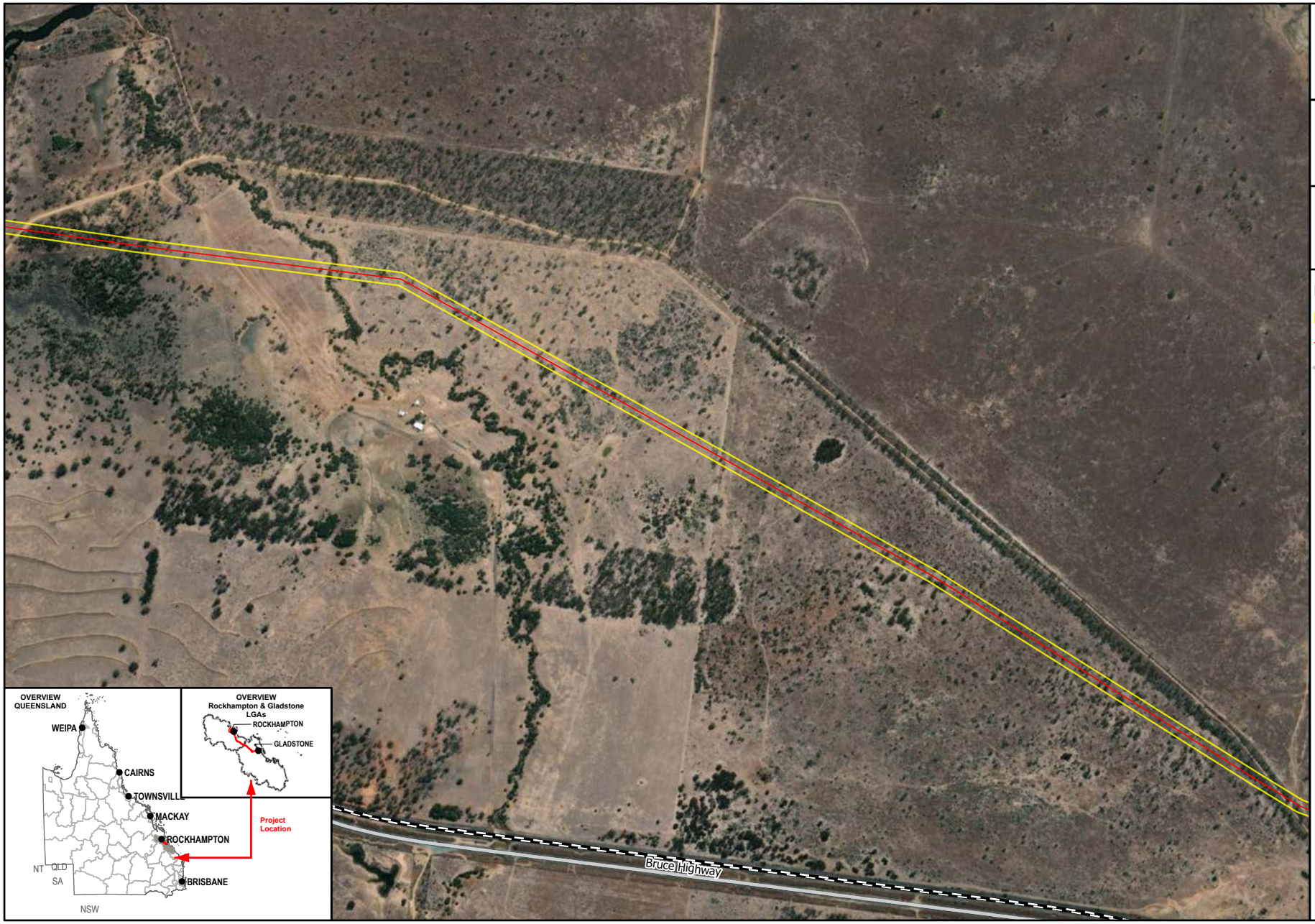
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7i
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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Legend

- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

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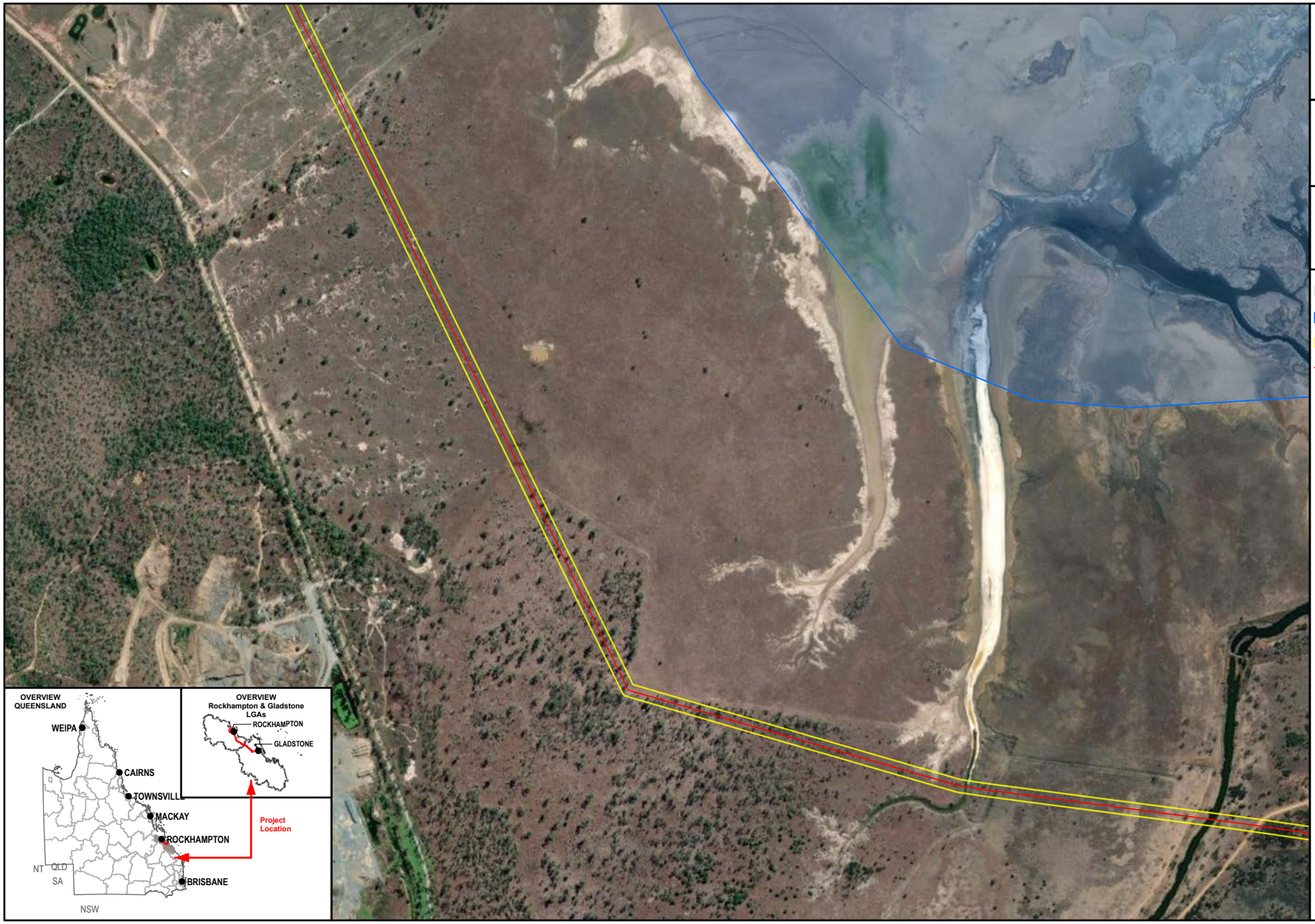
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7j
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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Legend

- Fitzroy River Delta
- Study Area
- SGIC SDA Pipeline Alignment

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Figure 4-7k
Mapped Wetlands Within the SGIC SDA Desktop Search Area

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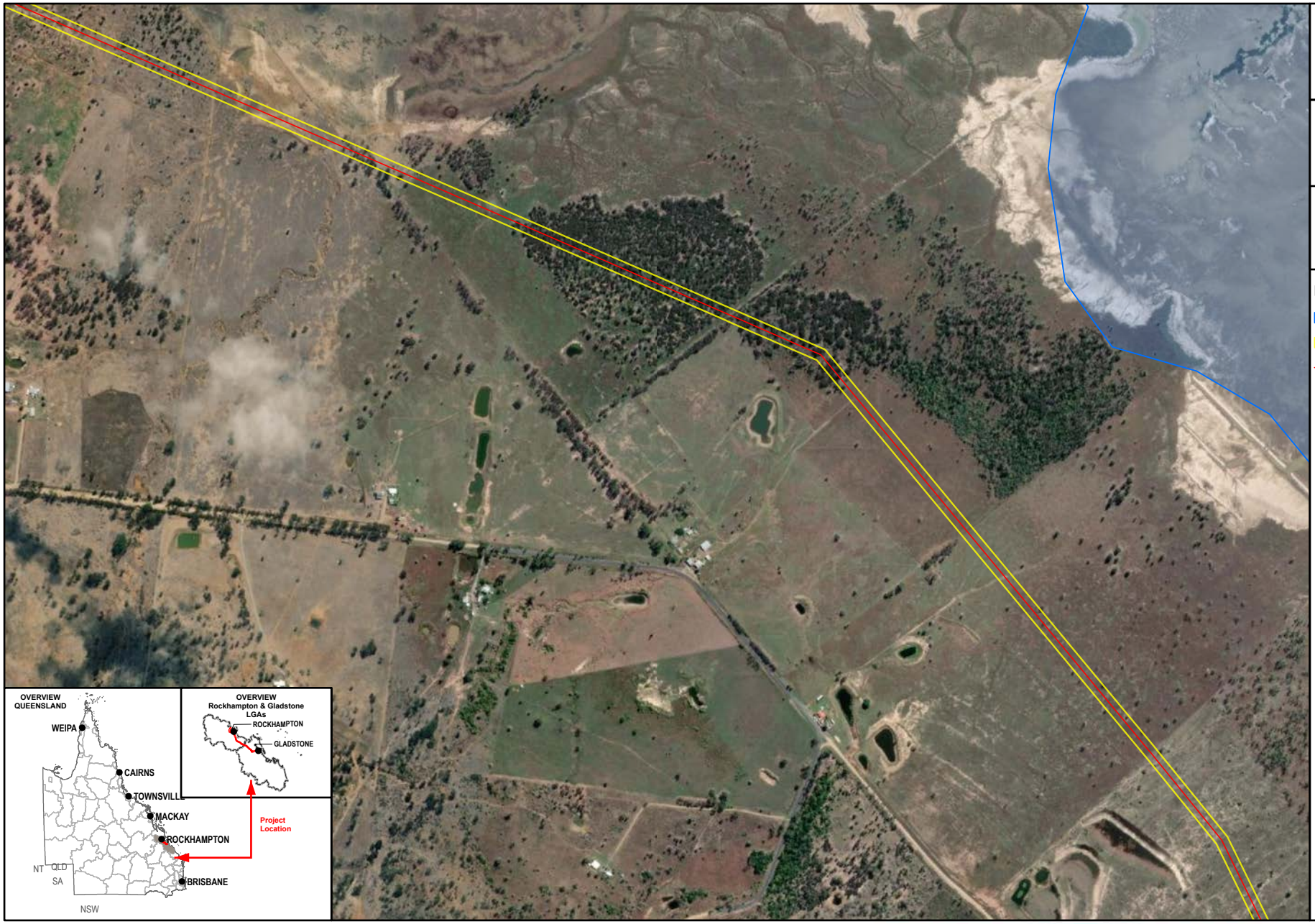

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- Fitzroy River Delta
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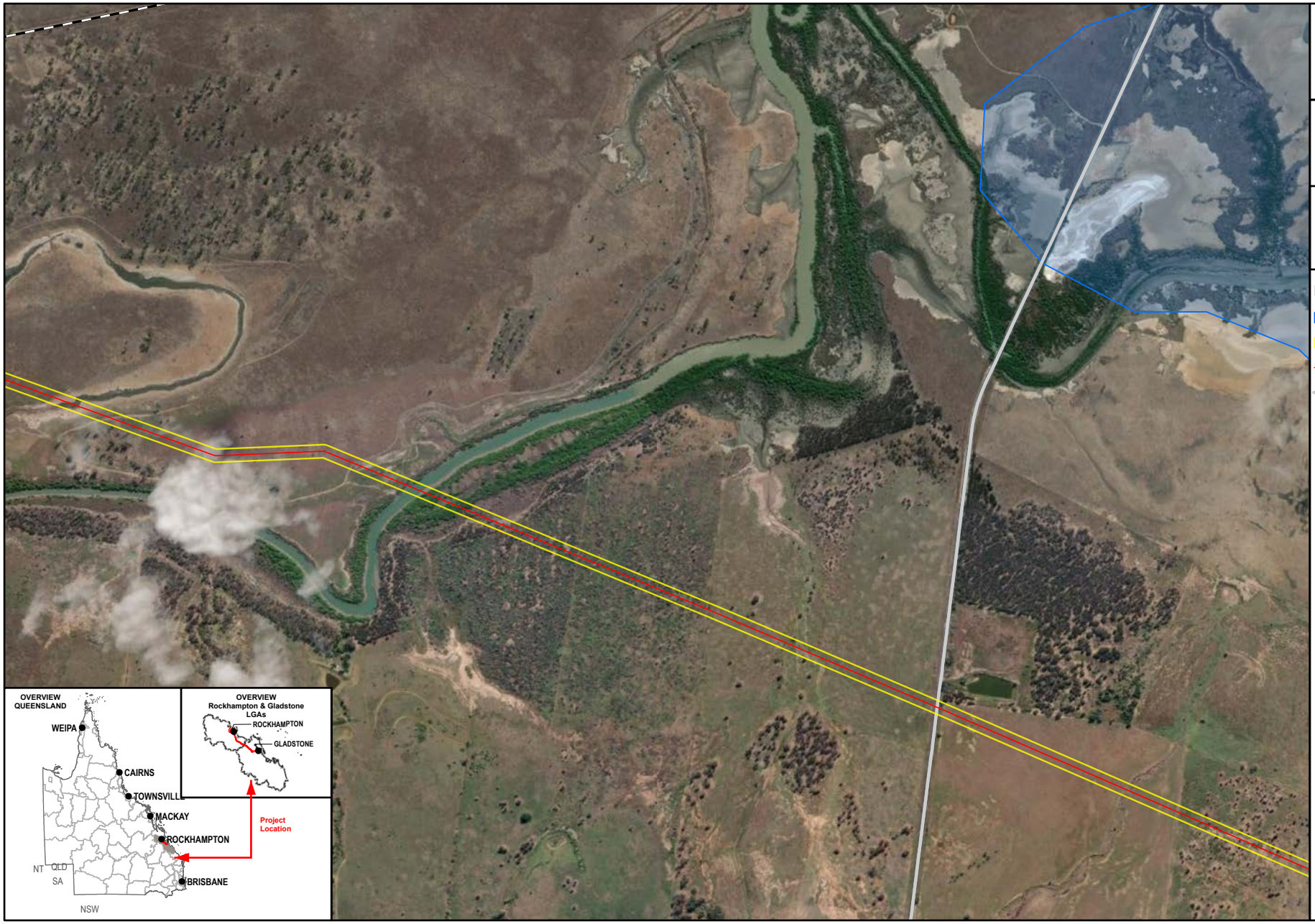
PROJECTION UTM Zone 56
(Datum GDA2020)

Compiled by:YS16239

Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7l
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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Legend

- Fitzroy River Delta
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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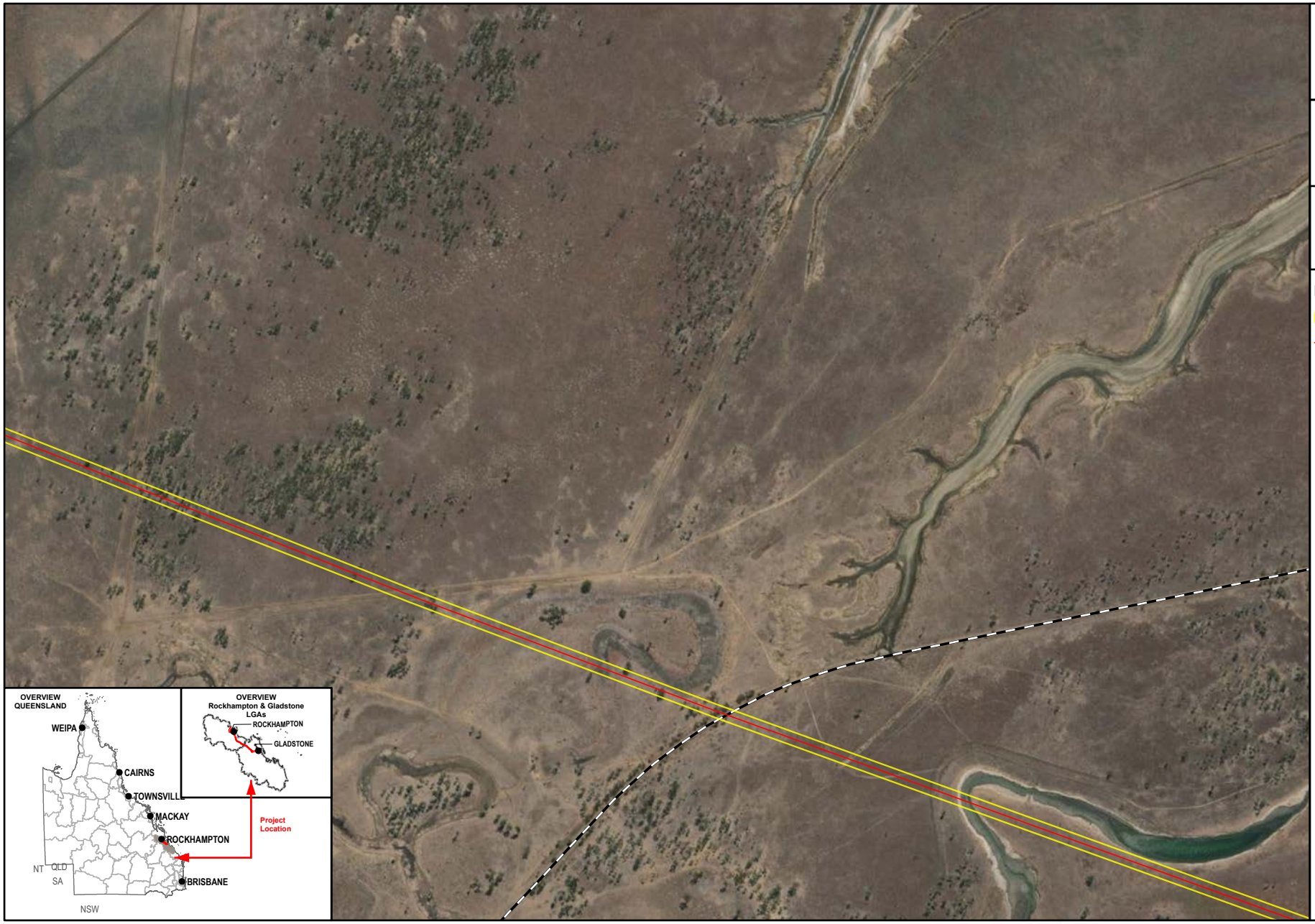
Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7m
Mapped Wetlands Within the SGIC SDA Desktop Search Area

000-G-MAP-2416 Version:3 Date:2022/09/12



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- Study Area
- SGIC SDA Pipeline Alignment
- Railways

Data Sources:
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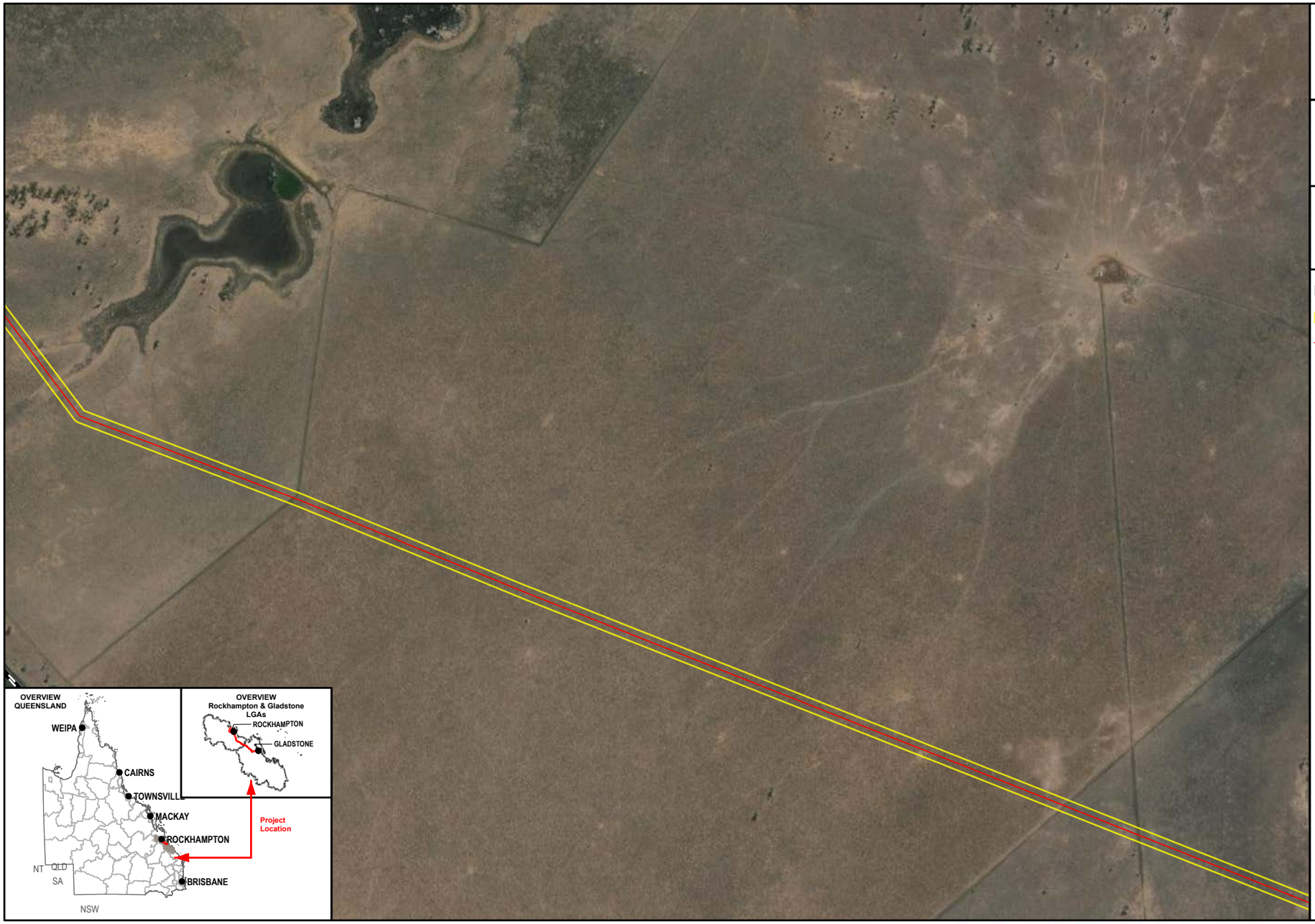
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7n
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- Study Area
- SGIC SDA Pipeline Alignment
- Railways

Data Sources:
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Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7o
Mapped Wetlands Within the SGIC SDA Desktop Search Area

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- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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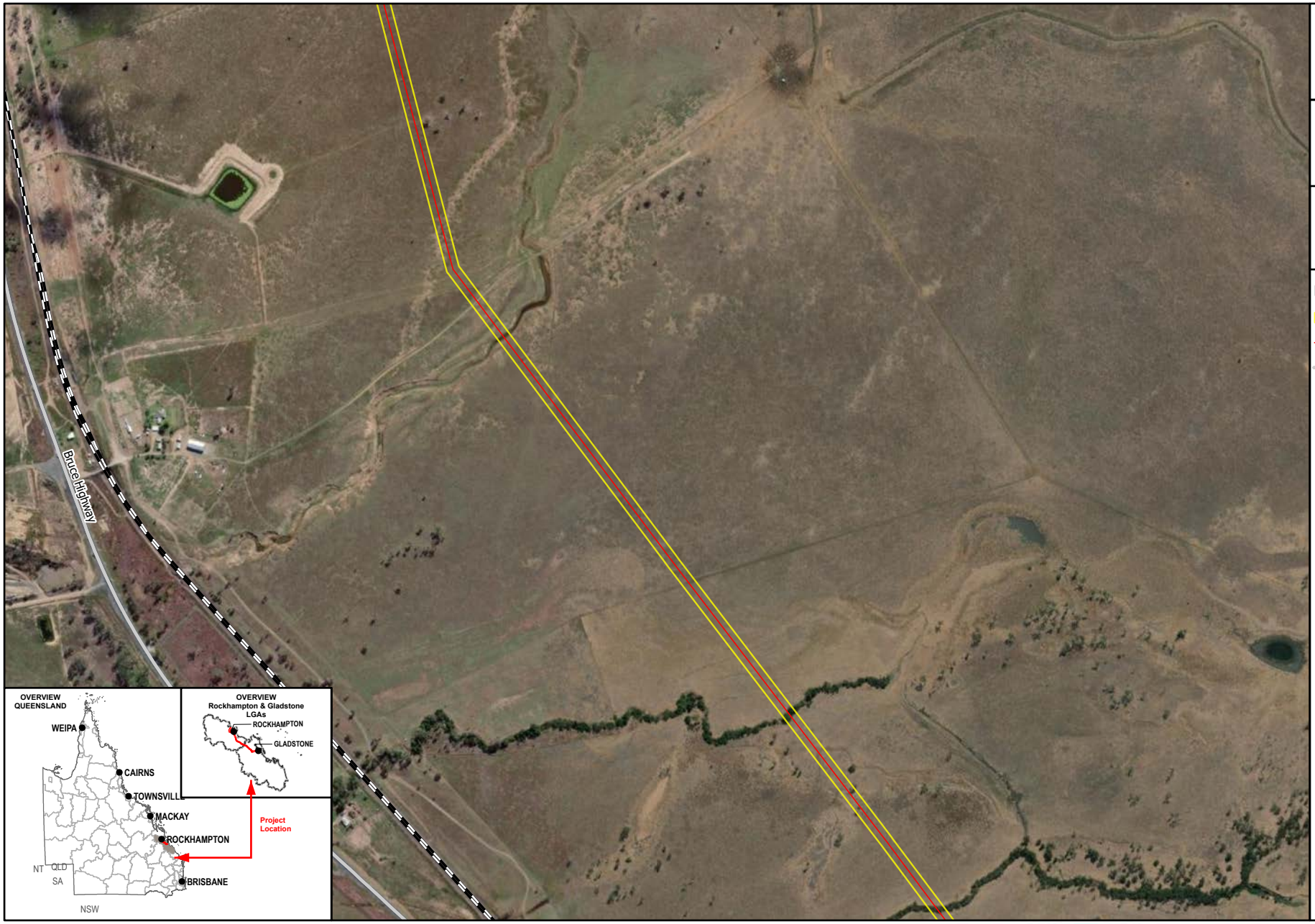
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7p
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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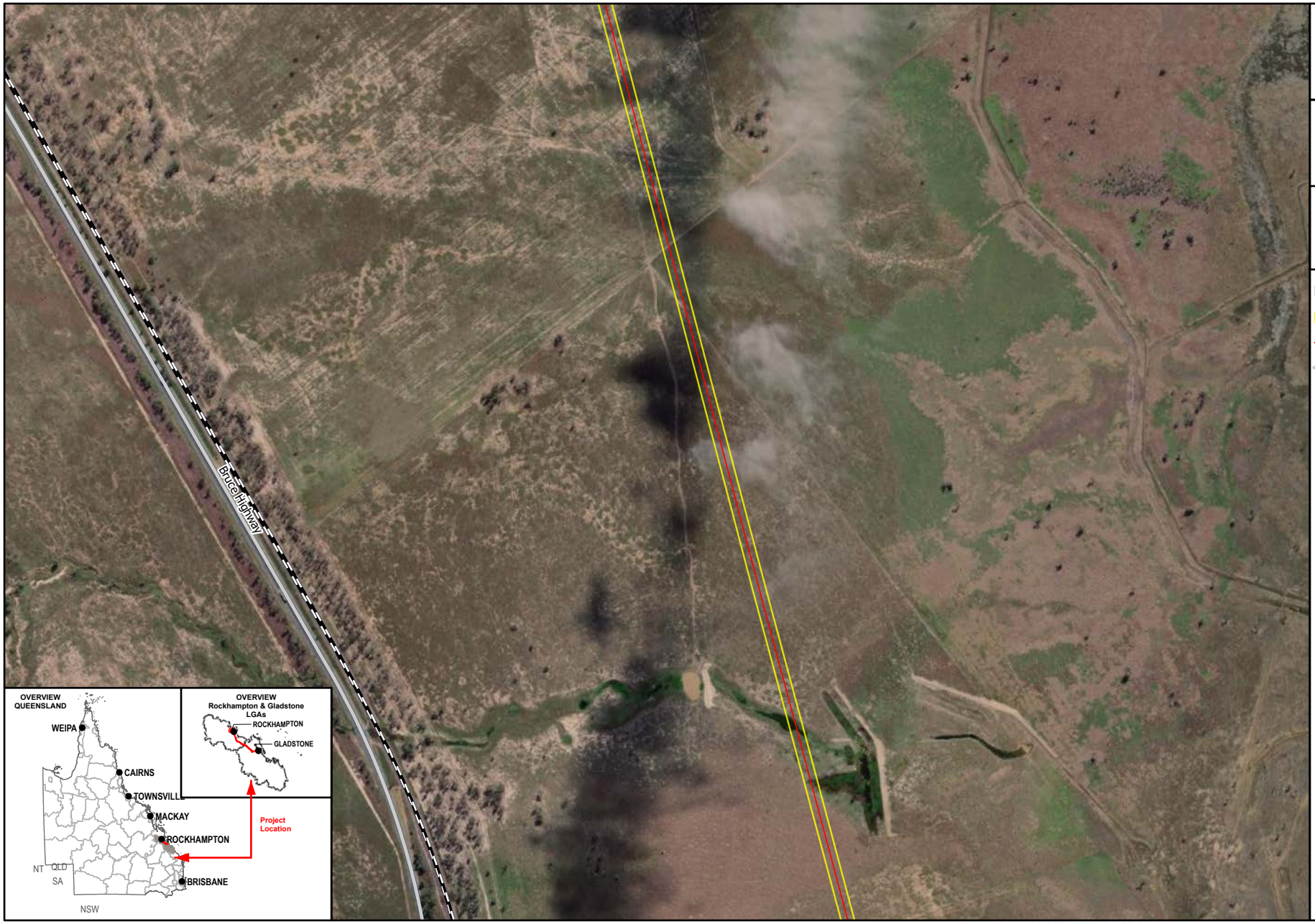
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7q
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

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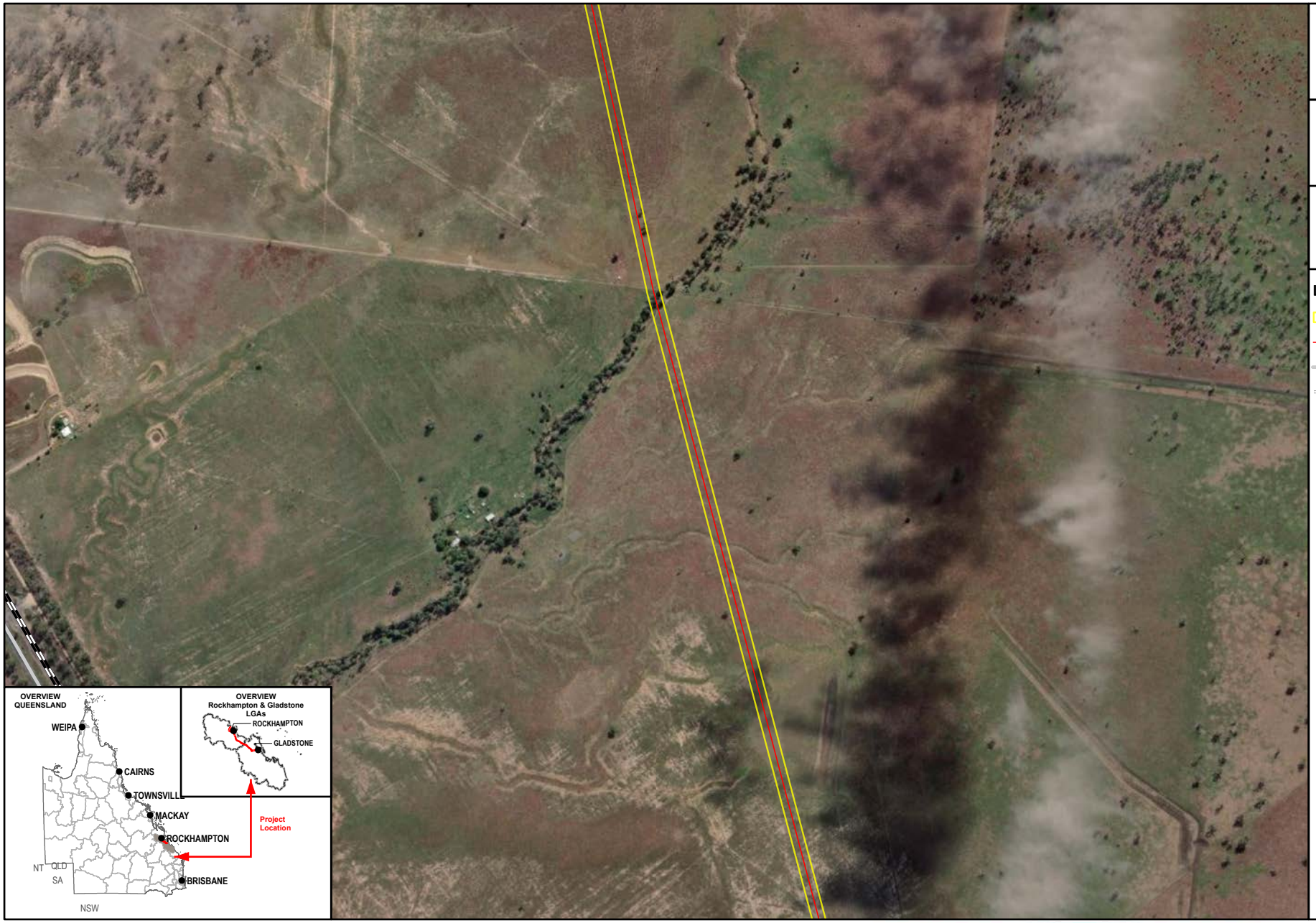
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7r
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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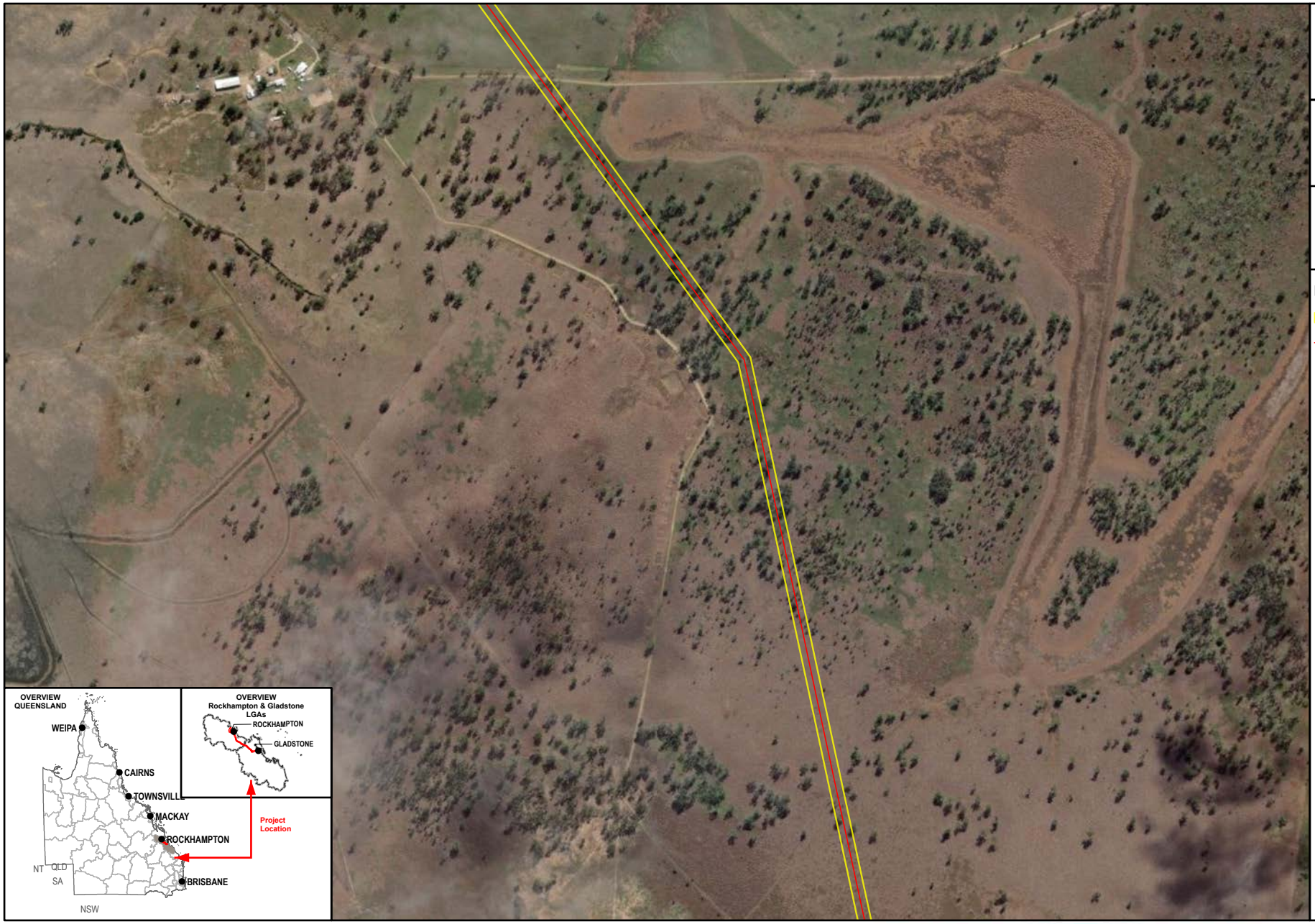
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7s
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- Study Area
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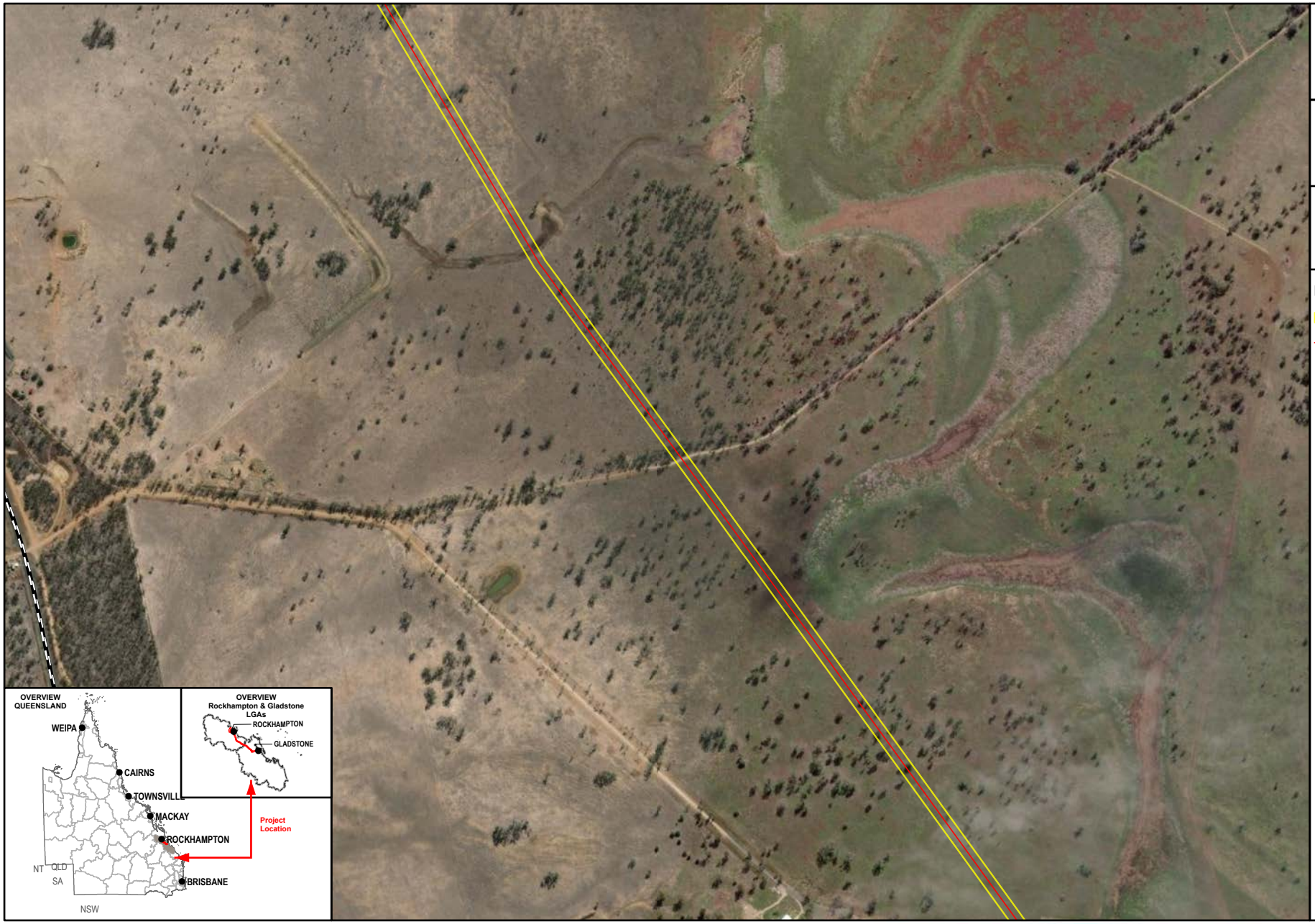
Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7t
Mapped Wetlands Within the SGIC SDA Desktop Search Area

000-G-MAP-2416 Version:3 Date:2022/09/12



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- Study Area
- SGIC SDA Pipeline Alignment
- Railways

Data Sources:
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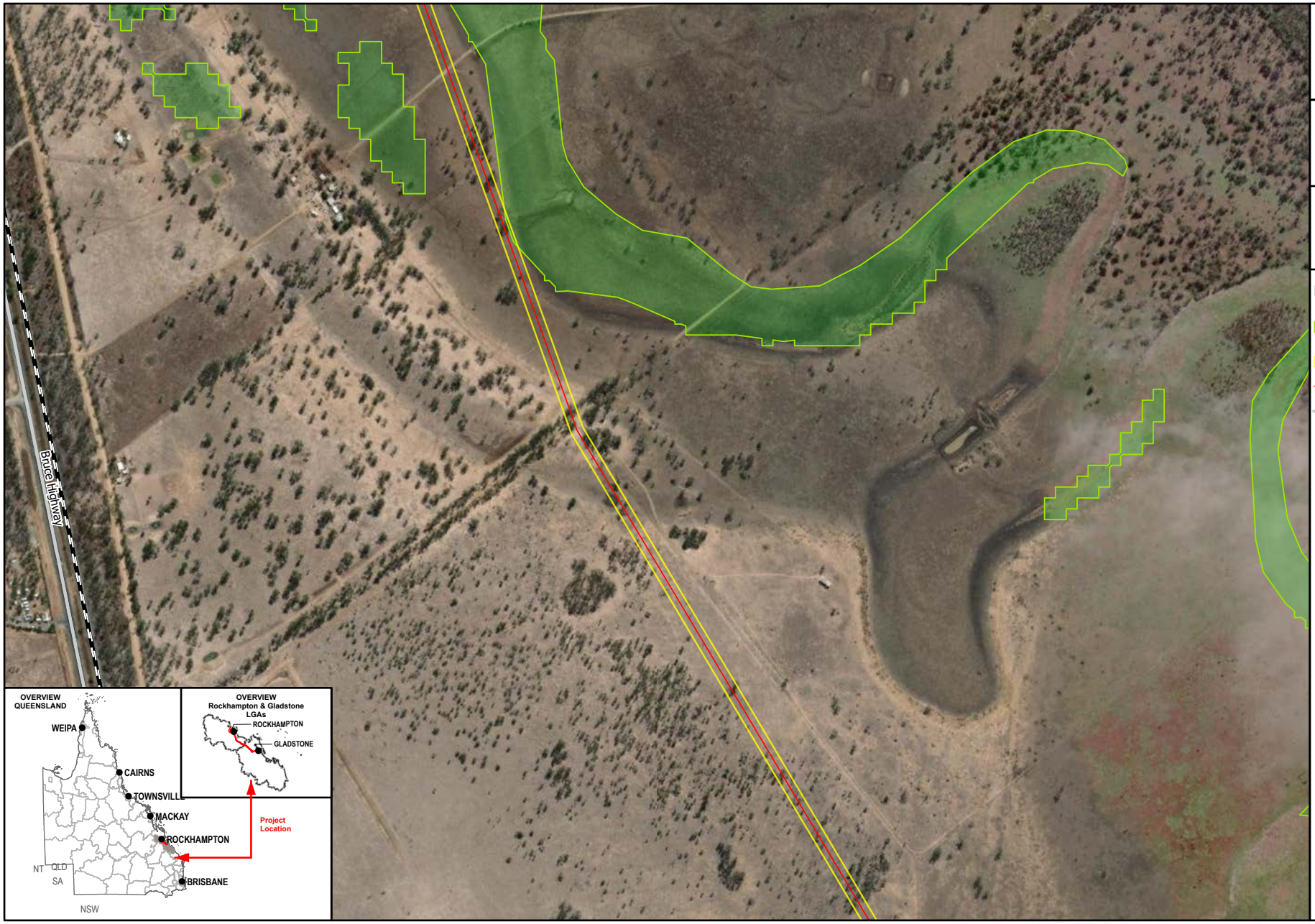
Figure 4-7u
Mapped Wetlands Within the SGIC SDA Desktop Search Area

000-G-MAP-2416 Version:3 Date:2022/09/12



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- MSES High Ecological Significance Wetlands
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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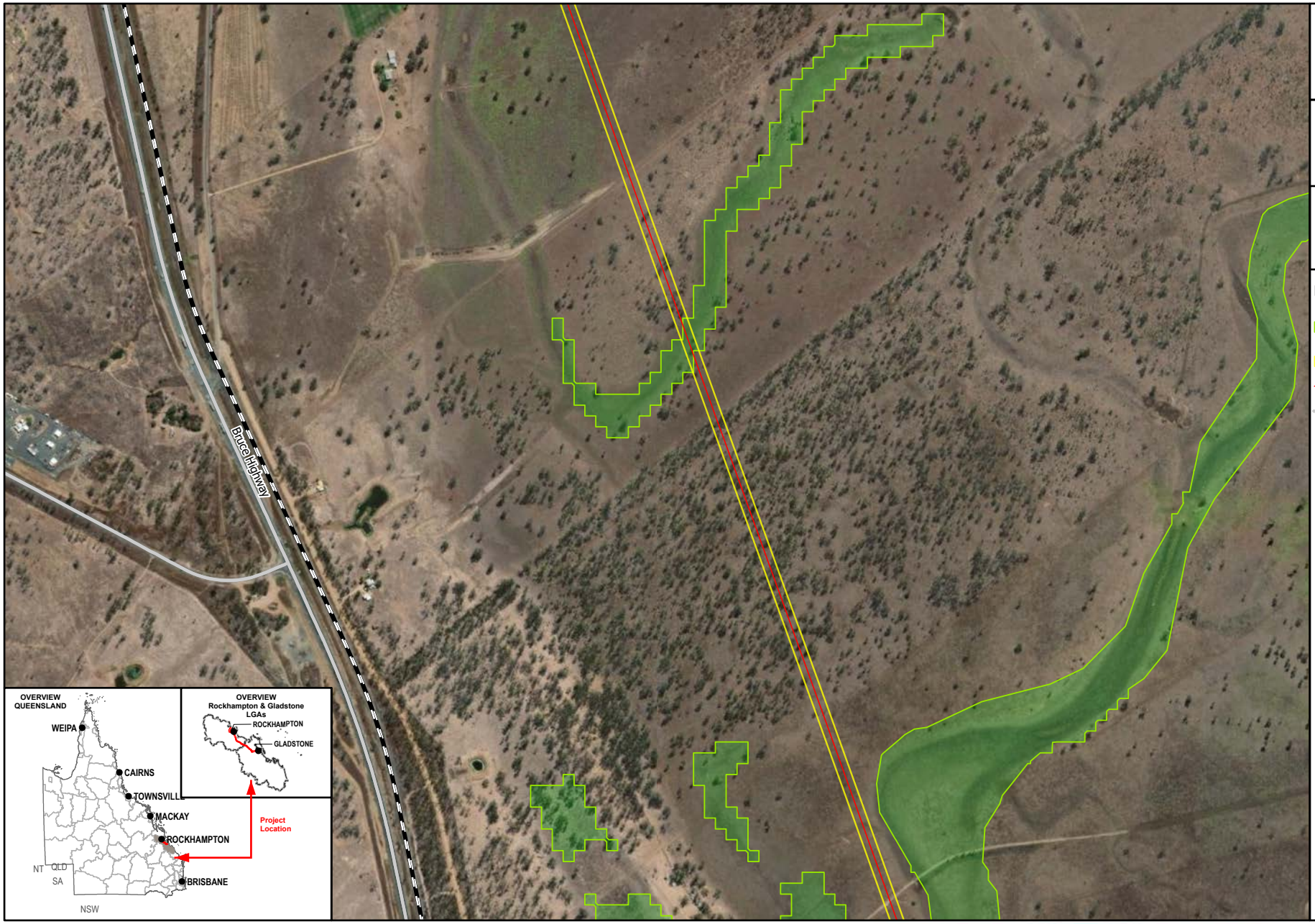
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7v
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- MSES High Ecological Significance Wetlands
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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Figure 4-7w
Mapped Wetlands Within the SGIC SDA Desktop Search Area

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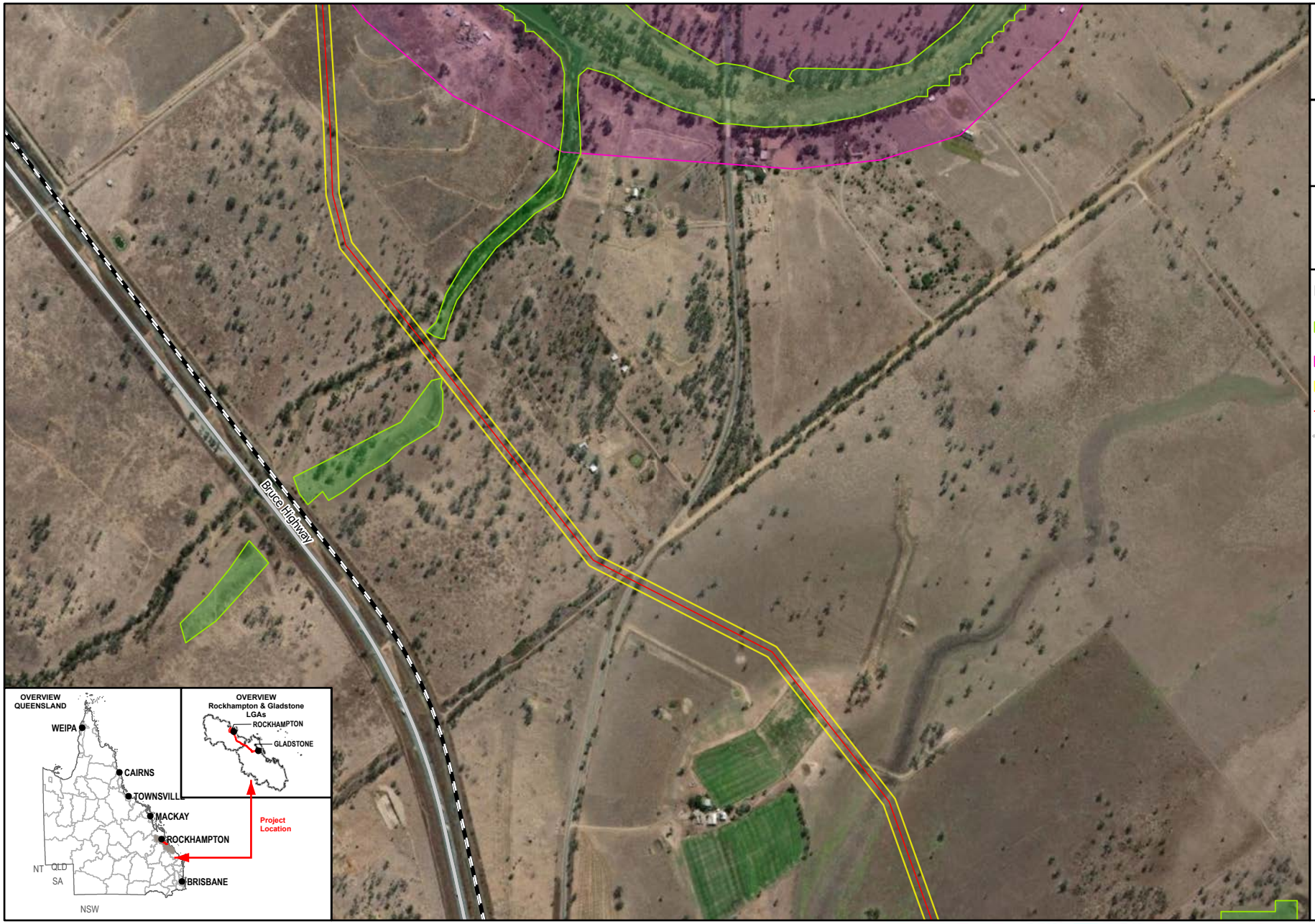

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- MSES High Ecological Significance Wetlands
- QLD013 Fitzroy River Floodplain
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads
- Railways

Data Sources:
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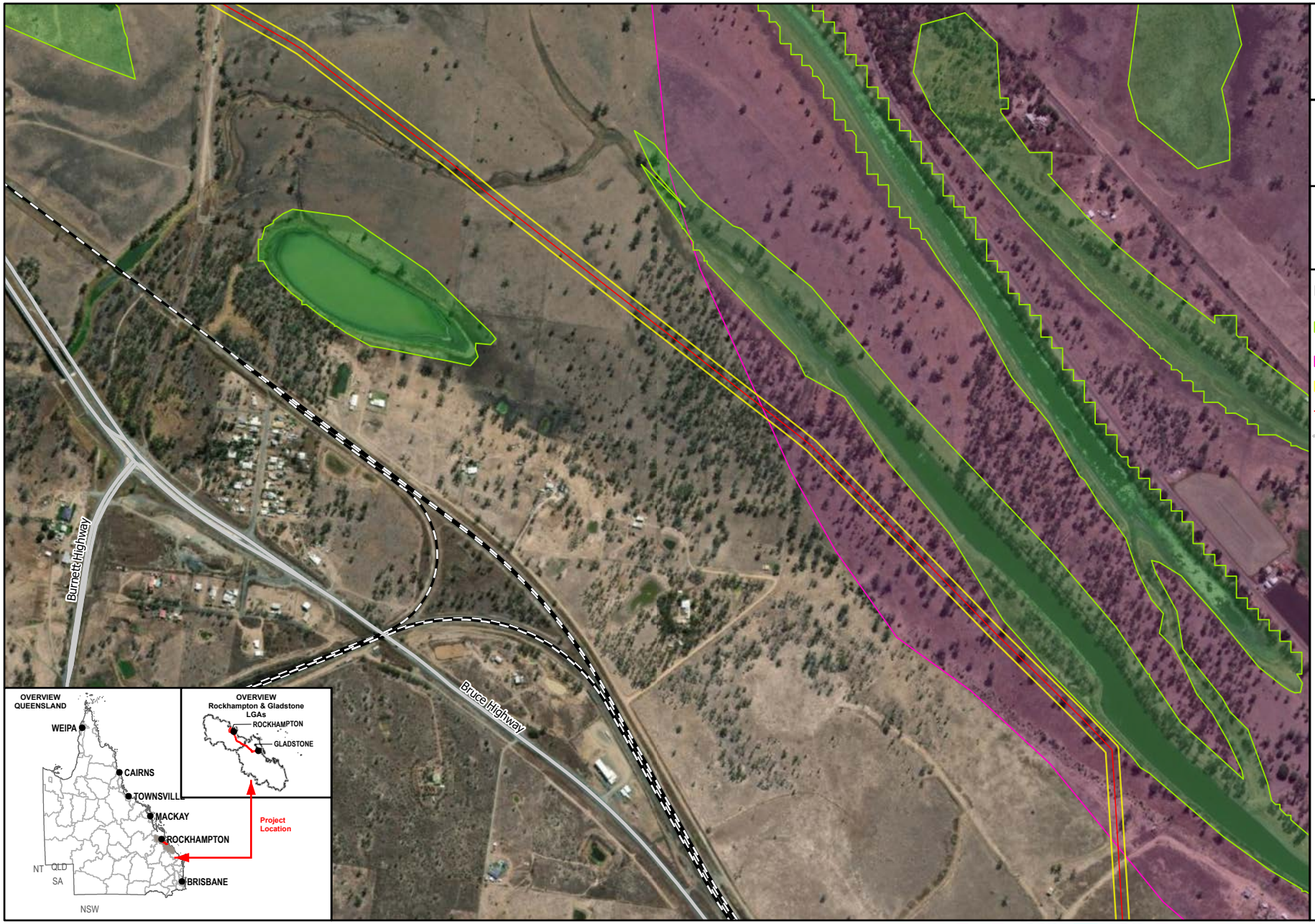
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7x
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- MSES High Ecological Significance Wetlands
- QLD013 Fitzroy River Floodplain
- Study Area
- SGIC SDA Pipeline Alignment
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- Railways

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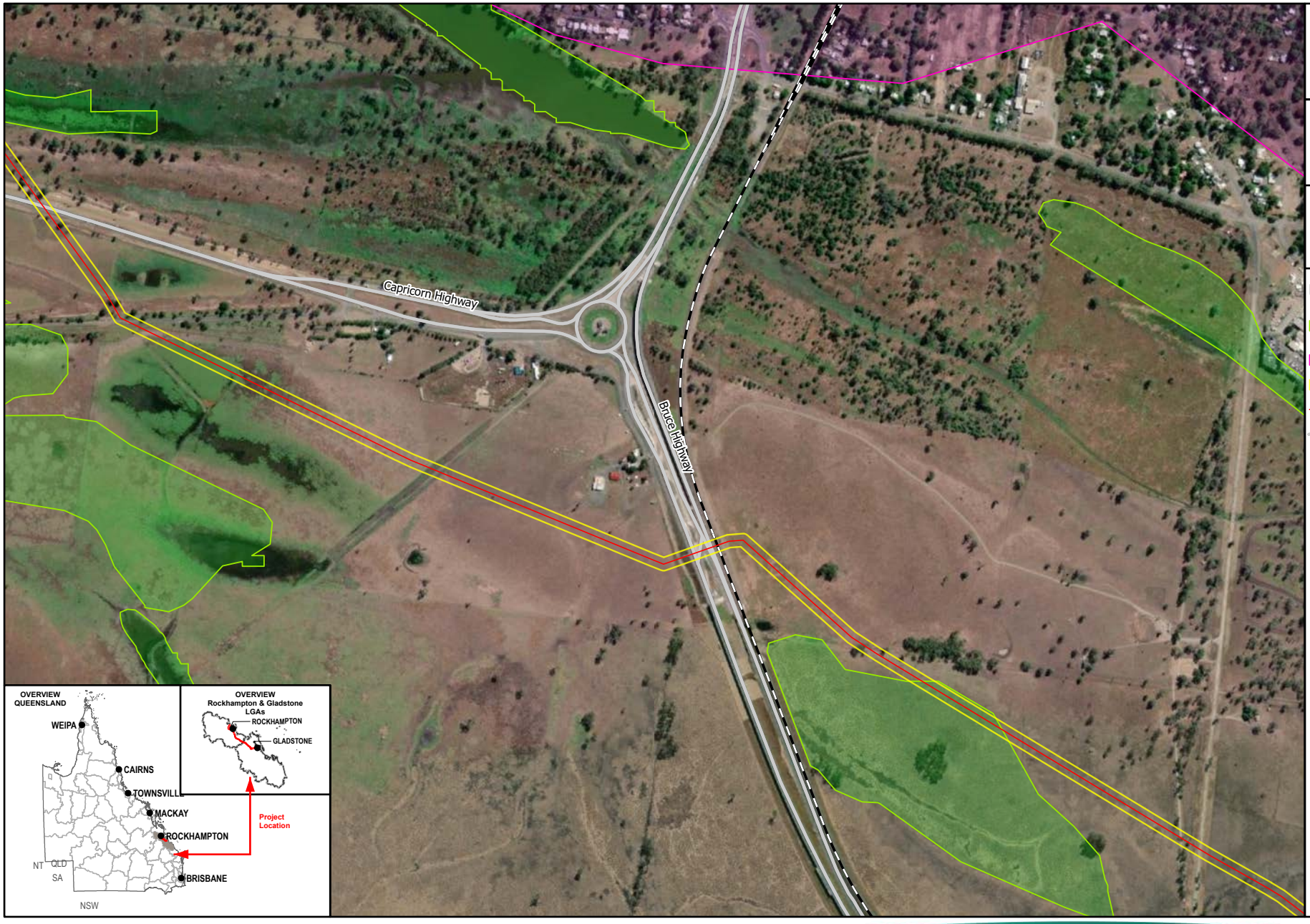
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7y
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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- MSES High Ecological Significance Wetlands
- QLD013 Fitzroy River Floodplain
- Study Area
- SGIC SDA Pipeline Alignment
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Figure 4-7z
Mapped Wetlands Within the SGIC SDA Desktop Search Area

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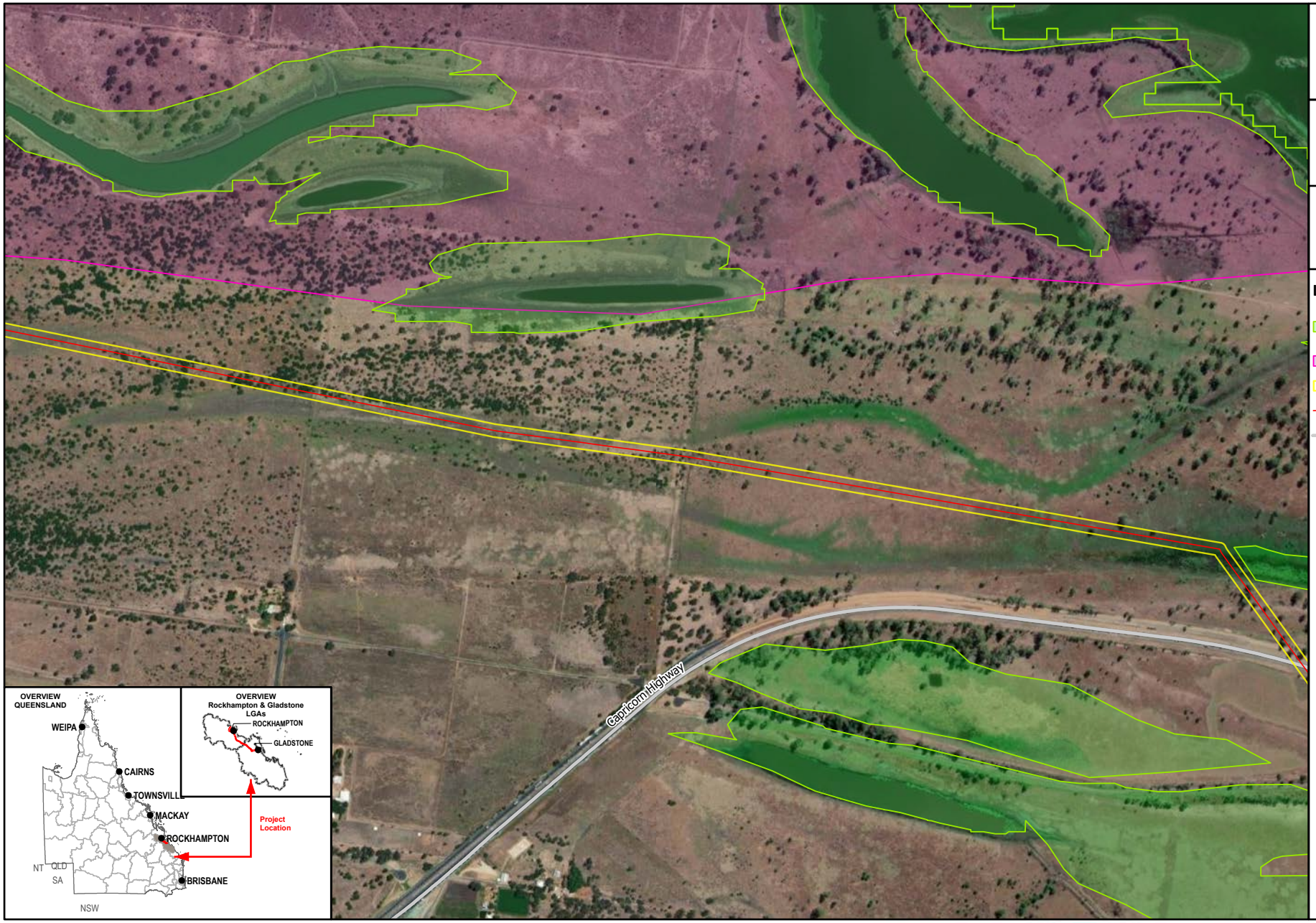

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- MSES High Ecological Significance Wetlands
- QLD013 Fitzroy River Floodplain
- Study Area
- SGIC SDA Pipeline Alignment
- Main Roads

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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7a1
Mapped Wetlands Within the SGIC SDA Desktop Search Area
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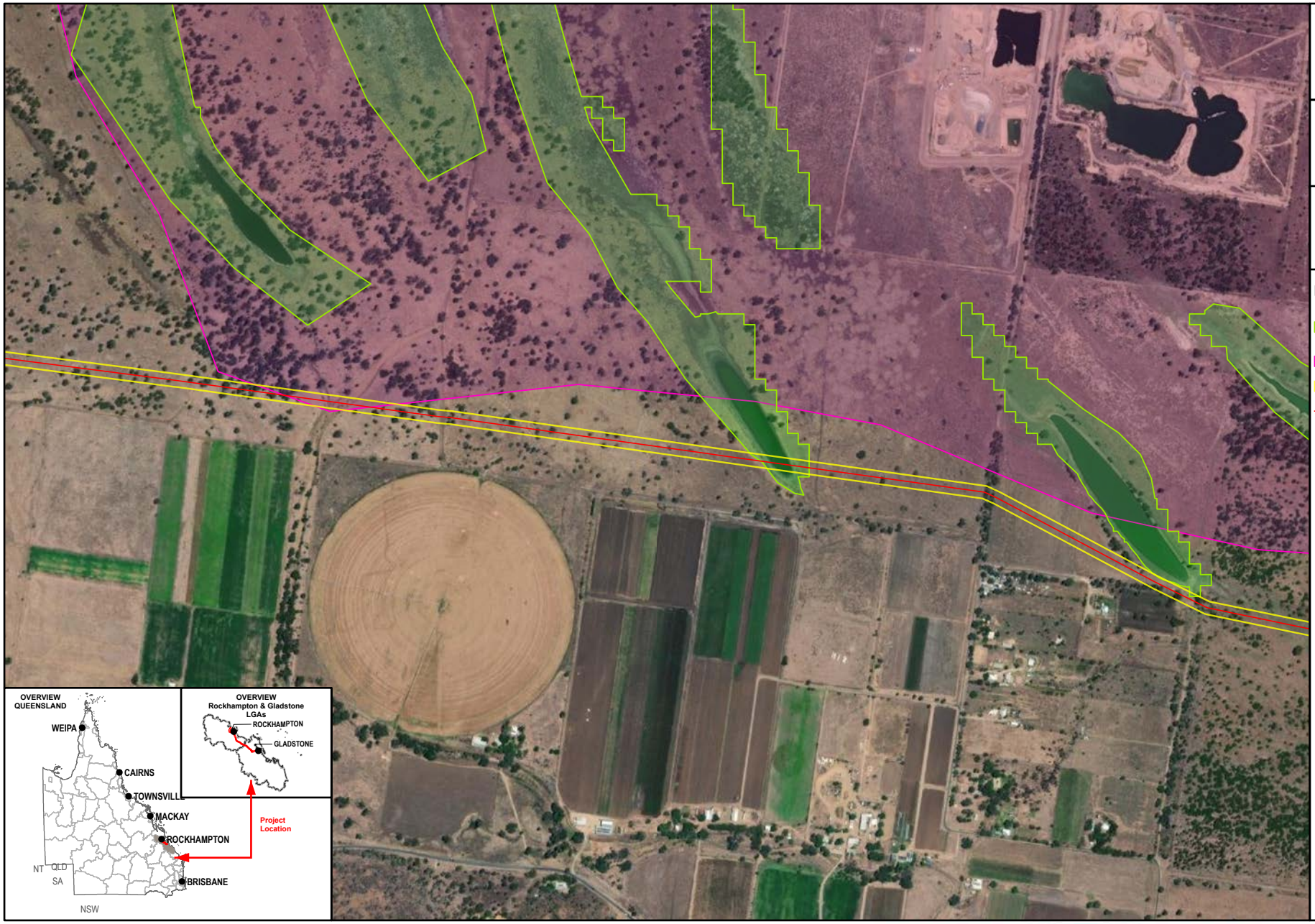

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- Study Area
- SGIC SDA Pipeline Alignment

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
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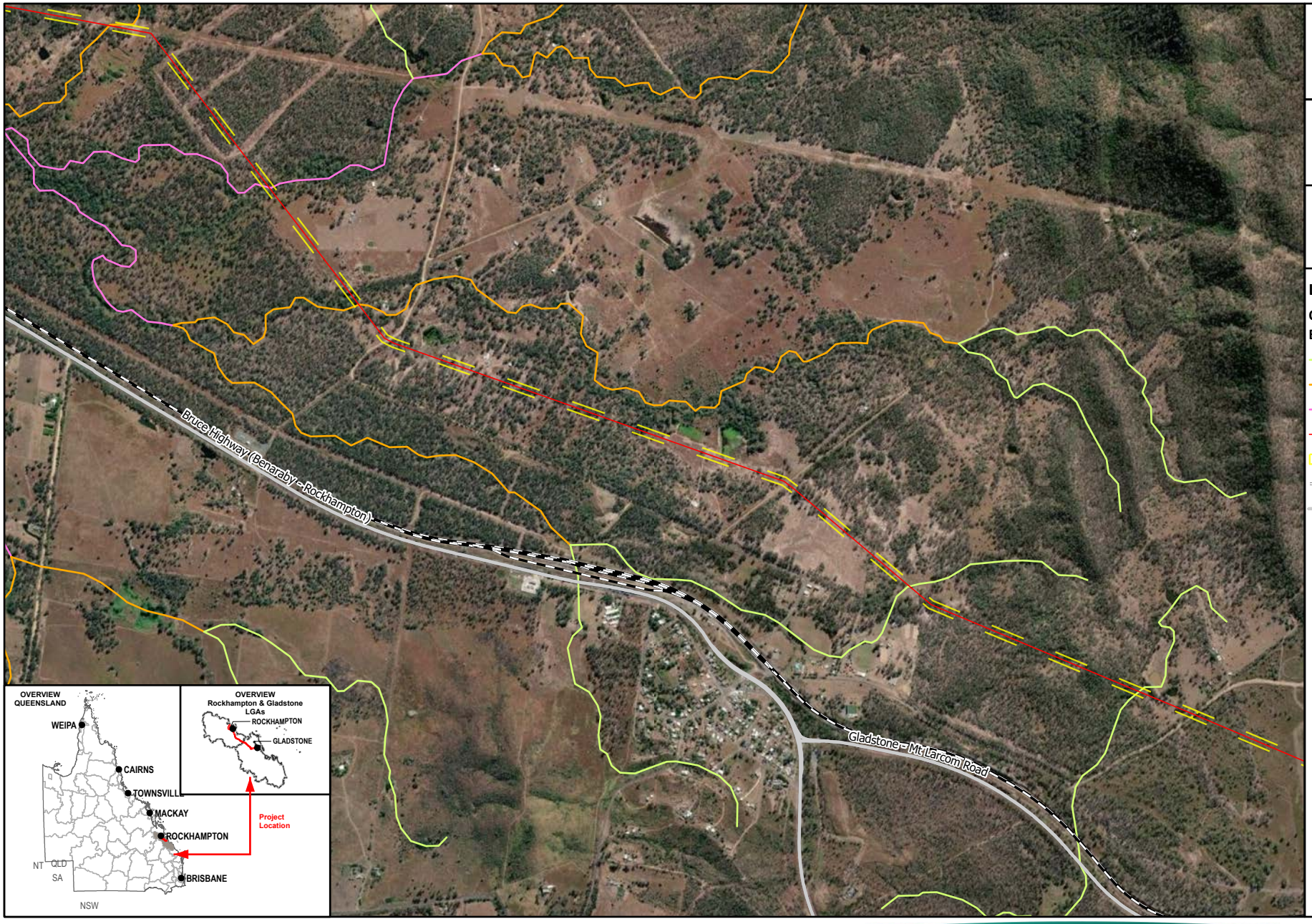
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-7b1
Mapped Wetlands Within the SGIC SDA Desktop Search Area
000-G-MAP-2416 Version:3 Date:2022/09/12



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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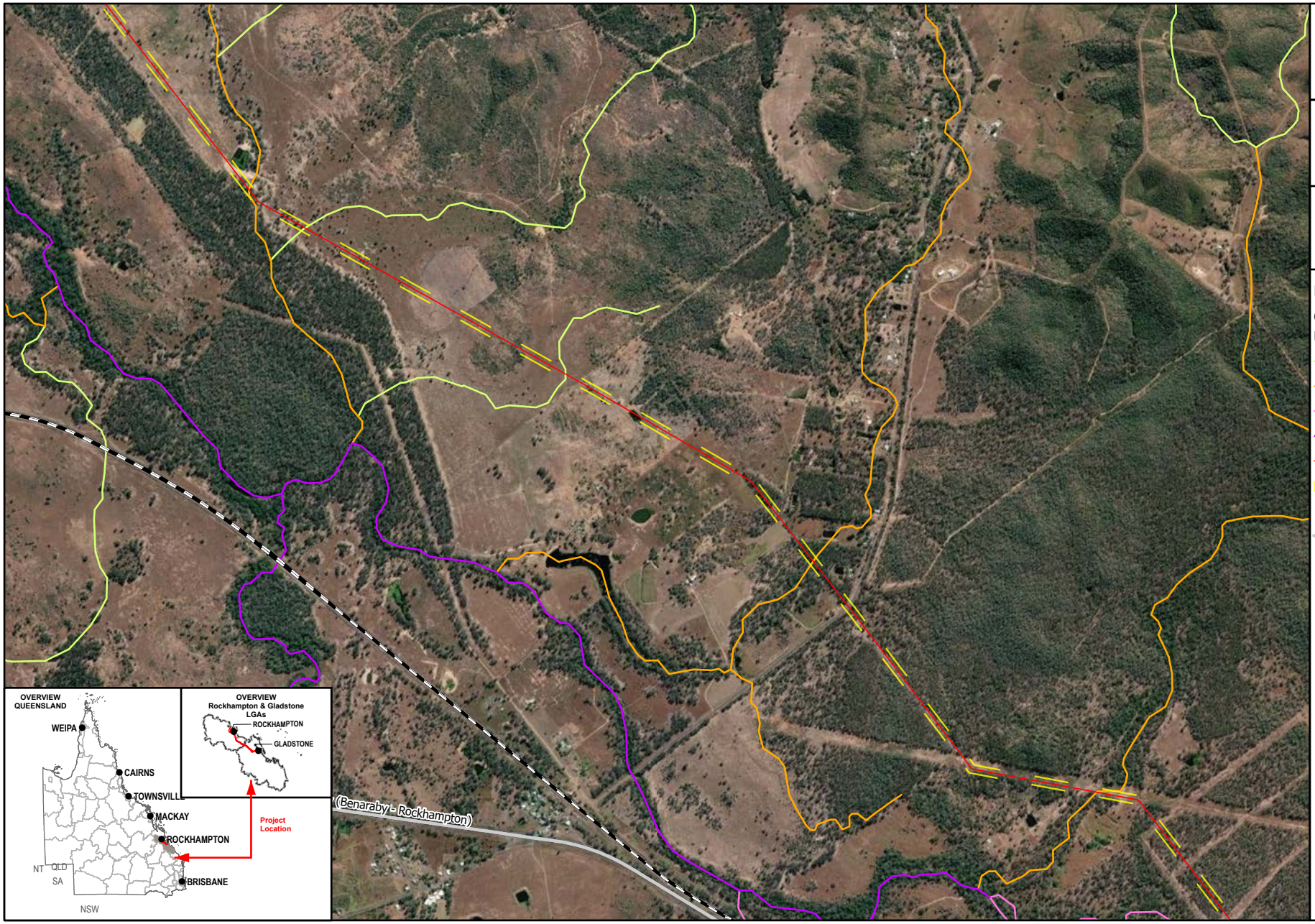
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8a Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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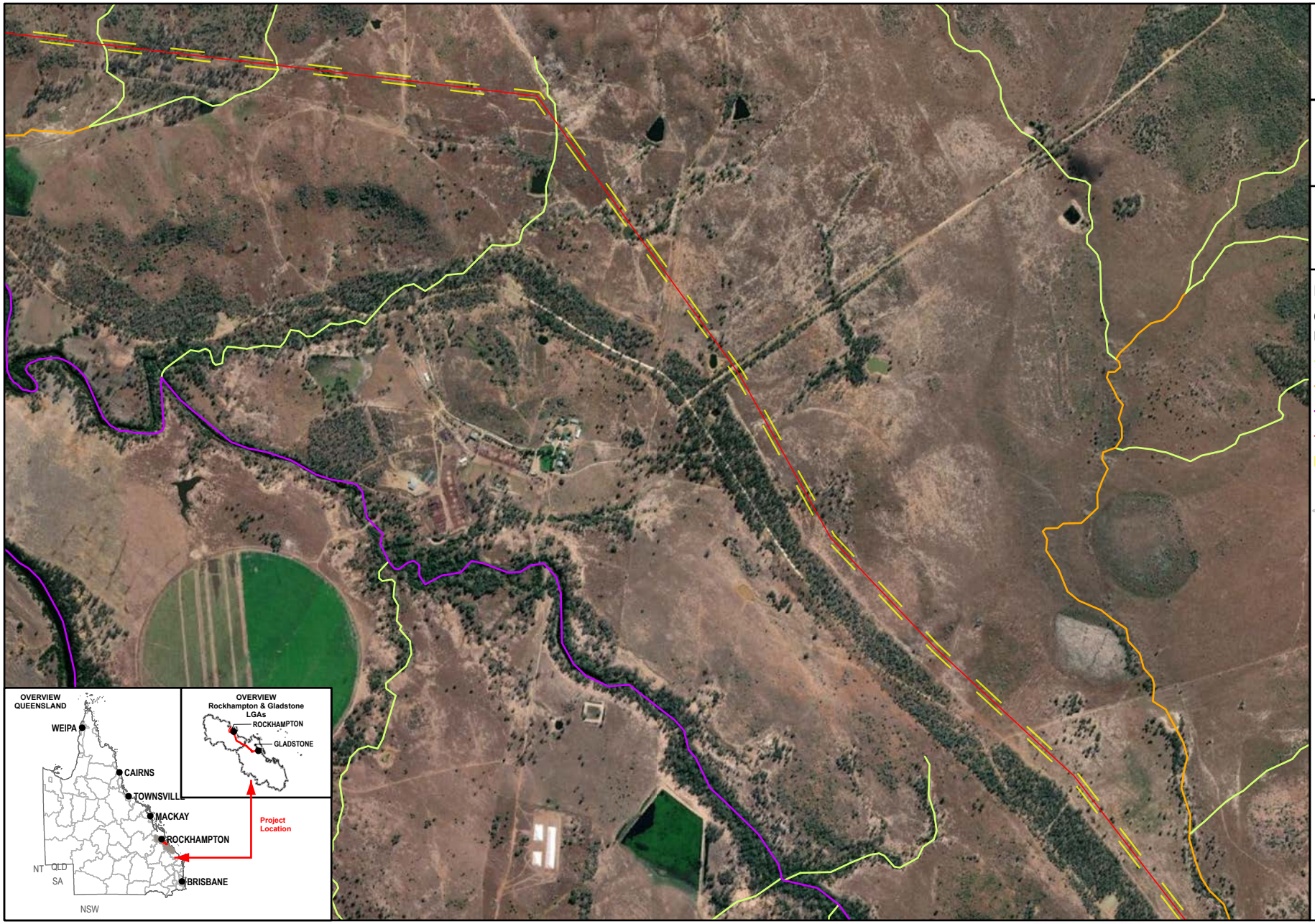
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8b Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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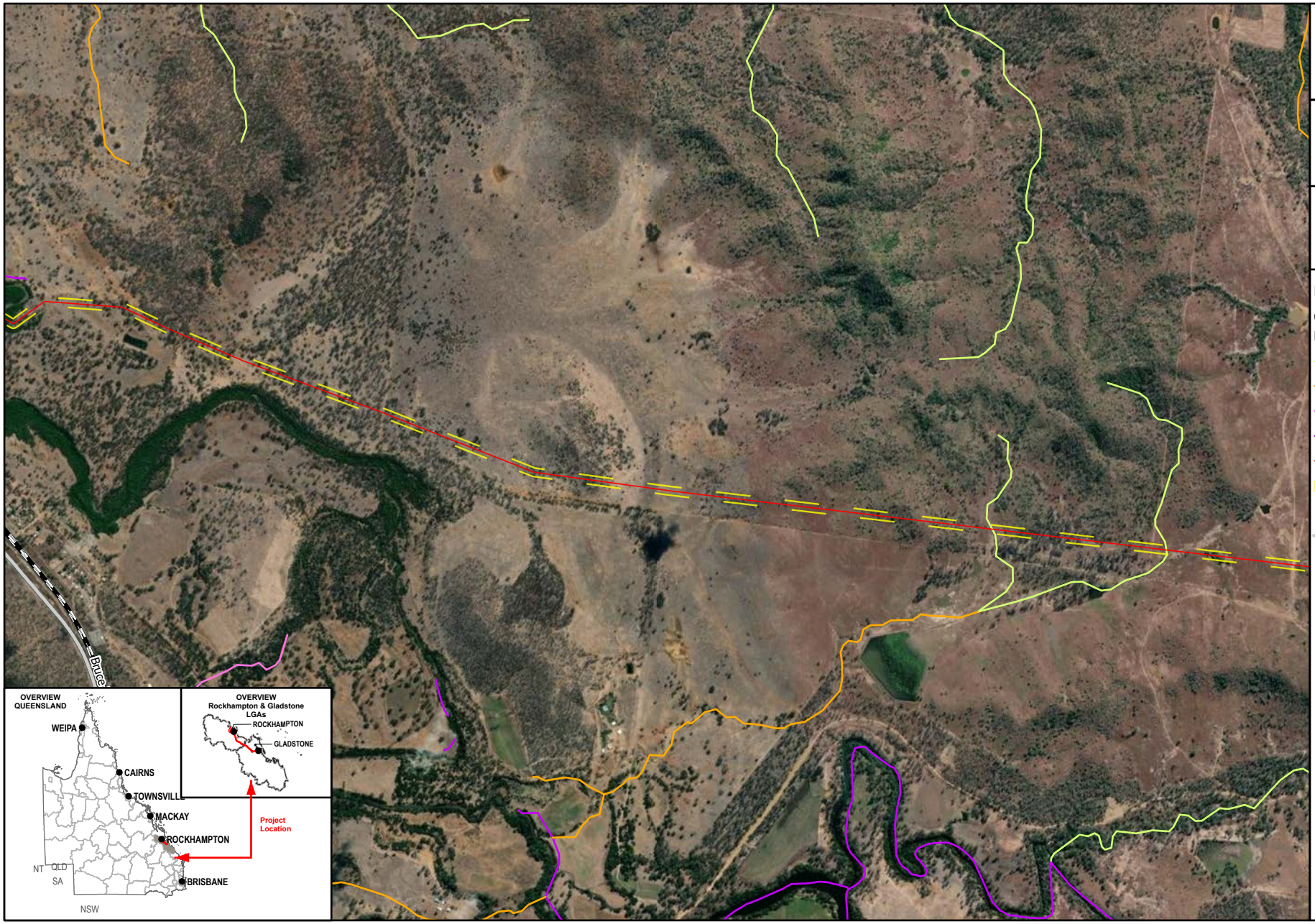
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8c Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Legend

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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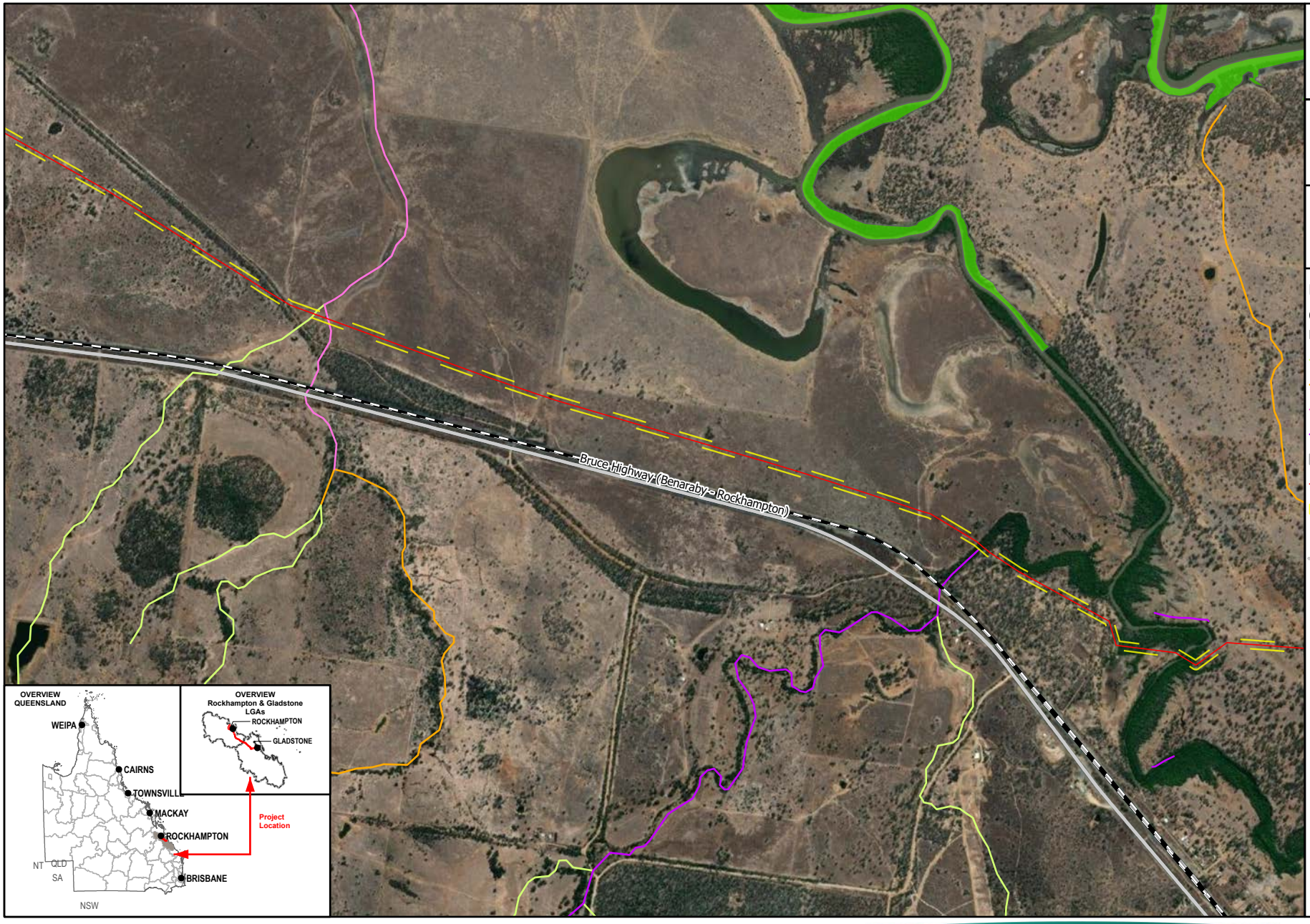
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8d Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- Fish Habitat Areas
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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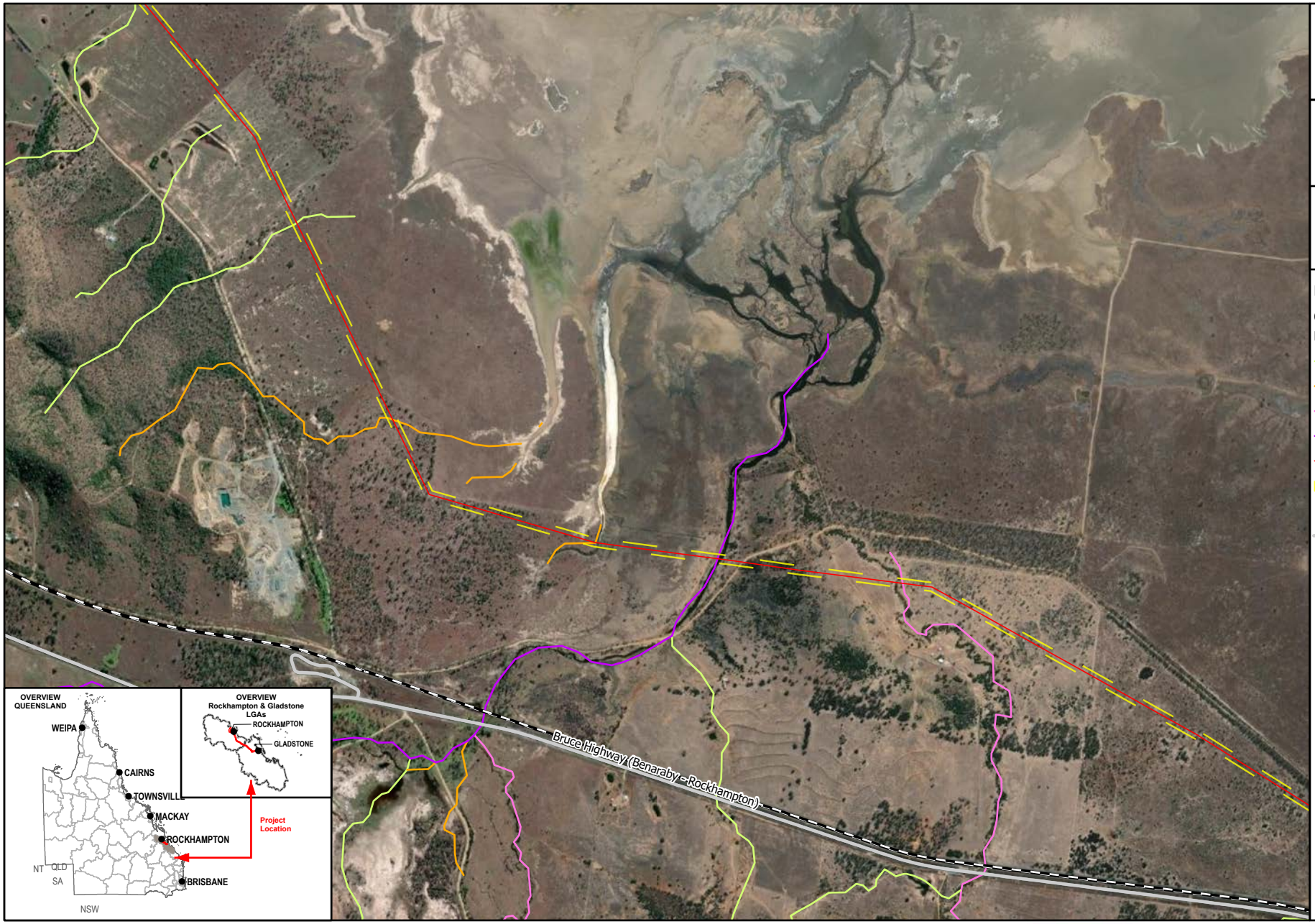
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8e Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent
000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

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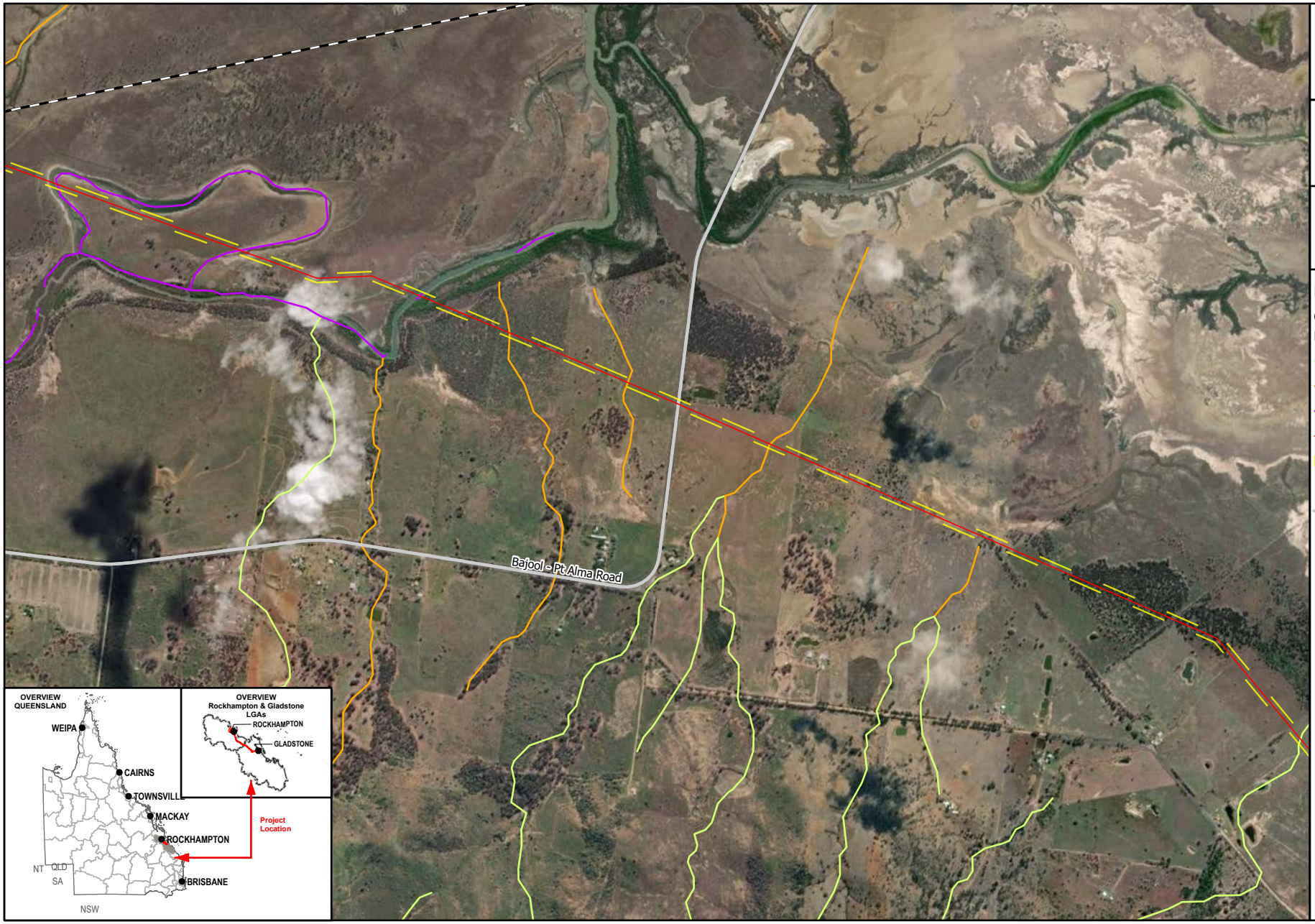
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8f Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
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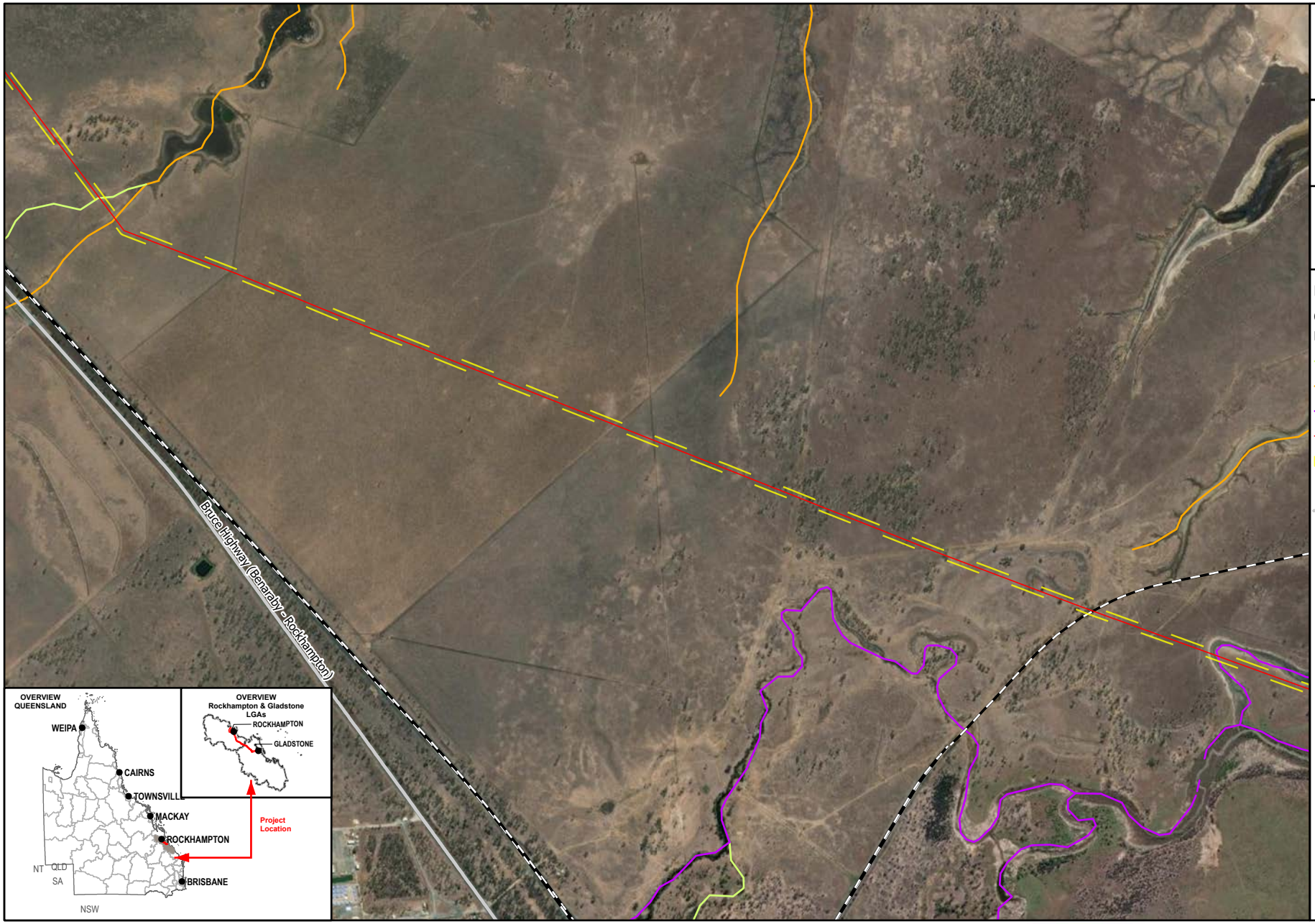
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8g Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent
000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
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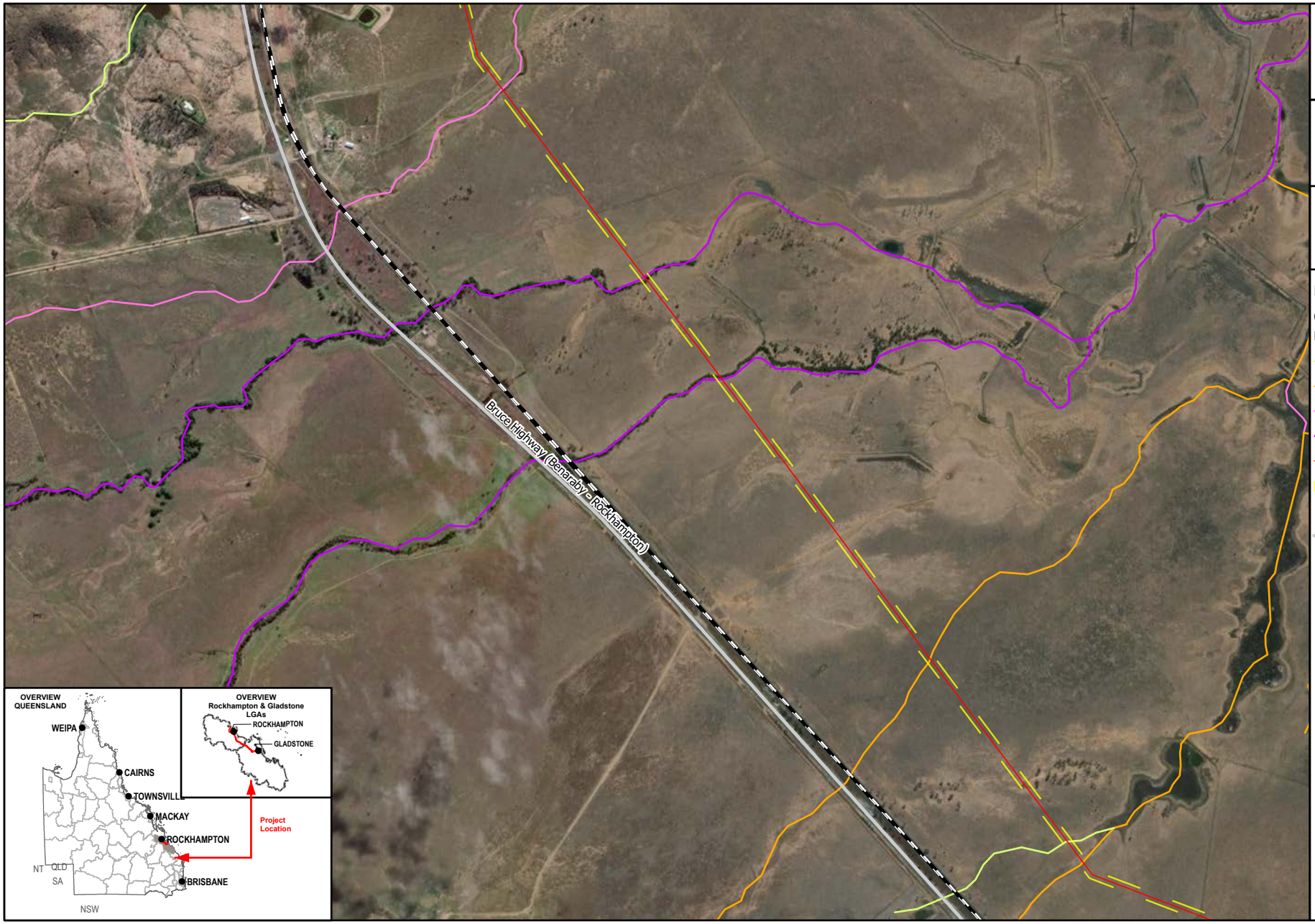
Figure 4-8h Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent
000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
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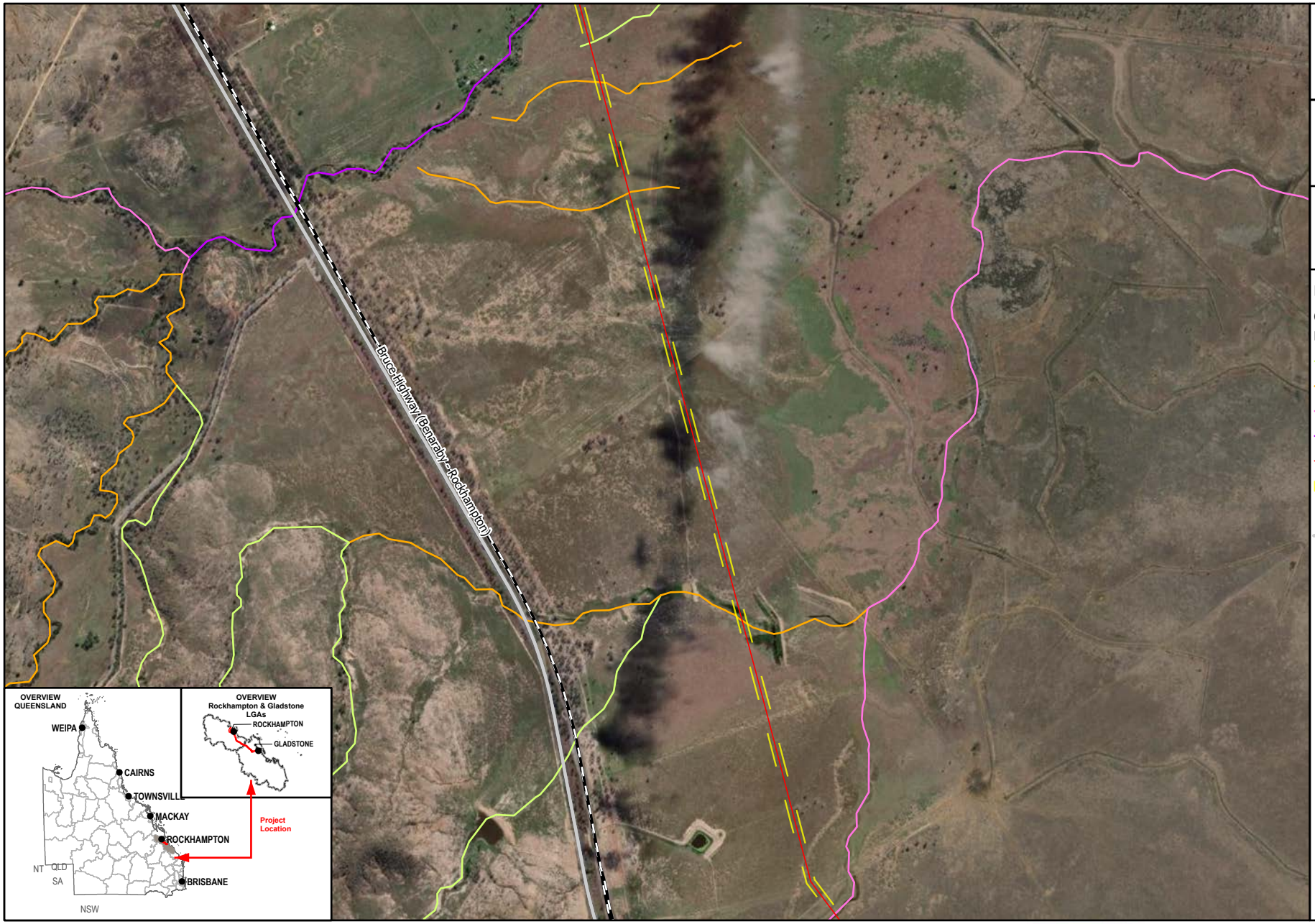
Figure 4-8i Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent
000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
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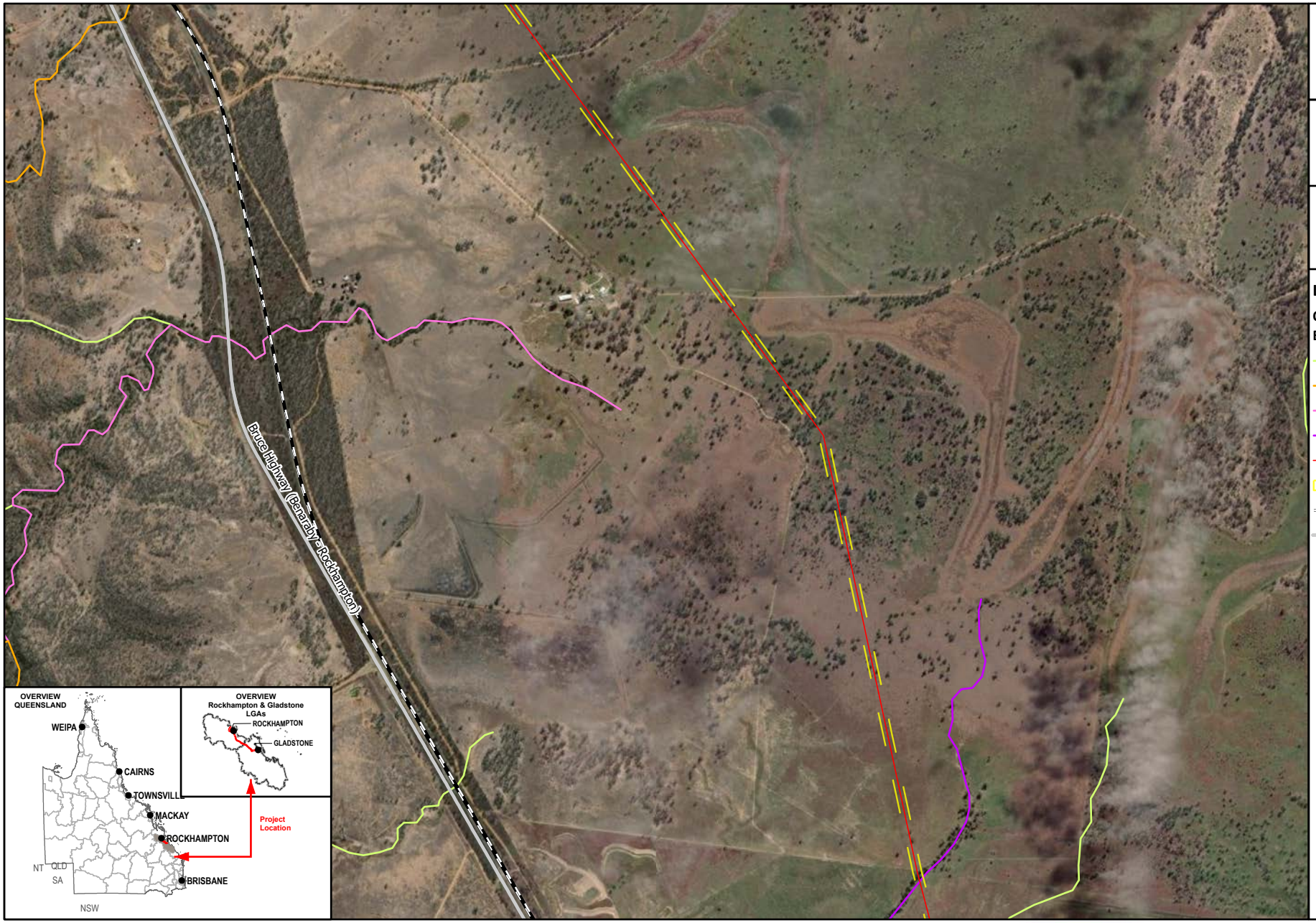
Figure 4-8j Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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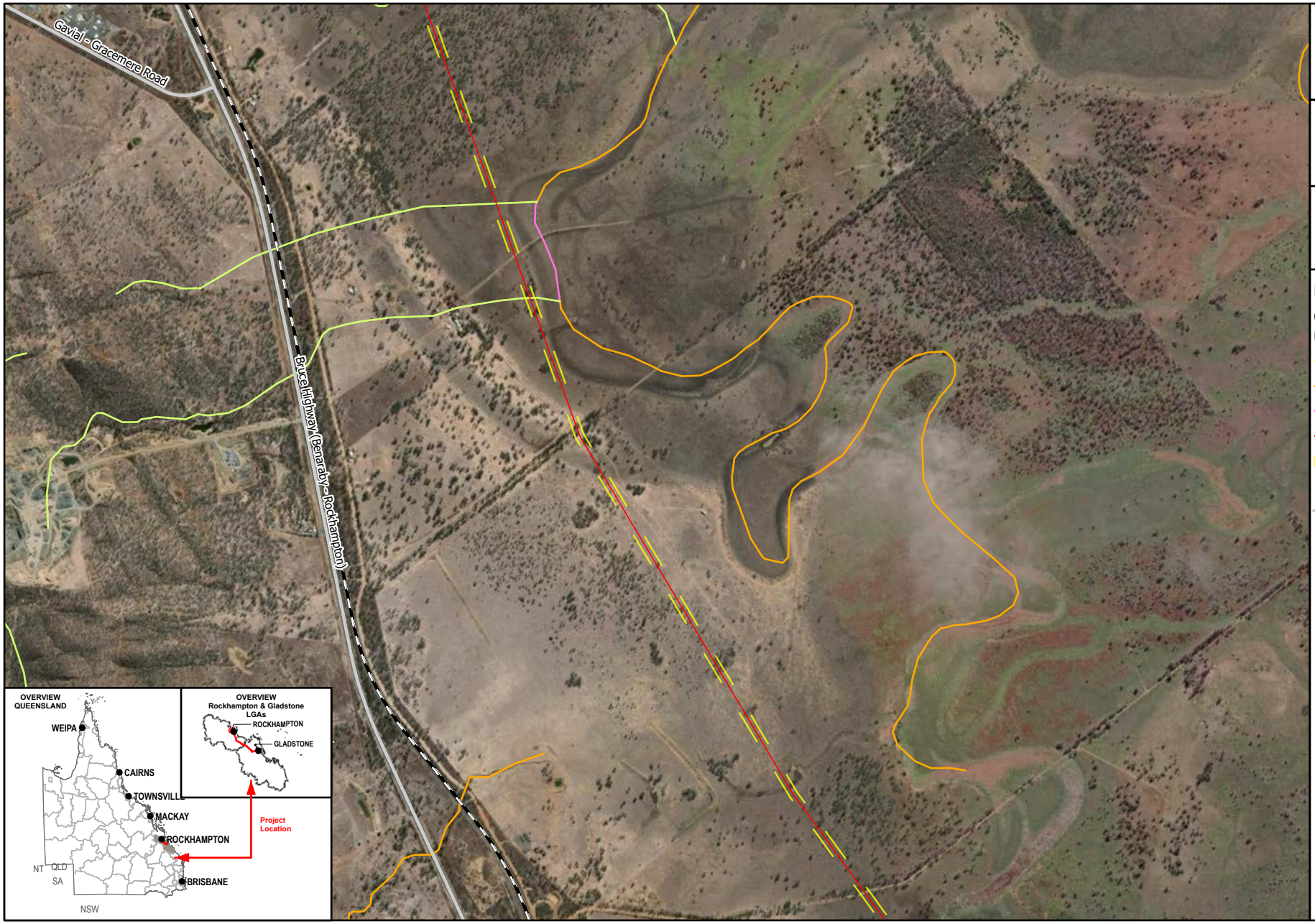
Figure 4-8k Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent
000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
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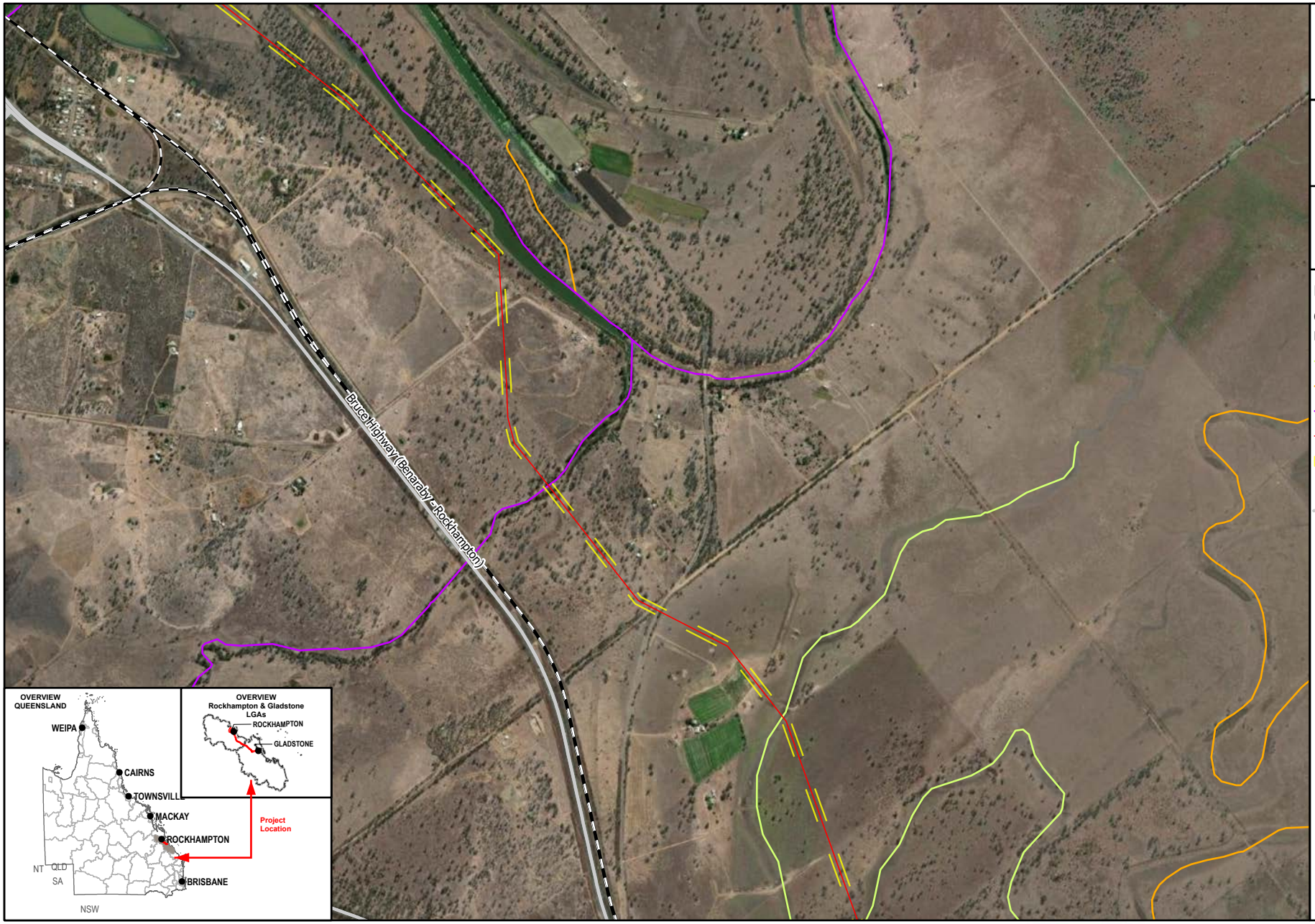
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8l Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
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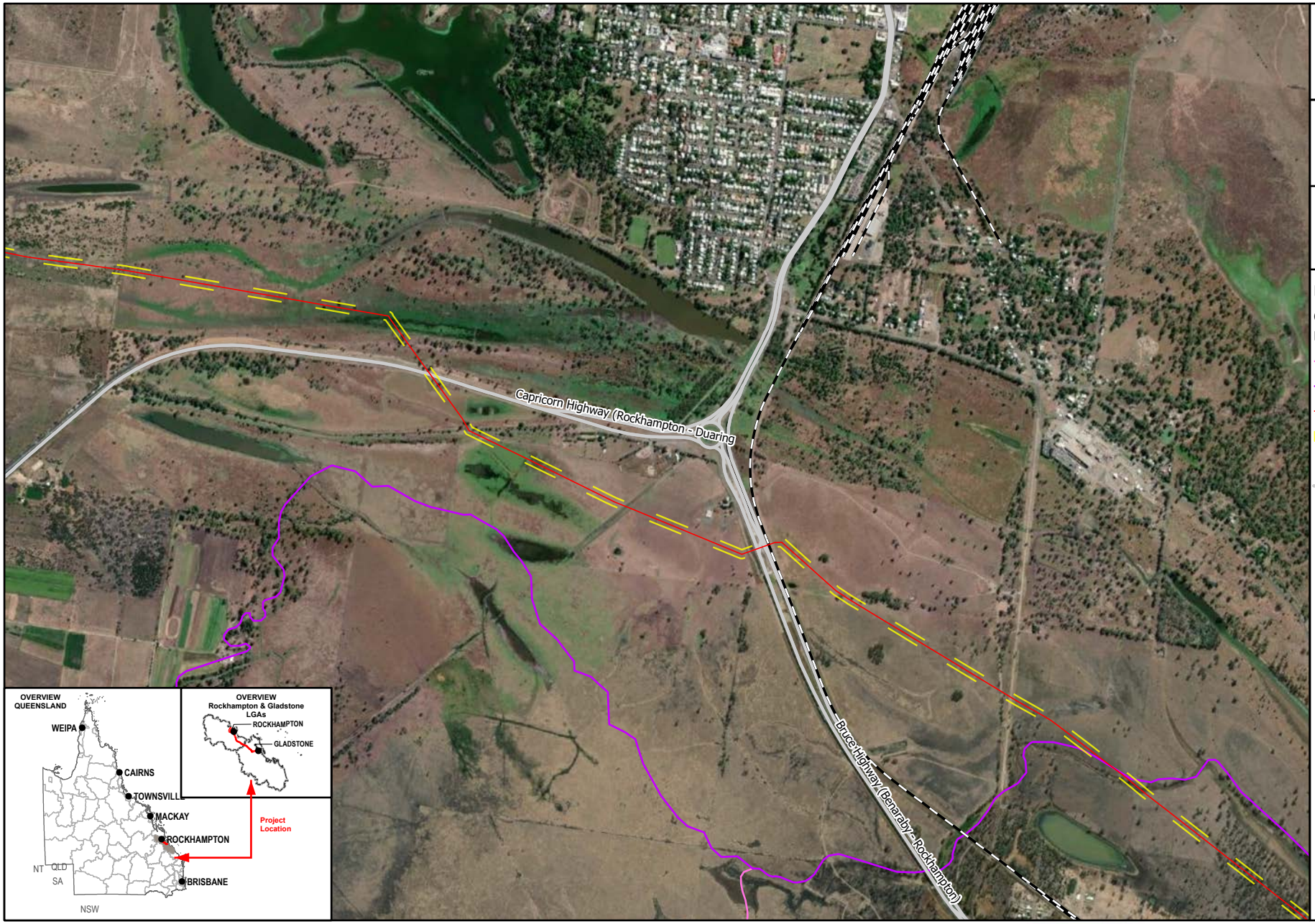
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8m Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent
000-G-MAP-2417 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

- 3 - High
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Railways
- Main Roads

Data Sources:
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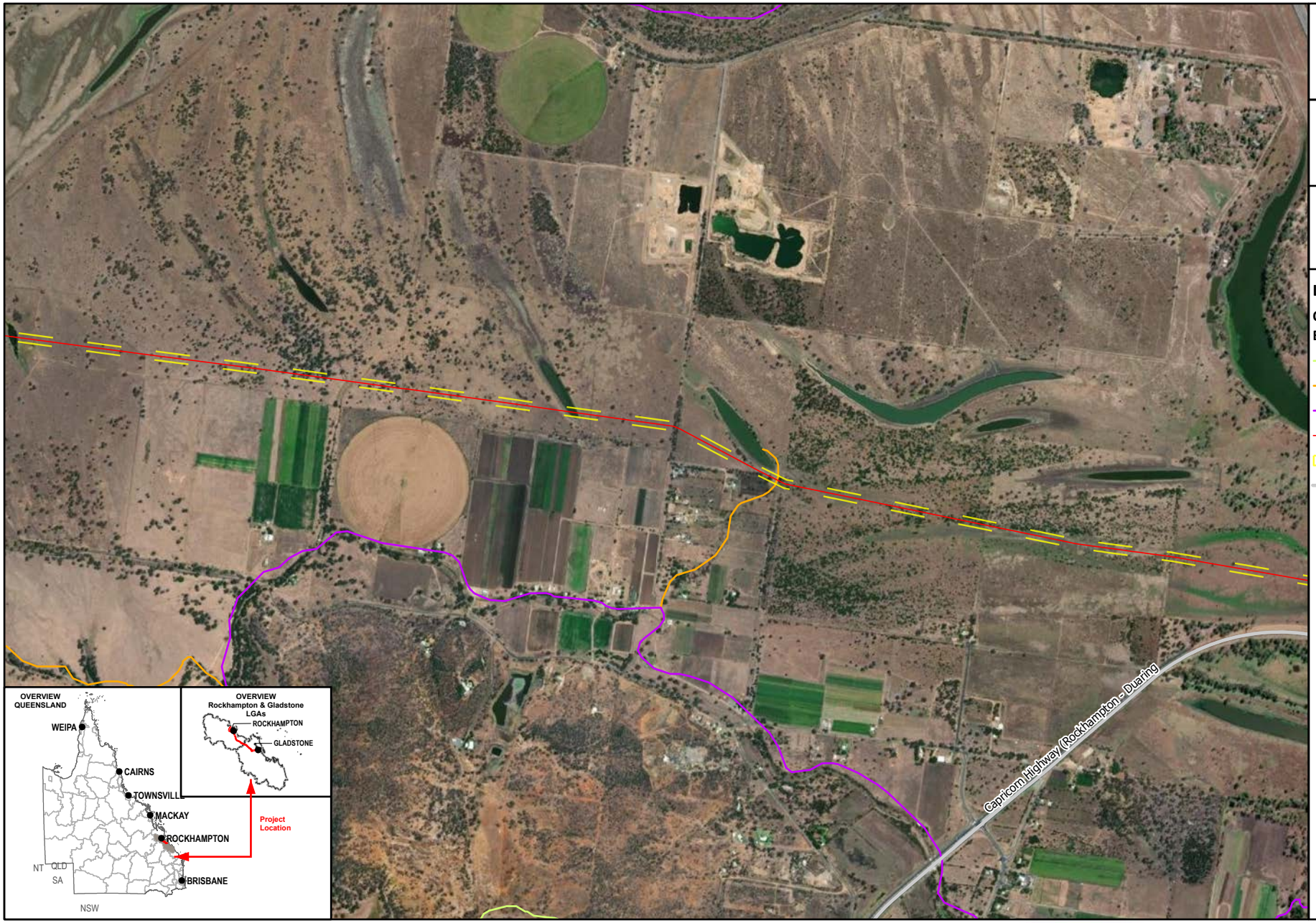
Figure 4-8n Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022



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Legend

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 4 - Major
- SGIC SDA Pipeline Alignment
- Study Area
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

SMEC Disclaimer:
Maps are for graphical purposes only. The information on this map is from a computer database accessed using a Geographic Information System (GIS). They do not represent a legal survey and the information provided includes inherent errors. SMEC cannot guarantee the accuracy of the information contained on this map. Each user of this map is responsible for determining its suitability for his or her intended use or purpose.

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PROJECTION UTM Zone 56
(Datum GDA2020)

Compiled by:YS16239

Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 4-8o Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the SGIC SDA Desktop Search Extent

000-G-MAP-2417 Version:1 Date:7/07/2022

4.6.2 Field survey results

4.6.2.1 Aquatic habitat

From the bioassessments of the nine waterways listed as major risk (purple) waterways in the WWBW spatial layer, seven sites were assessed as in fair condition, while the remaining two sites were in poor condition (Table 4-18). Three waterways, Twelve Mile Creek, Bob's Creek, and Gavial Creek have large permanent waterways providing refuge throughout the dry season. All other waterways assessed were ephemeral, some of which contained small, isolated pools during the time of survey. The majority of the major risk waterways displayed similar site characteristics including good or excellent condition bank stability and bank vegetation and stability, while the bottom substrate, embeddedness, and velocity and depth category were of poor condition. These results indicate that most sites are well vegetated but have low habitat complexities as a result of a silt/clay dominated substrate.

The bioassessments of four waterways listed as high-risk (red) waterways by the WWBW spatial layer resulted in two sites assessed to be in fair condition (sites 7 and 11) and two sites in poor condition (sites 10 and 18) as shown in Table 4-19. All of the high-risk waterways assessed were ephemeral, and either had no surface water present or were reduced to small isolation pools. The majority of sites whilst scoring well in bank vegetation and stability category, also scored poorly in the bottom substrate and embeddedness, indicating that these sites have limited habitat complexity due to some erosion and substrates dominated by silt/clay.

The bioassessments of five waterways listed as low and moderate risks (green and amber) waterways by the WWBW spatial layer (Table 4-20) resulted in one site as being assessed as in fair condition (site 8), while the remaining four sites were in poor condition. All sites whilst scoring well in bank vegetation and stability category, scored poorly in most categories, indicating that these sites have limited habitat complexity due to some erosion, channel alteration and substrates dominated by silt/clay.

Site characteristics and ecological values from the habitat assessments for all waterways and wetlands within the SGIC SDA are detailed below in Table 4-21. AusRivAS bioassessments are used as a standardised method to monitor and assess the ecological condition of Australian rivers. These bioassessments were only conducted upon riverine sites as they are not relevant to wetland sites.

Table 4-18 Bioassessment scores for major risk waterway (purple) sites within the SGIC SDA

Habitat variable	Scale	Site 3	Site 5	Site 6	Site 9	Site 14	Site 15	Site 17	Site 21	Site 24
Bottom substrate	0-20	2	7	0	2	0	0	2	0	14
Embeddedness	0-20	0	2	3	1	1	0	1	0	10
Velocity and depth category	0-20	1	6	5	1	2	1	1	1	2
Channel alteration	0-15	13	3	15	1	14	15	3	1	8
Bottom scouring and deposition	0-15	15	4	12	4	12	10	2	1	7
Pool/riffle, run/bend ratio	0-15	3	3	0	7	1	4	5	2	4
Bank stability	0-10	10	5	9	10	10	10	5	2	7
Bank vegetation and stability	0-10	10	6	10	10	10	5	6	5	10
Streamside cover	0-10	5	9	10	10	3	4	5	3	8
Totals	**0-135**	**59**	**45**	**64**	**46**	**53**	**49**	**30**	**15**	**70**

Habitat variable	Scale	Site 3	Site 5	Site 6	Site 9	Site 14	Site 15	Site 17	Site 21	Site 24
Habitat score category		**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Poor**	**Poor**	**Good**

Table 4-19 Bioassessment scores for high-risk waterway (red) sites within the SGIC SDA

Habitat variable	Scale	Site 7	Site 10	Site 11	Site 18
Bottom substrate	0-20	10	1	2	1
Embeddedness	0-20	8	0	1	0
Velocity and depth category	0-20	0	0	2	0
Channel alteration	0-15	7	3	4	1
Bottom scouring and deposition	0-15	1	12	4	1
Pool/riffle, run/bend ratio	0-15	0	1	4	2
Bank stability	0-10	5	6	8	3
Bank vegetation and stability	0-10	8	10	8	4
Streamside cover	0-10	9	4	8	5
Totals	**0-135**	**57**	**37**	**41**	**17**
Habitat score category		**Fair**	**Poor**	**Fair**	**Poor**

Table 4-20 Bioassessment scores for low and moderate risk waterway (green and amber) sites within the SGIC SDA

Habitat variable	Scale	Site 8	Site 12	Site 13	Site 16	Site 19
Bottom substrate	0-20	5	2	0	0	4
Embeddedness	0-20	3	4	0	0	4
Velocity and depth category	0-20	0	3	0	0	0
Channel alteration	0-15	8	3	1	1	2
Bottom scouring and deposition	0-15	8	2	1	0	1
Pool/riffle, run/bend ratio	0-15	0	3	1	1	3
Bank stability	0-10	8	7	1	6	5
Bank vegetation and stability	0-10	10	7	6	9	6
Streamside cover	0-10	5	4	4	5	5
Totals	**0-135**		**35**	**14**	**22**	**30**
Habitat score category		**Fair**	**Poor**	**Poor**	**Poor**	**Poor**

Table 4-21 Site characteristics and ecological values of sites within the SGIC SDA

Site	Characteristics	Ecological values
Site 2 – Raglan Creek		
Upstream 	– Tidal – tidal waterway mapped under the WWBW spatial layer. – Water was higher than the watermark and was an incoming tide at time of survey. – Channel width was approximately 8 m, and a depth of approximately 2 m. – The left bank was steep and approximately 5 m high, while the right bank has a low slope and only 2 m high. – Land use adjacent to the survey area on the left bank was subject to grazing while the right bank was natural and dense mangroves. – There was no evidence of erosion along the banks. – Water within creek was highly turbid. – Bed and bank substrate was primarily silt/clays.	– Instream habitat consisted of a mangrove roots and some small woody debris. – The creek would support marine, estuarine and some freshwater fish species. – Mangrove and marine cooch species were recorded along the banks and in the riparian zone. – Site is marginal for sawfish and dugong and species are unlikely to occur. – White-throated snapping turtle habitat is unsuitable and the species is unlikely to occur. – Site optimal for estuarine crocodile foraging and refuge and the species is likely to occur at this site. – The site provides marginal foraging habitat for marine turtle species, green turtle is likely to occur.
Downstream 		

Site	Characteristics	Ecological values
Site 3 – Twelve Mile Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – Twelve Mile Creek at site 3 is a mildly sinuous channel that was approximately 10 m wide, and an average depth >1.5 m. – Water flow was still at the time of the survey but was above the watermark. – Water clarity was clear. – Land use adjacent to the survey area on both banks was cattle grazing. – Bed substrate was stable, with deposition of silt upon the substrate. – The left bank had a low slope and was approximately 1 m high, while the right bank has a flat slope and was 0.5 m high, both banks were concave in shape. – Riparian vegetation was continuous on both banks with moderate amounts of grasses and sedges, and scatted *Eucalyptus* trees >10 m high, providing >5% shading.	– Overall habitat condition rating was fair (59). – A culvert was located approximately 1 km upstream of the study site. – Instream habitat consisted of deep pools, and some submerged aquatic macrophytes. – The creek would support small to large estuarine and freshwater fish species. – The site provides habitat for freshwater turtle species. – Site is sub-optimal for estuarine crocodile foraging, with sub-optimal breeding habitat and the species may occur at this site. – Optimal foraging and burrowing habitat present for platypus and species is likely to occur.

Site	Characteristics	Ecological values
Site 4 – Inkerman Creek		
Upstream  Downstream 	– Tidal – tidal waterway mapped under the WWBW spatial layer. – Inkerman Creek at site 4 consisted of a mildly sinuous channel that was approximately 18 m wide and approximately 5 m deep. – Water flow was slow and on the incoming tide at the time of the survey and was below the mangrove leaf line. – Water clarity was turbid. – Land use adjacent to the survey area on the left bank was dense native mangrove forest, while the land use adjacent to the right bank was grazing. – Bed substrate was stable, with deposition of silt upon the substrate. – The left bank had a low slope and was approximately 2 m high, while the right bank has a steep slope and was 8 m high. – Riparian vegetation was continuous on both banks with several species of mangroves.	– Instream habitat consisted of roots from various mangrove species. – The creek would support small to large estuarine and freshwater fish species. – A green turtle , was observed at the site at the time of survey. – The site provides sub-optimal habitat for other marine turtle species. – Site is marginal for sawfish and dugong species and the species is unlikely to occur. – Site is optimal foraging and marginal breeding habitat for the estuarine crocodile habitat and the species is likely to occur.

Site	Characteristics	Ecological values
Site 5 – Bobs Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – Bobs Creek at Site 5 consisted of a mildly sinuous channel with a bank full width that was approximately 10 m wide. – The average depth was 1.4 m and a maximum depth of 2 m and a wetted width of 4 m. – There was no flow at the time of the survey, and the water level was below the watermark. – Water clarity was slightly turbid. – Land use adjacent to the survey area on both banks were subject to cattle grazing. – The was a moderate amount of erosion present and compacted bed substrate that consisted of 20% sand and 80% silt/clay. – The left bank had a steep slope, while the right bank had a vertical slope. Both banks were 4 m high and with a high level of erosion. – Riparian vegetation isolated/scattered on both banks with some *Eucalyptus* trees <10 m high, and a moderate amount of grasses, and some shrubs.	– Overall habitat condition rating was fair (45). – Instream habitat consisted of deep and shallow pools, with large woody debris and beds of water lily. – This location provides suitable habitat for many fish and turtle species. – Optimal foraging and burrowing habitat present for platypus and species is likely to occur. – Outside of any known range for any other threatened aquatic species.

Site	Characteristics	Ecological values
Site 6 – Gavial Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – Gavial Creek at site 6 has a meandering channel with a wetted with of 10 m and a depth >2 m. – There was no Water flow at the time of the survey and was below the watermark. – Water clarity was turbid. – Land use adjacent to the survey area on both banks were subject to cattle grazing. – The was a moderate amount of erosion present and with a loosely compacted bed substrate that consisted of 100% silt/clay. – Both banks had a low slope and were 5 m high and with a moderate level of erosion. – Riparian vegetation was regularly spaced on both banks with a moderate amount of *Eucalyptus* trees <10 m and >10m high providing the site with 25% shading and 15% trailing bank vegetation – The riparian zone also contained a moderate amount of grasses, and some shrubs.	– Overall habitat condition rating was fair (64). – Instream habitat consisted of deep pools, with some submerged and some floating aquatic macrophytes. – There were some log jams and woody debris present within the waterbody. – Gavial Creek at this location provides suitable habitat for many fish and turtle species. – Provides optimal habitat and burrowing opportunities for the platypus, and the species is likely to occur at this site. – Site is sub-optimal foraging and marginal breeding habitat for the estuarine crocodile. The species may occur at this site

Site	Characteristics	Ecological values
Site 7 – Unnamed waterway		
Upstream  Downstream 	– Red – high-risk waterway mapped under the WWBW spatial layer. – Site 7 consisted of an irregularly meandering channel with a bank full width of 10 m. – Water was absent during the survey. – Land use adjacent to the survey area was grazing. – Bed substrate was moderately eroded, with some deposition upon the substrate. – Bed substrate comprised of 5% bedrock, 5% cobble, 20% pebble, 30% gravel, 30% sand, and 10% silt/clay. – The banks were moderately stable, with some evidence of local catchment erosion. – The banks on both sides of the river were steep, and concave in shape and were 4 m high. – Riparian vegetation was semi-continuous on both banks with moderate amounts of *Eucalyptus*, *Melaleuca*, and *Casuarina* trees >10 m high and <10 m high providing the site with 25% shading and 15% trailing bank vegetation. – The riparian zone also contained some bare ground, grasses, and shrubs.	– Overall habitat condition rating was fair (57). – Instream habitat consisted of pool, run, and riffle sections, as well as undercut banks. – This location would provide suitable habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 8 – Unnamed Creek		
Upstream  Downstream 	– Orange – moderate risk waterway mapped under the WWBW spatial layer. – The unnamed creek at Site 8 consisted of an irregular meandering channel with a bank full width of 3 m. – Water was absent during the survey. – Land use adjacent to the survey area was grazing. – Bed substrate was moderately aggregated, with some deposition upon the substrate. – Bed substrate comprised of 20% pebble, 30% gravel, 30% sand, and 20% silt/clay. – The left bank was moderately steep and 2 m high, while the right bank had a low slope and was 1 m high. – The was little local catchment erosion present. – The riparian zone was semi-continuous on both banks with some of *Eucalyptus*, *Melaleuca* and *Casuarina* trees >10 m and <10 m high providing the site with 25% shading and 25% trailing bank vegetation. – The riparian zone also contained a moderate proportion of grasses and shrubs.	– Overall habitat condition rating was fair (47). – Giant rat's tail grass (*Sporobolus pyramidalis*) present throughout site. – Instream habitat consisted of pool, run, and riffle sections. – There were no aquatic macrophyte species present. – This location would provide sub-optimal habitat for small bodied fish species for a short duration during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 9 – Horrigan Creek		
Upstream  Downstream 	– Purple / tidal – major/tidal risk waterway mapped under the WWBW spatial layer. – The site is located where the tidal mapped area connects with the major risk mapped waterway and is list as a major risk and tidal waterway. – Horrigan Creek at Site 9 consisted of a regular meandering channel with a bank full width of 8 m. – Water was absent during the survey. – Land use adjacent to the survey area on the left bank was cleared for cattle grazing and the right bank is vegetated floodplain and forest. – Bed substrate was moderately aggregated, with some compaction of the substrate. – Bed substrate comprised of 100% silt/clay. – The left bank was moderately steep and 3 m high, while the right bank had a flat slope and was 0.5 m high. – The was no evidence of local catchment erosion present. – The riparian zone was continuous on both banks with a moderate amount of mangrove trees and exotic trees species >10 m and <10 m high providing the site with 50% shading and 25% trailing bank vegetation. – The riparian zone also contained a moderate proportion of grasses, some shrubs and bare ground.	– Overall habitat condition rating was fair (46). – A culvert was located approximately 1 km upstream of the study site. – Instream habitat consisted of mangroves and woody debris. – This location would provide suitable habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 10 – Pelican Creek		
Upstream 	– Red – high-risk waterway mapped under the WWBW spatial layer. – Pelican Creek at site 10 consisted of an irregularly meandering channel with a bank full width of 3 m. – Water was absent during the survey. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately aggregated, with heavy compaction of the substrate. – Bed substrate comprised of 100% silt/clay. – The left bank had a low slope, while the right bank had a flat slope. Both banks were 1 m high. – The was some local catchment erosion present. – The riparian zone was continuous on both banks with grasses, and a moderate amount of exotic grass species present. – There were no trees present within site and no shading present.	– Overall habitat condition rating was poor (37). – Instream habitat consisted of a shallow run and some emergent macrophytes. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.
Downstream 		

Site	Characteristics	Ecological values
Site 11 – Marble Creek		
Upstream  Downstream 	– Red – high-risk waterway mapped under the WWBW spatial layer. – Marble Creek at site 11 consisted of a irregularly meandering channel with a wetted width of 3 m. – Water was present in a small, isolated pool that was 0.3 m deep. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately aggregated, with heavy compaction of the substrate. – Bed substrate comprised of 100% silt/clay. – The left bank had a steep slope, while the right bank had a moderate slope. Both banks were 3 m high. – The was a moderate level of local catchment erosion present. – The riparian zone was thick in clumps and sparse through most of the reach. There was a moderate amount of *Casuarina* trees <10 m high, providing the site with 25% shading and 15% trailing bank vegetation. – The riparian zone also contained a moderate proportion of grasses including exotic clover, some shrubs and bare ground.	– Overall habitat condition rating was fair (41). – Instream habitat consisted of a shallow run and some tree roots. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 12 – Unnamed waterway		
Upstream  Downstream 	– Green – minor risk waterway mapped under the WWBW spatial layer. – The unnamed creek at Site 12 consisted of a mildly sinuous creek with a bank full width of 2 m. – Water was absent during the survey. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately eroded, with a low level of compaction of the substrate. – Bed substrate comprised of 2% gravel, 5% sand, and 93% silt/clay. – Both banks had a steep slope, were benched and were 1 m high. – The was some local catchment erosion present and moderate bank stability. – The riparian zone was isolated/scattered on both banks, with extensive amounts of exotic species of grasses, with a little amount of bare ground and shrubs. – There were no trees present within site and no shading present.	– Overall habitat condition rating was poor (35). – Instream habitat consisted of shallow runs, pools and undercut banks. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 13 – Unnamed waterway		
Upstream  Downstream 	– Orange – moderate risk waterway mapped under the WWBW spatial layer. – The unnamed creek at Site 13 consisted of a mildly sinuous creek with a wetted width of 2 m. – Water was present in a small, isolated pool with a green coloration containing scum and was 0.3 m deep. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately aggregated, with a low level of compaction of the substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a steep slope, were benched and were 2 m high. – The was some local catchment erosion present and high bank stability. – The was no riparian zone, only with extensive amounts of exotic species of grasses along the banks. – There were no trees present within site and no shading present.	– Overall habitat condition rating was poor (14). – Instream habitat consisted of shallow runs, and some emergent macrophytes. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 14 – Anabranch of Inkerman Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – The anabranch of Inkerman Creek at site 14 consisted of an irregularly meandering creek with a wetted width of 0.5 m. – Water was present in a small creek bed that was 0.2 m deep and below the watermark. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately eroded, with a tightly compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a low slope, were convex in shape and were 1 m high. – The was some local catchment erosion present and high bank stability. – The riparian zone contained occasional clumps of mangrove and marine grass species along both banks. – The riparian zone consisted of a moderate amount of bare ground, some grasses, and shrubs. There were no trees present within site and no shading present.	– Overall habitat condition rating was fair (53). – Juvenile mangroves present within the waterway. – Instream habitat consisted of shallow runs, and some emergent macrophytes. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 15 – Anabranch of Inkerman Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – The anabranch of Inkerman Creek at site 15 consisted of an irregular meandering creek with a wetted width of 1 m. – Water was slowly flowing in a small creek bed that was 0.3 m deep and below the watermark. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately eroded, with a tightly compacted substrate. – Bed substrate comprised of 100% silt/clay. – The left bank had a steep slope and convex shape, the right bank had a moderate slope and a concave shape. Both banks were 2 m high. – The was some local catchment erosion present and high bank stability. – The riparian zone contained occasional clumps of marine grass species along both banks. – The riparian zone consisted of a moderate amount of bare ground, some grasses and shrubs. There were no trees present within site and no shading present.	– Overall habitat condition rating was fair (49). – Instream habitat consisted of shallow runs, and some emergent macrophytes. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 16 – Unnamed waterway		
Upstream  Downstream 	– Orange – moderate risk waterway mapped under the WWBW spatial layer. – The unnamed creek at site 16 consisted of a straight channel with a bank full width of 30 m. – Water was absent during the survey. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately aggregated, with a moderate level of compaction of the substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a low slope, were concave in shape. The left bank was 2 m high, and the right bank was 1 m high. – The was some local catchment erosion present and high bank stability. – The was no riparian zone, only with extensive amounts of exotic species of grasses along the banks. – There were no trees present within site and no shading present.	– Overall habitat condition rating was poor (22). – Instream habitat consisted of shallow runs and emergent macrophytes (paragrass). – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 17 – Station Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – Station Creek at site 17 consisted of a mildly sinuous channel with a wetted width of 4 m. – Water was present in a small, isolated pool that was 0.2 m deep. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately aggregated, with a moderate compaction of the substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a vertical slope and were benched. Both banks were 3 m high. – The was a moderate level of local catchment erosion present. – The riparian zone was thick in clumps and sparse through most of the reach. There were some *Eucalyptus* trees <10 m high, providing the site with 15% shading and 25% trailing bank vegetation. – The riparian zone also contained an extensive proportion of grasses and some shrubs including exotic species.	– Overall habitat condition rating was poor (30). – Instream habitat consisted of deep pools, runs, undercut banks, large woody debris, and emergent macrophytes (paragrass). – This location would provide optimal habitat for small bodied fish and sub-optimal habitat for large bodied fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 18 – Unnamed waterway		
Upstream  Downstream 	– Red – high-risk waterway mapped under the WWBW spatial layer. – The unnamed creek at site 18 consisted of a mildly sinuous channel with a bank full width of 5 m. – Water was absent during the survey. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was severely aggregated, with a tightly compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a low slope and a concave shape. The left bank was 2 m high, and the right bank was 1 m high. – The was some local catchment erosion present and moderate bank stability. – The was a continuous riparian zone comprised exclusively by grasses along the banks, many of which were exotic species. – There were no trees present within site and no shading present.	– Overall habitat condition rating was poor (17). – Instream habitat consisted of shallow runs, and emergent macrophytes (*Typha sp.*). – This location would provide some habitat for fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 19 – Unnamed waterway		
Upstream  Downstream 	– Amber – moderate risk waterway mapped under the WWBW spatial layer. – The unnamed creek at site 19 consisted of a regularly meandering channel with a minimum bank full width of 5 m and a maximum bank full width of 30 m. – Water was present in a small, isolated pool that was 0.1 m deep. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was severely aggregated, with a moderately compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a moderate slope and a concave shape. Both banks were 0.5 m in height. – The was some local catchment erosion present and high level of bank stability. – The was a continuous riparian zone comprised exclusively by grasses along the banks, many of which were exotic species. – There were no trees present within site and no shading present.	– Overall habitat condition rating was poor (30). – Instream habitat consisted of shallow pools, and emergent macrophytes including *Juncus sp.* and paragrass. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 21 – Scrubby Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – Scrubby Creek at site 21 consisted of an irregularly meandering channel with wetted width of 4 m. – Water was present in an isolated pool that was 0.3 m deep. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was stable, with a loosely compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a low slope and a concave shape. Both banks were 0.5 m in height. – The was some local catchment erosion present and high level of bank stability. – The was a semi-continuous riparian zone along both banks that contained a moderate amount of grasses and shrubs, and some trees >10 m and <10 m in height. A moderate amount of the species present were exotic. – Shading was 5% and trailing bank vegetation 10%.	– Overall habitat condition rating was poor (15). – Instream habitat consisted of pool/run habitat containing some small woody debris, – This location would provide optimal habitat for many fish species during wet periods. – Site not suitable for platypus refuge or borrowing opportunities.

Site	Characteristics	Ecological values
Site 24 – Oaky Creek		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – Oaky Creek at site 24 consisted of a mildly sinuous channel with wetted width of 3 m. – Water was present in an isolated pool that was 0.2 m deep. – Land adjacent to the survey area on both banks cleared for cattle grazing. – Bed substrate was moderately aggregated, with a moderately compacted substrate. – Bed substrate comprised of 5% cobble, 15% pebble, 20% gravel, 30% sand, and 30% silt/clay. – Both banks had a vertical slope and a benched shape. Both banks were 4 m in height. – The was a little evidence of local catchment erosion present and high level of bank stability. – The was a regularly spaced riparian zone along both banks that contained a moderate amount of grasses and shrubs, and some trees <10 m in height. Some of the species present were exotic. – Shading was 75% and trailing bank vegetation 50%.	– Overall habitat condition rating was fair (70). – Instream habitat consisted of shallow pools, and large woody debris – This location would provide optimal habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 26 – Unnamed wetland near Raglan Creek		
Photo 1  Photo 2 	– Mapped HSE wetland. – The wetland type is described as an upper mangrove wetland. – The site was dry during the survey with no evidence of recent inundation. – The site is located less than 100 m Raglan Creek and would be inundated during spring high tides and during floods. – Adjacent land use is natural, with evidence of horse grazing. – Mangrove species dominated the tree canopy level, while patches of marine couch dominated the understory. – The substrate was stable with little signs of erosion.	– The site was dominated entirely by grasses and mangroves. There was some large and small woody debris present that when inundated by water would provide the site with some habitat and refugia. Overall, with the absence of surface waters the site is marginal for aquatic species and only for a short period of time when inundated. – Site not suitable for foraging, refuge or breeding of any marine aquatic species. – Site not suitable for foraging, refuge or breeding of any freshwater aquatic species. – Site not suitable for estuarine crocodile refuge, foraging or nesting.

Site	Characteristics	Ecological values
Site 27 – Unnamed wetland		
Upstream 	– Mapped HSE wetland. – The wetland type is described as an open wetland with grass understorey. – The site was dry during the survey with no evidence of recent inundation. – The wetland and land adjacent to the survey area was cleared for cattle grazing. – Bed substrate was severely aggregated, with a tightly compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a flat slope and a concave shape. – The was little local catchment erosion present and moderate bank stability. – The was a continuous riparian zone comprised exclusively by grasses in the bed and along the banks, many of which were exotic species. – There were no trees present within site and no shading present.	– A dam wall that was approximate 3 m high was located approximate 300 m downstream of the site and another of the same height located approximately 1 km upstream of the site. – Instream habitat was minimal and consisted of terrestrial grasses. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species. –
Downstream 		

Site	Characteristics	Ecological values
Site 28 – Unnamed wetland		
Photo 1  Photo 2 	– Mapped HSE wetland. – The wetland type is described as an open wetland with grass understorey. – The site was dry during the survey with no evidence of recent inundation. – The wetland and land adjacent to the survey area was cleared for cattle grazing. – Bed substrate was severely aggregated, with a tightly compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a flat slope and a concave shape. – The was little local catchment erosion present and moderate bank stability. – The was a continuous riparian zone comprised exclusively by grasses in the bed and along the banks, many of which were exotic species. – There were no trees present within site and no shading present.	– Instream habitat was minimal and consisted of terrestrial grasses. – This location would provide limited habitat for many fish species during extremely wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 29 – Unnamed wetland		
Upstream  Downstream 	– Mapped HSE wetland. – The wetland type is described as an open floodplain watercourse with grass understorey. – The site was dry during the survey with no evidence of recent inundation. – The wetland and land adjacent to the survey area was cleared for cattle grazing. – Bed substrate was severely aggregated, with a tightly compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a flat slope and a concave shape. – The was little local catchment erosion present and moderate bank stability. – The was a continuous riparian zone comprised exclusively by grasses in the bed and along the banks, many of which were exotic species. – There were no trees present within site and no shading present.	– Instream habitat was minimal and consisted of terrestrial grasses. – This location would provide limited habitat for many fish species during wet periods. – Outside of any known range for threatened aquatic species.

Site	Characteristics	Ecological values
Site 30 – Unnamed wetland		
Photo 1  Photo 2 	– Mapped HSE wetland. – The wetland type is described as a floodplain billabong. – The site was wet during the survey, and water level below the watermark. – Water was turbid. – The wetland dimensions were approximately 1500 m long by 100 m wide and greater than 1.5 m deep. – Connection to other waterbodies only occurs during floods. – The wetland and land adjacent to the survey area was cleared for cattle grazing. – Bed substrate was severely aggregated, with a tightly compacted substrate. – Bed substrate comprised of 100% silt/clay. – Both banks had a flat slope and a concave shape. – The was little local catchment erosion present and moderate bank stability. – The was a continuous riparian zone comprised exclusively by grasses in the bed and along the banks, many of which were exotic species. – There were no trees present within site and no shading present.	– Habitat large shallow pool, with deep middle. – Small woody debris present – Site not suitable for white-throated snapping turtle refuge or nesting. – Site not suitable for platypus refuge or borrowing opportunities. – Site sub-optimal for estuarine crocodile refuge or nesting and may occur.

4.6.2.2 Physico-chemical water quality

The *in-situ* water quality data obtained from accessible sites indicated that only the Ph and turbidity were within the guidelines for the region at all sites. The conductivity was higher than the baseline guidelines for sites 3 and 11, while the dissolved oxygen was within the guidelines for all sites except for site 6, which was lower than the guidelines (Table 4-22).

Table 4-22 Water Quality Data at sites within the SGIC SDA

Parameter	Water quality objective*	Site 3	Site 5	Site 6	Site 11
Date	-	08/05/2022	05/05/2022	04/05/2022	08/05/2022
Time	-	9:25 am	1:25 pm	3:45 pm	10:50 am
Depth of location (m)	-	0.3	0.3	0.3	0.2
Temperature (ºC)	-	23.8	22.8	25.7	22.2
Ph	6.5-8.5	-	6.79	6.76	7.74
Electrical conductivity (µS/cm)	< 445 (baseflow) < 250 (high flow)	1131	265.2	219.4	2179
Dissolved oxygen (mg/L)	-	7.57	7.52	4.07	7.90
Dissolved oxygen (% saturation)	85-110	89.0	87.4	49.9	91.1
Turbidity (NTU)	<50	13.9	16.3	22.2	18.4
Key to table: (*) – As per the moderately disturbed aquatic ecosystem objectives in the Fitzroy River sub-basin fresh waters (DEHP 2013)					

4.6.2.3 Aquatic flora

There were no threatened aquatic flora species confirmed present or predicted to occur within the study area. Details of the aquatic species present during the survey is in Table 4-21.

4.6.2.4 Freshwater fishes

A total of 34 native and three pest freshwater fish species are known to occur within the Fitzroy River catchments (Pusey *et al.* 2004). Of the native species to occur within the Fitzroy River catchment none are conservation significant.

A total of four fish species were captured throughout the surveys within the SGIC SDA. All species observed were common species. Agassiz's glassfish was the most abundant species recorded. The other species recorded were the fly-specked hardyhead, western carp gudgeon, and spangled perch (*Leiopotherapron unicolor*). Further details of the surveys are outlined in Appendix J.

All species recorded were native. No conservation significant species were recorded during the field survey, there were also no conservation significant species predicted to occur in the desktop search outlined in Section 4.6.1.1. No pest species were recorded during the field survey, biosecurity matters are further discussed in Sections 6.2.8 and 6.3.4.

4.6.2.5 Other aquatic fauna

Four known species of freshwater turtles are known to occur in the study area, two of which, the white-throated snapping turtle and Fitzroy River turtle, are conservation significant species. The white-throated snapping turtle has one occurrence in the estuarine waters of Raglan Creek downstream of site 2, as well as several records within the freshwaters of Raglan Creek upstream of Raglan (Thomson *et al.* 2006). However, the species is found in the upper-most freshwater reaches to the freshwater and brackish water interface but does not inhabit brackish waters (Thomson *et al.* 2006), or estuarine waters. The species prefers flowing waters with a complexity of subsurface structure including large woody debris, undercut banks and irregular rocky substrates (Thomson *et al.* 2006), none of which are present at site 2. It is based upon these criteria for habitat preference and distribution that the occurrence within the estuarine waters of Raglan Creek is an anomaly and that the species is unlikely to

occur at Raglan Creek at site 2. No previous records of this species occurring within any other waterway throughout the SGIC SDA exist and therefore the species is unlikely to occur throughout the SGIC SDA.

The Fitzroy River turtle is only known to occur within the main river system of the Fitzroy River and is unlikely to occur at any waterway crossings within the SGIC SDA. No observations of this species occurred throughout the surveys within the SGIC SDA and therefore the species is unlikely to occur. During the surveys within the SGIC, only one freshwater turtle was observed, an adult Krefft's river turtle, which was captured at Twelve Mile Creek (site 3).

Platypus are known to occur in the Fitzroy River and tributaries upstream of Rockhampton (ALA 2022) and the species has been identified within the desktop searches as known to occur within the SGIC SDA. Twelve Mile Creek (site 3), Bobs Creek (site 5) and Gavial Creek (site 6) contain permanent large pool sections with large woody debris, tree roots and aquatic macrophytes providing foraging and burrowing habitat for the species. The platypus is therefore considered likely to occur within the SGIC SDA.

Previous observations of estuarine crocodiles have been recorded in the Fitzroy River. The species is known for large migration and movements. Raglan Creek (site 2) and Inkerman Creek (site 4) are estuarine tidal creeks that lead into the Fitzroy River Delta. Both creeks contain optimal habitat for estuarine crocodiles and the species is therefore likely to occur at these locations. Twelve Mile Creek (site 3) and Gavial Creek (site 6) contain sub-optimal habitat for the species. Therefore, estuarine crocodile may occur within these waterways. Site 30 is an isolated floodplain billabong near the Fitzroy River, movement from estuarine crocodiles in and out of this billabong is able to occur during floods. The billabong contains sub-optimal habitat for the species and is able to support a small crocodile throughout the year, not just during flood times and therefore the species may still occur at this location.

Australian snubfin dolphin occurs throughout northern Australia and as far south on the east coast to Brisbane River and are known to occur within costal and estuarine waters (DCCEEW 2022d). Previous occurrence records of the species are recorded from the mouth of the Fitzroy River (ALA 2022). The pipeline alignment of the pipeline is located within the upper tidal reaches of Raglan Creek (site 2) and Inkerman Creek (site 4). Sub-optimal habitat for the species occurs within these two sites and therefore the species may occur.

Australian humpback dolphins are known to occur across northern Australia and as far south on the east coast as the Queensland and New South Wales border, and are known to inhabit inlets, estuaries, major tidal rivers, shallow bays, inshore reefs and coastal archipelagos (DCCEEW 2022g). Previous occurrence records of the species are recorded from the coastline of the SGIC SDA (ALA 2022) and with species able to cover considerable range therefore, the species may occur within the tidal reaches of Raglan Creek (site 2) and Inkerman Creek (site 4) which contain sub-optimal habitat for these species.

Of the marine species of turtles that are predicted to occur or habitat likely to occur within the SGIC SDA, the green turtle is the only species to have previous occurrences recorded in the estuarine waters within the region between Rockhampton and Gladstone (ALA 2022). A confirmed sighting of the green turtle at site 4 during the survey at Inkerman Creek indicates that the species is also likely occur within Raglan Creek at site 2. The other marine turtles are not known to occur within the upper tidal reaches of the waterways within the SGIC SDA and therefore those species are unlikely to occur.

4.7 Likelihood of occurrence

Based on the desktop searches and field survey results, the following conservation significant species have the potential to occur within the SGIC SDA study area (Table 4-23). The ornamental snake, yellow chat, squatter pigeon, Australian painted snipe and *Samadera bidwillii* were identified as controlling provisions at the time of EPBC approval. These species also listed under the NC Act were assessed against the Queensland Government's *Significant Residual Impact Guidelines* (DEHP 2014b) for MSES (Section 7.2). A detailed likelihood of occurrence assessment is provided in Appendix E.

Table 4-23 Likelihood of occurrence summary

Scientific name	Common name	Status		Likelihood of occurrence	EPBC approval
		EPBC Act	NC Act		
Threatened species					
Calidris ferruginea	Curlew sandpiper	CE, Mig	CE	**Likely to occur**	
Chelonia mydas	Green turtle	V, Mig	V	**Confirmed present**	
Crocodylus porosus	Estuarine crocodile	Mig	V	**Likely to occur**	
*Denisonia maculata**	Ornamental snake	V	V	**Confirmed present**	✓
*Epthianura crocea macgregori**	Yellow chat (Dawson)	CE	E	**Confirmed present**	✓
*Geophaps scripta scripta**	Squatter pigeon (southern)	V	V	**Confirmed present**	✓
Hemiaspis damelii	Grey snake	NL	V	**Likely to occur**	
Hirundapus caudacutus	White-throated needletail	V, Mig	V	**Likely to occur**	
Ninox strenua	Powerful owl	NL	V	**Likely to occur**	
Ornithorhynchus anatinus	Platypus	NL	SL	**Likely to occur**	
Petauroides volans	Greater glider (southern and central)	E	E	**Likely to occur**	
Petaurus australis australis	Yellow-bellied glider (south-eastern)	V	V	**Likely to occur**	
*Phascolarctos cinereus**	Koala	E	E	**Confirmed present**	
Pteropus poliocephalus	Grey-headed flying-fox	V	LC	**Likely to occur**	✓
Rostratula australis	Australian painted snipe	E	E	**Likely to occur**	✓
Samadera bidwillii	-	V	V	**Likely to occur**	✓
Migratory species					
Apus pacificus	Fork-tailed swift	Mig	SL	**Likely to occur**	
Calidris acuminata	Sharp-tailed sandpiper	Mig	SL	**Likely to occur**	
Calidris falcinellus	Broad-billed sandpiper	Mig	SL	**Likely to occur**	
Calidris ruficollis	Red-necked stint	Mig	SL	**Likely to occur**	
Chlidonias leucopterus	White-winged black tern	Mig	SL	**Likely to occur**	
Cuculus optatus	Oriental cuckoo	Mig	SL	**Likely to occur**	
Gallinago hardwickii	Latham's snipe	Mig	SL	**Likely to occur**	
Gelochelidon nilotica	Gull-billed tern	Mig	SL	**Likely to occur**	
Hydroprogne caspia	Caspian tern	Mig	SL	**Likely to occur**	

Scientific name	Common name	Status		Likelihood of occurrence	EPBC approval
		EPBC Act	NC Act		
Limosa limosa	Black-tailed godwit	Mig	SL	**Likely to occur**	
Monarcha trivirgatus	Spectacled monarch	Mig	SL	**Likely to occur**	
Myiagra cyanoleuca	Satin flycatcher	Mig	SL	**Likely to occur**	
Numenius minutus	Little curlew	Mig	SL	**Likely to occur**	
Pandion haliaetus	Osprey	Mig	SL	**Likely to occur**	
Plegadis falcinellus	Glossy ibis	Mig	SL	**Likely to occur**	
Pluvialis fulva	Pacific golden plover	Mig	SL	**Likely to occur**	
Tringa nebularia	Common greenshank	Mig	SL	**Likely to occur**	
Tringa stagnatilis	Marsh sandpiper	Mig	SL	**Likely to occur**	
Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; NL – not listed; (*) – confirmed present during the Arup (2008) field surveys.					

5. Northern Section ecological values

5.1 Threatened ecological communities

5.1.1 Desktop assessment results

The EPBC Act PMST search predicted four TECs have the potential to occur within the desktop search extent of the Northern Section (i.e. from the Fitzroy River to the SGIC SDA) (Appendix A). The predicted TECs and their associated REs are summarised in Table 5.1.

Although four TECs were shown as predicted to occur within the search area, only two were listed at the time of the EPBC approval, and as such, subject to the EPBC approval including:

– Brigalow (*Acacia harpophylla* dominant and co-dominant) (listed as endangered)

– Semi-evergreen vine thickets of the brigalow belt (listed as endangered).

Neither of the abovementioned communities was confirmed present within the Northern Section study area during the previous field survey (Arup 2008). It is also noted that the overwhelming majority of the Northern pipeline alignment occurs within the Interim Biogeographic Regionalisation for Australia (IBRA) Brigalow Belt North Bioregion which does not support the Coolibah – Black Box Woodlands TEC.

Table 5-1 TECs predicted to occur within the desktop search extent

TEC	EPBC Act status	Associated REs	RE(s) mapped in study area
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	E	11.3.3, 11.3.16, 11.3.15, 11.3.37, 11.3.28	No
Poplar Box Grassy Woodland on Alluvial Plains	E	11.3.2, 11.3.17, 11.4.7, 11.4.12, 12.3.10	No
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E	11.11.18, 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.13, 11.8.3, 11.8.6, 11.9.4, 11.9.8	No
Weeping Myall Woodlands	E	11.3.2, 11.3.28	No
Key to table: E – endangered			

5.1.2 Field survey results

No vegetation communities were observed that met the diagnostic or condition criteria of any EPBC Act listed TEC. In most instances, vegetation communities lacked the floristic composition to constitute a listed TEC or were not in a mandatory bioregion for the TEC.

5.2 Regional Ecosystems and regulated vegetation

5.2.1 Desktop assessment results

The Northern study area is largely located within the Marlborough Plains subregion of the Brigalow Belt bioregion. The exception being a small section of the Northern pipeline alignment (approximately 380 m) that encroaches into the Mount Morgan Ranges subregion of the Brigalow Belt bioregion. The study area is mapped by DoR as comprising a mixture of Category B, Category R, Category C and Category X vegetation. Descriptions of currently mapped REs and regrowth vegetation within the study area, together with their status under the VMA are provided in Table 5-2. PMAVs are also in place across substantial portions of the study area. The majority of the mapped polygons in the PMAVs are Category X. Essential habitat, defined watercourses and regulated vegetation within 100 m of a wetland are also intersected by the Northern Section pipeline alignment.

DoR vegetation mapping relative to the study area is provided in Appendix C.

Table 5-2 REs mapped within the Northern Section study area, either as components of heterogenous polygons or as homogenous polygons

Mapped RE	VM Act status	Short description	Broad Vegetation Group
11.3.1	E	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	25a
11.3.2	OC	*Eucalyptus populnea* woodland on alluvial plains	17a
11.3.3	OC	*Eucalyptus coolabah* woodland on alluvial plains	16c
11.3.4	OC	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. Woodland on alluvial plains	16c
11.3.25	LC	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	16a
11.3.25f	LC	Main river channels. Open water or exposed stream beds and bars	16a
11.3.27b	LC	Open water +/- aquatics and emergents. Often with fringing woodland	34d
11.3.27c	LC	Mixed sedges or grasses with areas of open water +/- aquatic species	34d
11.3.27x1b	LC	Sedgelands to grasslands on Quaternary deposits	34d

5.2.2 Field survey results

A number of discrepancies were identified between the mapped DoR RE layer and the field verified REs within the Northern Section study area. Most commonly, mapped heterogenous polygons comprising multiple REs were comprised of single RE or floristics observed within the extent of the pipeline alignment did not match the mapped RE. Often, the VMA status (endangered, of concern, least concern) and/or remnant status (remnant, regrowth, non-remnant) of verified polygons remained the same, despite the change in RE designation. Where a change was recorded, the VMA status was typically a lower conservation status (i.e. less threatened). The only exception was a patch of RE11.3.25/11.3.27 within Lot 102 LN176 which was remapped as RE11.3.4. This resulted in a change in VMA status of the patch from least concern to of concern.

Several areas containing PMAVs were mapped as Category X, despite vegetation appearing to have reached remnant status. These polygons were historically secured as Category X vegetation through the PMAV process and their assigned designation within the study area was retained.

Field verified RE mapping is provided in Figure 5-1. It is noted that DoR vegetation mapping was accepted for those polygons not ground-truthed during surveys (refer hatched polygons in Figure 5-1). Impact areas for respective REs within the GSDA, based on field verified mapping and a nominal 30 m wide corridor, are provided in Table 5-3.

A description of REs where field verification has resulted in a change to the VMA status or remnant status of the mapped polygon (version 12.1) is provided in Table 5.5-4.

Table 5-3 Impact areas for REs mapped within the northern pipeline alignment

RE	VMA Class	VMA Status	Total area (m^2)
11.3.1/11.3.4	High value regrowth	E	5,216
11.3.2	High value regrowth	OC	1,205
11.3.3	High value regrowth	OC	2,095
11.3.3/11.3.27c	High value regrowth	OC	1,596
11.3.3/11.3.4	Remnant	OC	4,223
11.3.4	High value regrowth	OC	13,683
11.3.4	Remnant	OC	1,241
11.3.4/11.3.2/11.3.27x1b	High value regrowth	OC	1,851
11.3.4/11.3.25	High value regrowth	OC	3,585

RE	VMA Class	VMA Status	Total area (m^2)
11.3.25e	High value regrowth	LC	3,356
11.3.27b	Remnant	LC	167
11.3.27c	Remnant	LC	5,765
Non-remnant	Non-remnant	NA	563,106
Water	Water	NA	283

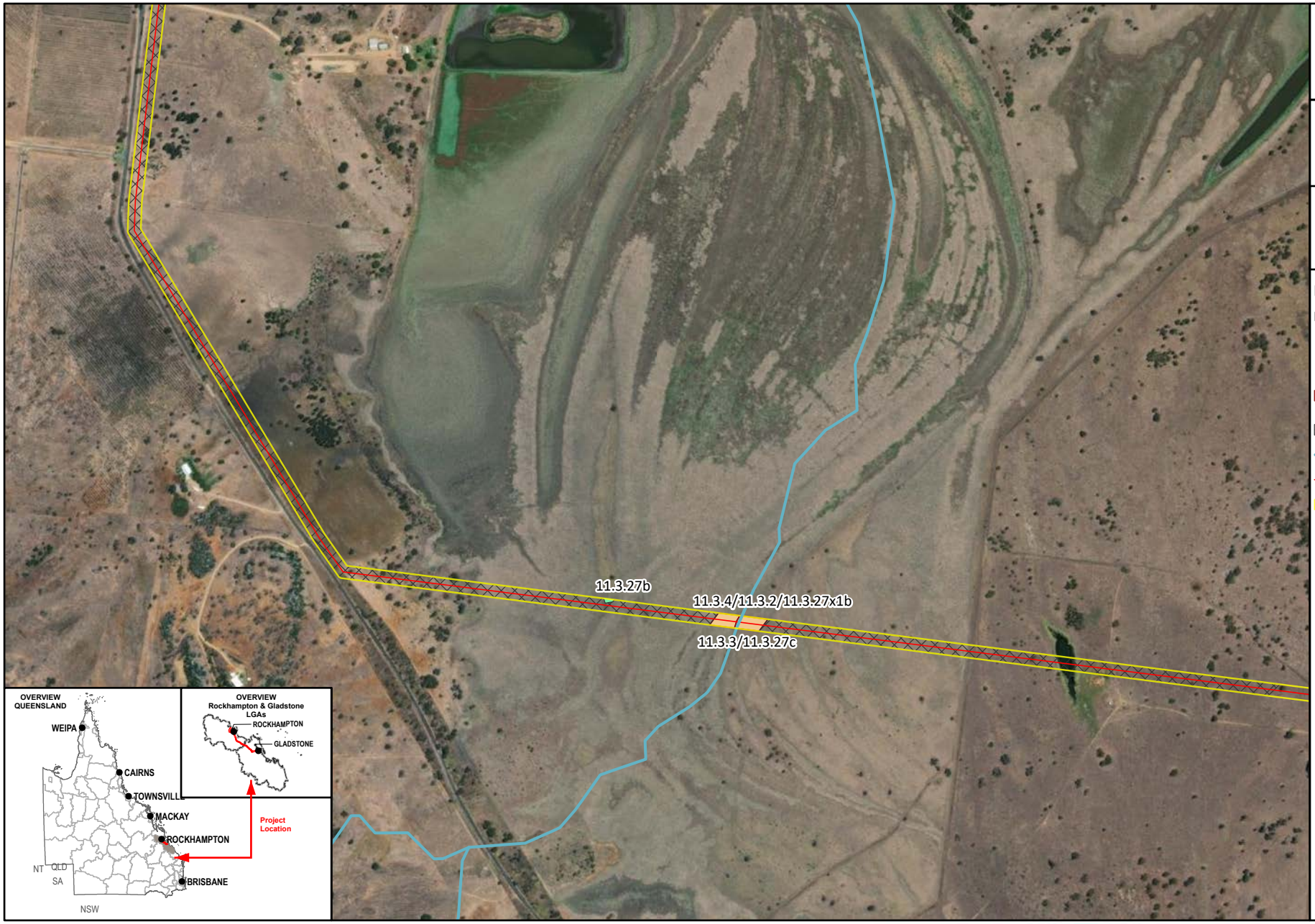
Table 5.5-4 Field verified REs and regulated vegetation changes in the Northern Section study area

Location	Mapped RE	Field verified RE	Field description	Representative photograph
-23.369, 150.400	Category B 11.3.3/ 11.3.4	Category X	E – *Eucalyptus tereticornis, Lysiphyllum* sp., *E. coolabah, Corymbia tessellaris* (14-20 m tall, 4% cover) G – *Megathyrsus maximus*, Urochloa mutica*, Dichanthium aristatum*, Eriochloa pseudoacrotricha, Echinochloa colona*, Parthenium hysterophorus*, Aeschynomene indica*, Sesbania cannabina, Macroptilium lathyroides*, Sida* spp. (1 m tall, 95% cover). Landform: alluvial plain Note: A substantial portion of the mapped polygon within study corridor lacks sufficient tree cover to meet remnant or Category C status.	
		Category B 11.3.3/ 11.3.4	T1 — *Eucalyptus tereticornis, E. coolabah* (12 – 18 m tall, 20 % cover). T2 — *Eucalyptus tereticornis, Lysiphyllum hookeri, E. coolabah, Corymbia tessellaris* (6-10 m tall, 10 % cover). G — *Eriochloa pseudoacrotricha, Megathyrsus maximus*, Urochloa mutica*, Parthenium hysterophorus*, Aeschynomene indica*, Sesbania cannabina, Macroptilium lathyroides*, Sida* spp. (0.3-1 m tall, 85% cover).	

Location	Mapped RE	Field verified RE	Field description	Representative photograph
-23.3462, 150.4052	Category B 11.3.25/11.3.27c	Category B 11.3.4	Aerial and hillshade imagery indicate lack of defined drainage line. Rather, vegetation occupies an alluvial plain surrounding shallow depression and is representative of 11.3.4.	
-23.2949, 150.4361	Category R 11.3.3	Category R 11.3.25e	T1 – *Eucalyptus camaldulensis, Melaleuca leucandendra* (18-23 m tall, 10 % cover) T2 – *Casuarina cunninghamiana* (2% cover) S1 – *E. camaldulensis* (1-2 m tall) G – *Megathyrsus maximus*, 387oriacea387t amplexicaulis*, Passiflora foetida*, Alternanthera sp., Echinochloa sp.* (0.2-1 m tall, 90% cover) Landform: watercourse	

Location	Mapped RE	Field verified RE	Field description	Representative photograph
-23.2947, 150.4367	11.3.25f	Water	Adjustment made to polygon boundary to more accurately reflect site observations and aerial imagery	

Key to table: Pale orange shading: High value regrowth regulated vegetation containing of concern REs; Orange shading: Remnant regulated vegetation containing of concern REs; Pale green shading: High value regrowth regulated vegetation containing least concern REs; (*) – introduced flora species.



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Queensland Government

SMEC
Member of the Surbana Jurong Group

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Meters

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Legend

Field verified REs

- Category A or B area that is least concern
- Category C or R area containing of concern
- Unverified Fields
- Waterways
- GSDA Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
(Datum GDA2020)

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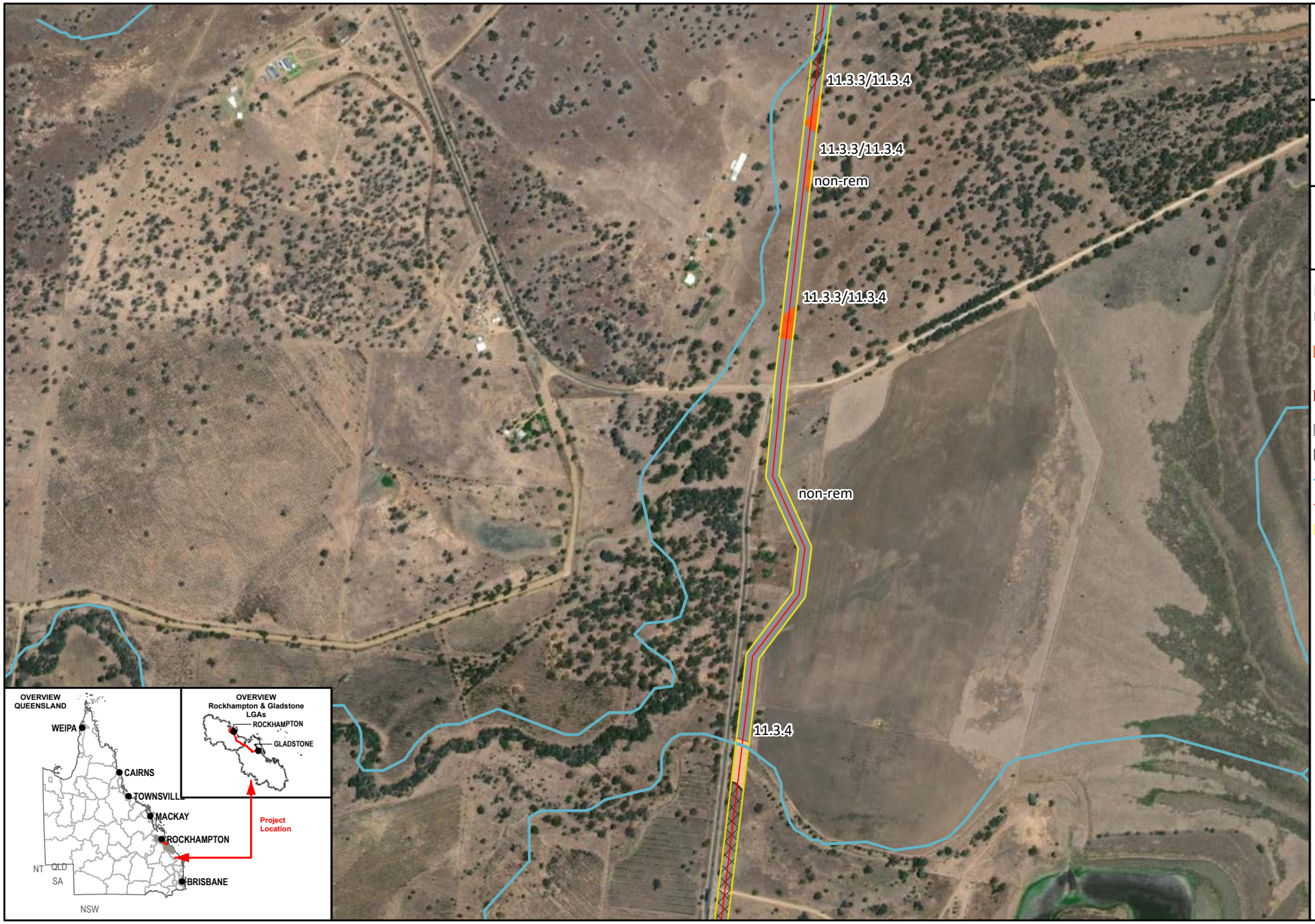
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-1a
Field Verified REs
Within the Northern Section Study Area
000-G-MAP-2418 Version:3 Date:2022/09/19



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Queensland Government

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Member of the Surbana Jurong Group

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Legend

Field verified REs

- Category A or B area containing of concern
- Category C or R area containing of concern
- Non-remnant
- Unverified Fields
- Waterways
- GSDA Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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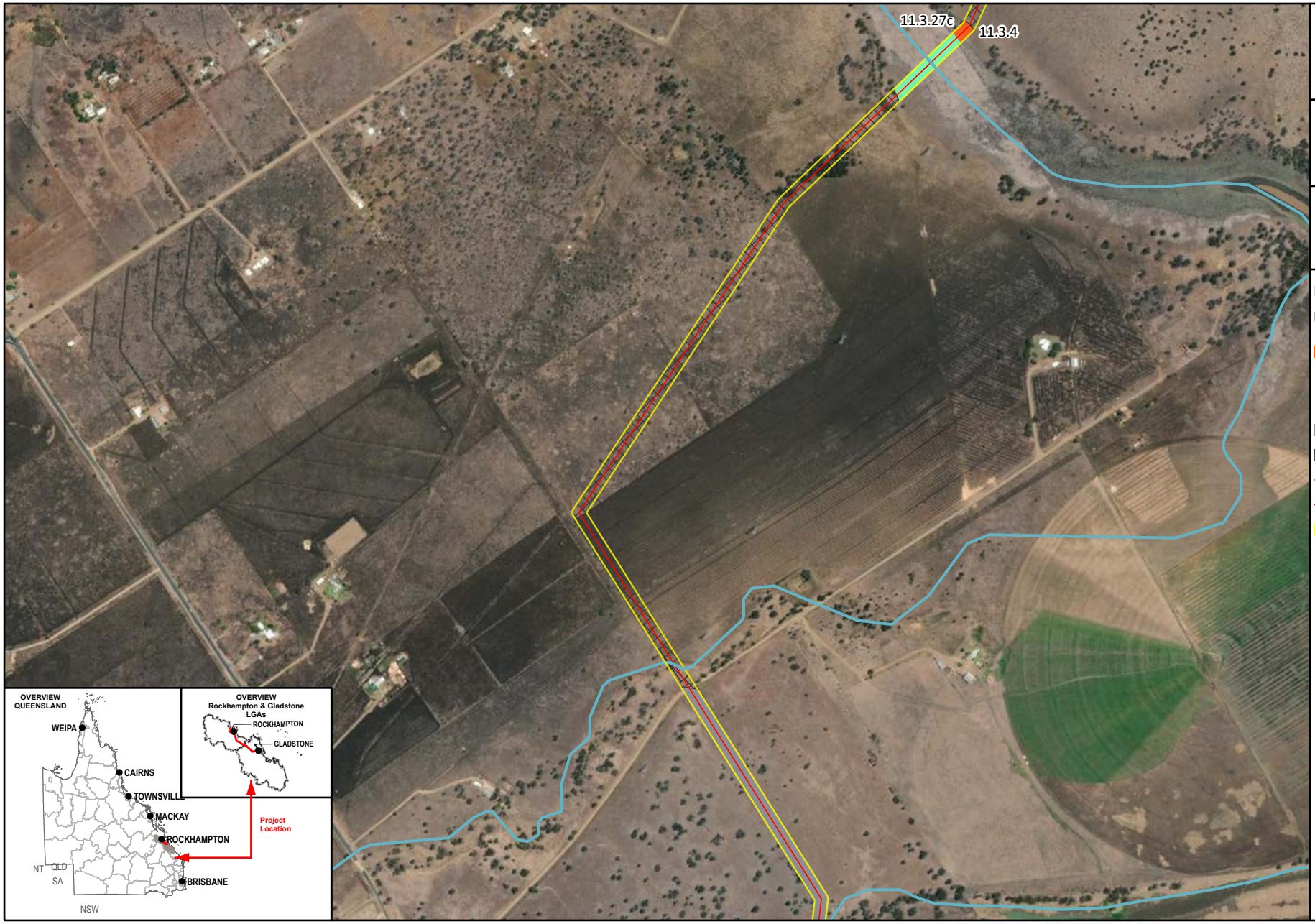
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-1b
Field Verified REs
Within the Northern Section Study Area
000-G-MAP-2418 Version:3 Date:2022/09/19



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Legend

Field verified REs

- Category A or B area containing of concern
- Category A or B area that is least concern
- Non-remnant
- Unverified Fields
- Waterways
- GSDA Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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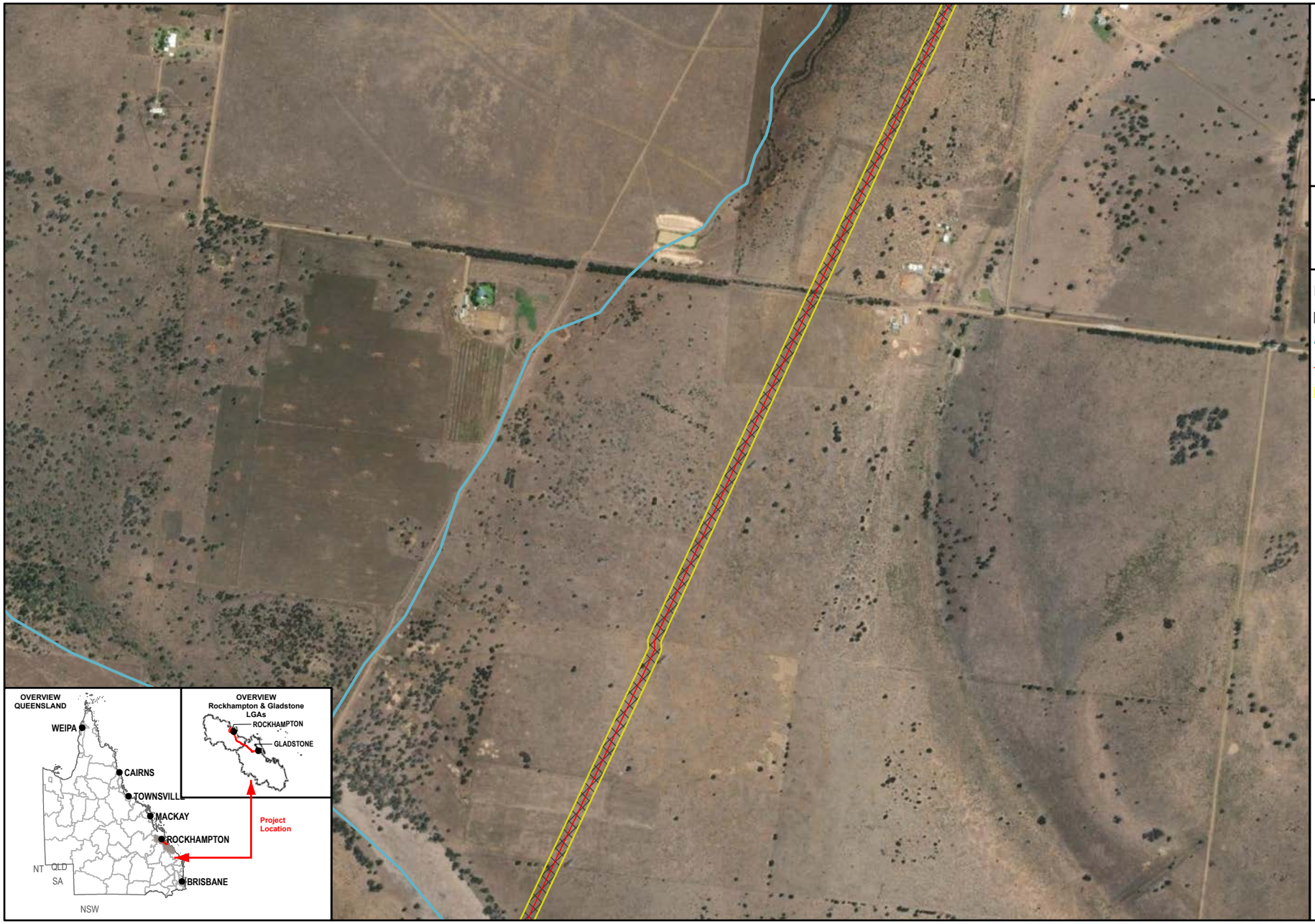
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-1c
Field Verified REs
Within the Northern Section Study Area
000-G-MAP-2418 Version:3 Date:2022/09/19



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- Unverified Fields
- Waterways
- GSDA Pipeline Alignment
- Study Area

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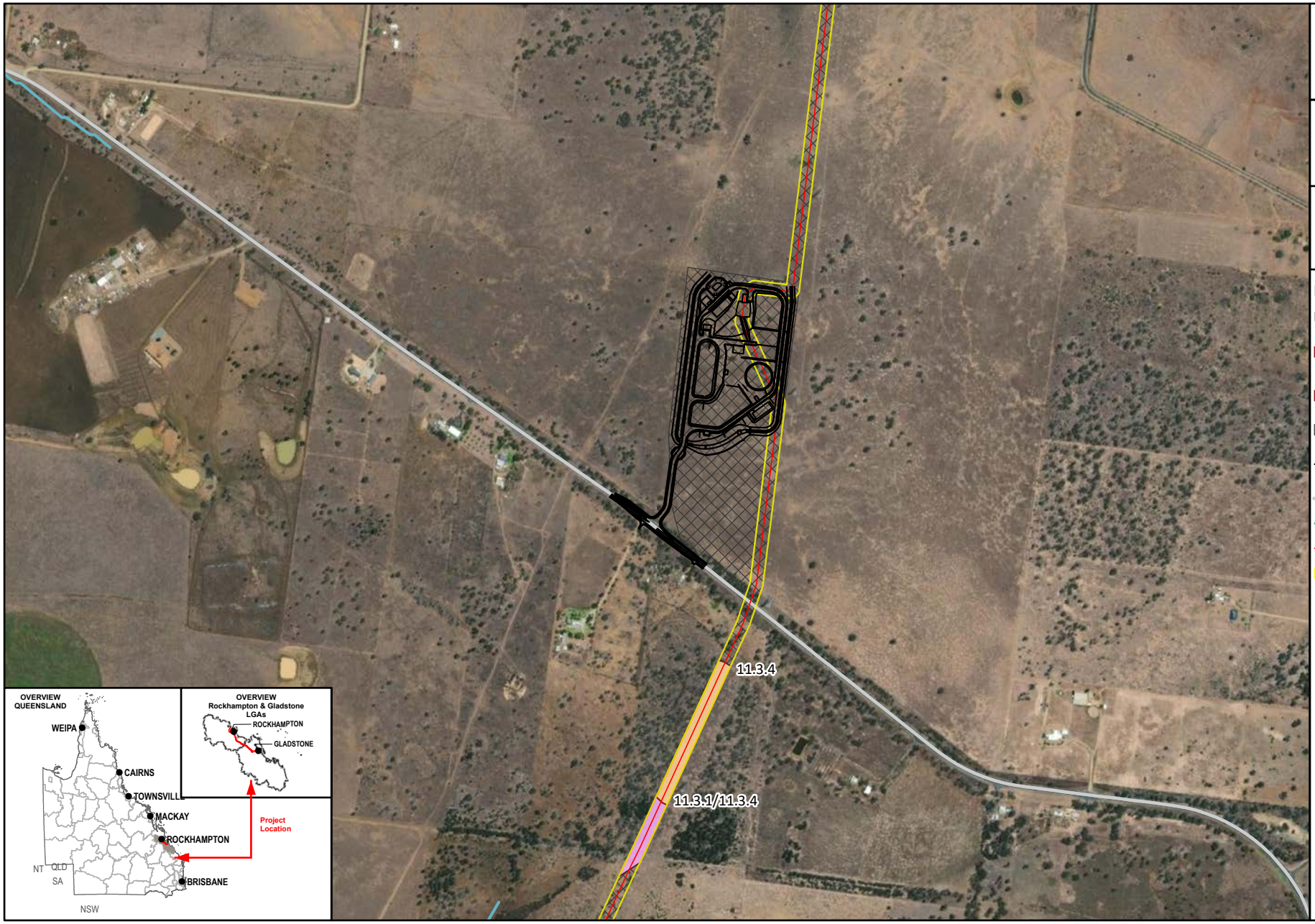
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-1d
Field Verified REs
Within the Northern Section Study Area

000-G-MAP-2418 Version:3 Date:2022/09/19



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Field verified REs

- Category C or R area containing endangered
- Category C or R area containing of concern
- Unverified Fields
- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
- Waterways
- GSDA Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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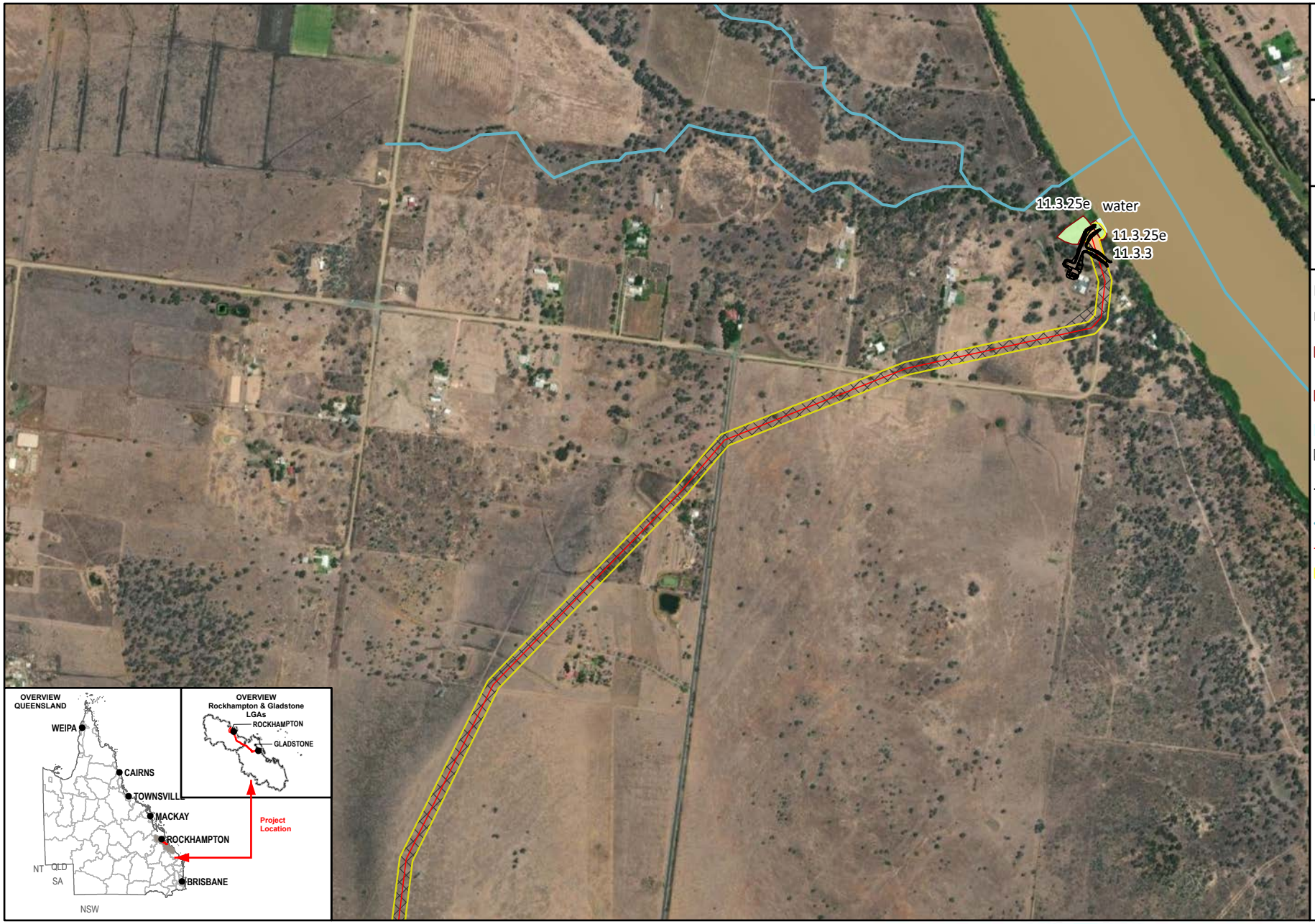
Figure 5-1e
Field Verified REs
Within the Northern Section Study Area
000-G-MAP-2418 Version:3 Date:2022/09/19



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Legend

Field verified REs

- Category C or R area containing of concern
- Category C or R area that is least concern
- Water
- Unverified Fields
- Fitzroy River Intake and Pump Station Layout
- Waterways
- GSDA Pipeline Alignment
- Study Area

Data Sources:
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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-1f
Field Verified REs
Within the Northern Section Study Area
000-G-MAP-2418 Version:3 Date:2022/09/19

5.3 Conservation significant flora

5.3.1 Desktop assessment results

5.3.1.1 Protected plants trigger areas

Two high-risk areas under the protected plants flora survey trigger mapping intersect the Northern Section pipeline alignment within the locality of Nine Mile (Figure 5-2). Results of the protected plant surveys are presented in a standalone flora survey report, included as Appendix D. A protected plants Exemption Notification was submitted to DES via email on 3 August 2022. Numerous trigger areas are also mapped within the broader desktop search extent, predominantly within remnant vegetation (Appendix A).

5.3.1.2 Previous field surveys

No conservation significant flora species were recorded in the Northern Section study area during the previous field survey (Arup 2008).

5.3.1.3 Database searches

Ten conservation significant flora species have been predicted to occur from the PMST search within the Northern Section desktop search extent (Table 5-5). Four conservation significant flora species have historical records from the WildNet and Atlas of Living Australia (ALA) databases within the Northern Section desktop search extent (Table 5-5). Table 5-5 also identifies threatened flora species that were identified as controlling provisions under the EPBC approval.

Table 5-5 Conservation significant flora species historical records (post 1980)

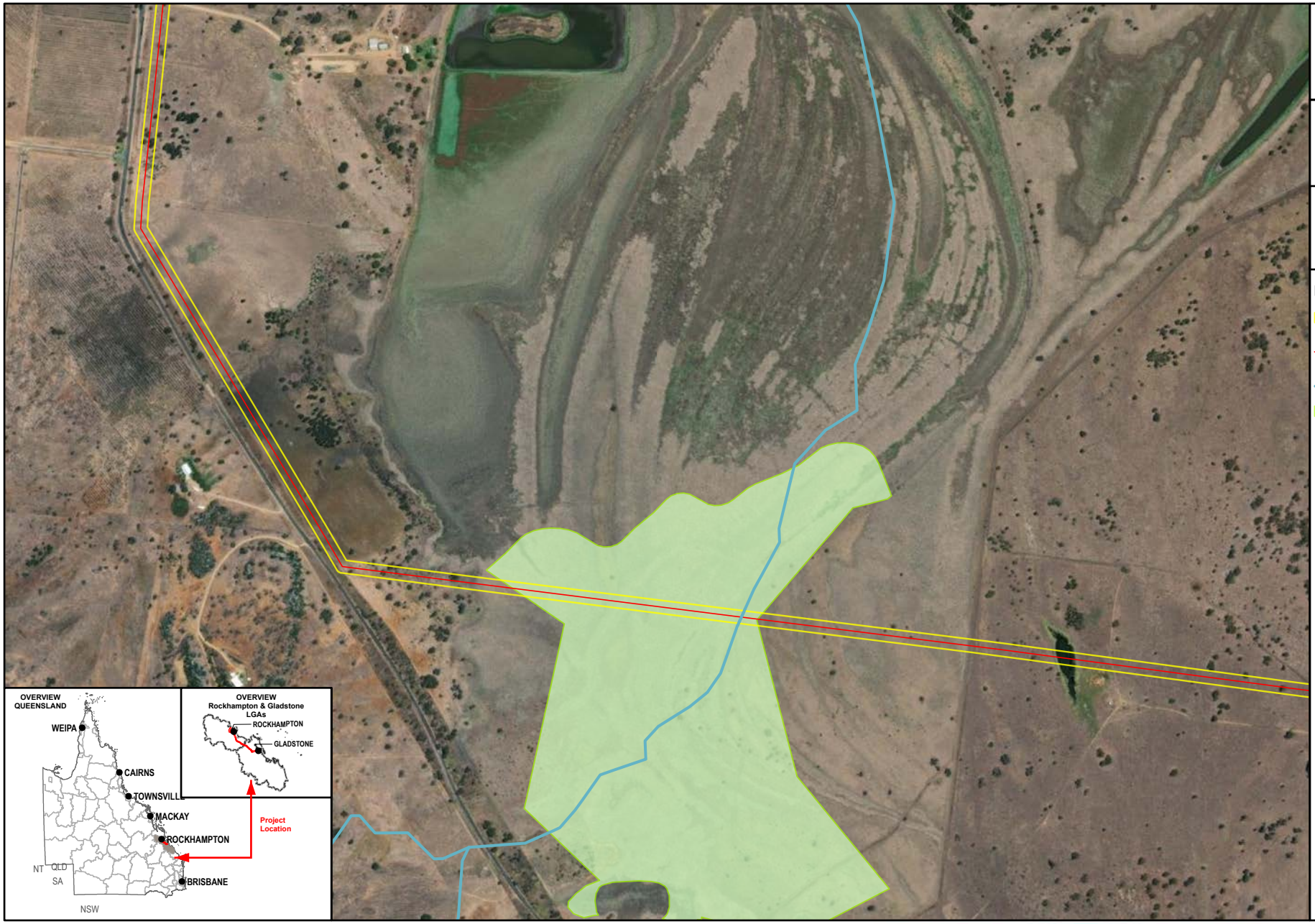
Scientific name	Status		Source	WN Records (post 1980)	Nearest Record to ROW	EPBC Approval
	EPBC Act	NC Act				
Bulbophyllum globuliforme	V	NT	PMST	-	>120 km	✓
Capparis humistrata	NL	E	WN	1	7.19 km	
Cossinia australiana	E	E	PMST	-	20.71 km	✓
Cupaniopsis shirleyana	V	V	PMST	-	79.49 km	✓
Cycas megacarpa	E	E	WN; PMST	1	7.54 km	✓
Cycas ophiolitica	E	E	WN; PMST	6	6.89 km	✓
Dichanthium setosum	V	LC	PMST	-	>230 km	
Eucalyptus raveretiana	V	LC	WN; PMST	20	8.44 km	✓
Marsdenia brevifolia	V	V	PMST	-	7.05 km	✓
Phaius australis	E	E	PMST	-	>200 km	
Samadera bidwillii	V	V	PMST	-	22.56 km	✓

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed. WN – WildNet; PMST – Protected Matters Search Tool.

5.3.2 Field survey results

5.3.2.1 Conservation significant species

Comprehensive surveys for conservation significant flora species were undertaken within sections of the pipeline alignment intersected by high-risk flora trigger areas. Opportunistic searches were also undertaken beyond the high-risk flora trigger areas. No conservation significant flora species were identified within the Northern Section study area during the field surveys. Results of the protected plant surveys completed in high-risk flora trigger areas (Figure 5-2) are presented in a standalone flora survey report, included as Appendix D. A protected plants Exemption Notification was submitted to DES via email on 3 August 2022.



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- Study Area
- Northern Section Pipeline Alignment
- Waterways
- High-risk Flora Trigger Areas

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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-2a
High-risk Flora Survey Trigger Mapping Within the Northern Section Desktop Search Area
000-G-MAP-2419 Version:3 Date:2022/09/12

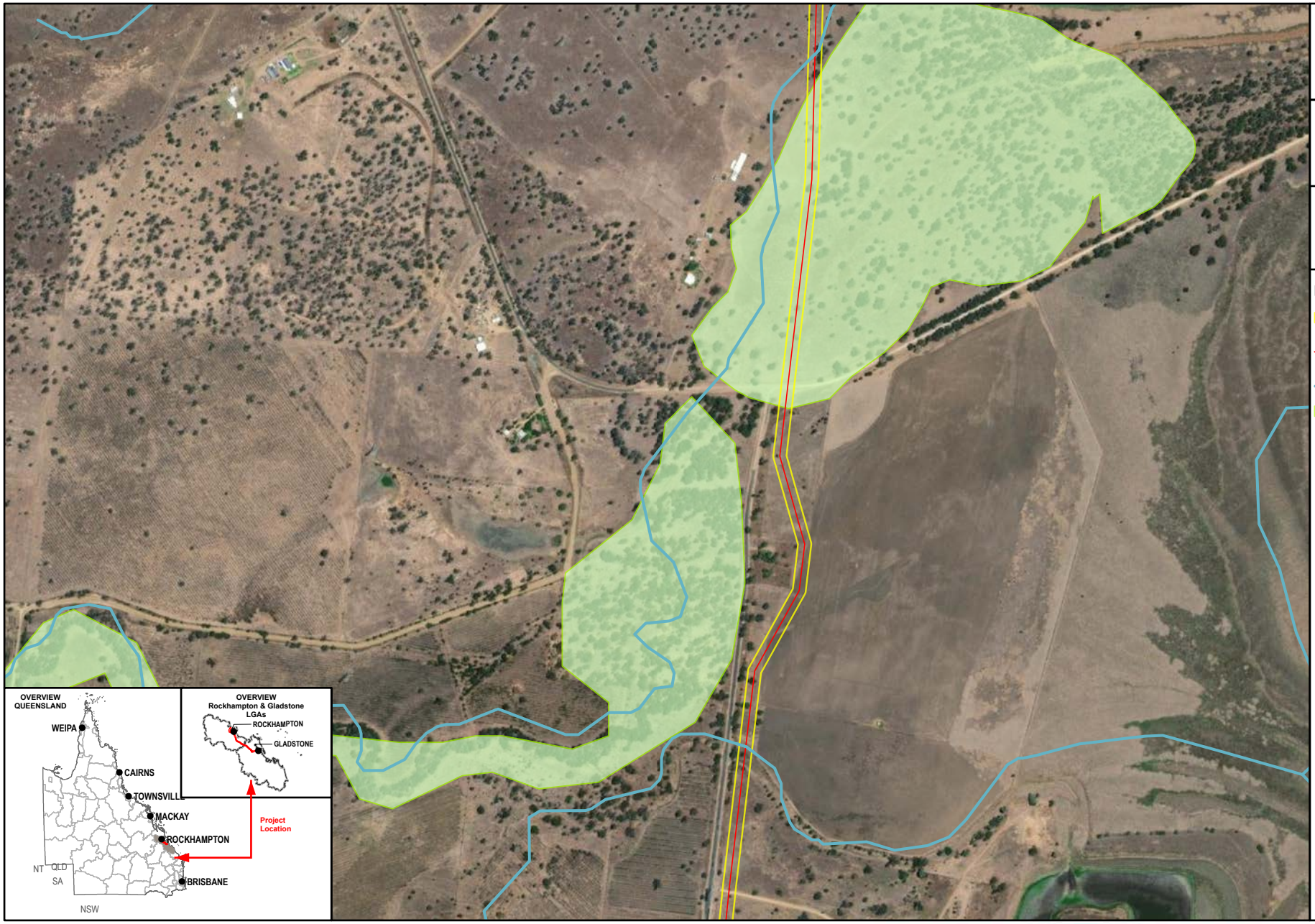

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Figure 5-2b
High-risk Flora Survey Trigger Mapping Within the Northern Section Desktop Search Area
000-G-MAP-2419 Version:3 Date:2022/09/12

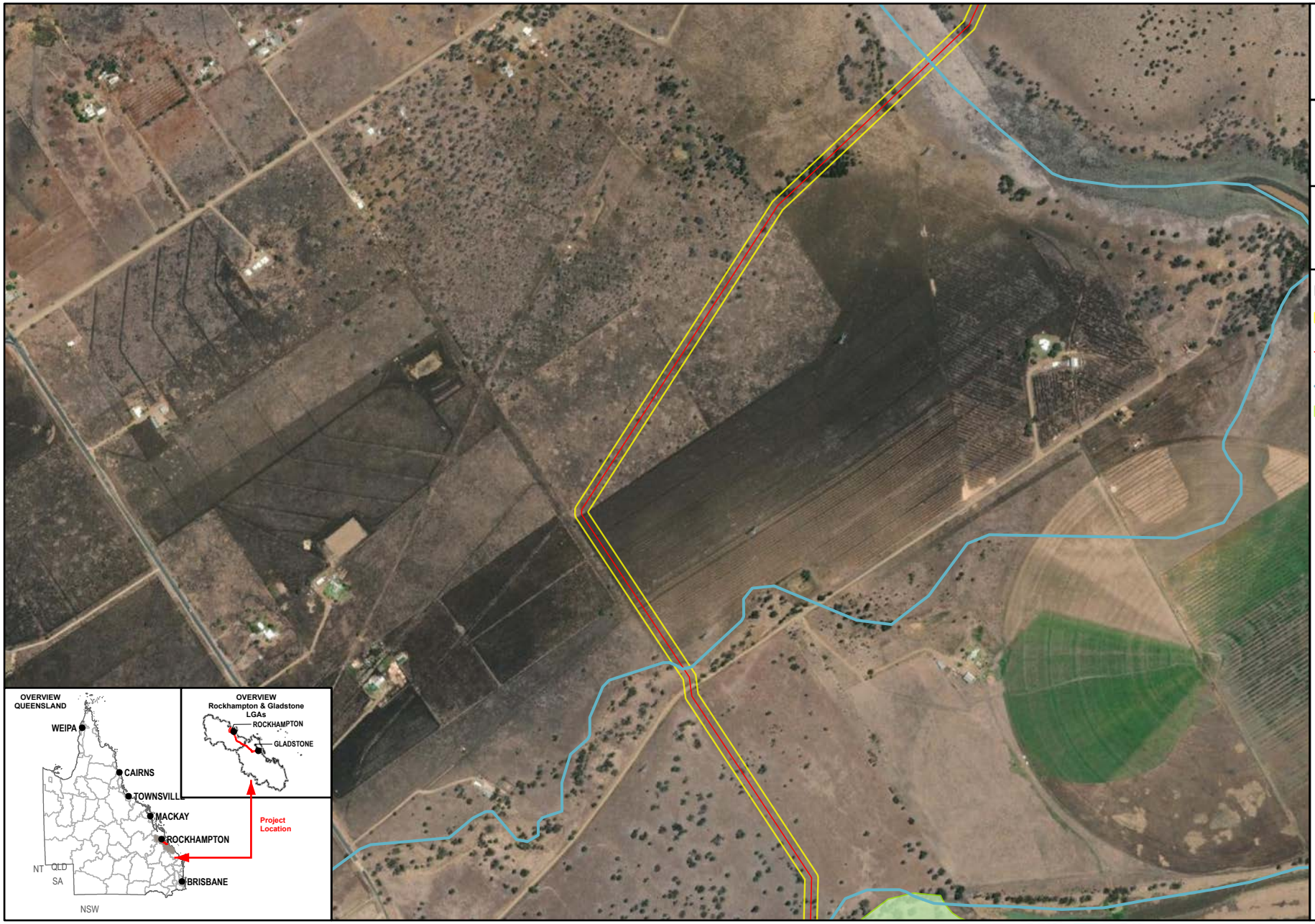

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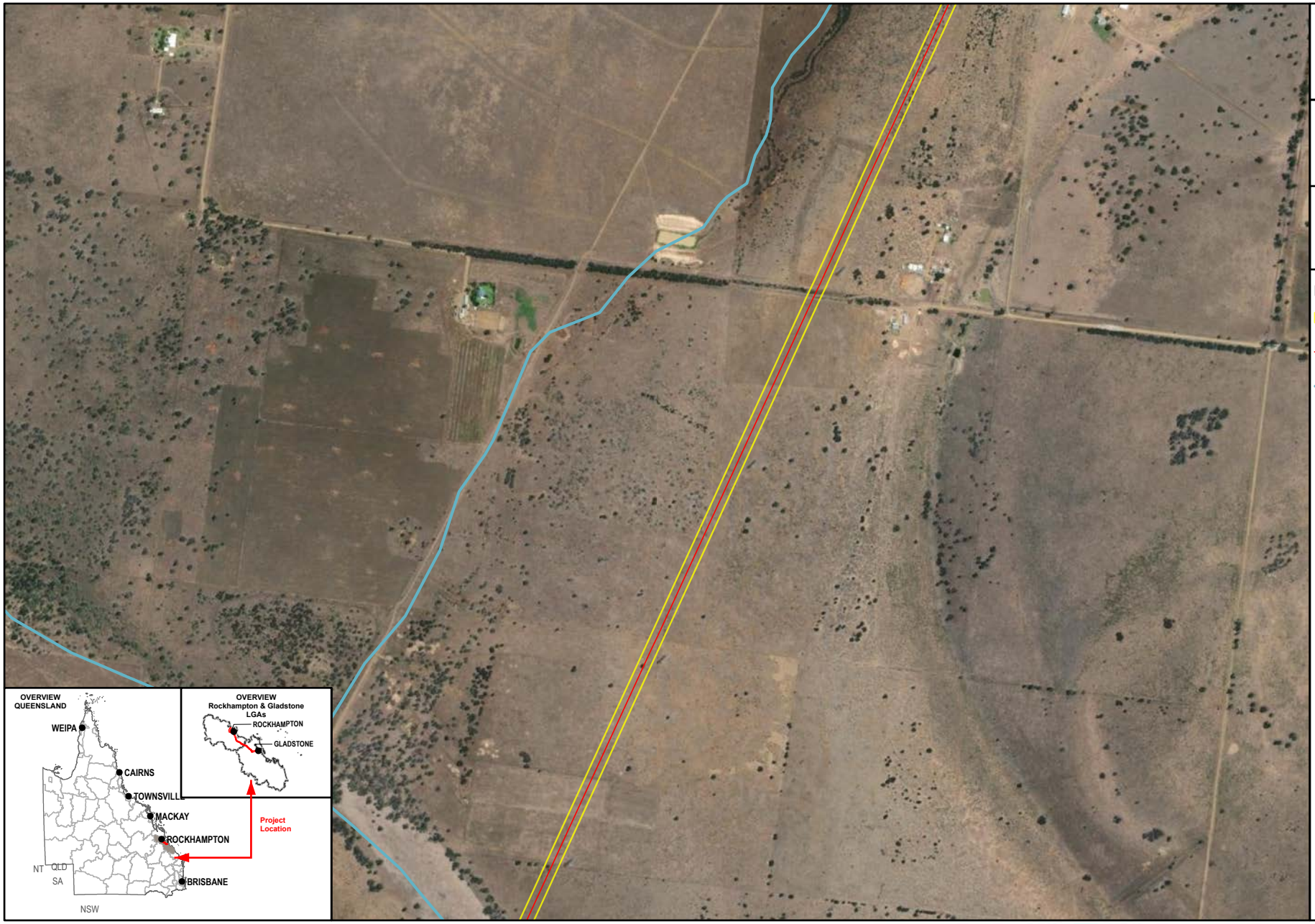
Figure 5-2c
High-risk Flora Survey Trigger Mapping Within the Northern Section Desktop Search Area
000-G-MAP-2419 Version:3 Date:2022/09/12



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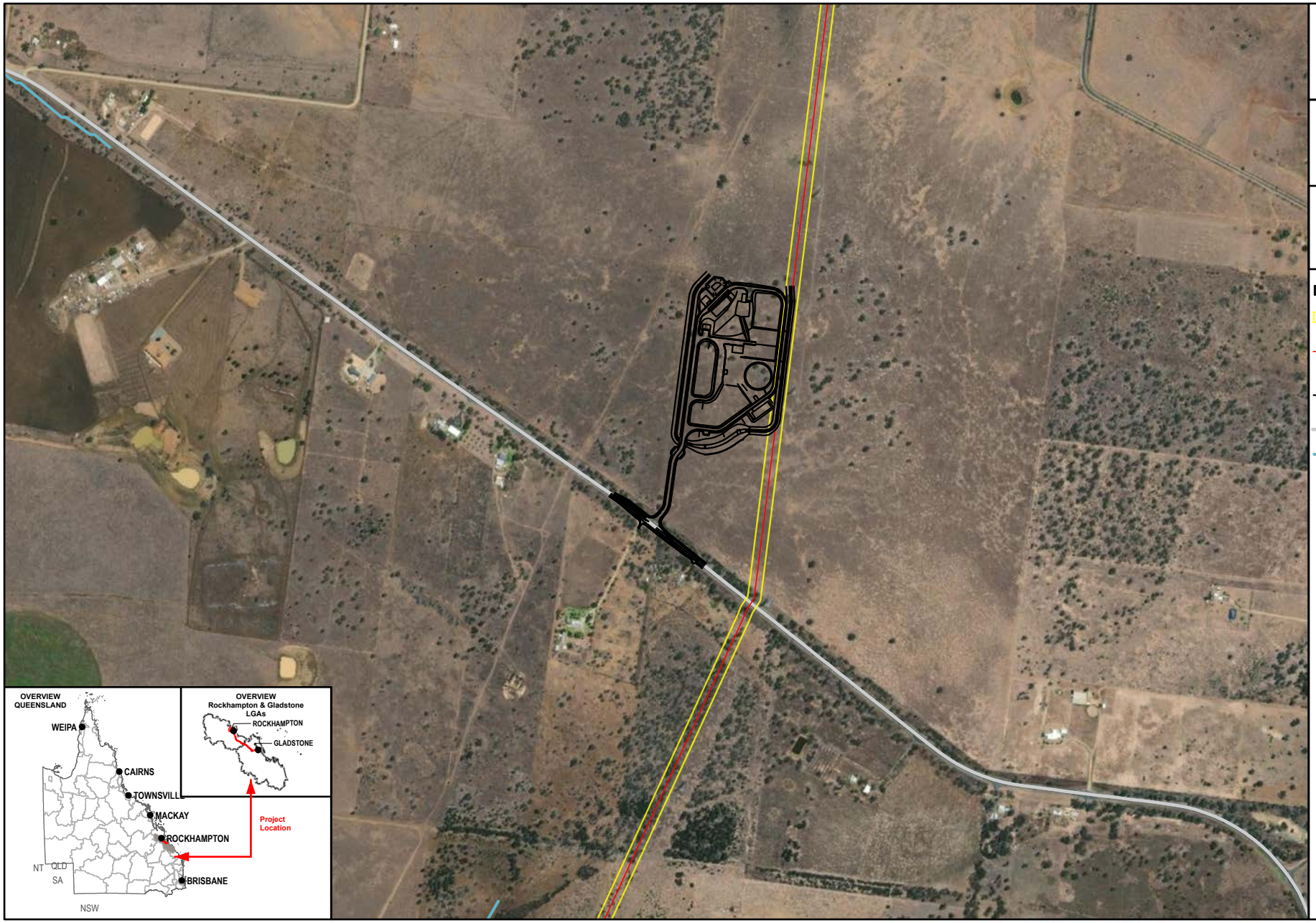

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- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
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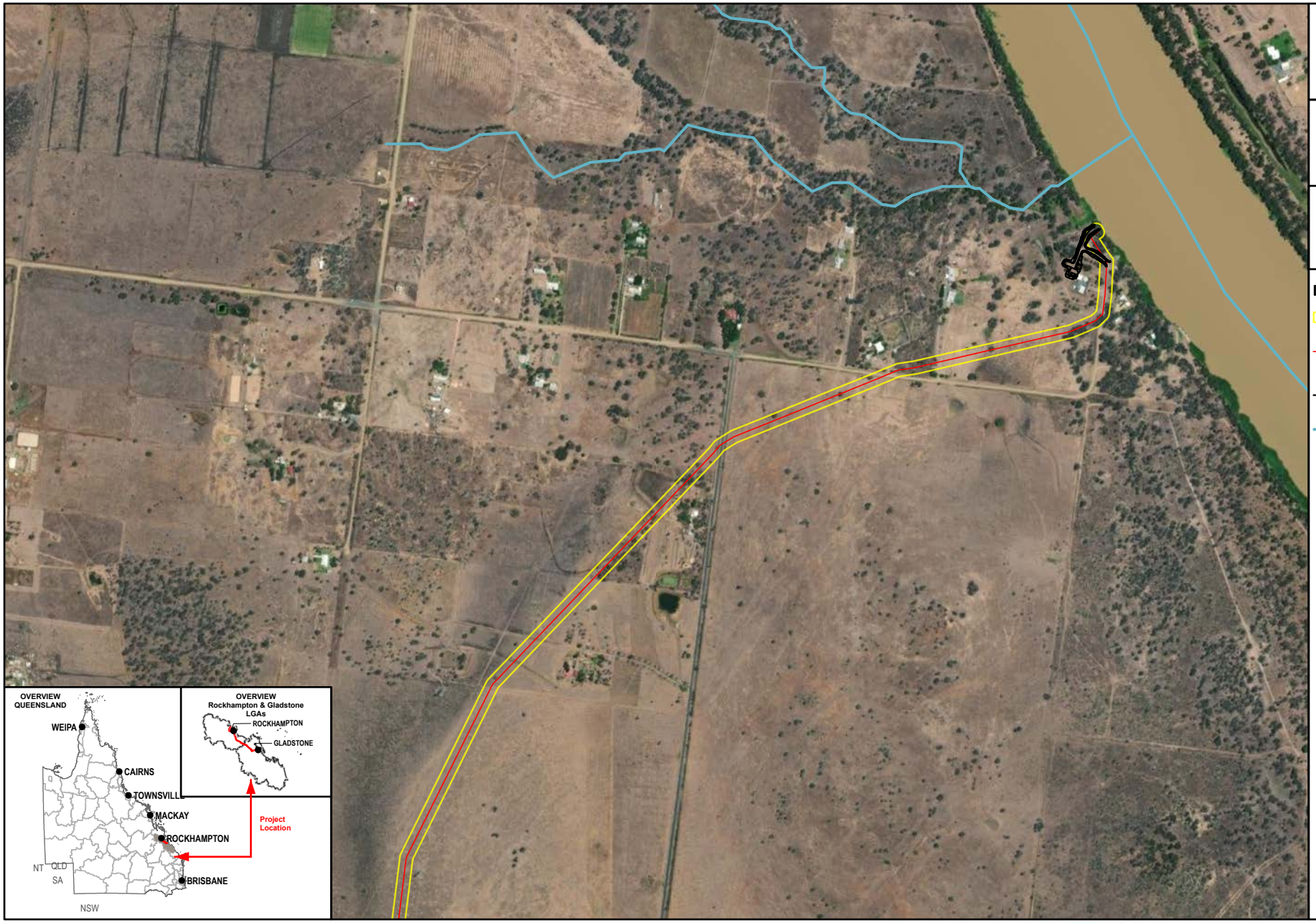

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Legend

- Study Area
- Northern Section Pipeline Alignment
- Fitzroy River Intake and Pump Station Layout
- Waterways

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Figure 5-2f
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000-G-MAP-2419 Version:3 Date:2022/09/12

5.4 Terrestrial fauna

5.4.1 Desktop assessment results

5.4.1.1 Threatened fauna species

The EPBC Act PMST database identified 28 threatened fauna species that have the potential to occur within the desktop search extent. State based searches (i.e. WildNet, Species Profile Search and Biomaps) identified 20 threatened fauna species that have been historically recorded within the desktop search extent. Note that marine species have been addressed in Section 5.6.

In aggregate, the searches identified 32 State and/or Federal threatened fauna species that are either predicted to occur or have been confirmed as occurring, within the desktop search extent. This comprised 18 birds, eight mammals and six reptiles. Some historical records identified within the desktop search extent are classified and therefore the exact location of these records within the search extent are unknown. The PMST and WildNet desktop search results are provided in Appendix A and summarised in Table 5-6.

Table 5-6 also identifies seven threatened fauna species that were identified as controlling provisions at the time of the EPBC approval.

Table 5-6 Threatened fauna species identified within the desktop search extent

Scientific name	Common name	Status		Source	Records	Nearest record to ROW	EPBC Approval
		EPBC Act	NC Act				
Birds							
Botaurus poiciloptilus	Australasian bittern	E	E	PMST	-	-	
Calidris ferruginea	Curlew sandpiper	CE, Mig	CE	WN; PMST	7	3.2 km	
Cyclopsitta diophthalma coxeni	Coxen's fig-parrot	E	E	PMST	-	-	
Epthianura crocea macgregori	Yellow chat (Dawson)	CE	E	WN; PMST	1	*	✓
Erythrotriorchis radiatus	Red goshawk	V	E	WN; PSMT	2	6.0 km	✓
Falco hypoleucos	Grey falcon	V	V	PMST	-	8.4 km	
Geophaps scripta scripta	Squatter pigeon (southern)	V	V	WN; PMST	2	100 m	✓
Grantiella picta	Painted honeyeater	V	V	PMST	-	-	
Hirundapus caudacutus	White-throated needletail	V, Mig	V	WN; PMST	3	5.0 km	
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	V	V	WN; PMST	4	2.0 km	
Lophochroa leadbeateri	Major Mitchell's cockatoo	NL	V	WN	1	*	
Macronectes giganteus	Southern giant petrel	E, Mig	E	PMST	-	-	
Neochmia ruficauda ruficauda	Star finch (eastern, southern)	E	E	WN; PMST	1	*	
Numenius madagascariensis	Eastern curlew	CE, Mig	E	PMST	-	-	
Poephila cincta cincta	Black-throated finch (southern)	E	E	WN; PMST	2	9.0 km	

Scientific name	Common name	Status		Source	Records	Nearest record to ROW	EPBC Approval
		EPBC Act	NC Act				
Rostratula australis	Australian painted-snipe	E	E	WN; PMST	4	*	
Thalassarche impavida	Campbell albatross	V, Mig	LC	PMST	-	-	
Turnix melanogaster	Black-breasted button-quail	V	V	WN; PMST	1	5.0 km	
Mammals							
Chalinolobus dwyeri	Large-eared pied bat	V	V	PMST	-	-	
Dasyurus hallucatus	Northern quoll	E	LC	WN; PMST	4	0.5 km	
Macroderma gigas	Ghost bat	V	E	WN; PMST	1	*	
Nyctophilus corbeni	Corben's long-eared bat	V	V	PMST	-	-	
Ornithorhynchus anatinus	Platypus	NL	SL	WN	4	3.8 km	
Petauroides volans	Greater glider (southern and central)	E	E	PMST	-	-	
Phascolarctos cinereus	Koala	E	E	WN; PMST	5	5.3 km	
Pteropus poliocephalus	Grey-headed flying-fox	V	LC	WN; PMST	3	9.22 km	✓
Reptiles							
Acanthophis antarcticus	Common death adder	NL	V	WN	1	770 m	
Delma torquata	Collared delma	V	V	PMST	-	-	✓
Denisonia maculata	Ornamental snake	V	V	WN; PMST	11	10.0 km	✓
Egernia rugosa	Yakka skink	V	V	WN; PMST	3	*	✓
Furina dunmalli	Dunmall's snake	V	V	PMST	-	-	
Hemiaspis damelii	Grey snake	NL	E	WN	7	5.4 km	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed;

WN – WildNet; PMST – Protected Matters Search Tool.

* – location of historical record classified

5.4.1.2 Migratory species

The desktop searches (i.e. PMST, WildNet, Species Profile Search and Biomaps) identified 30 migratory species that have the potential to occur within the desktop search extent (Table 5-7). The PMST and WildNet desktop search results of migratory species are provided in Appendix A and summarised in Table 5-7. Migratory species listed as threatened under the EPBC Act and NC Act have also been included in Table 5-7.

At the time of the EPBC Referral and EPBC approval, migratory species were not identified as controlling provisions.

Table 5-7 Migratory species identified within the desktop search extent

Scientific name	Common name	Status		Source	Records
		EPBC Act	NC Act		
Actitis hypoleucos	Common sandpiper	Mig	SL	PMST	-
Apus pacificus	Fork-tailed swift	Mig	SL	WN; PMST	7
Calidris acuminata	Sharp-tailed sandpiper	Mig	SL	WN; PMST	28
Calidris ferruginea	Curlew sandpiper	CE, Mig	CE	PMST	-
Calidris melanotos	Pectoral sandpiper	Mig	SL	PMST	-
Calonectris leucomelas	Streaked shearwater	Mig	SL	PMST	-
Charadrius dubius	Little ringed plover	Mig	SL	WN	1
Chlidonias leucopterus	White-winged black tern	Mig	SL	WN	2
Cuculus optatus	Oriental cuckoo	Mig	SL	PMST	-
Gallinago hardwickii	Latham's snipe	Mig	SL	WN; PMST	37
Gelochelidon nilotica	Gull-billed tern	Mig	SL	WN	8
Hirundapus caudacutus	White-throated needletail	V, Mig	V	PMST	-
Hydroprogne caspia	Caspian tern	Mig	SL	WN	34
Limosa lapponica	Bar-tailed godwit	Mig	SL	PMST	-
Limosa limosa	Black-tailed godwit	Mig	SL	WN	22
Macronectes giganteus	Southern giant petrel	E, Mig	E	PMST	-
Monarcha melanopsis	Black-faced monarch	Mig	SL	WN; PMST	7
Monarcha trivirgatus	Spectacled monarch	Mig	SL	WN; PMST	5
Myiagra cyanoleuca	Satin flycatcher	Mig	SL	WN; PMST	1
Numenius madagascariensis	Eastern curlew	CE, Mig	E	PMST	-
Numenius minutus	Little curlew	Mig	SL	WN	1
Pandion haliaetus	Osprey	Mig	SL	WN; PMST	9
Plegadis falcinellus	Glossy ibis	Mig	SL	WN	63
Pluvialis fulva	Pacific golden plover	Mig	SL	WN	2
Rhipidura rufifrons	Rufous fantail	Mig	SL	WN; PMST	7
Sternula albifrons	Little tern	Mig	SL	WN	1
Thalassarche impavida	Campbell albatross	V, Mig	SL	PMST	-
Tringa brevipes	Grey-tailed tattler	Mig	SL	WN	1
Tringa nebularia	Common greenshank	Mig	SL	WN; PMST	6
Tringa stagnatilis	Marsh sandpiper	Mig	SL	WN	42

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed;

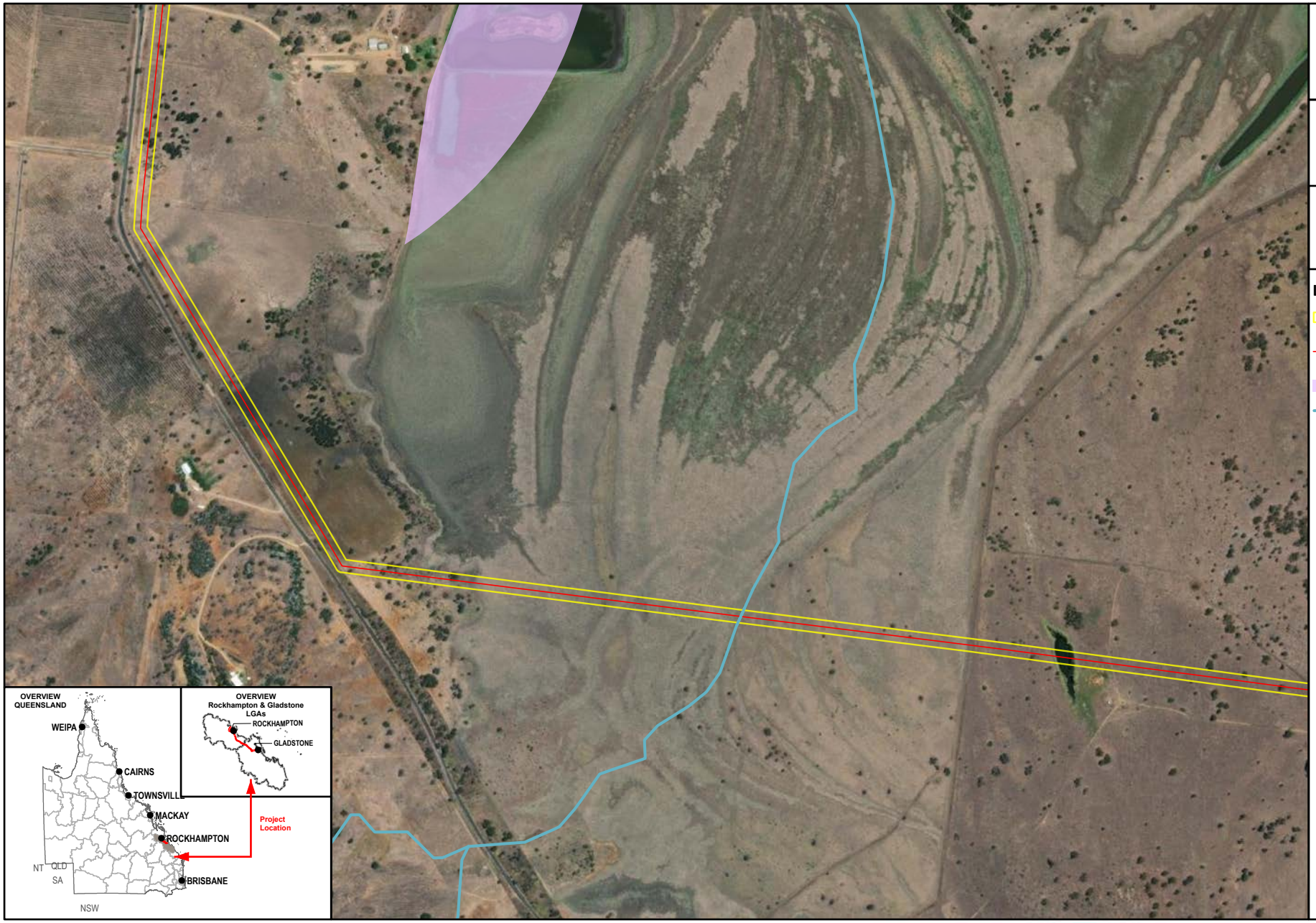
WN – WildNet; PMST – Protected Matters Search Tool.

5.4.1.3 Essential habitat

The Northern Section pipeline alignment intersects two areas of mapped essential habitat for conservation significant species listed under the NC Act. These areas include essential habitat for the ornamental snake (*Denisonia maculata*) and grey snake (*Hemiaspis damelii*) (Figure 5-3).

5.4.1.4 State and regional wildlife corridors

The Northern Section pipeline alignment crosses one regional riparian corridor which follows Lion Creek in a north-east direction, approximately 750 m north of Nine Mile Road (Figure 5-3). The Northern Section pipeline alignment also intersects one state riparian corridor which follows the Fitzroy River in a south-east direction (Figure 5-3).



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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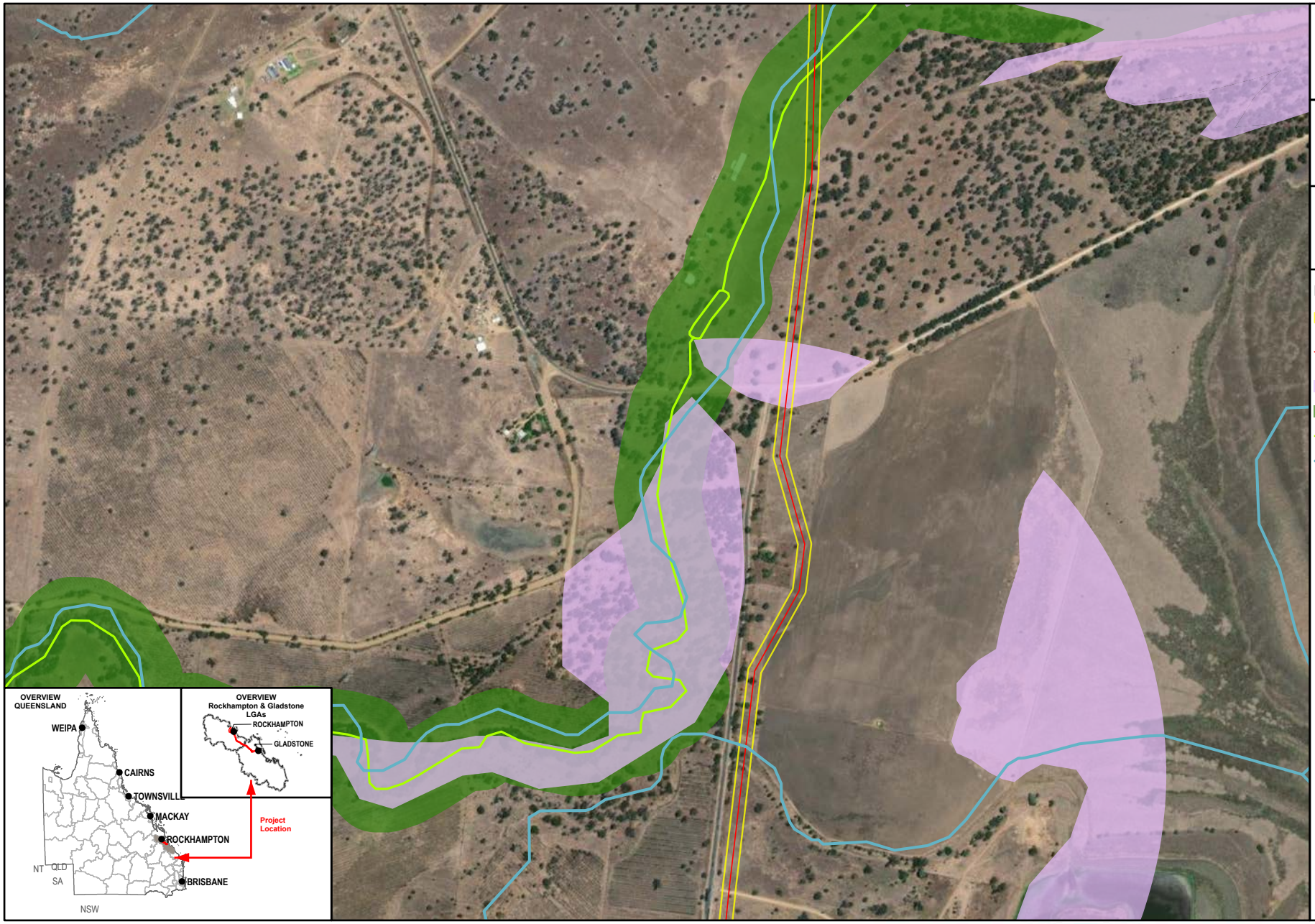
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3a
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Regional Wildlife Corriors
- Riparian Corridor Centrelines
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Fitzroy to Gladstone Pipeline
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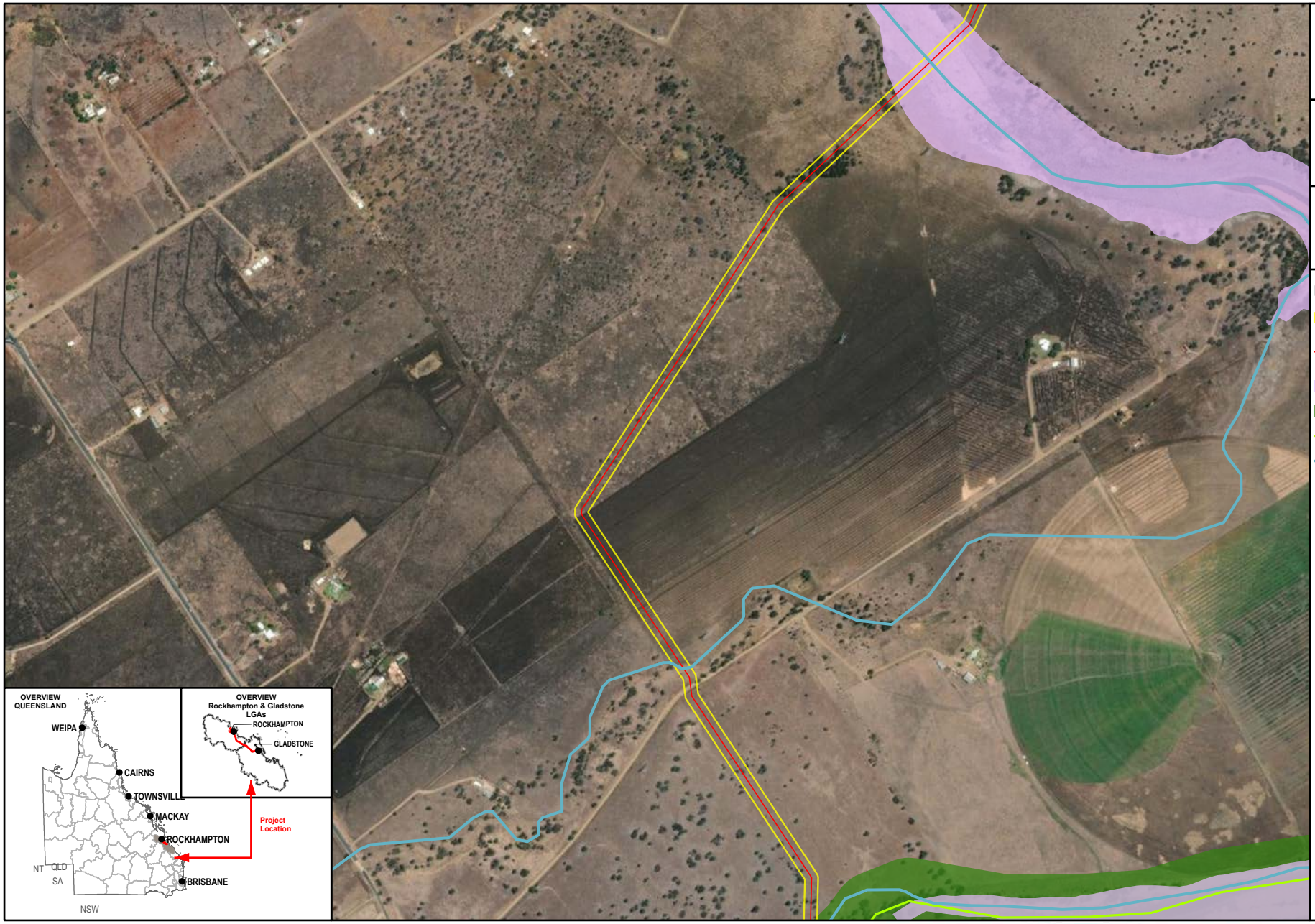
Figure 5-3b
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Regional Wildlife Corriors
- Riparian Corridor Centrelines
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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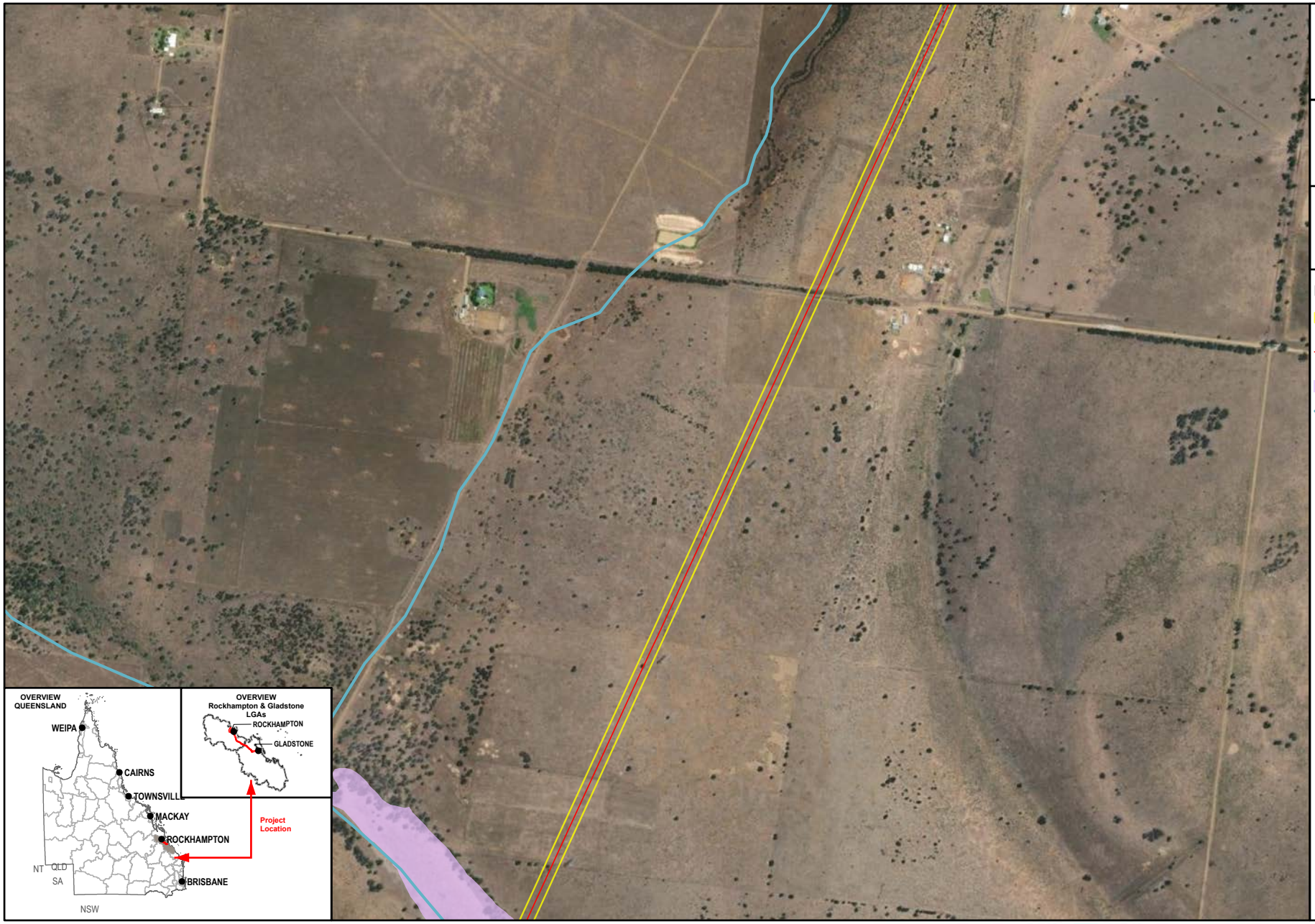
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3c
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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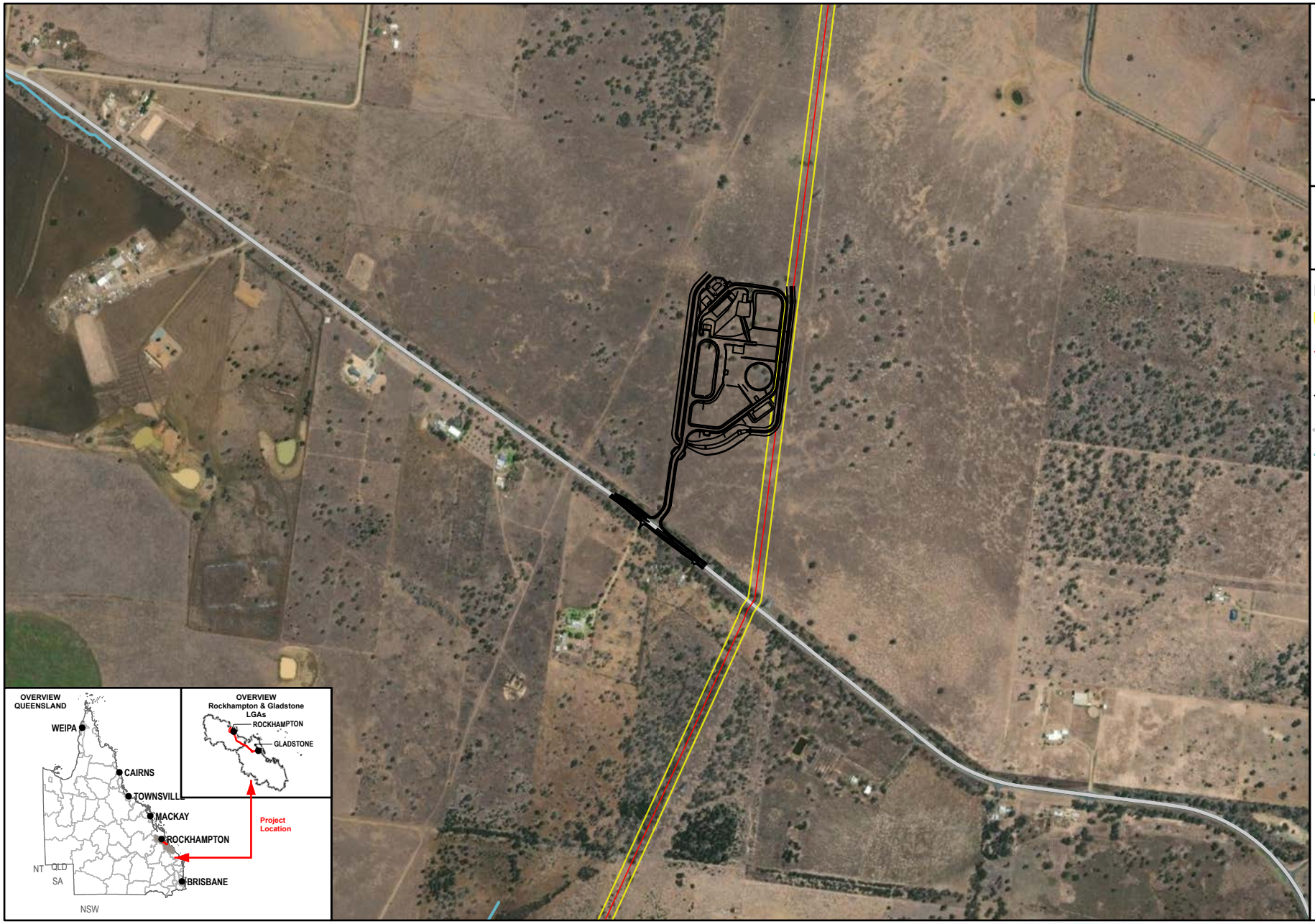
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3d
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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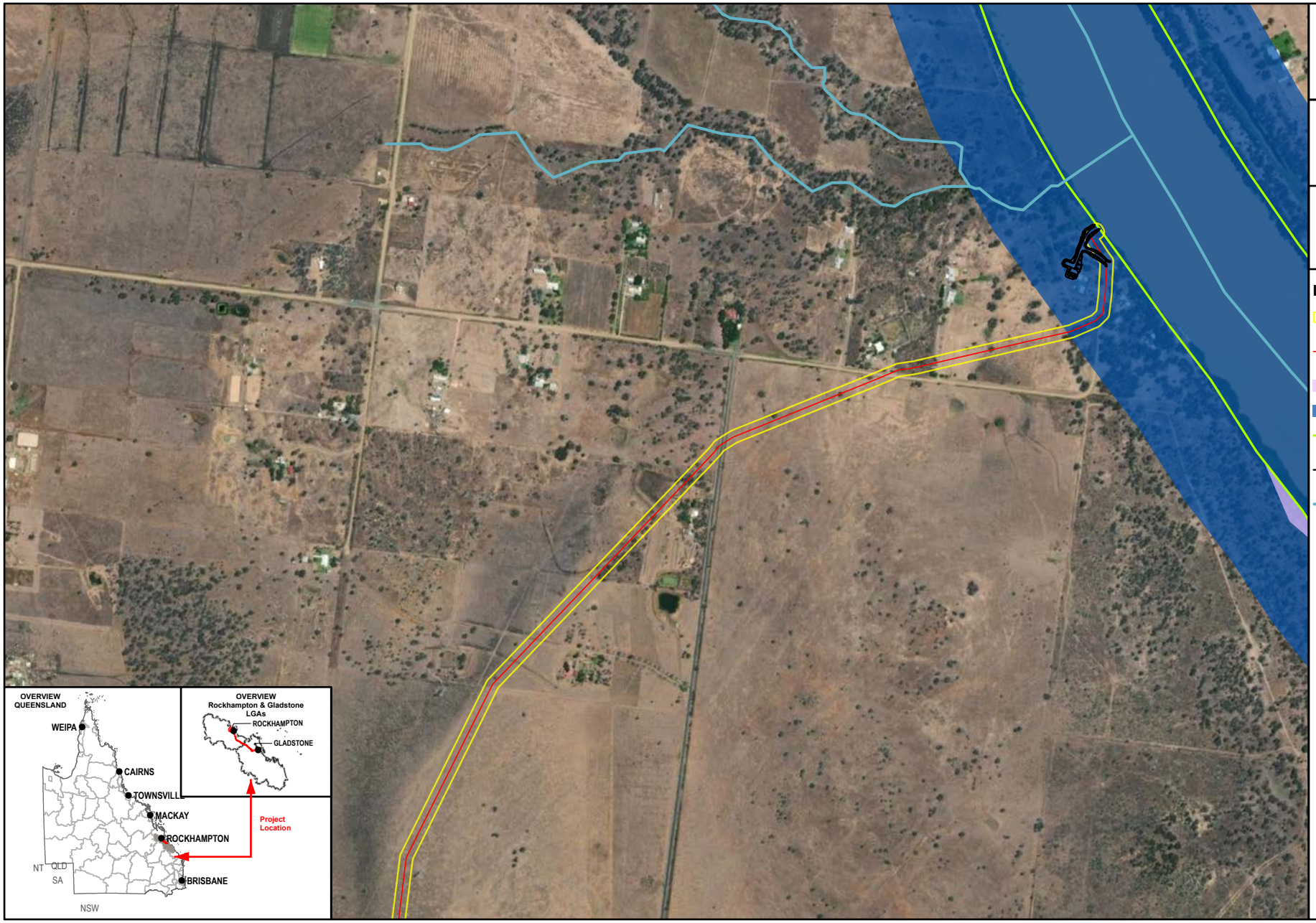
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3e
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- State Wildlife Corriors
- Riparian Corridor Centrelines
- Fitzroy River Intake and Pump Station Layout
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3f
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12

5.4.2 Field survey results

5.4.2.1 Terrestrial fauna survey methods

Survey methods undertaken within the Northern Section study area are listed below:

– Habitat assessments
– Bird surveys
– Active searches
– Hollow-bearing tree counts
– Nocturnal searches and spotlighting
– Opportunistic searches.

Details of each survey method is provided in Table 2-5.

5.4.2.2 Terrestrial fauna communities

A total of 51 terrestrial fauna species were recorded during the ecological surveys within the Northern Section study area. This comprised of 38 species of birds, three species of mammals, four species of reptiles and six species of amphibians. A description of each of the fauna groups is provided below. A list of fauna species encountered in the field survey is provided in Appendix H.

Birds

No conservation significant bird species were confirmed present within the Northern Section study area during the 2022 field surveys. The squatter pigeon (southern) (Section 7.3.1.1), white-throated needletail (Section 0) and Australian painted snipe (Section 7.3.1.4) are considered likely to occur.

A total of 38 bird species were recorded during the field surveys within the Northern Section study area. Compared to habitat types present within the GSDA and SGIC SDA study areas, the vegetation within the Northern Section study area was relatively simplistic with notably less woody vegetation. This lack of woodland habitats was reflected by fewer woodland bird species recorded within the Northern Section study area. Woodland associated bird species included the apostlebird (*Struthidea cinerea*), willie wagtail and the rainbow bee-eater.

Open areas provided foraging habitat for raptors including the whistling kite, and nankeen kestrel. Grassland bird specialists including the emu (*Dromaius novaehollandiae*) and golden-headed cisticola, were observed utilising both the native and exotic grassland elements of the landscape. Aquatic bird species were much more abundant within the Northern Section study area. Species such as the Australasian grebe (*Tachybaptus novaehollandiae*), Australian white ibis (*Threskiornis molucca*) and little pied cormorant (*Microcarbo melanoleucos*), were observed frequenting freshwater water bodies and their fringing riparian vegetation.

Mammals

No conservation significant mammal species were recorded within the Northern Section study area during the 2022 field surveys. The koala (Section 7.3.1.3) is considered likely to occur.

A total of three introduced mammal species were recorded within the Northern Section during the field surveys. These included the cat (*Felis catus*), European rabbit and feral pig. No remote cameras or anabat detectors were deployed within the Northern Section study area.

Reptiles

No conservation significant terrestrial reptile species were recorded within the Northern Section during the 2022 field surveys. No conservation significant terrestrial reptiles are considered likely to occur. More information is detailed in the likelihood of occurrence assessment in Appendix E.

Four reptile species were identified within the Northern Section study area. Reptile species recorded during the field surveys included dubious dtella*,* Bynoe's gecko*,* eastern bearded dragon and keelback *(Tropidonophis mairii*). Species observations were not recorded within the highly disturbed areas, with increased records sighted within woodland and riparian habitats.

Amphibians

No conservation significant frog species were recorded within the Northern Section during the 2022 field surveys. No conservation significant frogs are considered likely to occur.

A total of six amphibian species were recorded within the Northern Section study area during the field surveys. Amphibian species were almost exclusively recorded within fringing riparian vegetation and freshwater waterbodies. Species observed included the ornate burrowing frog (*Platyplectrum ornatum*), the cane toad, desert tree frog, green-striped burrowing frog (*Cyclorana alboguttata*), spotted marsh frog (*Limnodynastes tasmaniensis*) and green tree frog.

5.4.2.3 Conservation significant fauna species

No conservation significant fauna species were confirmed present during 2022 and Arup (2008) field surveys in the Northern Section study area. Survey effort undertaken for threatened fauna species within the study area is outlined in Table 2-6.

5.4.2.4 Essential habitat

Based on the field verified REs within the Northern Section study area, the mapped essential habitat for conservation significant species, identified in Section 5.4.1.3, did not change.

5.4.2.5 Habitat types

Historically, the landscape has been impacted by decades of disturbance from cattle grazing, vegetation clearing and intrusion by invasive weeds. These processes have altered local ecosystem composition and processes, reducing in places the density of native vegetation including eucalypts, and habitat for threatened species. Despite this, sizeable remnants of natural habitat have been retained.

Four broad habitat types were identified within the Northern Section during the field survey, including:

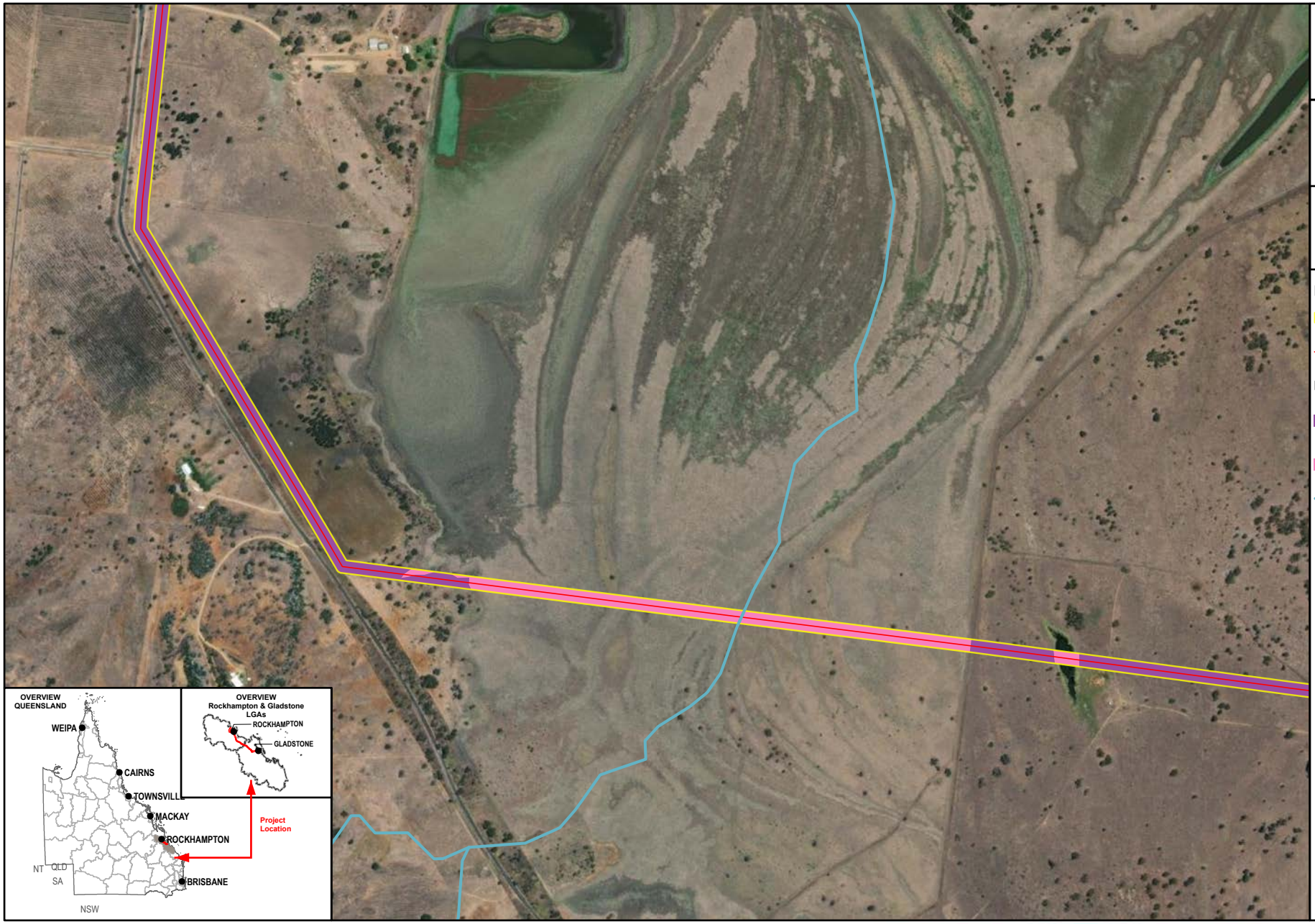
– Regrowth and scattered *Eucalyptus/Corymbia/Acacia* trees
– Freshwater waterbodies and seasonal wetlands
– Fringing riparian vegetation
– Cleared and highly modified landscapes.

Broad habitat types were defined and broadly mapped throughout the study area based on habitat assessments, DoR and field verified RE mapping, and aerial imagery. These habitat types were validated, and mapping refined, through the ecological field surveys. A representative photograph and description of each of these habitat types are provided in Table 5-8, together with identification of which habitat types provide potential habitat for fauna that are MNES and MSES. Habitat types identified within the study area are mapped in Figure 5-4.

Table 5-8 Habitat types recorded within the Northern Section study area

Habitat type	General characteristics and ecological values
Regrowth and scattered *Eucalyptus/Corymbia/Acacia* trees 	– Characterised by low to moderate density of mature and regrowth vegetation and is dominated by introduced pasture grasses. – Eucalypts provide blossoms and nesting opportunities for honeyeaters, and foraging habitat for flying-foxes. – Variety of koala food trees present, including *Eucalyptus tereticornis*, *E. populnea* and *E. crebra*. – Few hollow-bearing trees present. – Arboreal termite mounds with an excavated hole provide suitable nesting sites for bird species, including the laughing kookaburra, blue-winged kookaburra and forest kingfisher. – Shrub layer was very sparse, consisting of various shrub species and juvenile canopy species. The shrub layer that does exist provides some nesting and foraging resources for shrub-nesting birds such as finches. – Ground-level microhabitats (e.g. logs, woody debris, leaf litter) was very sparse. These microhabitats provide shelter and foraging microhabitat for ground-dwelling mammals and reptiles. – Ground cover was relatively dense with a mixture of introduced grasses herbaceous weeds. Grasses provide food resources for some granivorous birds and herbivorous mammals. – Small, isolated patches of *Casuarina cristata* occurred within the landscape.
	MNES and MSES species: – Potential foraging habitat for the squatter pigeon (southern) within 1 km (for breeding) and 3 km (for foraging) of a suitable, permanent or seasonal waterbody. – Potential foraging habitat for the koala.
Freshwater waterbodies and seasonal wetlands 	– Permanent to semi-permanent waterbodies (i.e. wetlands) provide foraging, breeding and nesting habitat for a range of waterbirds, such as the plumed whistling duck (*Dendrocygna eytoni*), Australian pelican (*Pelecanus conspicillatus*) and white-faced heron (*Egretta novaehollandiae*). – Within the context of the local environment, permanent waterbodies provide an important reliable source of drinking water for birds, macropods, reptiles and amphibians. These features are particularly important during times of drought. – Waterbodies support local food webs. A local abundance of invertebrates provides prey items for microbats and amphibians. In turn, these attract predators including snakes, waterbirds, and raptors. – Canopy and/or shrub layer was either very sparse or absent. – Wetlands contained dense sedges, rushes and grasses, as well as dead stags within small (<10 cm) hollows, ground logs and woody debris. – Low density of deep cracking clays present.
	MNES and MSES species: – Potential foraging habitat for the Australian painted-snipe and migratory bird species. – Potential foraging habitat for the squatter pigeon (southern).

Habitat type	General characteristics and ecological values
Fringing riparian vegetation 	– Fringing riparian vegetation along the banks of the Fitzroy River was dominated by Melaleuca sp. With associated Eucalyptus camaldulensis. – Eucalyptus and Melaleuca species provide blossoms and nesting opportunities for honeyeaters and parrots, and foraging habitat for flying-foxes. – Low density of small (< 10 cm) tree hollows along the banks of the Fitzroy River. Small hollow-bearing trees provide suitable habitat for microbats, snakes and tree frogs. – Fringing Melaleuca trees is moderately dense providing shelter and nesting habitat for finches, fairy-wrens and other shrub-dwelling birds. – Ground-level microhabitats, including coarse woody debris and dense ground cover, provide shelter and foraging habitat for a variety of reptile and frog species. – An important movement corridor for native mammals, birds, reptiles and amphibians, and are important foraging routes and flyways for microbats. – Important source of drinking water that is utilised by a variety of fauna species for months after the wet season has ended.
	MNES and MSES species: – Potential foraging habitat for the koala. – Potential foraging habitat for the squatter pigeon (southern). – Potential foraging habitat for migratory bird species.
Cleared and highly modified landscapes 	– Characterised by the absence or very low density of canopy and shrub vegetation and is dominated by introduced pasture grasses. – Very low density of koala food trees present (< 1 tree per ha), including *Eucalyptus, Corymbia* and *Acacia* species. – Introduced grass species provide food resources for some grassland birds, and herbivorous mammals such as macropods. – The open landscape provides foraging habitat for raptors and snakes. – Ground-level microhabitats have been historically cleared and lack structural complexity. – In most areas, the ground-layer has been heavily altered by cattle grazing and trampling, and intensive cultivation. These alterations have reduced the presence of suitable microhabitats for a range of fauna species.
	MNES and MSES species: – No suitable habitat for conservation significant fauna species.



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- Study Area
- Northern Section Pipeline Alignment

Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Freshwater Waterbodies and Seasonal Wetlands
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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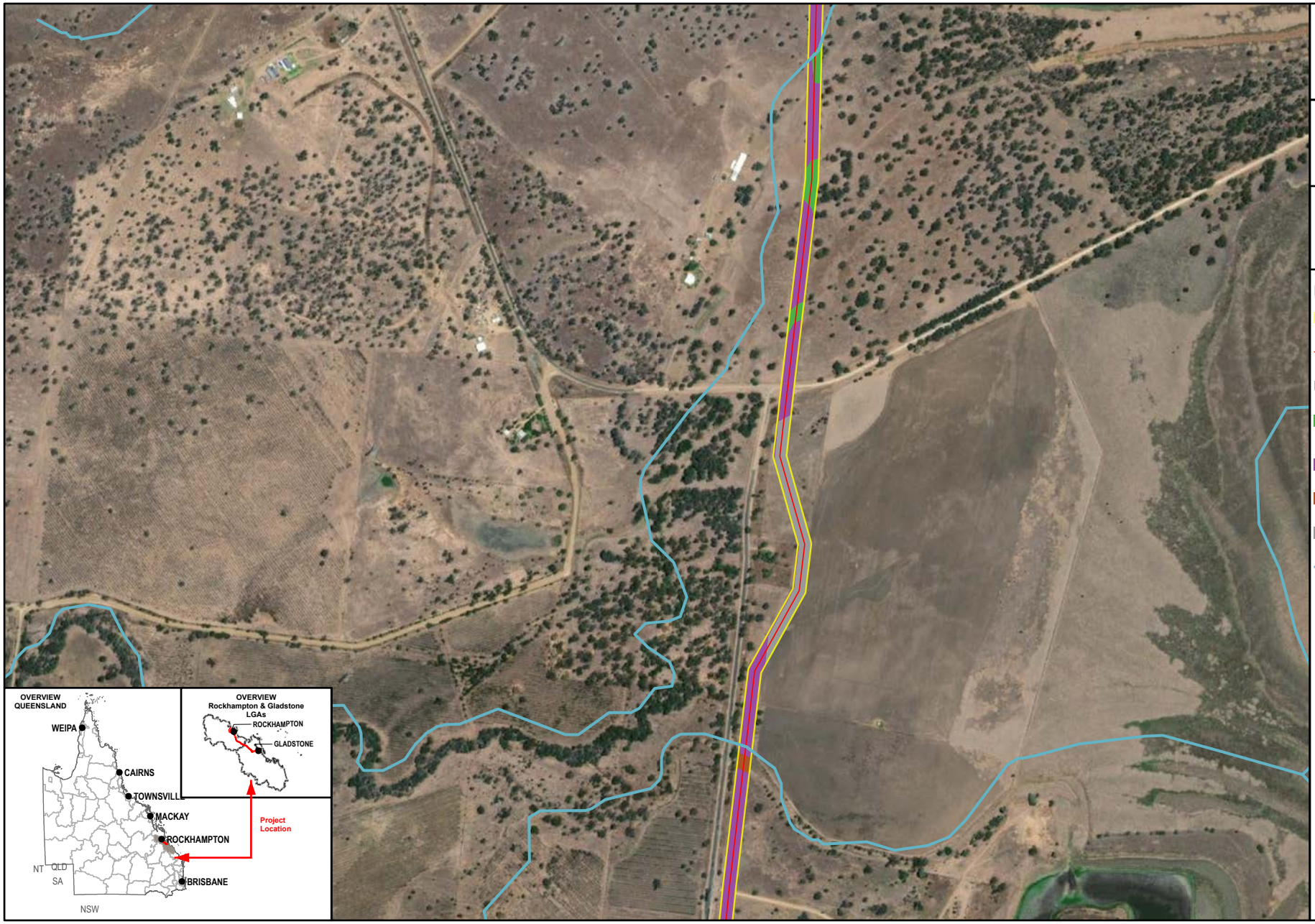
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-4a
Habitat Types Identified Within the Northern Section Study Area
000-G-MAP-2421 Version:3 Date:2022/09/12



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Legend

- Study Area
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Habitat Type

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Cleared and Highly Modified Landscapes
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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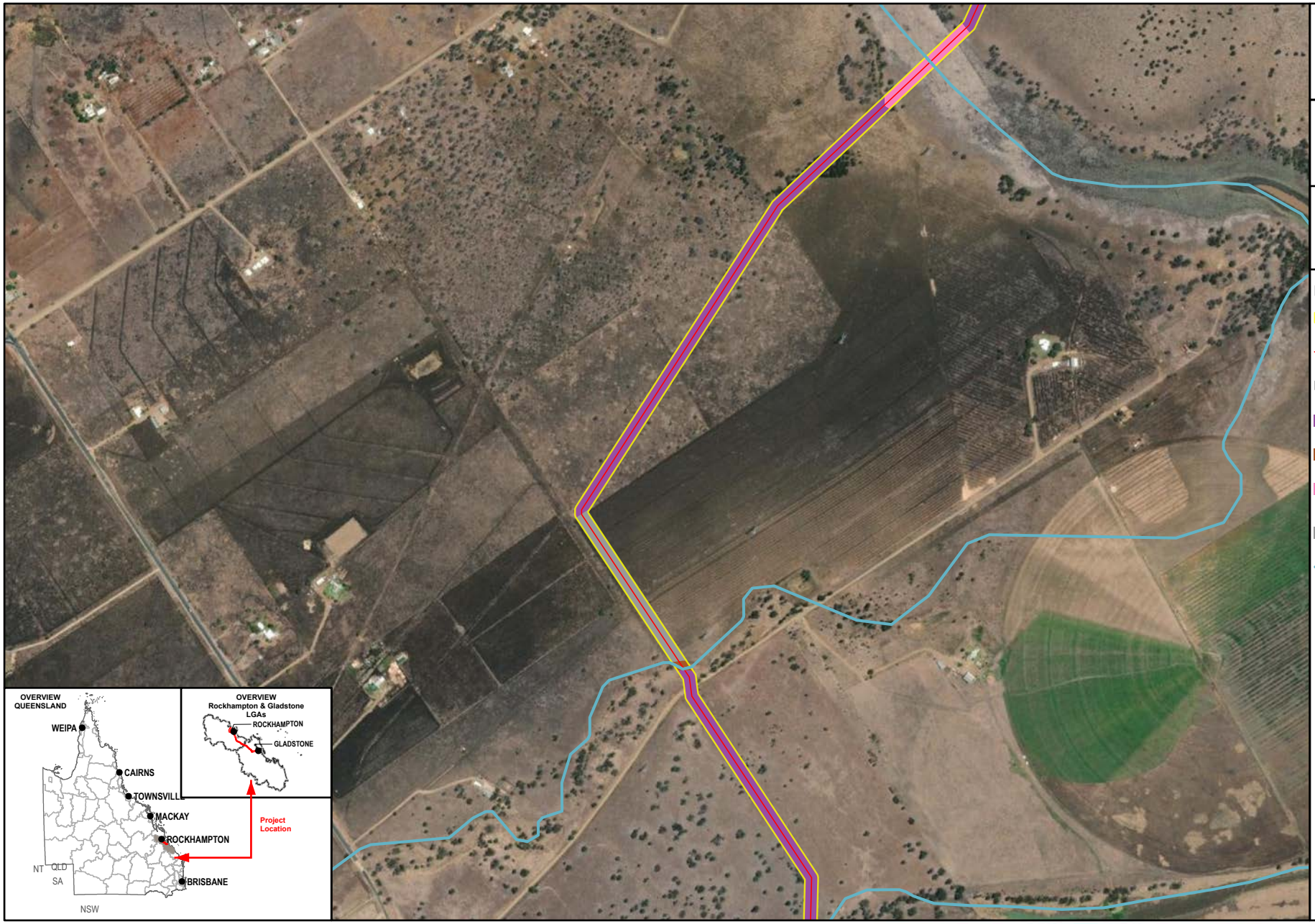
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-4b
Habitat Types Identified Within the Northern Section Study Area
000-G-MAP-2421 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment

Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Waterways

Data Sources:
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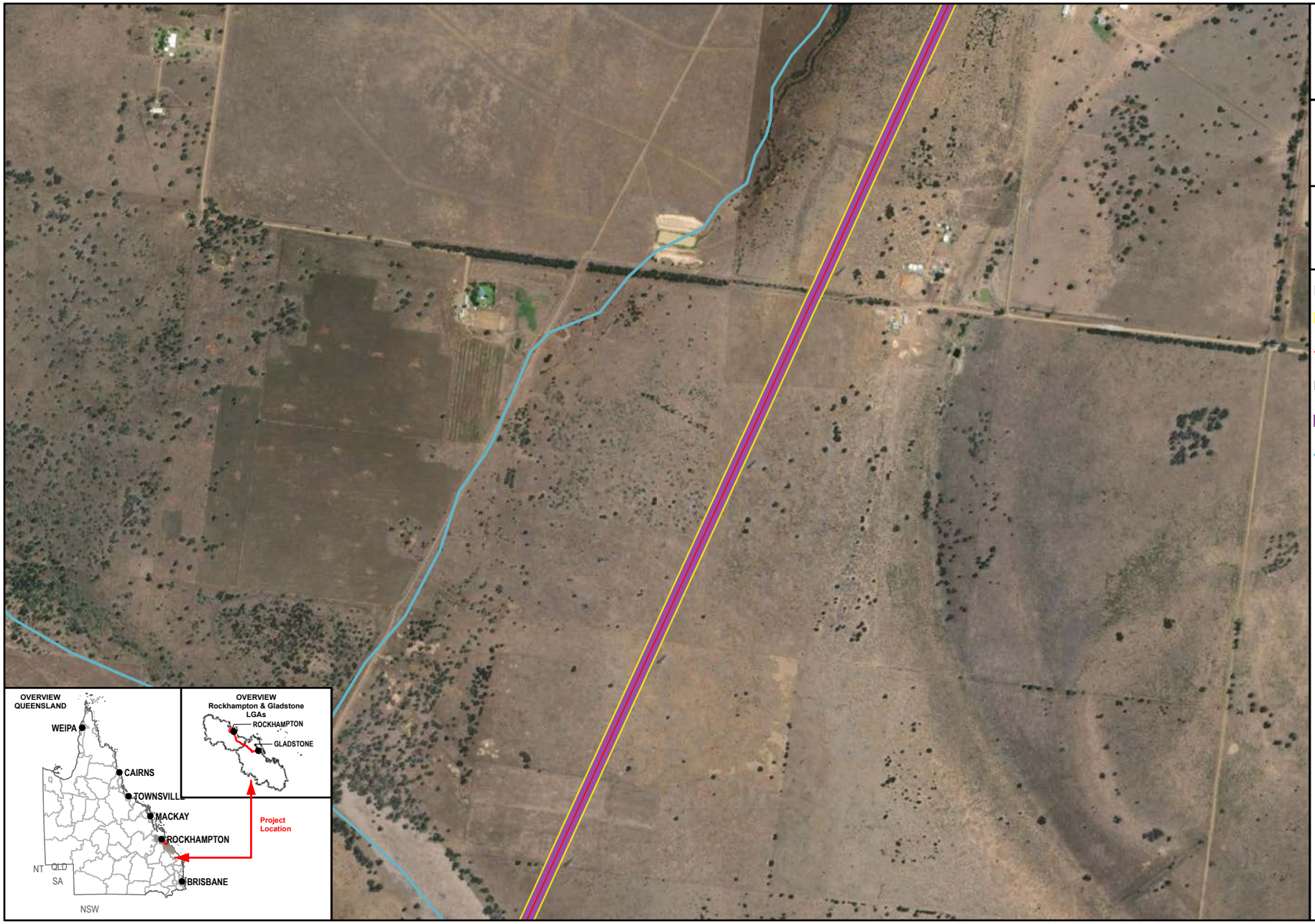
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-4c
Habitat Types Identified Within the Northern Section Study Area
000-G-MAP-2421 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment

Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Waterways

Data Sources:
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2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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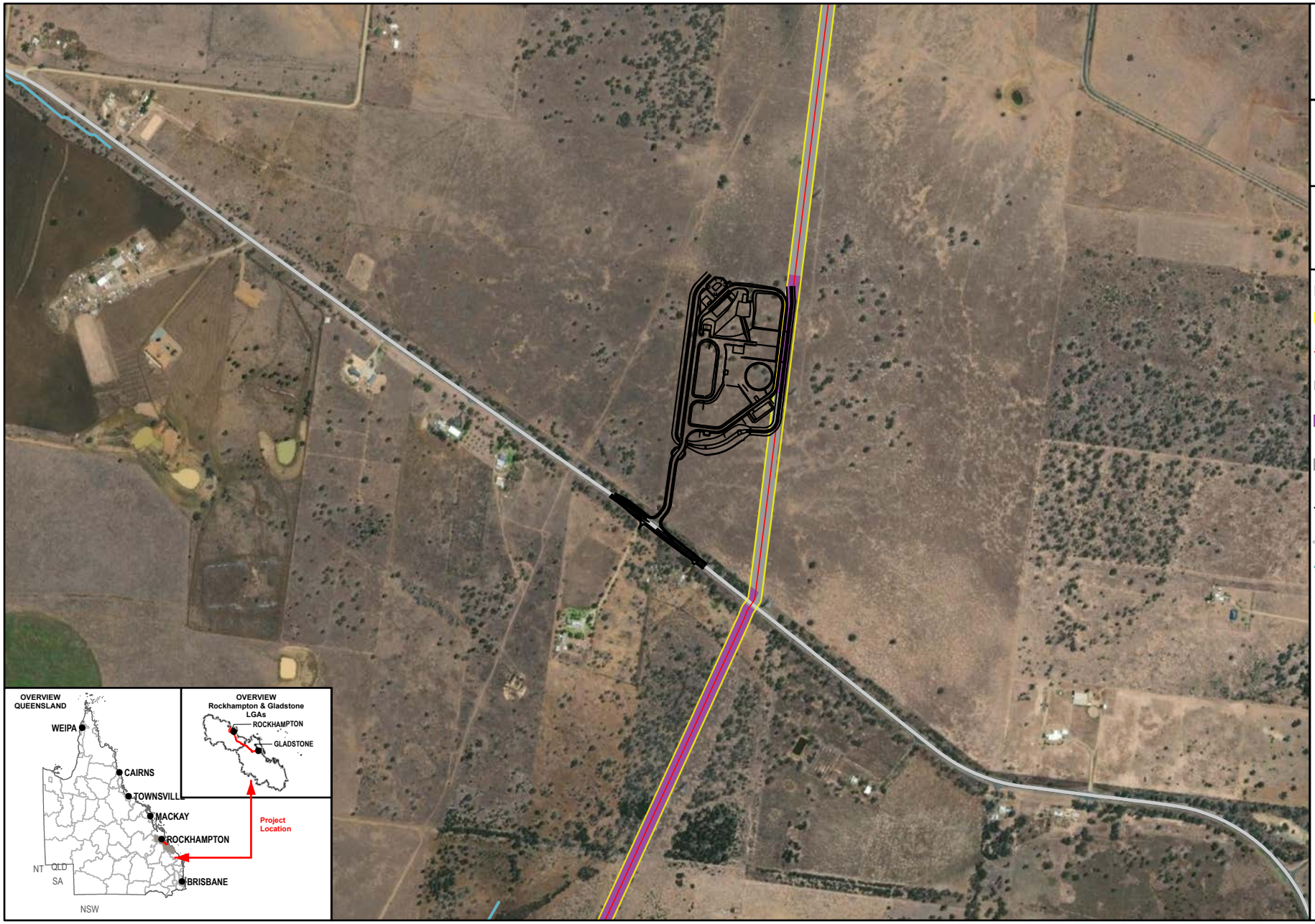
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-4d
Habitat Types Identified Within the Northern Section Study Area

000-G-MAP-2421 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment

Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Cleared and Highly Modified Landscapes
- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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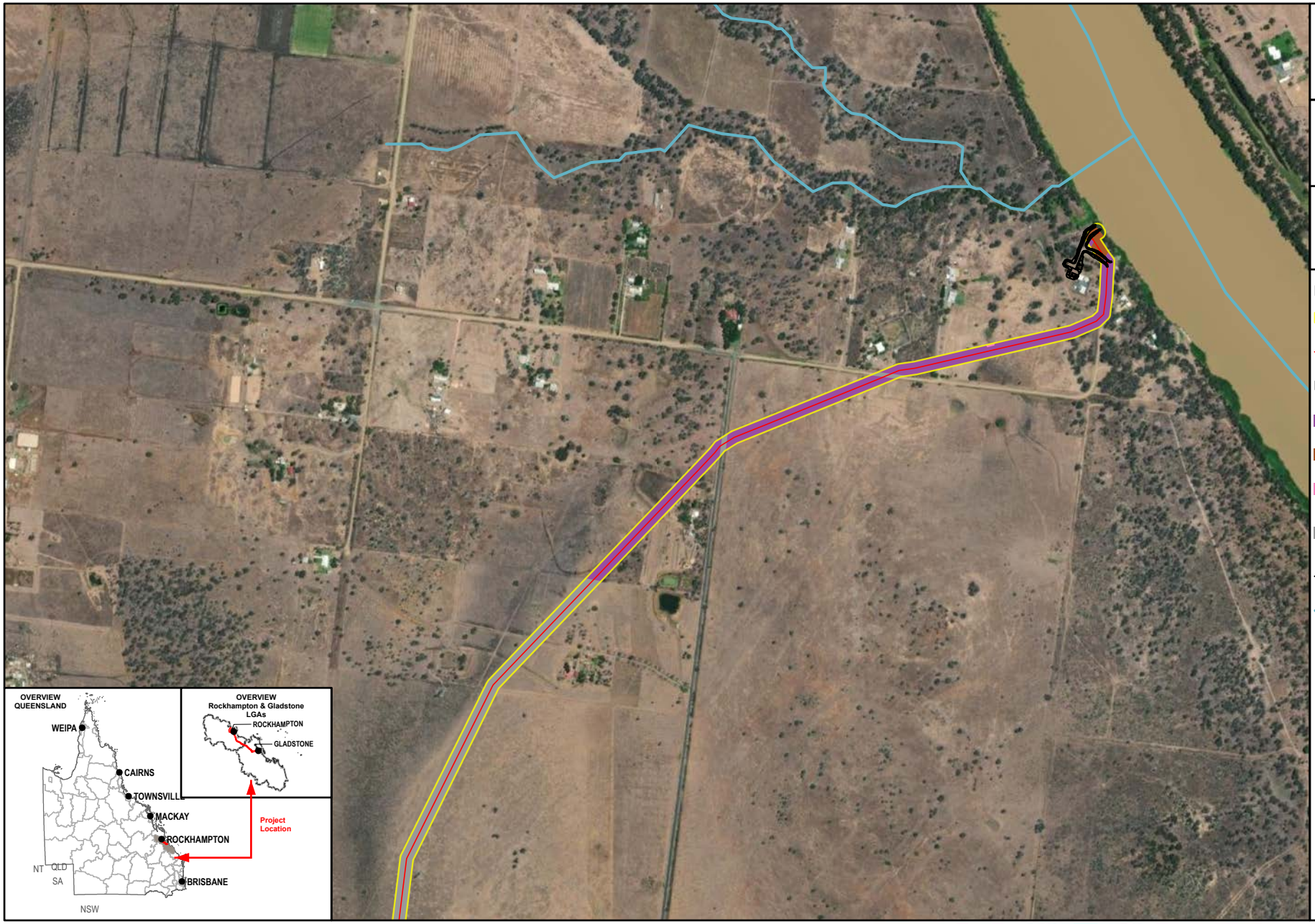
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-4e
Habitat Types Identified Within the Northern Section Study Area
000-G-MAP-2421 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment

Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Fitzroy River Intake and Pump Station Layout
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report

Figure 5-4f
Habitat Types Identified Within the Northern Section Study Area

000-G-MAP-2421 Version:3 Date:2022/09/12

5.5 Biosecurity matters

5.5.1 Field survey results

5.5.1.1 Introduced flora species

Weed species were commonly observed throughout the study area. WoNS and restricted invasive weeds (listed under the Biosecurity Act) recorded in the Northern Section study area are listed in Table 5-9. All restricted invasive plants recorded are Category 3 restricted matters.

Table 5-9 Introduced flora species recorded within the Northern Section study area

Species name	Common name	WoNS	State declaration Biosecurity Act
Parthenium hysterophorus	Parthenium	X	Category 3
Lantana camara	Lantana	X	Category 3
Opuntia stricta	Common pest pear	X	Category 3
Opuntia tomentosa	Velvet tree pear	X	Category 3
Sporobolus pyramidalis	Giant rat's tail grass		Category 3
Cryptostegia grandiflora	Rubber vine	X	Category 3
Harrisia martinii	Harrisia cactus		Category 3
Parkinsonia aculeata	Parkinsonia	X	Category 3
Cardiospermum grandiflorum	Balloon vine		Category 3
Hymenachne amplexicaulis	Hymenachne		Category 3
Eichhornia crassipes syn. Pontederia crassipes	Water hyacinth	X	Category 3
Lantana montevidensis	Creeping lantana		Category 3

5.5.1.2 Introduced fauna species

Four introduced fauna species were identified within the Northern Section study area (Table 5-10), including three mammal species declared as restricted invasive animals under the Queensland's *Biosecurity Act 2014* (DAF 2017).

Table 5-10 Introduced fauna species recorded within the Northern Section study area

Species name	Common name	State declaration Biosecurity Act
Oryctolagus cuniculus	European rabbit	Category 3, 4 and 6
Rhinella marina	Cane toad	-
Felis catus	Cat	Category 3, 4 and 6
Sus scrofa	Feral pig	Category 3, 4 and 6

5.6 Aquatic environment

5.6.1 Desktop assessment results

5.6.1.1 Threatened aquatic species

The EPBC Act PMST database identified 10 threatened aquatic species that have the potential to occur within the desktop search extent. State based searches (i.e. WildNet, Species Profile Search and Biomaps) identified two threatened aquatic species that have been historically recorded within the desktop search extent. The white-throated snapping turtle has been recorded within 3 km upstream of the intake structure, while the platypus has been recorded in the Fitzroy River 15 km downstream of the intake structure (ALA 2022). Combined., all searches identified 11 threatened aquatic species within the desktop search extent. This comprised the estuarine crocodile, green sawfish, platypus and eight turtle species, two of which were freshwater species, while the other six species were marine.

The PMST and WildNet desktop search results are provided in Appendix A and summarised in Table 5-11. This table also includes threatened aquatic species that were identified as controlling provisions under the EPBC approval.

Several species identified within the database searches are not expected to be located within study area due to unsuitable habitat conditions. The loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle, olive ridley turtle, flatback turtle, and the green sawfish are all marine species. Although they can also be found in estuarine waters, the Northern Section pipeline alignment and intersections with waterways, are upstream of the tidal areas and with many natural barriers, including the Fitzroy River barrage, preventing movement upstream into the freshwater reaches of the Fitzroy River. Therefore, these species are unlikely to occur within the study area and are therefore excluded from any further assessment within the Northern Section.

Other aquatic species including the Fitzroy River turtle, estuarine crocodile, white-throated snapping turtle, and platypus are likely to occur within the study area and are further discussed below.

Table 5-11 Threatened aquatic species identified within the Northern desktop search extent

Scientific name	Common name	Status		Source	WN Records	Nearest Record to ROW	EPBC Approval
		EPBC Act	NC Act				
Reptiles							
Caretta caretta	Loggerhead turtle	E, Mig	E	PMST		52.0 km	
Chelonia mydas	Green turtle	V, Mig	V	PMST		52.22 km	
Crocodylus porosus	Estuarine crocodile	Mig	V	PMST		12.07 km	
Dermochelys coriacea	Leatherback turtle	E, Mig	E	PMST		52.08 km	
Elseya albagula	White-throated snapping turtle	CE	CR	WN, PMST	1	11.4 km	
Eretmochelys imbricata	Hawksbill turtle	V, Mig	E	PMST		52.86 km	
Lepidochelys olivacea	Olive Ridley turtle	E, Mig	E	PMST		>250 km	
Natator depressus	Flatback turtle	V, Mig	V	PMST		52.20 km	
Rheodytes leukops	Fitzroy River turtle	V	V	PMST		17.67 km	✓

Scientific name	Common name	Status		Source	WN Records	Nearest Record to ROW	EPBC Approval
		EPBC Act	NC Act				
Sharks							
Pristis zijsron	Green sawfish	V, Mig	NL	PMST		>1,000 km	
Mammals							
Ornithorhynchus anatinus	Platypus	NL	SL	WN	4	4.48 km	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed;

WN – WildNet; PMST – Protected Matters Search Tool.

5.6.1.2 Great Barrier Reef Marine Park

The GBR is listed as a World Heritage Area, National Heritage Property, Marine Park and nationally important wetland. The GBR supports a large number of conservation significant species including marine megafauna, shorebirds, and marine fish species. It contains approximately ten per cent of the coral reef ecosystems in the world and supports an enormous amount of biodiversity.

The Northern Section pipeline alignment is located 71 km upstream of the GBR where the Northern Section pipeline alignment intersects with the Fitzroy River (Figure 5-5). The Northern Section pipeline alignment intersects Lion Creek, 9 km south of the intake structure on the Fitzroy River. Lion Creek flows into the Fitzroy River and subsequently the GBR (Figure 5-5). The Northern Section pipeline alignment with have no direct impacts upon the GBR, and mitigation measures (see Section 6) enacted to minimise potential risks to the GBR.

5.6.1.3 Wetlands

Three Nationally Important Wetlands listed under the Directory of Important Wetlands in Australia are located downstream of the Northern Section pipeline alignment along the coastline at the confluence with the Fitzroy River as outlined in Table 5-12 and shown in Figure 5-5. The Northern Section pipeline alignment intersects one Nationally Important Wetland, the Fitzroy River Floodplain, at two separate locations.

Table 5-12 Nationally Important Wetlands in relation to the Northern Section pipeline alignment

Wetland ID	Wetland name	Location
QLD013	Fitzroy River Floodplain	Intersects with alignment 10 km northwest of Rockhampton and 9.5 km west of Rockhampton
QLD012	Fitzroy River Delta	17 km downstream of the intake structure at Fitzroy River
QLD021	The Narrows	75 km downstream of the intake structure at Fitzroy River
QLD100	Great Barrier Reef Marine Park	67 km downstream of the intake structure at Fitzroy River

The Northern Pipeline intersects two MSES listed wetlands which are mapped as high ecological significance wetlands and wetland protection areas as shown in Figure 5-5. These two wetlands are also listed within the Fitzroy River Floodplain wetland. The pipeline intake structure is located on the Fitzroy River and located adjacent to the Fitzroy River Floodplain. The Northern section pipeline alignment crosses another two waterways nine and 10 km south of the intake structure respectively. All three waterways have MSES listed wetlands downstream of the Northern Section pipeline alignment as shown in Figure 5-5.

There are numerous mapped MSES high ecological significance wetlands further downstream of the Northern Section pipeline alignment within the Fitzroy River Delta, from its most northern point (17 km downstream of the intake structure) to its eastern point at Balaclava Island (Figure 5-5).

5.6.1.4 Waterways and fish habitat

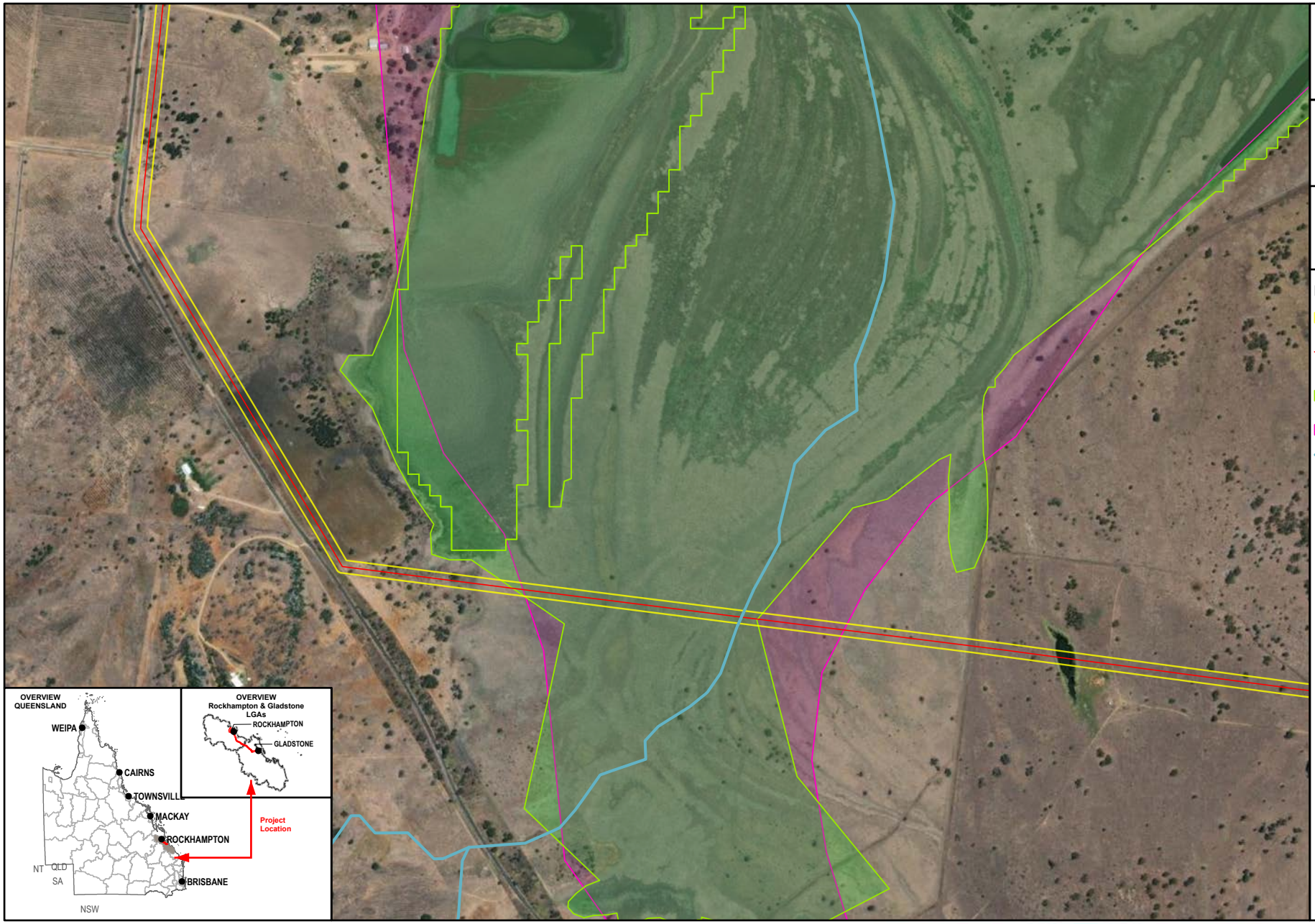
The waterways within the desktop search extent are generally mapped moderate risk (amber) waterways for fish passage under the WWBW spatial layer (Figure 5-6). The Fitzroy River (purple) is mapped as major risk for fish passage and is the location for the intake structure. There is also Lion Creek which is mapped as major risk for fish passage (purple) and four moderate risk (amber) waterways that are intersected by the Northern Section pipeline alignment (Figure 5-6). All waterways mapped within the desktop search extent flow into either the Fitzroy River or Lions Creek. A summary of all waterway crossings is provided in Table 5-13.

The risk ratings assist with the determination of DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), based on the shape and location of the waterway in the catchment, as well as the characteristics of species that reside within them (DAF 2021). Waterways with a rating of major or high-risk to fish passage generally contain larger biomasses of fish populations and contain species that are more likely to have weaker swimming abilities (DAF 2021). Low or moderate risk waterways for fish passage are often in the upper reaches of a catchment and have steeper slopes and would generally have a lower biomass of fish populations than downstream reaches (DAF 2021).

Table 5-13 Summary of all waterway crossings in the Northern Section

Waterway barrier works risk rating	Number of waterways intersected
Purple (major)	2
Amber (moderate)	4

Thirty kilometres downstream of the Northern Section pipeline alignment is a mapped fish habitat area (management A) within the Fitzroy River (Figure 5-6) that extends beyond the mouth of the river.



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Legend

- Study Area
- Northern Section Pipeline Alignment
- MSES High Ecological Significance Wetlands
- QLD013 Fitzroy River Floodplain
- Waterways

Data Sources:
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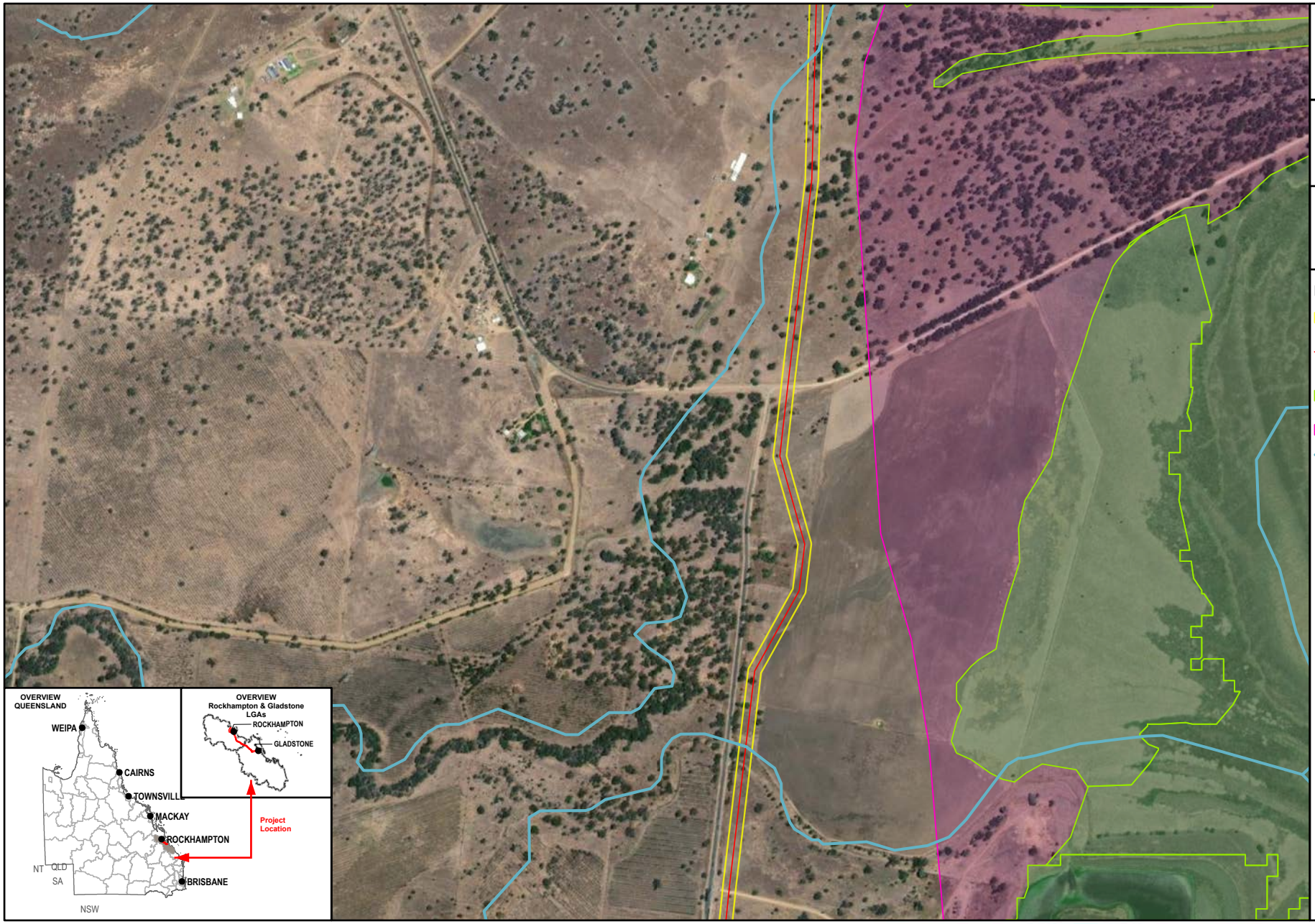
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-5a
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Fitzroy to Gladstone Pipeline
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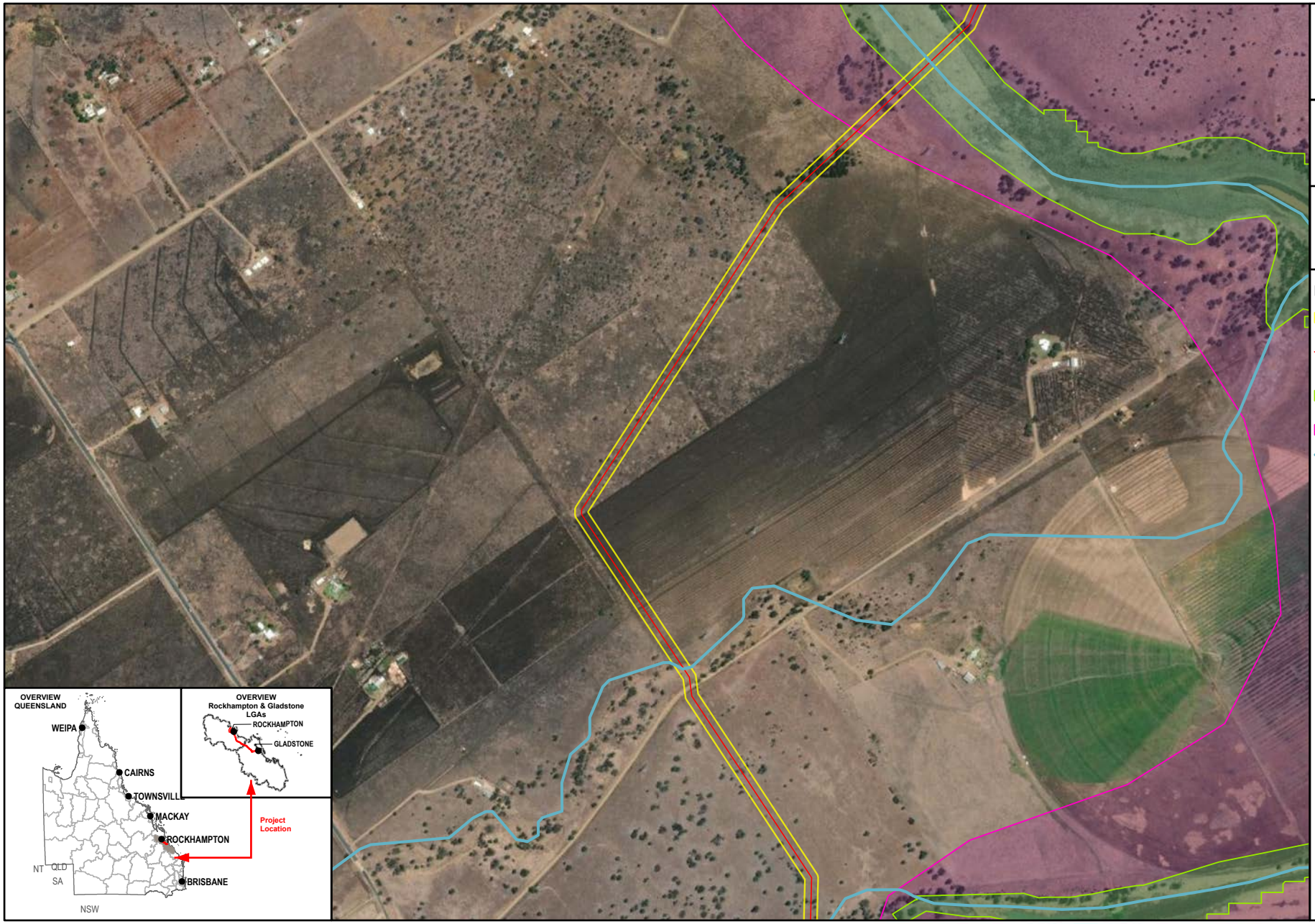
Figure 5-5b
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- MSES High Ecological Significance Wetlands
- QLD013 Fitzroy River Floodplain
- Waterways

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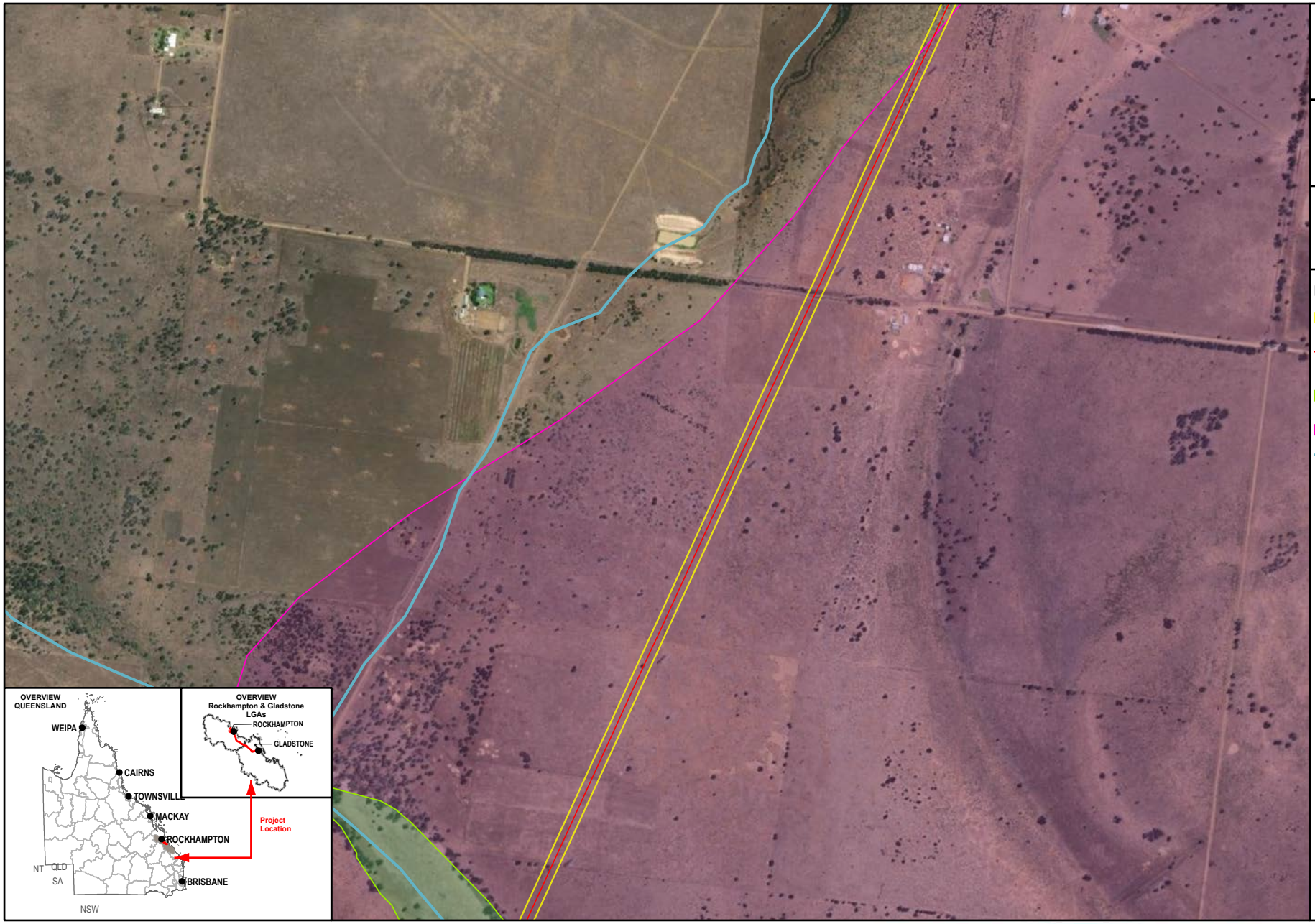
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-5c
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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- Study Area
- Northern Section Pipeline Alignment
- MSES High Ecological Significance Wetlands
- QLD013 Fitzroy River Floodplain
- Waterways

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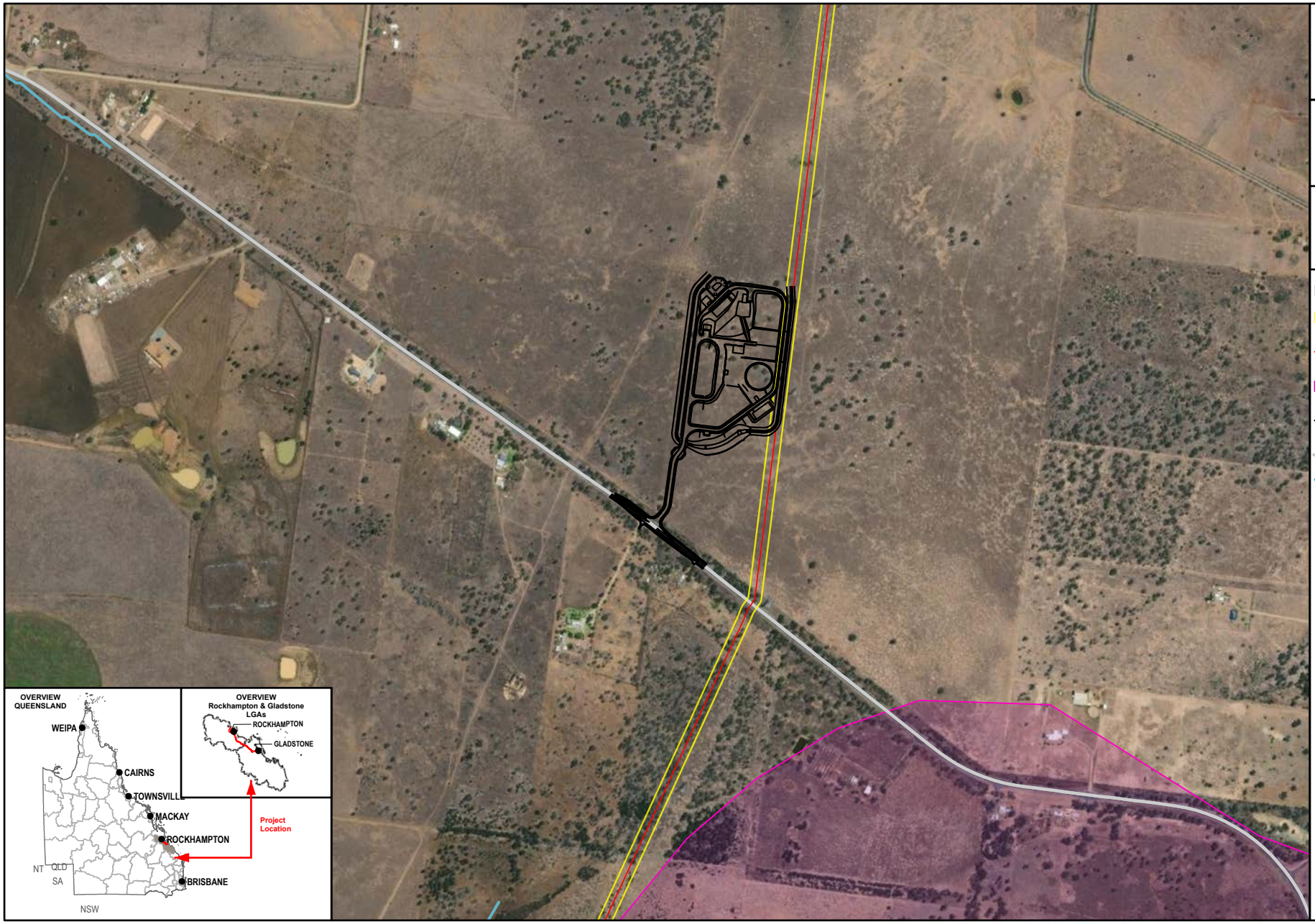
Figure 5-5d
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- QLD013 Fitzroy River Floodplain
- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
- Waterways

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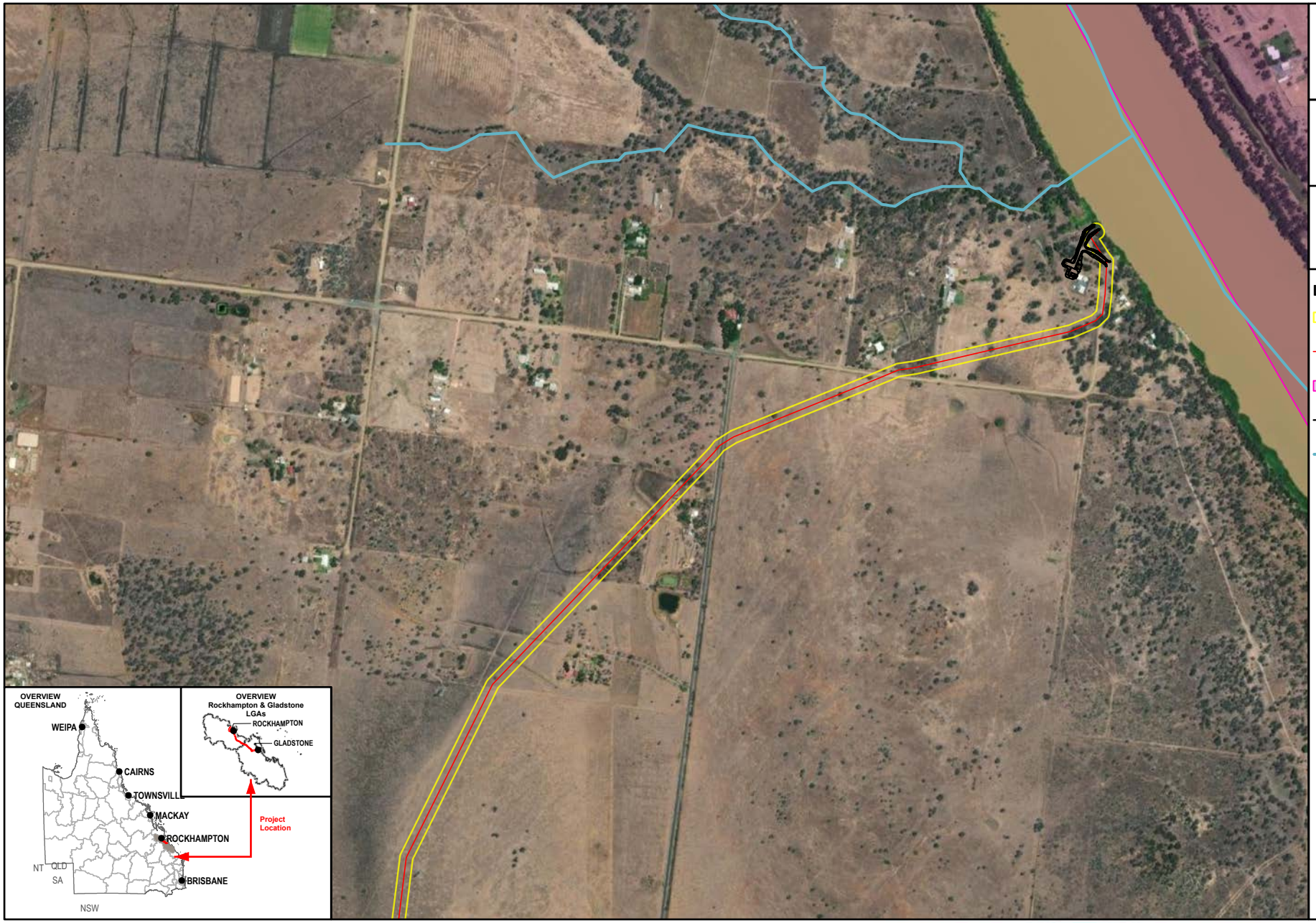
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-5e
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- QLD013 Fitzroy River Floodplain
- Fitzroy River Intake and Pump Station Layout
- Waterways

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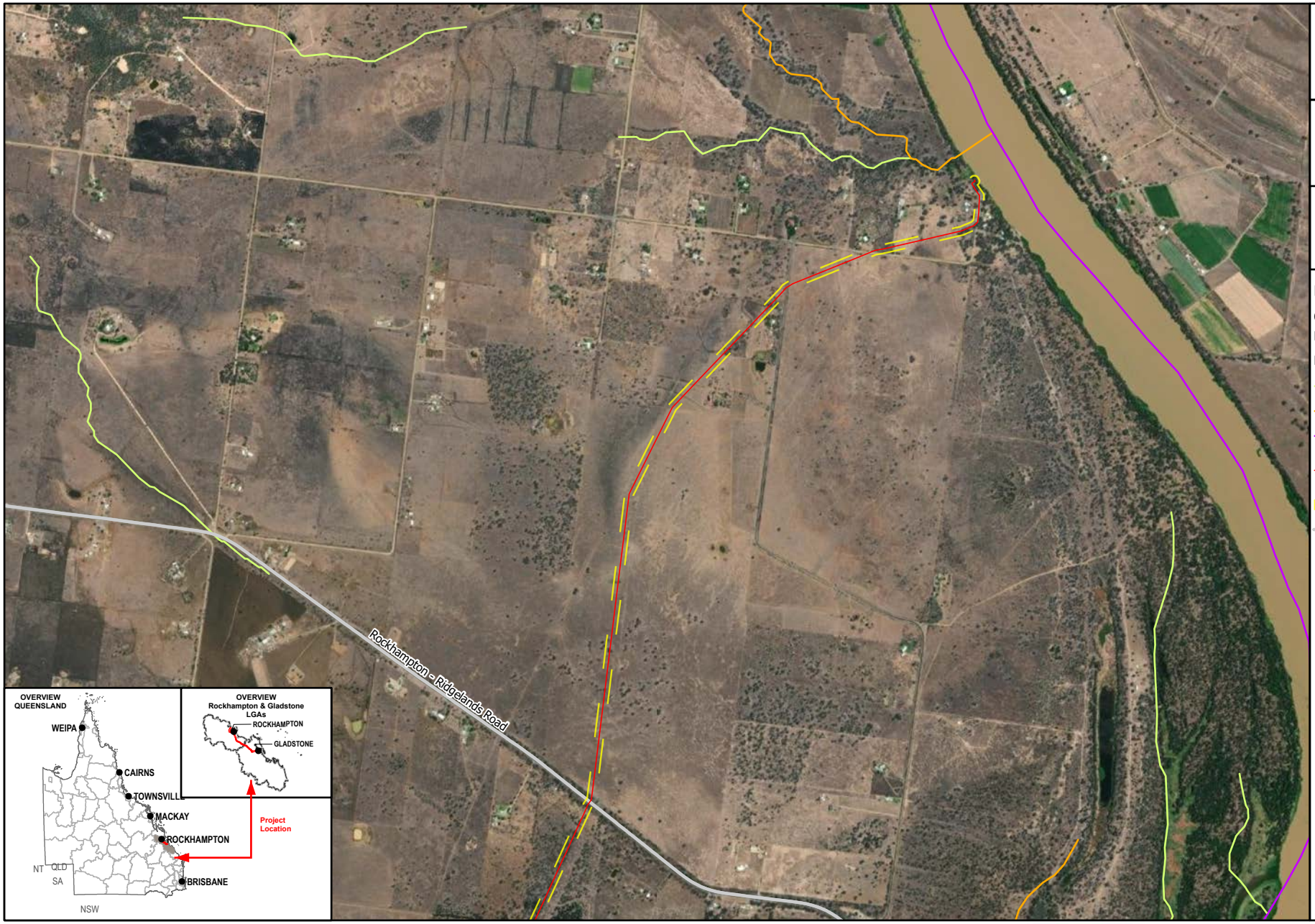
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-5f
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Legend

Queensland Waterways for Waterway Barrier Works

FISH_PASS

- 1 - Low
- 2 - Moderate
- 4 - Major

Northern Section Pipeline Alignment

Study Area

Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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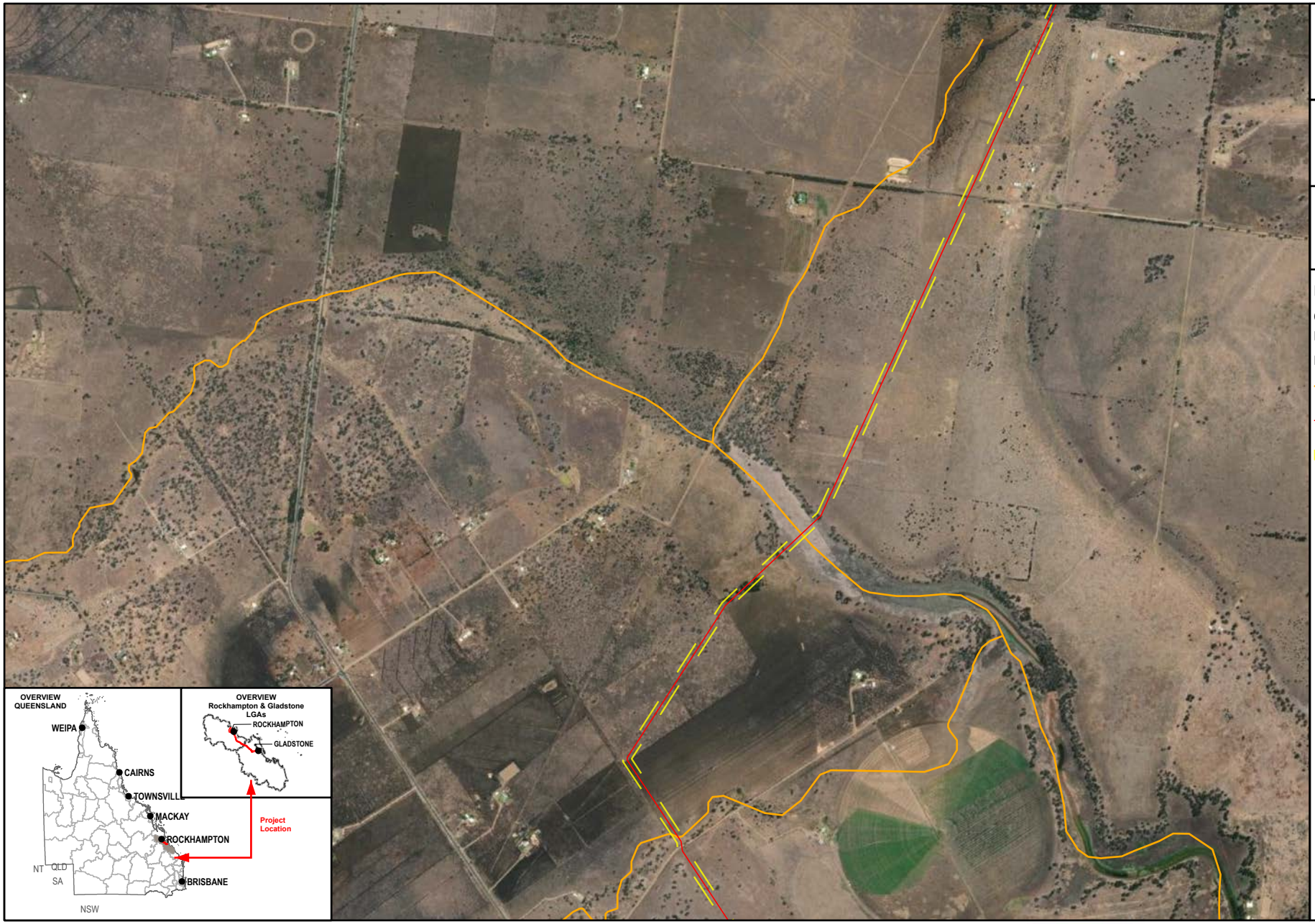
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-6a Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the Northern Section Desktop Search Extent
000-G-MAP-2423 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

FISH_PASS

- 2 - Moderate
- Northern Section Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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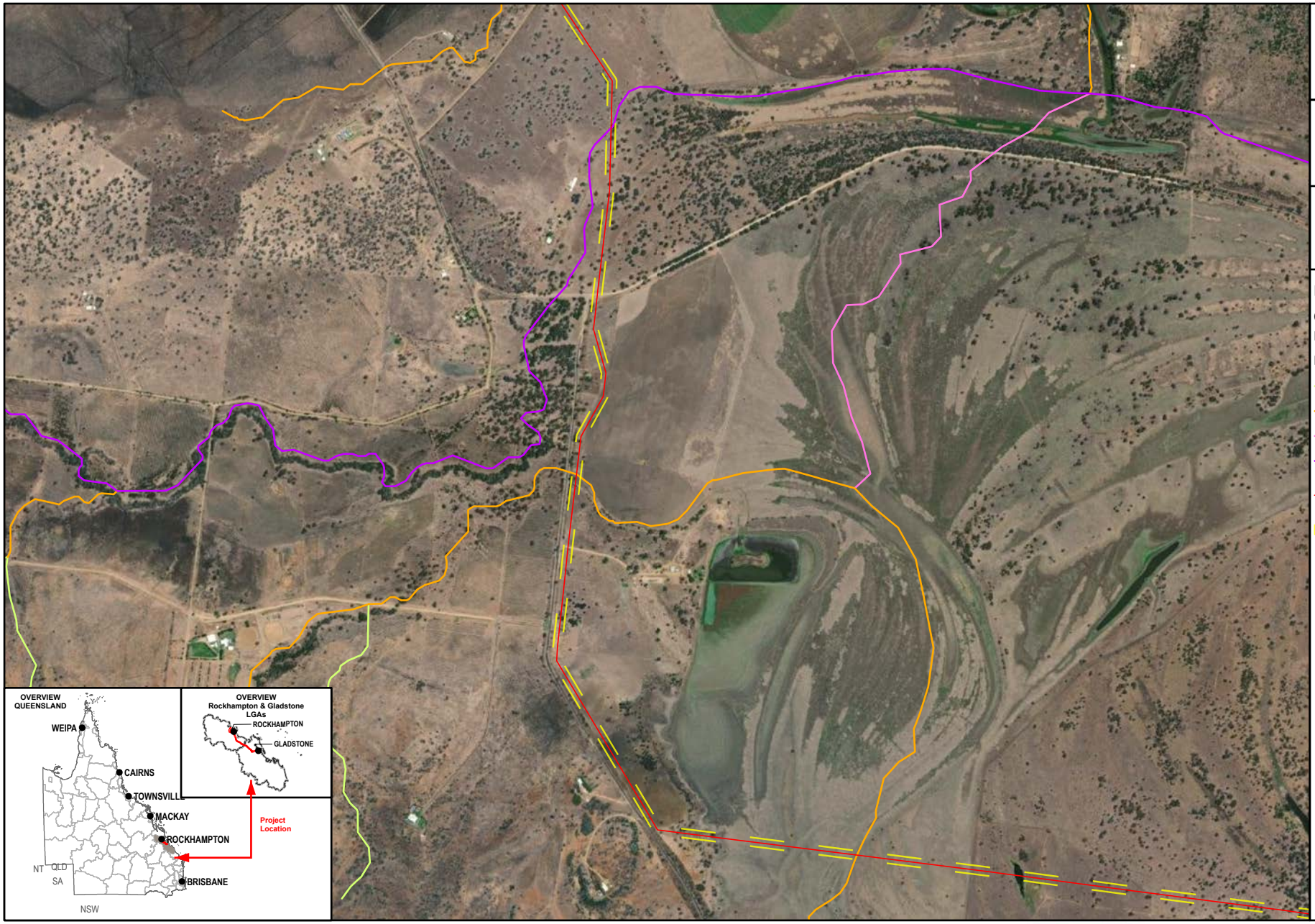
Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-6b Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the Northern Section Desktop Search Extent
000-G-MAP-2423 Version:1 Date:7/07/2022



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Legend

Queensland Waterways for Waterway Barrier Works

FISH_PASS

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- Northern Section Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

SMEC Disclaimer:
Maps are for graphical purposes only. The information on this map is from a computer database accessed using a Geographic Information System (GIS). They do not represent a legal survey and the information provided includes inherent errors. SMEC cannot guarantee the accuracy of the information contained on this map. Each user of this map is responsible for determining its suitability for his or her intended use or purpose.

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PROJECTION UTM Zone 56
(Datum GDA2020)

Compiled by:YS16239

Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-6c Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the Northern Section Desktop Search Extent

000-G-MAP-2423 Version:1 Date:7/07/2022

5.6.2 Field survey results

5.6.2.1 Aquatic habitat

Habitat bioassessment scores were conducted from three riverine sites within the Northern Section (Table 5-14). Habitat bioassessments did not occur at the two high ecological significance (HES) wetland sites (site 31 and site 32) as this assessment is designed for riverine sites and would therefore provide inaccurate assessment of the overall condition of the wetland.

Site 22 is an unnamed creek that flows into Lion Creek and is located 10 km south of the intake structure. The site was assessed as 'fair', with a score of 44. This site performed poorly in the embeddedness, velocity and depth, and riffle/run, run/bend ratio categories due mainly to the small water body present and the lack of flowing water and connectivity within the reach.

The overall condition of the Fitzroy River at site 23, the location of the intake structure, was assessed as 'good', with a score of 75. The site characteristics of bottom substrate and embeddedness consisted of large woody debris and rocky habitats. The riffle/run, run/bend ratio categories were assessed as poor. This reach of the Fitzroy River is a large slow flowing channel with lack of riffles and runs due to the barrage downstream. The banks of the river are well vegetated with large trees, grasses and aquatic macrophytes creating stable banks and streamside cover in excellent condition.

Site 25 is located on Lion Creek and is upstream of Lions Lagoon. The overall condition of site 25 was assessed as 'fair', with a score of 49. This site performed poorly in the bottom substrate, embeddedness, velocity and depth, and riffle/run, run/bend ratio categories due mainly to the absence of surface water within the reach. The channel alteration, bottom scouring and deposition, and the bank stability categories were assessed as in excellent condition.

Site characteristics and ecological values from the habitat assessment for all sites located within the Northern Section as detailed below in Table 5-15. AusRivAS bioassessments are used as a standardised method to monitor and assess the ecological condition of Australian rivers. These bioassessments were only conducted upon riverine sites as they are not relevant to wetland sites.

Table 5-14 Bioassessment scores for sites within the Northern Section

Habitat variable	Scale	Site 22	Site 23	Site 25
Bottom substrate	0-20	6	8	2
Embeddedness	0-20	5	8	2
Velocity and depth category	0-20	1	10	0
Channel alteration	0-15	6	10	13
Bottom scouring and deposition	0-15	7	11	12
Pool/riffle, run/bend ratio	0-15	3	3	0
Bank stability	0-10	5	7	9
Bank vegetation and stability	0-10	6	9	6
Streamside cover	0-10	5	9	5
Totals	**0-135**	**44**	**75**	**49**
Habitat score category		**Fair**	**Good**	**Fair**

Table 5-15 Site characteristics and ec7ological values of sites within the Northern Section

Site	Characteristics	Ecological values
Site 22 – unnamed waterway		
Upstream 	– Orange – moderate risk waterway mapped under the WWBW spatial layer. – Water was isolated in a small pool within the main channel. – Channel width was approximately 9 m, with vertical banks on both banks 2.5 m high. – The wetted width of the pool at this location was approximately 4.5 m, and was 17 m long, the maximum depth was approximately 0.3 m. – Land use adjacent to the survey area was subject to cattle grazing. – Adjacent riparian zone had no bare ground and was covered extensively in grass. – Large barrier immediately upstream of the study site. – There was evidence of scouring occurring in the reach from the culvert upstream and moderation erosion of the streambed. – Water within pool was highly turbid. – Bed substrate was primarily silt/clays, with some cobbles, pebbles, and gravel.	– Overall habitat condition rating was poor (44). – Instream habitat consisted of a small pool that contained some small woody debris. – The pool would support some small bodied fish species, for a limited time, with the ephemeral nature of the waterway the pool is likely to dry out during the dry season. – During large flows the pool would provide refuge and habitat for transient fish species. – No aquatic plant species were recorded. – Large culvert upstream of site likely to cause some restriction on aquatic fauna movement. – Site not suitable for white-throated snapping turtle foraging or nesting. – Site not suitable for Fitzroy River turtle foraging or nesting. – Site not suitable for platypus foraging or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.
Downstream 		

Site	Characteristics	Ecological values
Site 23 – Fitzroy River		
Upstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – The Fitzroy River at Site 23 consisted meandering channel that was approximately 350 m wide. – Water flow was only very slow at the time of the survey but was above the watermark. – Water clarity was very turbid. – Land use adjacent to the survey area was native forest, national park and cattle grazing. – Bed substrate was stable, with deposition of silt upon the substrate. – The banks on both sides of the river were moderately steep, moderately stable and concave in shape with little erosion. – Riparian vegetation was semi-continuous on both banks with moderate amounts of *Eucalyptus* and *Melaleuca* trees >10 m high, and a moderate amount of grasses.	– Overall habitat condition rating was good (75). – Instream habitat consisted of deep pools, and aquatic macrophytes that consisted of the exotic water hyacinth (*Eichhornia crassipes*) and other grass like species. – The Fitzroy River at this location provides suitable habitat for many fish and turtle species, platypus, as well as estuarine crocodiles. – Optimal foraging habitat for white-throated snapping turtle and likely to occur. Unlikely to support aggregated nesting, however isolated nesting may occur. – Optimal foraging habitat for Fitzroy River turtle and likely to occur. Unlikely to support aggregated nesting, however isolated nesting may occur. – Provides optimal habitat and likely optimal burrowing opportunities for platypi and is therefore likely to occur at this site. – Optimal foraging habitat occurs at this site, as well as sub-optimal breeding habitat for estuarine crocodile and therefore the species is likely to occur at this site.
Downstream 		

Site	Characteristics	Ecological values
Site 25 – Lion Creek, Upstream of Lions Lagoons		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – The location at the time of survey was dry. – The site was a low-lying area with no defined creek bed or banks. – Land use adjacent to the survey area was predominantly cattle grazing and land clearing. – The substrate was stable, with moderate compaction and comprised entirely of silt/clay. – The bank consisted of material similar to the substrate at the survey site and has a low to flat slope. – Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and in the understorey. – The riparian vegetation was isolated along the banks and semi-continuous with the study location and provided vegetation for cover.	– Overall habitat condition rating was fair (49). – The site was dominated entirely by terrestrial trees and grasses. There was some large and small woody debris present that when inundated by water would provide the site with some habitat and refugia. Overall site not suitable for aquatic species. – Site not suitable for white-throated snapping turtle refuge or nesting. – Site not suitable for Fitzroy River turtle refuge or nesting. – Site not suitable for platypus refuge or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.

Site	Characteristics	Ecological values
Site 31 – unnamed, upstream of Gracemere Lagoon		
Upstream  Downstream 	– Mapped HSE wetland. – The wetland type is described as an open wetland with grass understorey. – The site was dry during the survey with no evidence of recent inundation. – The site is located less than 200 m from the nearest wetland which contained water at the time of survey. – Adjacent land use is predominantly used for cattle grazing. – No native aquatic plant species was present. – The site had a high proportion of weeds present, including *Parthenium hysterophorus*. – Tall trees were rare, all were eucalypts. – The banks were stable with little signs of erosion, similarly to the substrate.	– The site was dominated entirely by grasses. There was some large and small woody debris present that when inundated by water would provide the site with some habitat and refugia. Overall, with the absence of surface waters the site is not suitable for aquatic species. – Site not suitable for white-throated snapping turtle refuge or nesting. – Site not suitable for Fitzroy River turtle refuge or nesting. – Site not suitable for platypus refuge or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.

Site	Characteristics	Ecological values
Site 32 – Lion Lagoon		
Upstream  Downstream 	– Mapped HSE wetland. – The site was dry during the survey with no evidence of recent inundation. – The wetland type is described as an open wetland with grass understorey. – The site is located less than 200 m from the nearest wetland which contained water during the time of survey. – Adjacent land use is predominantly used for cattle grazing. – Native aquatic species included *Eleocharis* sp., *Persicaria attenuate*, *Cyperus difformis*, *Ludwigia peploides*, and nardoo. – Exotic aquatic plant species present included *Eichhornia crassipes*. – The site had grass weeds present, including *Parthenium hysterophorus*. – Tall and medium sized trees were frequent, all were eucalypts. – The banks were stable with little signs of erosion, similarly to the substrate.	– The site was dominated entirely by grasses. There was some large and small woody debris present that when inundated by water would provide the site with some habitat and refugia. Overall, with the absence of surface waters the site is not suitable for aquatic species. – Site not suitable for white-throated snapping turtle refuge or nesting. – Site not suitable for Fitzroy River turtle refuge or nesting. – Site not suitable for platypus refuge or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.

5.6.2.2 Physico-chemical water quality

No *in-situ* water quality samples were able to be obtained at Site 23 for safety reasons associated with the potential presence of estuarine crocodiles. The pool at site 22 was too shallow to obtain reliable measurements of water quality. The remaining locations, sites 25, 31, and 32, had no surface water present and, therefore unable to obtain samples.

5.6.2.3 Aquatic flora

There were no threatened aquatic flora species confirmed present or predicted to occur within the study area. Details of the aquatic species present during the survey is in Table 5-15.

5.6.2.4 Freshwater fishes

A total of 34 native and three pest freshwater fish species are known to occur within the Fitzroy catchment (Pusey *et al.* 2004). Of the native species to occur within the Fitzroy River catchment, none are conservation significant.

All sites surveyed in the Northern Section were rapid assessment sites, which included AusRivAS habitat assessment, aquatic macrophyte inventory and AusRivAS bioassessments. Targeted surveys for fish species were not conducted, although opportunistic observations of fish species were undertaken. No fish were observed whilst undertaking surveys.

5.6.2.5 Other aquatic fauna

Five species of freshwater turtles are known to occur in the study area, two of which, the white-throated snapping turtle and Fitzroy River turtle, are conservation significant species. These two species are known to occur along the Fitzroy River in the reach at site 23; however, no records for the species occur in the other sites surveyed in the Northern Section. Optimal foraging habitat occurs at site 23 for the conservation significant turtle species, however the site is unlikely to support aggregated nesting, although isolated nesting may occur.

Sites 22, 25, 31, and 32 were unsuitable for refuge for all turtle species, and also unsuitable for nesting. No turtles were observed whilst undertaking surveys.

Previous records of platypus have been observed in the Fitzroy River in the reaches near site 23 (ALA 2022). Habitat conditions, such as large woody debris, tree roots and aquatic macrophytes present at site 23 provide optimal foraging habitat for the species. Due to safety reasons associated with the potential presence of estuarine crocodiles, a confirmation on the presence of burrows was unable to occur. However, suitable observations of the bank conditions and visual habitats present were assessed and the site considered likely to contain suitable burrowing habitat. The remaining locations, sites 22, 25, 31, and 32, had little or no surface water present and therefore were not suitable to maintain the species throughout the year, no individuals or evidence of burrows were observed whilst undertaking surveys at these sites.

Similar to the platypus, previous records of estuarine crocodiles have been observed in the Fitzroy River in the reaches near site 23 (ALA 2022). Optimal foraging habitat for crocodiles occurs at this site, as well as sub-optimal breeding habitat. The remaining locations, sites 22, 25, 31, and 32, had little or no surface water present and therefore were not suitable to maintain the species throughout the year, no individuals or evidence of nesting were observed whilst undertaking surveys at these sites.

5.7 Likelihood of occurrence

Based on the desktop searches and field survey results, the following conservation significant species have the potential to occur within the Northern Section study area (Table 5-16). The Fitzroy River turtle was identified as controlling provisions at the time of EPBC approval. The Fitzroy River Turtle is also listed under the NC Act was assessed against Queensland Government's *Significant Residual Impact Guidelines* (DEHP 2014b) for MSES (Section 7.3). A detailed likelihood of occurrence assessment is provided in Appendix E.

Table 5-16 Likelihood of occurrence summary

Scientific name	Common name	Status		Likelihood of occurrence	EPBC Approval
		EPBC Act	NC Act		
Threatened species					
Crocodylus porosus	Estuarine crocodile	Mig, Mar	V	**Likely to occur**	
Elseya albagula	White-throated snapping-turtle	CE	CE	**Known to occur**	
Geophaps scripta scripta	Squatter pigeon (southern)	V	V	**Likely to occur**	
Hirundapus caudacutus	White-throated needletail	V, Mig	V	**Likely to occur**	
Phascolarctos cinereus	Koala	E	E	**Likely to occur**	
Rheodytes leukops	Fitzroy River turtle	V	V	**Likely to occur**	✓
Rostratula australis	Australian painted snipe	E	E	**Likely to occur**	
Migratory species					
Apus pacificus	Fork-tailed swift	Mig	SL	**Likely to occur**	
Calidris acuminata	Sharp-tailed sandpiper	Mig	SL	**Likely to occur**	
Chlidonias leucopterus	White-winged black tern	Mig	SL	**Likely to occur**	
Gallinago hardwickii	Latham's snipe	Mig	SL	**Likely to occur**	
Gelochelidon nilotica	Gull-billed tern	Mig	SL	**Likely to occur**	
Hydroprogne caspia	Caspian tern	Mig	SL	**Likely to occur**	
Limosa limosa	Black-tailed godwit	Mig	SL	**Likely to occur**	
Numenius minutus	Little curlew	Mig	SL	**Likely to occur**	
Pandion haliaetus	Osprey	Mig	SL	**Likely to occur**	
Plegadis falcinellus	Glossy ibis	Mig	SL	**Likely to occur**	
Tringa nebularia	Common greenshank	Mig	SL	**Likely to occur**	
Tringa stagnatilis	Marsh sandpiper	Mig	SL	**Likely to occur**	
Species least concern					
Ornithorhynchus anatinus	Platypus	NL	SL	**Likely to occur**	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; NL – not listed.

6. Potential impacts and mitigation measures

6.1.1 Avoided impacts

In progressing the proposed pipeline and its ancillary and requisite (construction) infrastructure, the following design decisions were made and actions committed to, in order to avoid impacts to the ecological values of the GSDA, SGIC SDA and Northern Section:

– The pipeline alignment has sought to collocate within existing cleared and disturbed areas along easements, within road reserves, existing waterway crossings, along fence lines and property boundaries
– Access and ancillary infrastructure – as far as practicable, site access will be collocated with existing tracks requiring augmentation and expansion rather than wholesale new clearing and development
– Trenchless construction methods will be considered for all major and high-risk waterways to avoid impact to these waterways during construction
– Sensitive areas will be identified and protected.

6.1.2 Minimisation of impacts

Best practice construction techniques have been specifically selected to reduce direct works within waterways and terrestrial habitats wherever possible. These construction techniques will substantially reduce the potential for impacts to matters of national, state and local environmental significance for achievement of proposed ecological outcomes. Reduction measures will include a commitment to design and implement the following plans:

– Site specific construction environmental management plan (CEMP) will be developed and implemented to detail actions and procedures for the protection of the aquatic and terrestrial environments. The CEMP will include:
    - Drainage, Erosion and Sediment Control measures will be developed and implemented. Management actions will be in accordance with the Best Practice Erosion and Sediment Control Guidelines (IECA 2008)
    - Waste and Hazardous Materials Management measures will be developed and implemented. Management actions will be in accordance with Australian Standards (Hazardous Material Management Programme)
    - Weed and Pest Management measures will be developed and implemented as detailed in the terrestrial ecology assessment
    - Water Quality Management Plan which is to consider upstream and downstream monitoring during creek works, and during discharge in accordance with the performance criteria outlined in the CEMP.

In addition to the avoidance and minimisation measures outline above, best practice construction techniques and stringent site-specific management actions have been specifically selected to further minimise potential risks to matters of national, state and local environmental significance and achieve proposed environmental outcomes. Key actions are described below against each potential impact.

6.1.3 Overview

This section discusses the potential impacts and associated mitigation measures for the terrestrial and aquatic ecological values within the pipeline alignment.

Avoidance measures have been considered to reduce impacts from the project, where possible (Section 6.2). Management strategies have been proposed to mitigate or minimise potential impacts of the project on ecological values. A rigorous assessment to quantify and contextualise residual significant impacts, following avoidance and minimisation, has been undertaken against the Queensland Environmental Offsets Policy *Significant Residual Impact Guideline* (DEHP 2014b). One conservation significant species, namely grey-headed flying-fox, was assessed against the Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013). The MSES and MNES significant impact assessments are provided in in Section 7.

This section details anticipated impacts to ecological values during the construction and operation phases of the project.

During the construction phase, the project is expected to result in the loss of vegetation and habitat, due to clearing for the following:

– Pipeline right of way (ROW) and associated infrastructure
– Ancillary infrastructure including access tracks, construction camps and laydown areas.

Vegetation clearing and construction activities may result in direct mortality and injury of wildlife. Indirect ecological impacts such as temporary disturbance of wildlife through construction light, noise, vibration and increased vehicle movements, restricted fauna movement and barrier effects as well as the degradation of adjacent habitats through erosion and sedimentation and weed and pest invasion may also occur.

Permanent habitat loss will also occur where new infrastructure is required to remain in-situ post-construction (e.g. access tracks). The ecological integrity of the local landscape may be altered due to a potential reduction in the availability of habitat, and changes to the ecological landscape.

The operation phase will result in a small number of additional, ongoing impacts to terrestrial biodiversity (i.e. above and beyond the impacts caused by pipeline's construction): for example relatively low-level risks of disturbance and injury/mortality of wildlife and spread of weeds and pests due to movement of maintenance vehicles.

The significance of residual impacts (i.e. those that remain after application of avoidance, minimisation and mitigation) is assessed in the significant impact assessments for MSES and MNES (listed at the time of the approval) values in Section 7.c

A general overview of the construction and operation impacts of the project identified in the EIS (Arup 2008) and CEMP (GHD, 2022) is summarised in Table 6-1 together with the principal measures that will be used to avoid and mitigate impacts.

Table 6-1 Summary of construction and operation impacts and mitigation measures

Potential impacts	Avoidance and mitigation measures
Construction phase	
Vegetation clearing within the pipeline alignment resulting in: – Loss of TECs – Loss of remnant and regrowth vegetation – Loss of marine plants – Loss of essential habitat – Loss of aquatic habitat – Loss of habitat for conservation significant species	– Avoid vegetation clearing where alternative options to site infrastructure exist, particularly within areas of higher environmental value – Minimise the clearing footprint – Clearly denote clearing areas – Clearly denote no go areas – Locate temporary construction footprint in areas of existing disturbance, where possible – Conduct trenchless construction methods for waterways mapped as major and high-risk waterways under the WWBW spatial layer and likely to contain water and contain aquatic values at the time of construction – Conduct trenchless construction methods underneath Raglan and Inkerman Creek to minimise impacts to marine plants occurring within the pipeline alignment – Construction of the pipeline at ephemeral waterways to occur via open trenching during the dry season – Rehabilitate and revegetate temporary construction areas – Restrict works to daylight hours as far as practicable
Injury and mortality of wildlife due to: – Vegetation clearing – Collision with construction vehicles and machinery – Entrapment in construction areas	– Enforce site speed limits – Restrict works to daylight hours as far as practicable – Educate employees on environmental values and nesting sites – Erect warning signage in high-risk areas – Install temporary fencing – Use fauna spotter catchers during clearing

Potential impacts	Avoidance and mitigation measures
	– Employ trenchless construction methods for major and high-risk waterways as necessary – Clearly demarcate no go zones for sensitive areas – Utilise sequential clearing practices – Allow fauna to disperse on their own accord – Install escape poles, logs etc., in open excavations – Minimise vehicles within site – Regular inspections of trenches – Develop adverse incident procedures as relevant
Disturbance of wildlife behaviour: – Light – Noise – Vibration	– Restrict works to daylight hours as far as practicable – Minimise use of artificial lighting – Install directional lighting where appropriate – Service and maintain all plant equipment – Maintain and monitor vehicle/plant noise
Fragmentation of terrestrial habitats resulting in: – Barrier effects and – Restricted fauna movement	– Limit construction or temporary fencing, and where needed, implement in a way that minimises disruption to fauna movement – Plan works area to maintain habitat connectivity, where possible – Maintain areas of existing vegetation to assist in providing a source of seed for local rehabilitation works – Co-locate or upgrade existing access tracks in areas that are already disturbed, wherever possible. – Use native species for rehabilitation wherever possible. If native species are unsuccessful introduced stoloniferous grasses may be used to achieve rapid surface coverage. – Limit construction laydown areas and stockpiles to areas that have already been cleared to minimise unnecessary clearing wherever possible
Restriction of aquatic movement by: – Trenching works within waterways	– Prepare and implement a Construction Environmental Management Plan (CEMP) – Utilise trenchless over trenching methods where possible
Degradation of aquatic habitats by: – Loss of marine plants – Increased sedimentation – Increased erosion – Potential for Acid Sulfate Soils	– Prepare and implement a CEMP which includes a Water Quality Monitoring Program (WQMP) and an Acid Sulfate Soils (ASS) Management Pan – Rehabilitate riparian habitats post construction – Inform construction personnel of environmental responsibilities – Monitor aquatic habitats immediately upstream and downstream of construction area for signs of degradation – Restrict works to daylight hours as far as practicable – Situate storage of contaminating material away from watercourses – Ensure emergency spill equipment is available onsite – Reinstate trenches with geofabric and rock spalls if erosion risk
Degradation of adjacent terrestrial habitats due to: – Erosion, dust and sedimentation	– Prepare a site-specific Erosion and Sediment Control Plan for the project – Map high-risk areas requiring protection – Install erosion and sediment controls prior to significant vegetation clearing – Monitor and maintain integrity of controls – Monitor weather to anticipate/avoid works in high-risk rainfall events – Restrict speed limits onsite – Develop a site-specific Waste and Hazardous Materials Management Plan, or similar – Undertake regular site inspections – Suppress dust using water carts, or other suitable methods – Rehabilitate temporary works areas as soon as possible post-construction.

Potential impacts	Avoidance and mitigation measures
	– Retain important habitat features (hollow-bearing trees, timber that will become instream snag and perch material), where possible
Introduction and/or spread of weeds and pests due to: – Movement of contaminated vehicles – Importation of contaminated fill – Creation of disturbance	– Prepare a site-specific Weed Management Plan and Introduced Fauna Management Plan, – Clean and certify vehicles and equipment prior to entering site – Use clean local fill where needed – Dispose of cut responsibly – Educate employees – Limit the clearing footprint – Manage existing weed/pest infestations
Operation phase	
Injury and mortality of terrestrial wildlife due to: – Entrapment/entanglement in structures – Collision with maintenance and recreational vehicles	– Enforce site speed limits – Educate employees – Erect warning signage in high-risk areas – Exclude fauna from high-risk areas – Exclude recreational use from ecologically sensitive areas – Restrict works to daylight hours as far as practicable
Aquatic fauna injury or mortality due to: – Entrapment/entanglement in structures – Collision with maintenance and recreational vehicles	– The intake structure will incorporate a design to reduce the potential for entrapment of aquatic fauna – Gradually increase flow rate to prevent turbulence – Prepare and implement an operations environmental management plan (OEMP) for management of weeds and feral pests
Disturbance of wildlife behaviour due to: – Operational light and noise – Vehicle movements	– Limit recreational vehicle movements, where possible – Enforce site speed limits – Install directional lighting where appropriate
Introduction and spread of weeds and pests	– Undertake weed monitoring and management as per the OEMP – Prohibit operational employees and recreational visitors from bringing domestic pets – Maintain construction weed wash-down facilities for long-term use of maintenance staff and recreational visitors to the area – Enforce weed hygiene protocols as per the OEMP

6.2 Construction phase impacts and mitigation

6.2.1 Loss and degradation of vegetation and terrestrial habitat

6.2.1.1 Potential impacts

In aggregate, construction of the pipeline alignment, its ancillary infrastructure, and all other construction-related disturbance, will cover an area of 375.14 ha, and will likely result in the loss of approximately 65.55 ha of vegetation, of which approximately 17.51 ha is mapped remnant vegetation. Impact areas for respective REs within each section of the pipeline alignment are provided in sections 3.2.2, 4.2.2 and 5.2.2.

Impacts associated with construction of the project will be minimised by locating the pipeline alignment in open (cleared) areas to the greatest extent possible. Despite this, construction of the project will involve clearing of mature eucalypt woodland, mixed *Eucalyptus/Corymbia* woodland, Brigalow woodland, estuarine environments, and fringing riparian environments. Estimated clearing extent of each habitat type for the pipeline alignment is listed in Table 6-2.

Table 6-2 Estimated habitat clearing extent for the pipeline alignment

Habitat type	Estimated clearing extent (ha)
Mature eucalypt woodland	4.78
Mixed *Eucalyptus* / *Corymbia* woodland	69.69
Regrowth and / or scattered *Eucalyptus* / *Corymbia* / *Acacia* trees	143.64
Brigalow (*Acacia harpophylla*) woodland	4.34
Estuarine environments	2.87
Freshwater waterbodies and seasonal wetlands	18.23
Fringing riparian environments	4.84
Cleared and highly modified landscapes	102.04

Vegetation clearing for the project will result in the direct loss of habitat for fauna. Direct loss of vegetation includes the removal of structural features (i.e. mature vegetation, hollow-bearing trees and hollow logs) that provide microhabitats and resources for an array of fauna. Loss of these habitat features creates a loss of perching, foraging and den/nesting resources for native species. This may reduce the number of individual animals that can be sustained in a given area and may increase competition for resources such as food and shelter in remaining remnant habitats. Hollow-bearing trees are recognised as a limited resource in lands that have been subject to grazing due to previous clearing and therefore, the loss of these habitat features is considered to be a major threat to Australia's biodiversity (Gibbons and Lindenmayer 2002). Reducing the abundance of tree hollows through land clearing potentially causes imbalances and restructured community assemblages in woodland areas (Isaac *et al*. 2014).

This report focuses on the values of impacted habitat for conservation significant species that were confirmed present in the study area or are considered likely to occur (see detailed assessment against the Queensland Government's *Significant Residual Impact Guideline* (DEHP 2014b) and Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013) in Section 7).

6.2.1.2 Mitigation measures

Where possible, concept design of the pipeline alignment, associated infrastructure, access tracks and laydown areas has sought to minimise the clearing footprint. Nonetheless, some unavoidable losses of remnant, regrowth and riparian vegetation (and the habitat values these support) will occur. To mitigate impacts of the loss of habitat resulting from construction activities for the pipeline alignment, the following measures will be instigated:

– Clearly marking vegetation clearing areas on construction plans and in the field. Areas that must not be cleared or damaged must also be identified
– Clearly identifying all fauna breeding habitat (e.g. hollow bearing trees) within the project footprint and managing in accordance with conditions of an approved Species Management Plan (SMP) for animal breeding places under the Queensland *Nature Conservation Act 1992* (NC Act)
– Commencing revegetation activities within the project footprint as soon as possible after the pipeline has been installed and buried
– Developing and implementing a site-specific CEMP to detail actions and procedures for the protection of the terrestrial and aquatic environments. The CEMP (GHD 2022) will include the following actions below to manage weeds, pests, dust, and waste and hazardous materials:
    - Implementation of a Weed Management Plan to remove existing weeds and prevent the introduction of new weeds and minimise the spread of declared weeds within the construction footprint prior to construction activities
    - Training key personnel on site to be capable of identifying weed species and preventing their spread and translocation
    - Undertaking daily inspections to monitor control and implementation of appropriate preventative measures for weed and pest species. The construction contractor must and treat all prohibited and restricted matters in accordance with the *Biosecurity Act 2014*

- Requiring all plant and equipment to be washed down prior to arriving on site, with a declaration stipulating that the plant and equipment is clean, in accordance with relevant project requirements.
- Minimising the generation of dust through restriction of speed limits and watering of exposed ground surfaces
- Developing and implementing fuel and chemical storage protocols and spill responses.

6.2.2 Loss and degradation of aquatic habitat

6.2.2.1 Potential impacts

Aquatic habitat will be temporarily impacted during the construction of the pipeline alignment through removal of riparian vegetation, disturbance of the bed and bank from trenching, trenchless construction methods, and the construction of the intake structure.

There are a total of 68 mapped waterway crossings within the pipeline alignment, including major waterways and high-risk waterways (Table 3-14, Table 4-17 and Table 5-13). In these areas, various trenchless construction methods will be used where possible, minimising the impacts to the aquatic ecosystems. Whilst these techniques do not physically disturb the bed and banks of the watercourse, they may require the removal of small amount of riparian vegetation. The removal of riparian vegetation within the pipeline alignment can reduce the extent of shade along the waterway, which provides overhanging and tailing bank structure for aquatic fauna, controls instream primary productivity and influences temperatures (Bunn *et al*. 1998, Davies *et al*. 2004).

The pipeline alignment is adjacent to numerous MSES declared high ecological significance wetlands. These are outside the pipeline alignment and as such no direct impact is expected to occur. However, there are a several HES declared wetlands that will be intersected by the pipeline alignment. Many of these wetlands are ephemeral and trenching methods will be used with restoration of bed and habitats to occur post construction to minimise impacts on aquatic habitat. There are several HES wetlands that contain water throughout the year, including site 32, in which microtunnelling will occur.

The conservation significant estuarine crocodile, platypus, Fitzroy River turtle, and white-throated snapping turtle are expected to occur within the Fitzroy River at the pipeline intake location only within the Northern Section. The estuarine crocodile is likely to or may occur at several riverine and tidal locations within the SGIC SDA which include sites 2, 3, 4, 6, and 30. Platypus are likely to occur at site 3, site 5, and site 6 within the SGIC SDA. The snubfin dolphin and the humpback dolphin may occur at sites 2 and 4. While the green turtle is confirmed as present at site 4, and likely to occur at site 2. The waterway crossings for the remainder of the pipeline alignment are not suitable habitat for these species. A pipe bridge will be constructed at Raglan Creek at site 2, and horizontal directional drilling (HDD) used at Inkerman Creek at site 4, and therefore no direct impacts will occur to these waterways or the aquatic species within.

Earthworks and construction activities may result in the indirect degradation of habitat due to increased erosion and sedimentation from surface water run-off and the disturbance of sediment at the intake structure. Erosion and sedimentation within aquatic environments can negatively impact water quality by increasing turbidity, decreasing oxygen levels and reducing light penetration, whilst also smothering habitat resources and impacting substrate composition (Wood and Armitage 1997; Wheeler *et al*. 2005). Surface runoff, and resultant gullying, is already a common occurrence throughout the study area. Initiation or exacerbation of gullying and bank instability is a concern during construction, particularly in banks consisting of highly erodible soils. Sediment mobilisation is most likely to be generated during the constructing of pipeline trenches and road crossings as a result of heavy machinery use, removal of riparian vegetation and erosive effects of construction in the vicinity of banks. Trenchless construction methods will be used under major waterways and are unlikely to generate a significant increase in sedimentation rates, as the entry and exit points of the tunnels will be situated outside the riparian zone. However, sediment and side-cast materials from pipeline trenches positioned near waterways could be mobilised if heavy rainfall occurs during construction. This has the potential to effect aquatic fauna via impacts to water quality. If impacts to water quality are realised, depending on the locality of the impact there is also potential for flow on impacts to high ecological significance wetlands located within and adjacent to the works.

During construction, large machinery will be required to transport materials and conduct earthworks for trenching, bed-level crossings, and pump installation. The use of machinery within waterways has the potential to degrade downstream environments as a result of accidental spillage of contaminants (e.g. fuels and lubricants). Many

chemicals, such as petrol and diesel fuel, drilling lubricants and pesticides, are particularly toxic to freshwater macroinvertebrate taxa. Construction materials like cement slurries are also highly caustic and can raise Ph above tolerable limits for aquatic taxa. In severe cases, a large-scale hydrocarbon spill would result in the formation of a toxic surface slick with the potential to cause death, poor health and / or reduced reproductive success in aquatic communities for a period of months to years.

6.2.2.2 Mitigation measures

- Minimising the loss of aquatic habitat during the design phase by locating pipeline alignment outside waterways where possible
- Where crossing waterways is required for construction, habitat loss will be minimised by developing temporary waterway barrier crossing in accordance with DAF's acceptable development requirements.
- Locating any additional construction areas or construction sites, such as laydown areas, access tracks and machinery/equipment storage within existing cleared areas and away from the waterway bed and banks
- Preparing and implementing a stringent and site-specific CEMP to detail actions and procedures for the protection of the aquatic environments
- Preparing and implementing site specific ESCPs as part of the CEMP in accordance with practices described in the International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline and/or Queensland Division of the Australian Institute of Engineers' Erosion and Sediment Control: Engineering Guidelines for Queensland Construction Sites. The ESCP will be prepared by a highly experienced certified professional in erosion and sediment control and will include the following methods to minimise degradation of aquatic habitats:
  - Installing sediment control devices to minimise downstream transport of sediments released during vegetation clearing and earthworks
  - Minimising erosion potential through scour protection treatments at abutments
  - Minimising vegetation clearing and the area of bare ground required for construction to only that which is necessary
  - Appropriately managing and protecting stockpiles.
- Monitoring of water quality conditions (visual and in situ recordings) as per the requirements in the WQMP to identify the potential for water quality degradation within waterways and allow for adaptive management if required
- Minimise the project footprint by restricting the clearing area to the smallest practical area and only where necessitated by the approved construction of roads, services, access and cut and fill
- HDD drilling will be investigated to be employed underneath major and high-risk waterways to avoid temporary loss of aquatic habitat
- Undertake construction in aquatic habitats during the dry season, where possible to coincide with the time that ephemeral watercourses are least utilised by aquatic fauna
- Locate laydown areas, site offices and other temporary works areas in areas already subject to existing disturbance wherever possible
- Inform all construction personnel of environmental responsibility with respect to the protection of vegetation and fauna habitat. Site inductions will include information on the location of important habitat to prevent disturbance and/or destruction of these areas
- Demarcate no-go areas of ecological sensitivity both on site and in construction plans, including all vegetation not to be cleared. All vegetation to be retained should be surveyed and clearly demarcated
- Rehabilitate and revegetate temporary construction areas as soon as possible after the completion of local construction works
- Restore bed and banks to pre-existing profiles and riparian vegetation re-established following completion of works.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No damage/degradation of ecologically-sensitive sites beyond demarcated construction zones
– No damage or degradation of waterways beyond demarcated construction zones
– No clearing of vegetation clearing where an alternative option to site requisite ancillary and temporary infrastructure/disturbance exists in cleared/degraded land
– No impact to waterways from ancillary infrastructure (excluding access track crossings)
– Rehabilitation of all temporary disturbance areas to at least their pre-disturbance floristic composition and ecological condition, and preferably an improved condition.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.3 Acid Sulfate Soils

6.2.3.1 Potential impacts

Acid sulfate soils (ASS) are commonly found at elevations below 5 m AHD and sometimes beneath newer soils below elevations of 20 m AHD. Acid sulfate soils are safe when undisturbed but when dug up or drained, the pyrite in the soil reacts with oxygen and oxidises. This process turns pyrite into sulfuric acid, which can damage the environment, buildings, roads and other structures (Queensland Government 2020). The likelihood that ASS would be encountered during construction activities as excavation below 20 m AHD is not anticipated, however there are several tidal crossings within SGIC SDA that occur at low elevations and therefore have a larger risk of ASS occurring than the majority of sites throughout the pipeline alignment.

If ASS are excavated and exposed to air, i.e. oxidised, the potential environmental impacts may include:

– Reduction in water quality resulting in damage to estuarine environments and reduction of wetland biodiversity
– Acidification
– Heavy metal precipitation (e.g. aluminium, iron and manganese), which causes poor plant productivity and smothers plant vegetation and microhabitat
– Corrosion of infrastructure.

6.2.3.2 Mitigation measures

The Construction Contractor will develop a site-specific ASS Management Plan, as required, to address the requirements of the ASS Investigations and in consideration of adopted construction methodologies. The ASS Management Plan will meet the requirements outlined in Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines (State of Queensland, 2014), and will include:

– Construction staff will be made aware of the signs of ASS
– Identified areas of ASS will be clearly shown on construction plans
– Where ASS investigations have identified the need to neutralise spoil this will be carried out within 24 hours of it being exposed at the designated rate and liming verification sampling and analysis be undertaken to confirm that adequate lime has been used
– A designated bunded area will be used for neutralisation (if not in-situ)
– Surface run-off is to be controlled and captured through appropriate stormwater management
– The Construction Contractor will develop a procedure to discharge water from the trench. The Ph of any water pooled onsite (groundwater seepage and after rainfall events), that requires to be discharged off site for any reason, will be monitored. If the Ph is acidic the water will be treated with hydrated lime if necessary. Bags of hydrated lime will be kept onsite in a dry state for this purpose but used as approved by the Delivery Authority.

6.2.4 Injury and mortality of wildlife

6.2.4.1 Potential impacts

The construction of the pipeline alignment has the potential to cause injury and mortality of wildlife through collision with construction vehicles and machinery, entanglement in site fencing, entrapment in open excavations and direct injury or mortality during clearing.

Approximately 65.55 hectares of vegetation clearing will be required within the pipeline alignment, of which approximately 17.51 ha is mapped remnant vegetation. Additional clearing will also be required for access tracks and laydown areas. Clearing activities have the potential to cause injury and mortality to local fauna sheltering in hollows, nests, trees and ground habitat (logs, burrows, soil, leaf litter, beneath rocks). Species that are most susceptible include nocturnal species that are likely to be sheltering during clearing activities (e.g. gliders and possums) and slow moving species or sedentary species that are unlikely to be able to flee the clearing zone (e.g. koala's, small ground–dwelling mammals, reptiles and frogs).

Construction activities associated with the project will involve a temporary increase in vehicular traffic and plant movement to, from and at the site, including traffic on existing access roads. This has the potential to increase the incidence of wildlife mortality from vehicle strike. Conservation significant fauna species at particular risk of vehicle strike include the squatter pigeon (southern), koala and ornamental snake, as well as ground-dwelling bird, mammal and reptile species that commonly occur on tracks throughout the region.

Breeding places for conservation significant species, including the squatter pigeon (southern), have the potential to be directly impacted during clearing of the pipeline alignment, causing a loss of critical ecological resources and the potential for injury and mortality of individual animals. Other conservation significant species with heightened risk of injury or mortality during construction include the koala (due to its likely occurrence and noting its relatively slow movement).

The risk of injury / mortality to aquatic fauna can occur at waterway crossings. Construction of the intake structure poses the highest risk of potential fauna injury and mortality with aquatic fauna likely to be present within the direct footprint of works. Habitat degradation of waterways within the project footprint resulting in poor water quality, alteration of flow, isolation of habitat, increase predation pressure and increased competition, may also indirectly cause injury and mortality of aquatic fauna.

Entrapment of wildlife within excavations pits, particularly within the pipeline network, poses an additional threat to wildlife. Most at risk wildlife includes wide-roaming fauna like macropods, snakes, and echidnas.

6.2.4.2 Mitigation measures

The following measures will be instigated to minimise wildlife injury and mortality during construction of the project:

– A pre-construction survey for breeding habitat will be conducted within disturbance footprints to determine the requirement for Species Management Plan (SMP) under the NC Act. Pre-clearance surveys by suitably trained and qualified ecologists
– Pre-clearance surveys will be undertaken prior to construction disturbance. This includes marking and retaining (where possible) trees with large hollows, marking all habitat trees retaining hollows, stick nests and arboreal termite mounds, and checking ground habitat features, including ground logs, woody debris and burrows. Fauna will be relocated to the nearest safe place within suitable habitat prior to clearing
– Fauna spotter/catchers to be present during all construction works that have the potential to cause injury / mortality to terrestrial and aquatic fauna within the construction footprint. This will involve checking felled habitat trees retaining hollows, stick nests or arboreal termite mounds, and safely removing and relocating resident fauna to the nearest suitable, safe habitat outside of the project footprint
– Flush areas of predicted habitat for the squatter pigeon (southern) immediately prior to clearing (i.e. spotter-catcher to walk in front of clearing machinery)
– Fauna spotter catchers to undertake daily inspections of trenches, excavations and machinery for the presence of trapped fauna
– Minimise the length and time that trenches and excavations are open

- Open trenches and excavations to contain fauna ramps to allow large fauna such as macropods to escape and damp hessian cloth to provide shelter for small fauna such as reptiles and frogs. This is especially relevant to any trenching required for the construction of the pipeline
- Construction at ephemeral waterways will occur during the dry season, where possible
- Aquatic fauna salvage, if required, will be undertaken in accordance with DAF Aquatic Fauna Salvage Guidelines
- Clearly demarcate no-go areas of sensitive vegetation and habitat, including all vegetation and habitat not to be cleared
- Sequential clearing of vegetation to allow resident fauna the opportunity to disperse away from the immediate project footprint
- A Traffic Management Plan will be developed for the construction site with designated access routes, speed limits and sensitive ecological areas (i.e. particularly areas where squatter pigeon (southern) have the potential to occur on access roads)
- All vehicles and plant will adhere to site rules relating to speed limits. Speed limits will be clearly signposted to minimise the potential for roadkill
- Given the specific susceptibility of the squatter pigeon (southern) and koala to vehicle collision, warning signs will be erected on all tracks that intersect potential habitat for the squatter pigeon (southern), koala and ornamental snake. Squatter pigeon (southern), koala and ornamental snake awareness will be included in all worker inductions, as well as speed limits and traffic volume in the Traffic Management Plan. A register of squatter pigeon (southern), koala and ornamental snake sightings will be maintained to identify current areas that have a risk of collision
- Minimising the need to travel near dawn or dusk, limit haulage and delivery of materials to the day time and/or where possible, minimise the number of vehicles travelling during this period through the use of car-pooling to transport construction personnel where possible
- Educating employees regarding the presence of conservation significant species and other fauna and livestock on access roads
- Erecting temporary construction fencing to exclude mobile animals such as macropods and livestock from the construction areas
- HDD drilling underneath major and high-risk waterways will be employed to avoid fauna injury or mortality during construction as necessary (subject to design development and site-specific construction methodologies)
- Develop adverse incident response procedures to detail actions to be taken in the event of wildlife injury or mortality during clearing. This will include procedures for capture and transport of injured wildlife to qualified veterinarian or humane on-site euthanasia and formalisation of arrangements with a local veterinarian to treat and care for wildlife injured during for the construction period.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

- No disturbance of active and utilised breeding sites for conservation significant-species– where active breeding sites for conservation-significant species are identified, construction activities will be managed in accordance with a high-risk SMP to allow for breeding to be successfully completed
- No injury or mortality of conservation-significant species as a result of vehicle and plant movements linked to the project
- No injury or mortality of conservation-significant species as a result of entanglement in fencing (or other site infrastructure), nor entrapment in excavations
- All aquatic fauna relocated from within active construction footprints within the pipeline alignment.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.5 Disturbance of wildlife through light, noise and vibration

6.2.5.1 Potential impacts

The operation of machinery and equipment has the potential to disrupt local fauna behaviour, through increased exposure to light, noise and vibration. This can adversely impact native wildlife through the disruption of foraging, breeding and nesting behaviours (Longcore and Rich 2004; Slabbekoorn *et al*. 2010; Popper and Hawkins 2016). Increased light, noise and vibration can alter the behaviour of individual animals and disrupt the balance of intra- and interspecies interactions. Such disruptions typically favour feral predators and generalist species that owe their success to broad ecological tolerances and have the possess the ability to tolerate or actively exploit disturbed environments.

Construction activities may require works to be undertaken at night. The impacts of artificial lighting will differ between faunal groups and individual species. Artificial lighting for safety and to facilitate night works has the potential to disturb wildlife and will likely result in the temporary movement of some nocturnal fauna away from the construction area. Nocturnal fauna can be particularly sensitive to light disturbance, causing more sensitive species to avoid areas exposed to artificial lighting (Longcore and Rich 2004). Artificial lighting can also attract opportunistic microchiropteran bat species that feed on insects at artificial light sources, to the detriment of more sensitive bat species.

Increased levels of disturbance (e.g. from noise, vibration, light, vehicles, machinery, personnel) also have the potential to disrupt the behaviour and dynamics (i.e. foraging, movement) of aquatic fauna inhabiting waterways and waterbodies within and adjacent to the project footprint. Behavioural changes expected to occur include avoidance and evasive (startled) movement leading to displacement from habitat and loss of resources within the direct areas of impact.

6.2.5.2 Mitigation measures

Routine mitigation measures should be undertaken to minimise the impact that noise, light, vibration and disturbance have on local wildlife populations during construction. This will be particularly important within the vicinity of habitat for conservation significant fauna species (refer to mapped habitat for conservation significant species in Section 7). The following measures will be instigated to minimise the impacts of light, noise and vibration during construction:

– The in-stream construction duration for major and high-risk waterways should be in accordance with the DAF guidelines and/or approval conditions. All works within waterway crossings will be in accordance with CEMP
– Maintaining river flow and aquatic fauna movement within its natural course for as long as possible and in accordance with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018) for operational work that is constructing or raising waterway barrier works' (DAF, 2018). A flow diversity strategy will be developed to limit river diversion to a single dry season and maintain flows during the construction period
– Using noise dampening devices on machinery wherever practical and requiring that all equipment is maintained and serviced in accordance with manufacturer's instructions to reduce noise levels
– Develop a Traffic Management Plan for the construction site to control vehicle movements and speeds and reduce the unnecessary generation of vehicular noise
– Minimise the number of vehicle movements during construction through the use of local construction camps and buses to transport construction personnel
– Limit construction activities to daylight hours wherever possible to reduce the need for lighting and resultant light spill into adjacent habitat and to reduce noise and vibration impacts on nocturnal fauna species
– Minimise site lighting to the minimum needed for safety. Install directional lighting and shields to minimise light spill outside of the immediate work areas having consideration for health and safety requirements
– Comply with construction vehicle maintenance schedules and operational restrictions designed to limit noise impacts during construction.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No illumination of remnant vegetation by non-essential construction lighting
– No injury or mortality of conservation-significant species due to vehicle and plant movements linked to the project.

6.2.6 Fragmentation of terrestrial habitats

6.2.6.1 Potential impacts

Habitat fragmentation is the process in which large, continuous habitats are converted into smaller, more isolated patches, often separated by a matrix of human-induced land cover (Haddad *et al* 2015; Wilcove *et al*. 1986). Habitat fragmentation can isolate populations by creating barriers to local fauna movement and the dispersal of plant seeds and fruit and increase habitat degradation due to concentration of animals in isolated patches. Fragmentation increases the amount of 'edge' habitat – while such ecotones are beneficial for some generalist and/or highly competitive species, they are prone to degradation through so-called 'edge effects'. Edge habitats tend to be exposed to increased exposure to light, noise, sediment-laden run-off, erosion and weed and pest infestation.

Vegetation clearing during construction has the potential to result in localised fragmentation of habitats adjacent to the project. Species susceptible to habitat fragmentation typically become more reliant on local resources and more vulnerable to impact from local disturbances (e.g. fires or localised flooding) (Fridley *et al*. 2007; Gilpin and Soule 1986; Kneitel and Chase 2004). Altering the pattern of the local landscape can reduce the resilience of some species' populations to perturbation. The nature and severity of habitat fragmentation impacts also tends to vary depending on the level of existing fragmentation within the landscape.

The pipeline alignment occurs in a landscape that has been transformed by agricultural and mining land use – the extent to which the landscape pattern is altered varies along the pipeline alignment. Within that context, habitat fragmentation resulting from the proposed pipeline alignment is unlikely to have a regional impact on fauna diversity (e.g. species richness) due to already modified nature of the landscape matrix. However, noting that the effects of fragmentation operate at multiple spatial scales, and manifest differently for species based on their ecological traits and life history attributes, it is likely to cause localised impacts for some less mobile and/or more specialised species, by intersecting corridors that may be important conduits for local wildlife movement (e.g. along watercourses). This barrier effect is likely to be insignificant for many species, noting that, as the pipeline alignment will be rehabilitated after the pipeline has been installed and buried. The movement of koalas, and other conservation significant fauna species that are known or likely to occur in woodlands and fringing riparian vegetation within and near the proposed pipeline alignment, are unlikely to be limited by such an alteration, although it could potentially expose some (arboreal) species to increased predation risk where it forces animals to spend more time on the ground.

The fragmentation of habitat may also have localised impacts on the composition of assemblages of woodland birds, reptiles and small ground mammals, by reducing the area of available habitat for edge-sensitive species that prefer intact woodland remnants, or 'core' habitat within fragmented patches. Of note is that such edges in fragmented agricultural landscapes may benefit hyperaggressive *Manorina* honeyeaters – birds which are known to depress the abundance of small woodland bird species. While woodland birds may experience localised adverse impacts from the fragmentation (increased edge) caused by the project, this is unlikely to be of consequence for any conservation significant bird species.

6.2.6.2 Mitigation measures

The following mitigation measures will be instigated to limit fragmentation and reduced connectivity:

– Limit construction or temporary fencing or utilise wildlife permeable fencing where risk of injury is low
– Demarcate areas of native vegetation requiring removal to equipment operators and supervisors before any clearance to ensure disturbance is minimised
– Maintain areas of existing vegetation to assist in providing a source of seed for local rehabilitation works.
– Co-locate or upgrade existing access tracks in areas that are already disturbed, wherever possible
– Use native species for rehabilitation wherever possible. If native species are unsuccessful introduced stoloniferous grasses may be to achieve rapid surface coverage

– Limit construction laydown areas and stockpiles to areas that have already been cleared to minimise unnecessary clearing wherever possible.
– Use of HDD drilling underneath waterways to avoid clearing riparian wildlife corridors.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No establishment of weeds at edges created as a result of construction activities – where new weed infestations are observed, these will be managed in accordance with the project's CEMP
– Notwithstanding requirements for access to maintain the pipeline during operations, 20 m of the 30 m wide pipeline alignment will be rehabilitated once constructed (buried).

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.7 Restriction of aquatic species movement

6.2.7.1 Potential impacts

Migrations are important for many of Australia's native aquatic fauna, with numerous aquatic fish species undertaking migrations as part of their lifecycle and/or movements as part of their day-to-day foraging activities. During construction, water flow within intersected waterways has the potential to be impact by construction works, particularly trenching across ephemeral and lower order waterways. As a consequence, upstream and downstream movement of aquatic fauna may be temporarily restricted thus affecting dispersal, life history movement stages, breeding and foraging.

The majority of other watercourses within the project footprint are ephemeral in nature, containing only seasonal running water in the wake of sustained rainfall events. For most of the year, these low and moderate risk waterways consist of dry creek beds or watercourses, while some waterways contain occasional disconnected pools, with no opportunity for broad-scale migrations/ movements for the majority of the year. Instream works have been timed in a manner that minimises impacts to aquatic fauna and are planned to occur during the dry season, as far as practicable. When intersecting an ephemeral watercourse, the pipelines will be buried in trenches, with disturbed substrate reinstated to construct bed level crossings. As construction is to occur within the dry season, flow controls or diversions are unlikely to be required. Should high rainfall climatic conditions occur during construction, these trenches may constitute a temporary barrier for aquatic species that may utilise the ephemeral tributaries as refuge habitat.

Several waterways were identified as being a high to major risk, as well as tidal within the WWBW for aquatic fauna. These waterways are likely to be permanent waterways with suitable refuge pools and habitat resources for aquatic fauna or are semi-permanent and offer some isolated habitat. Due to the adopted construction approach of trenchless methods, the project works are unlikely to restrict the movement of aquatic taxa within major and high-risk waterways as no physical barrier will be constructed. If trenchless methods are not a viable option at a waterway containing aquatic habitat during construction the aquatic fauna movement will be temporally disrupted during the period of construction activities within the waterway. This disruption is likely to occur for a short period up of to several weeks and therefore the disruption of movement is unlikely to disrupt breeding or season migrations.

The structure at the Fitzroy River has the potential for temporary restriction of movement whilst construction is underway. Construction will require the diversion / exclusion of the river around the footprints with the use of coffer dams. Considering the coffer dam will not extend across the entirety of the watercourse, fauna movement is expected to be maintained. Pre-construction surveys will be undertaken to identify breeding habitat for conservation significant species and a high-risk SMP will be prepared and implemented if required.

Works will be undertaken in accordance with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018) and will allow for continued or facilitated movements. Temporary works will also comply with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018). Where works con not comply with the DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), a WWBW development approval will be required to demonstrate that

adequate fish passage will be maintained during construction. Overall, restriction of fauna movement will be localised and temporary.

6.2.7.2 Mitigation measures

Management controls being investigated for mitigating impacts to the restriction of movement for aquatic species include:

– Undertaking works in accordance with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018)
– Use of HDD on high and major risk waterways, where possible
– Maintain flow and fauna movement within the waterways if trenchless construction methods are not possible
– Maintain flow and fauna movement within the Fitzroy River during construction of the intake structure
– A pre-construction survey for breeding habitat will be conducted within disturbance footprints of waterways, including the intake structure at the Fitzroy River, to determine the requirement for Species Management Plan (SMP) under the NC Act. Pre-clearance surveys by suitably trained and qualified ecologists.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– Upstream and downstream movement of aquatic fauna will be maintained during the construction period
– Construction methodology complies with Acceptable Development Requirements.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.8 Introduction and spread of weeds and pests

6.2.8.1 Potential impact

Construction activities have the potential to introduce and/or spread exotic pests throughout the project. This can result in disruptions to natural ecosystem functioning by altering the balance of inter-species competition and predation. Inappropriate waste disposal and provision of water have the capacity to attract higher local concentrations of feral predators, increasing the predation pressures on local wildlife. Pest fauna species recorded within the study area included the feral pig European red fox, European rabbit and cane toad. The pipeline alignment and access tracks created for the project have the potential to facilitate movement of feral predators such as wild dogs and foxes, thereby increasing predation pressures on local wildlife, including koalas and freshwater turtles. Additionally, cane toads are considered to pose a threat to the ornamental snake. Control programs are recommended to mitigate impacts on terrestrial and aquatic fauna species. Although the study area is likely already exposed to relatively high levels of pest infestation, mitigation measures will be required to limit the spread of pest animals that could result from construction activities.

An increase in bare ground and open areas, associated with land clearance will favour weed species, which can suppress the regeneration of native species and reduce the available habitat. This can cause significant damage to Queensland's primary industries and undermine the ecological integrity of bushland remnants by competitively excluding native plant species that provide food, shelter and nesting resources for native wildlife.

A total of 13 restricted invasive weeds were recorded during the field surveys (Section 3.5, 4.5 and 5.5). Construction activities typically have the potential to introduce invasive weeds through the increased movement of people and machinery. Additionally, established weed populations may be spread throughout the project footprint by personnel and work vehicles during construction of the project. Additionally, surface water flow has the potential to distribute weed species from construction areas to nearby watercourses, resulting in weeds being distributed further downstream.

Given the project is located within a predominantly agricultural landscape, the risks of weed introductions carry heightened consequences. Strict vehicle hygiene and weed management protocols will be required to control risks of introducing or spreading weeds during construction.

6.2.8.2 Mitigation measures

The following measures will be instigated to minimise the introduction and spread of introduced species throughout the study area:

- Identification and management of pest species will be undertaken in accordance with the plans and strategies in the *Biosecurity Act 2014*. Likewise, management of declared local pests will be undertaken in accordance with relevant local government strategies and plans, including the Gladstone Regional Council Biosecurity Plan 2021-25 (GRC 2021) and Rockhampton Regional Council Biosecurity Plan for Pest Management 2017-2021 (RRC 2017)
- Develop and implement a site-specific Weed and Pest Management Plan to inform all construction activities that outlines protocols to prevent the introduction of weed and pest species into the area and minimise the spread of declared weeds and pests within the project footprint
- Undertake prevention and management of pest animal and invasive species in accordance with the *Biosecurity Act 2014*. Likewise, management of declared local pests and invasive species will be undertaken in accordance with relevant local government strategies and plans, including the Gladstone Regional Council Biosecurity Plan 2021-25 (GRC 2021) and Rockhampton Regional Council Biosecurity Plan for Pest Management 2017-2021 (RRC 2017), as applicable
- Establish appropriate on-site waste-storage and disposal protocols, with designated waste-storage areas and appropriate (i.e. closed) waste receptacles and frequent waste disposal schedules to minimise attracting feral animals (e.g. dogs, foxes and pigs)
- Include weed and pest management protocols in all worker inductions
- Prohibit employees from bringing domestic animals onto the construction accommodation camps or site
- Enforce strict weed hygiene protocols including weed-washdowns, inspections and weed and seed certifications of all vehicles, machinery and plant prior to entering the construction site. Wash-downs and inspections should also be undertaken regularly for vehicles travelling to different parts of the site to minimise internal spread of weeds within the works area
- Establish a designated access track network and restrict all vehicle movements to designated access tracks. Enforce no off-road driving
- Undertake pre-construction inventory and mapping of all weed-affected areas and identify areas of high-risk that should be designated as no-go areas or areas requiring active weed management during and after construction
- Undertake periodic inspections of weed-affected areas throughout the construction period and implement weed control to weeds of management concern, including declared and environmental weeds
- Identify and control all declared weed infestations on the construction site throughout construction
- Monitor treated areas to assess the success of declared pest/weed eradication
- Rehabilitate and revegetate temporary works areas as soon as possible to minimise the potential for weed establishment
- Utilise stockpiled topsoil and mulched vegetation during landscaping and revegetation
- Utilise native species endemic to the region in revegetation to minimise importation of plants
- Undertake regular post-construction monitoring of rehabilitation areas and high-risk weed areas.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

- No establishment of previously unrecorded weed species at or near construction sites associated with the pipeline alignment.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.3 Operation phase impacts and mitigation

The operational phase will have relatively minor, localised impacts on ecological values. Impacts and mitigation measures are detailed below.

6.3.1 Injury and mortality of terrestrial wildlife

6.3.1.1 Potential impacts

Noting the pipeline will be buried once operational, the project has minimal potential to cause wildlife injury and mortality. Any risk would be from direct collision (e.g. with maintenance vehicles) or entanglement of wildlife with structures including exclusion fencing (should this be required to protect any above-ground infrastructure/for safety purposes). While occasional injury and mortality of fauna is anticipated, this will be at a level that impacts on individuals only with no anticipated impact on the long-term viability of local fauna populations.

6.3.1.2 Mitigation measures

The following measures will be instigated to mitigate injury and mortality of wildlife during the operation phase:

– Enforce on-site speed limits to restrict the incidence of vehicle strike. Enforce no off-road driving rules
– Educate maintenance and operations employees regarding the presence of conservation significant species, particularly species with increased risk of injury and mortality such as the squatter pigeon (southern), koala and ornamental snake
– Avoid the use of barbed wire in perimeter fencing wherever possible. Consider following the Queensland Government's guidelines for koala-friendly fencing where fencing required around permanent infrastructure
– Prohibit public recreational access to areas of high ecological sensitivity or high roadkill risk areas such as local drinking and breeding sites for the squatter pigeon (southern).

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No injury or mortality of conservation-significant species due to vehicle movements once the pipeline is operational
– No injury or mortality of conservation-significant species as a result of entanglement in fencing (or other site infrastructure).

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.3.2 Aquatic fauna injury and mortality at pipeline intakes and outlets

6.3.2.1 Potential impact

Operation phase impacts are primarily located at the intake site on the Fitzroy River, which has the potential to injure or result in mortality of resident aquatic fauna. Entrainment of biota has the potential to occur where intake velocities exceed the swimming speed of aquatic fauna, or where fauna can directly enter a wet well.

Water extraction from the intake structure presents a potential risk of physical harm and drowning of resident aquatic fauna at the river intake site. To mitigate the risk the intake structure will incorporate a design to reduce the potential for macroinvertebrate and fish entrainment, as outlined below. Therefore, the overall likelihood of fauna injury or mortality at the pipeline intake locations is considered low.

6.3.2.2 Mitigation measures

The following measures are proposed to avoid/minimise injury and mortality to aquatic fauna during operation:

– Placing the intake at a depth that aims to prevent bed scour
– Providing an adequate distance between the pump and the intake screens to reduce the risk of fauna being impinged of the intake screens
– Designing the intake to include scour protection by using suitable rock/grout construction.
– Flow rates will gradually increase into and out of the pipeline structures to prevent sudden changes in water velocity and turbulence to prevent physical harm to aquatic fauna such as turtles, platypus and fish
– Rapid drawdowns at the river extraction site will be avoided to maintain flow downstream and quality of aquatic habitat within the Fitzroy River
– A site-specific OEMP will be prepared to detail actions and procedures for the protection of the aquatic environments. The OEMP will include procedure for the control and management of weeds and feral pest species.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No aquatic fauna injured or killed at the pipeline intake infrastructure
– Aquatic habitat condition maintained within the Fitzroy River.

Regular monitoring and auditing will be undertaken in accordance with approval conditions, with corrective actions strictly enforced where performance criteria are not being met.

6.3.3 Disturbance of wildlife by light, noise and vibration

6.3.3.1 Potential impacts

Operation of the pipeline will have minimal, highly localised disturbances to wildlife from noise and light. Pumps required along the pipeline alignment will generate low frequency and amplitude noise impacts. These will have only localised impact on fauna within the immediate vicinity of pumping stations. Operation of the project will involve occasional vehicle movements to transport staff to and from the site which generate additional noise, however these impacts are anticipated to have limited ecological impact considering the low frequency of vehicle movements.

6.3.3.2 Mitigation measures

The following measures are being investigated to mitigate noise and light impacts on native wildlife:

– Incorporate routine noise-suppression design features in the design of the pumping stations
– Inspect and maintain all vehicles, machinery and plant regularly to minimise operational noise
– Prohibit employees from bringing domestic animals to the pipeline area when conducting operations/maintenance work.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– All equipment is to be inspected and maintained in accordance with operational CEMP.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.3.4 Introduction and spread of weeds and pests

6.3.4.1 Potential impacts

A maximum width of 10 m adjacent to the pipeline alignment will be permanently cleared to allow access for service and maintenance vehicles during the operation phase. Although access tracks could facilitate movement by feral predators, particularly wild dogs and foxes, it is unlikely that the project will increase introduced fauna species abundance beyond existing levels.

Operation activities typically has the potential to introduce and disperse invasive weeds through the movement of people and machinery. Additionally, established weed populations may be spread along the pipeline alignment by personnel and work vehicles during operation and decommissioning of the project. Given the project is located within a predominantly agricultural landscape, the risks of weed introductions carry heightened consequences. Strict vehicle hygiene and weed management protocols will be required to control risks of introducing or spreading weeds during the operational phase.

Operation of the pipeline and the intake structure have the potential to translocate aquatic flora as organic material (e.g. plant fragments and seeds) may be drawn into the pipeline and transferred to the receiving environment. Algae (particularly blue green algae), algal blooms and other water borne pest and weed species also have the potential to become a problem if they are not contained promptly at the beginning before entering the pipeline.

Aquatic pests and weed species may become more prevalent along the pipeline corridors as well as the intake structure due to the previous increase in disturbance of habitats during construction. Maintenance vehicles during routine management may also serve as vectors should weed washdown protocols be inappropriately addressed, allowing organic material to be transported upon the vehicle.

6.3.4.2 Mitigation measures

The following measures will be instigated to minimise the introduction and spread of introduced species during the operation of the project:

– Undertake prevention and management of pest animal and invasive species in accordance with the *Biosecurity Act 2014*. Likewise, management of declared local pests and invasive species will be undertaken in accordance with relevant local government strategies and plans, including the Gladstone Regional Council Biosecurity Plan 2021-25 (GRC 2021) and Rockhampton Regional Council Biosecurity Plan for Pest Management 2017-2021 (RRC 2017), as applicable
– Develop and implement a site-specific Weed and Pest Management Plan to inform all activities that outlines protocols to prevent the introduction of weed and pest species into the area and minimise the spread of declared weeds and pests along the pipeline alignment
– Runoff and sedimentation from easements to waterways will be minimised
– Maintain weed wash-down facilities for long-term use of maintenance staff. These facilities will be bunded and located away from drainage lines to minimise the risk of weed spread
– Enforce strict weed hygiene protocols including weed-washdowns and inspections for maintenance vehicles travelling along permanent pipeline and powerline easements
– Restrict all vehicle movements to designated access tracks. Enforce no off-road driving, unless required for safety reasons and following approval by the relevant GAWB person.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No establishment of previously unrecorded weed species within the pipeline alignment.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

7. Significant Impact Assessments

As identified in Section 1.2, EPBC approval has been granted for the project, with the controlling provisions being threatened species and ecological communities listed at the time of the approval. A SIA was undertaken in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines – MNES (May 2006) as part of the EIS and SEIS and the approval conditions based on this assessment for these MNES controlling provisions. In this report, a significant residual impact (SRI) assessment was undertaken in accordance with the Queensland *Significant Residual Impact Guideline* (DEHP 2014b) for 20 flora and fauna species currently listed under both the EPBC Act and NC Act that have been confirmed present or likely to occur. In addition, the grey-headed flying-fox (*Pteropus poliocephalus*) is only listed under the EPBC Act, and therefore, an SIA was undertaken for this species.

7.1 GSDA

7.1.1 Significant Impact on MNES and MSES species

This section assesses the significance of the GSDA impacts on MNES and MSES that have been confirmed present or are considered likely to occur within the GSDA study area. The significance of impact assessment has been undertaken in accordance with the Queensland Government's *Significant Residual Impact Guidelines* (DEHP 2014b). The grey-headed flying-fox is listed only under the EPBC Act and Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013). A summary of outcomes of the MNES and MSES significant impact assessment are presented in Table 7-1.

Table 7-1 Summary of residual significant impact assessment on MSES and MNES

Species	Significant impact	EPBC Approval	Assessed as MSES	Assessed as MNES
Flora				
Cycas megacarpa	Unlikely	✓	✓	
Samadera bidwillii	Unlikely	✓	✓	
Fauna				
Glossy black-cockatoo	Unlikely		✓	
Squatter pigeon (southern)	Likely	✓	✓	
White-throated needletail	Unlikely		✓	
Powerful owl	Unlikely		✓	
Greater glider (southern and central)	Likely		✓	
Yellow-bellied glider (south-eastern)	Likely		✓	
Koala	Likely		✓	
Grey-headed flying-fox	Likely	✓		✓

7.1.1.1 Cycas megacarpa

Conservation status and species ecology

Cycas megacarpa is listed as endangered under both the NC Act and the EPBC Act and was listed as an MNES at the time of the approval. It grows to 5 – 8 m in height, with a trunk 8 – 14 cm diameter and a glossy green crown with leaves 40 – 110 cm long (Queensland Herbarium 2007; DES 2021). Seeds are produced at the top of the trunk, within the crown of fronds and are ovoid in shape, and 35 – 45 mm in diameter (Hill 1992). As a member of the *Cycadaceae* family, the plant is dioecious (i.e. individual plants are either male or female).

It is thought that pollen dispersal occurs via wind and insects, including moths and beetles (James *et al*. 2018; DES 2021). Forster *et al*. 1994 (cited in Queensland Herbarium 2007) reported beetles from the genera Hapalips

and Ulomoides have been recorded on the male cones of *Cycas megacarpa*. Fruiting cones are produced on female plants between May and February, with seeds ripening from March onwards. Seeds do not germinate for at least nine months. Male cones shed pollen and female megasporophylls are receptive in November (Queensland Herbarium 2007). Seed dispersal is restricted by the large seed size, resulting in short range dispersal (James *et al.* 2018).

Significance of impact assessment

The project is considered unlikely to result in a significant residual impact on *Cycas megacarpa*. A significance of impact assessment of the project on *Cycas megacarpa* (endangered under the EPBC Act and NC Act) is provided in Table 7-2.

Table 7-2 Significance of impact on Cycas megacarpa

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** Although this species is considered likely to occur based on the species distribution and habitat present, no individuals have been confirmed present in the GSDA pipeline alignment during successive on-ground survey efforts by various consultants. Furthermore, the closest historical record is 5.5 km west of the GSDA study area. As such the project is unlikely to result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project is unlikely to result in a reduction in the extent of occurrence of the species.
Fragment an existing population	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no fragmentation of an existing population is expected to occur.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The project is unlikely to impact any local occurrences or their supporting habitats and opportunities for breeding and dispersal are not expected to be impeded by the project. As such, the project is unlikely to result in the isolation of habitats for the species or the formation of genetically distinct populations.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The project is unlikely to result in an invasive species becoming established within the GSDA pipeline alignment. Strict biosecurity measures will be incorporated in the Project's Construction Environmental Management Program (CEMP) to limit the introduction of weeds and other organic matter from outside of the project footprint.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not considered to be a key threat to *Cycas megacarpa*; however, hygiene management measures will be utilised during the construction phase to limit the introduction of organic matter into the GSDA pipeline alignment.
Interfere with the recovery of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no interference with the recovery of the species has been identified.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project area is not considered to be ecologically significant for this species.
Conclusion	The project is unlikely to result in a significant residual impact on *Cycas megacarpa*. No individuals or population have been recorded historically or during recent surveys efforts within the GSDA pipeline alignment. Biosecurity and hygiene measures will be incorporated in the project's CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.

7.1.1.2 Samadera bidwillii

Conservation status and species ecology

Samadera bidwillii is listed as a vulnerable under both the NC Act and the EPBC Act and was listed as an MNES at the time of the approval. It is a small shrub or tree that grows up to 6 m in height. Its leaves are stiff and leathery and up to 9 cm in length and 6 to 12 mm wide. Flowering occurs from November to March. Inflorescences occur in axillary clusters of 1 to 4; sepals are 0.75 mm to 1 mm long and petals are up to 2.5 mm long. The fruit is a drupe (up to 1 cm long) with short hairs (DotE, 2015). Fruiting typically occurs from February to April but only a small proportion of plants produce viable seed in any one season. Plants often resprout from rootstock following disturbance.

Samadera bidwillii typically inhabits lowland rainforest or rainforest margins and can also be found in other forest types including open forest and woodland and habitats adjacent to temporary and permanent watercourses (DotE, 2015).

Significance of impact assessment

The project is unlikely to result in a significant residual impact on *Samadera bidwillii*. A significance of impact assessment of the project on *Samadera bidwillii* (vulnerable under the EPBC Act and NC Act) is provided in Table 7-3.

Table 7-3 Significance of impact on Samadera bidwillii

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** Although this species is considered likely to occur based on the species distribution and habitat present, no individuals have been confirmed present in the GSDA pipeline alignment during successive on-ground survey efforts by various consultants. Furthermore, the closest historical record is 4.5 km from the GSDA study area. As such the project is unlikely to result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project is unlikely to result in a reduction in the extent of occurrence of the species.
Fragment an existing population	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no fragmentation of an existing population is expected to occur.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The project is unlikely to impact any local occurrences or their supporting habitats and opportunities for breeding and dispersal are not expected to be impeded by the project. As such, the project is unlikely to result in the isolation of habitats for the species or the formation of genetically distinct populations.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The project is unlikely to result in an invasive species becoming established within the GSDA pipeline alignment. Strict biosecurity measures will be incorporated in the Project CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not considered to be a key threat to *S. bidwillii*; however, hygiene management measures will be utilised during the construction phase to limit the introduction of organic matter into the GSDA pipeline alignment.
Interfere with the recovery of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no interference with the recovery of the species has been identified.

Significant residual impact criteria	Assessment
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project footprint is not considered to be ecologically significant for this species.
Conclusion	The project is unlikely to result in a significant residual impact on *Samadera bidwillii.* No individuals or population have been recorded historically or during recent surveys efforts within the GSDA pipeline alignment. Biosecurity and hygiene measures will be incorporated in the project's CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.

7.1.1.3 Glossy black-cockatoo

Conservation status and species ecology

The glossy black-cockatoo is listed as vulnerable under the NC Act. Glossy black-cockatoos occur in forest and open woodland areas of south-east Queensland and coastal New South Wales. The species has a specialist diet, feeding selectively on cones of *Casuarina* and *Allocasuarina*. The species forages widely throughout its range, moving between areas of foraging habitat, as feeding resources become available. Key food tree species include *Allocasuarina littoralis* (black she-oak), *Allocasuarina torulosa* (forest she-oak) and to a lesser extent, *Casuarina equisetifolia* (coastal she-oak), *Casuarina cunninghamiana* (river she-oak) and *Casuarina cristata* (belah) (Glossy Black Conservancy 2010). Glossy black-cockatoos nest in large living or dead hollow-bearing trees, typically in vertical chimneys 10 - 20 m above ground-level (Glossy Black Conservancy 2010).

Field survey results and distribution of suitable habitat

The glossy black-cockatoo was confirmed present during the Arup (2008) field surveys. One individual was recorded within remnant vegetation near the existing slurry pipeline easement in the southern extent of the GSDA study area. The species was not recorded during the 2022 field surveys. Predicted suitable foraging and nesting habitat is restricted in the south-east extent of the GSDA pipeline alignment. Narrow strips of *Casuarina cunninghamiana* were recorded along riparian woodland areas, providing potentially suitable foraging habitat for the species. The density of suitable hollow-bearing trees were low within woodland areas in proximity to suitable foraging habitat, but does provide limited potential suitable nesting habitat for the species. The distribution of predicted glossy black-cockatoo habitat is mapped in Figure 7-1.

Significance of impact assessment

The project is unlikely to result in a significant residual impact on the glossy black-cockatoo. A significance of impact assessment of the project on the glossy black-cockatoo (vulnerable under the NC Act) is provided in Table 7-4.

Table 7-4 Significance of impact on the glossy black-cockatoo

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The project will result in the loss of 4.68 ha of potential foraging and nesting habitat. This represents 0.04 % of the potential habitat available within a 5 km buffer. The glossy black-cockatoo has not been historically recorded within the GSDA pipeline alignment or study area (i.e. no records in desktop databases); however, one individual was recorded within the local landscape during the Arup (2008) field surveys. Potential breeding and nesting habitat was widely recorded along riparian corridors outside of the GSDA pipeline alignment. Pre-clearance surveys will be undertaken prior to clearing to identify and mark suitable nesting trees. Sequential clearing and the use of a fauna spotter-catcher during clearing will be included to further reduce the potential impacts on the species. Given the scarcity of records, and recognising the availability of habitat within the local landscape and the species' capacity to fly up to 12 km to forage, loss of strips of vegetation within the GSDA pipeline alignment are unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources (especially noting that the dearth of historical records indicates that

Significant residual impact criteria	Assessment
	adjacent habitats are unlikely to be at carrying capacity). The project is unlikely to lead to a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** The GSDA pipeline alignment is proposed to traverse waterways retaining suitable foraging habitat (i.e. *Casuarina cunninghamiana*) and woodland areas retaining potentially suitable nesting habitat (i.e. hollow-bearing trees). A large proportion of vegetation within the GSDA pipeline alignment retains regrowth vegetation or younger remnant vegetation that has been fragmented by linear infrastructure such as railways, roads, access tracks and pipelines. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. The project will result in a loss of 4.68 ha of potential habitat for the glossy black-cockatoo. This represents only a small percentage of the predicted habitat available within a 5 km buffer (0.04 %). Clearing along the GSDA pipeline alignment is unlikely to impact the species' ability to move nor access resources in adjacent habitats, as the proposed clearing extent is narrow (30 m) and mostly linear, and unlikely to generate edge effects or impact ecosystem structure and functioning. The nature of the project is unlikely to result in substantial indirect disturbance to the species that would inhibit the species' capacity to utilise adjacent habitat areas. The localised impacts experienced through loss of habitat or direct collision mortality is unlikely to result in a reduction in the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *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.*
Fragment an existing population	**Unlikely** The GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared for linear infrastructure such as railways, roads, access tracks and pipelines. Given the species is known to travel up to 12 km to foraging habitats (Garnett *et al*. 1999), clearing a 30 m wide corridor for the GSDA pipeline alignment is not expected to impact the species' ability to move across the local landscape. Habitat losses projected for the project represent 0.04% of the predicted habitat available within a 5 km buffer. As such, this represents a relatively localised impact within the context of the species' home range and is not anticipated to fragment an existing population. It is noted that populations of this bird in the landscape are likely to be very low, noting the lack of historic records.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is not likely to cause any loss of gene transfer that would cause genetically distinct populations to form.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** There is potential for the spread of invasive weeds during the construction and operation phase. This potential will be addressed within the CEMP and could provide the opportunity to enhance the quality of the environment utilised by the glossy black-cockatoo by providing measures to mitigate introduced species. The removal of climbing weeds, particularly rubber vine (*Cryptostegia grandiflora*), as rubber vine can adversely affect trees of the genera *Eucalyptus* and *Corymbia*. With appropriate mitigation, the project is unlikely to result in the introduction of invasive species that are harmful to the glossy black-cockatoo.
Introduce disease that may cause the population to decline	**Unlikely** The project is not anticipated to introduce new diseases that may cause the species to decline. Although the glossy black-cockatoo is susceptible to Psittacine Beak and Feather Disease, the disease has not been recorded within Queensland glossy black-cockatoo populations and the project is highly unlikely to facilitate an increase in the transmission or incidence of this disease (DoE 2015).
Interfere with the recovery of the species	**Unlikely** The project will remove 4.68 ha of potentially suitable habitat, equating to 0.04% of habitat available within a 5 km buffer. Targeted pre-clearance surveys will be undertaken by a suitably trained fauna spotter catcher to identify and retain (where possible) suitable nesting trees within the GSDA pipeline alignment. Therefore, the project is unlikely to cause a loss of habitat during the construction phase. Noting the above points relating to very limited if any effects on local

Significant residual impact criteria	Assessment
	populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the glossy black-cockatoo.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** The project will result in a direct loss of 4.68 ha of potentially suitable foraging and nesting habitat for the glossy black-cockatoo. Clearing for the GSDA pipeline alignment therefore has the potential to directly impact the species nesting sites and suitable foraging trees (i.e. *Casuarina cunninghamiana*) along watercourses. During targeted pre-clearance surveys, a suitably trained fauna spotter catcher will identify and mark suitable nesting trees to be retained (where possible) during the construction phase of the project. Provided this is undertaken, disruption to significant breeding sites is considered unlikely. No ecologically significant feeding locations were recorded within the investigation areas; however, foraging habitat is locally abundant.
Conclusion	The project is unlikely to result in a significant residual impact on the glossy black-cockatoo. The project will result in a small loss (4.68 ha) of potentially suitable foraging and breeding habitat for the glossy black-cockatoo; however, given the species is known to travel up to 12 km to foraging habitats (Garnett *et al*. 1999) and large remnants of suitable habitat will persist within the surrounding landscape, clearing a 30 m wide corridor for the GSDA pipeline alignment is not expected to impact the species. Pre-clearance surveys will be undertaken to retain (where possible) suitable nesting habitat, to further reduce the impact to potential breeding places within the GSDA pipeline alignment.

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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
(Datum GDA2020)

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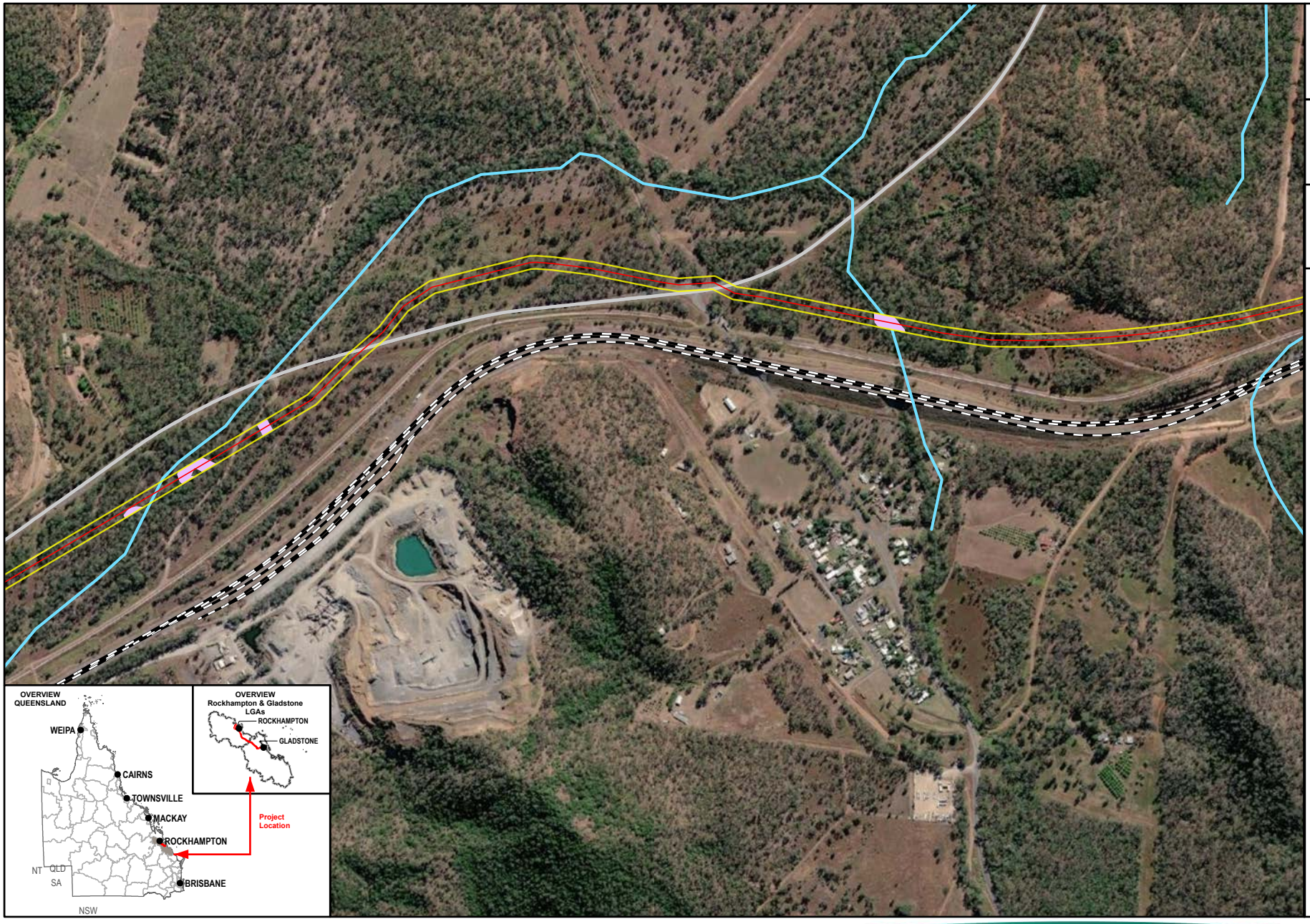
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1a
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
(Datum GDA2020)

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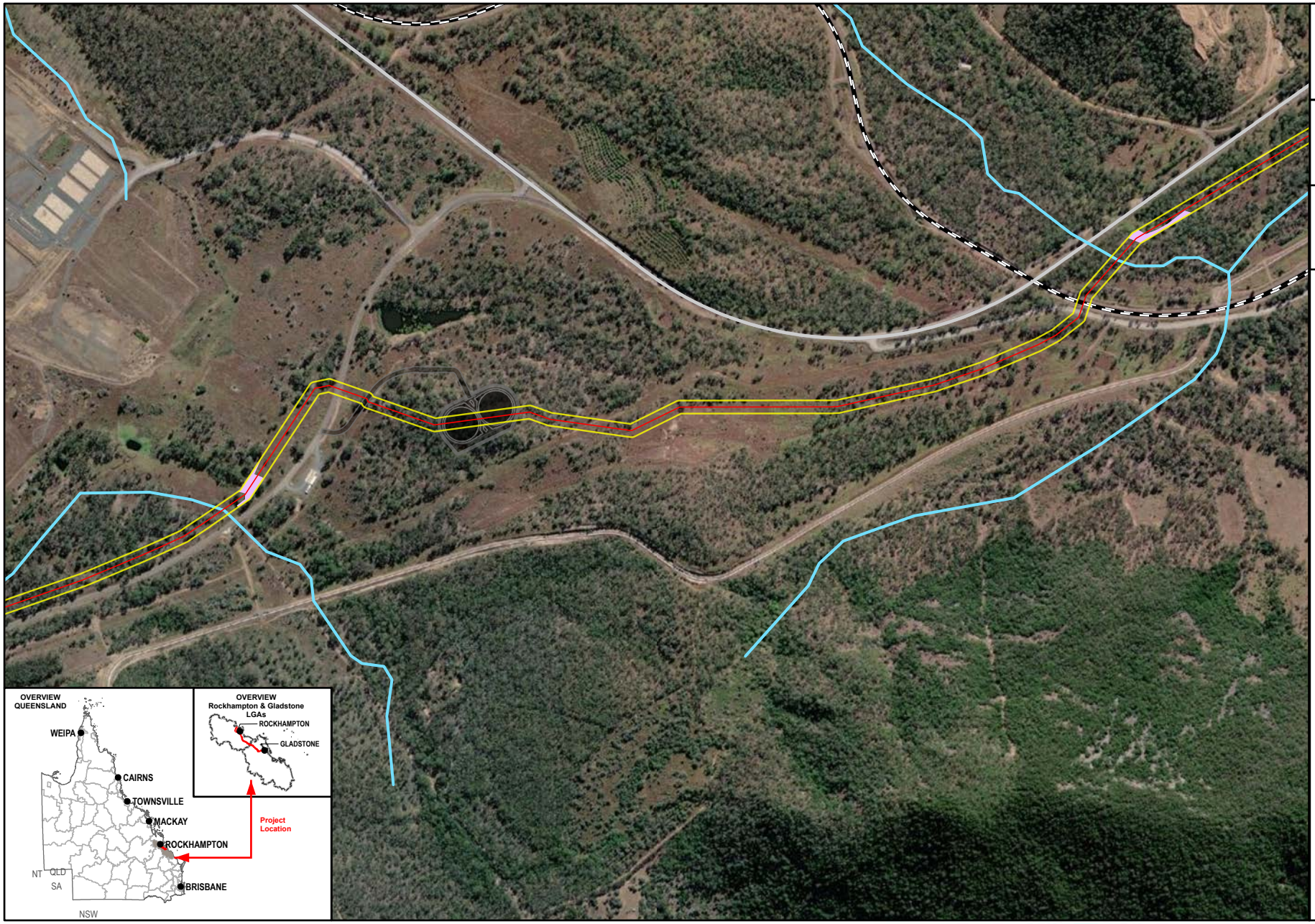
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1b
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
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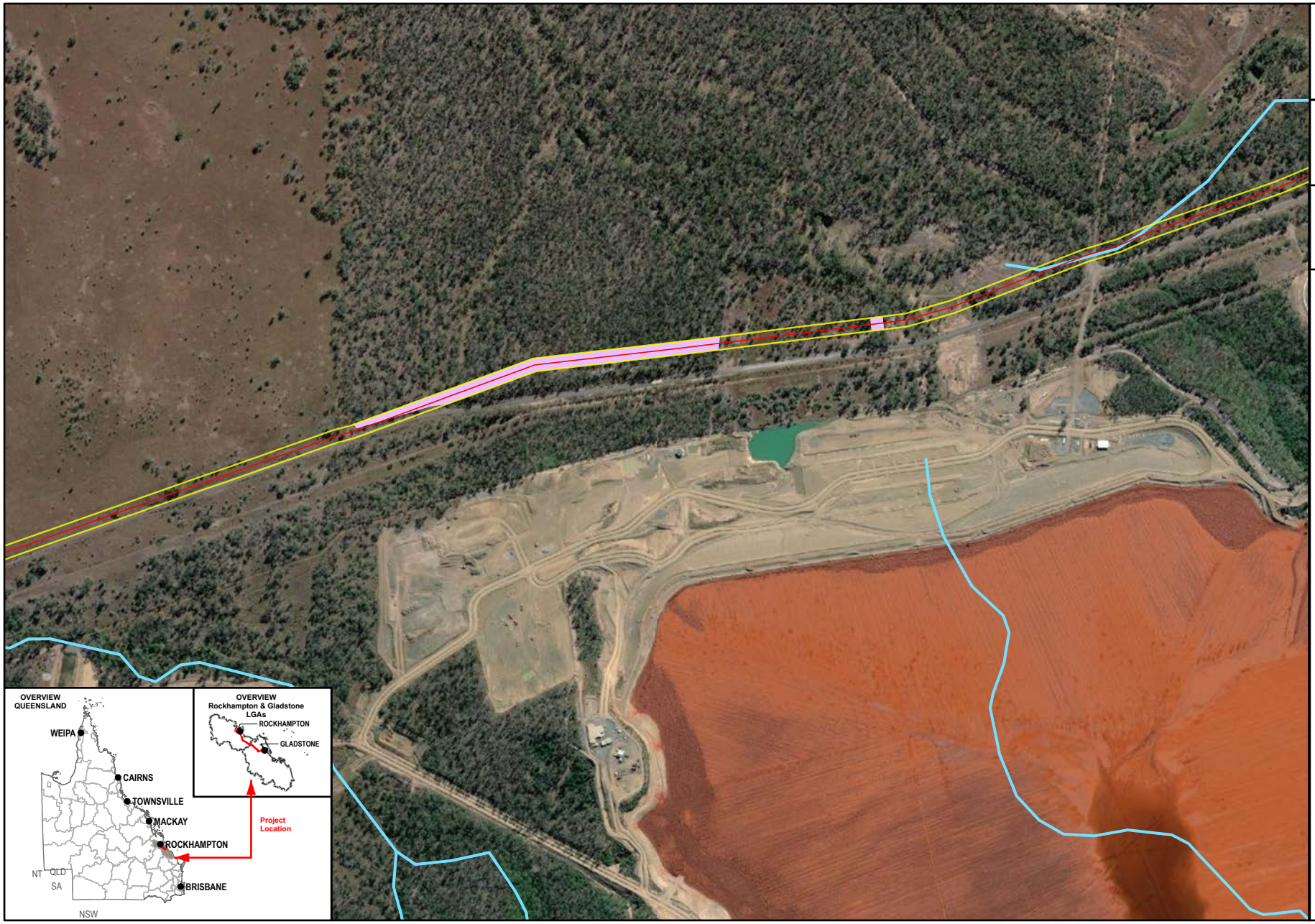
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1c
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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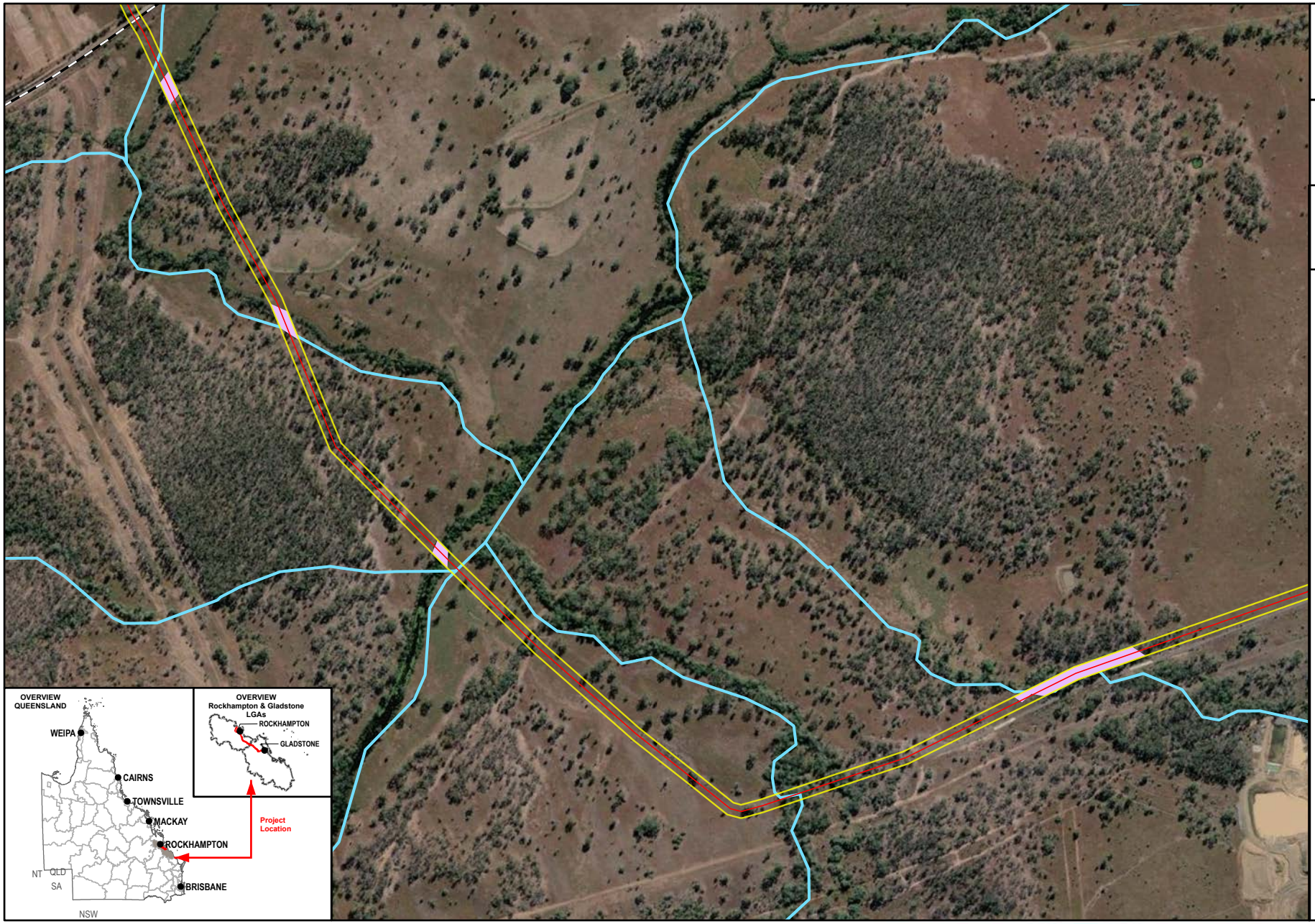
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1d
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area

000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Waterways
- Railways

Data Sources:
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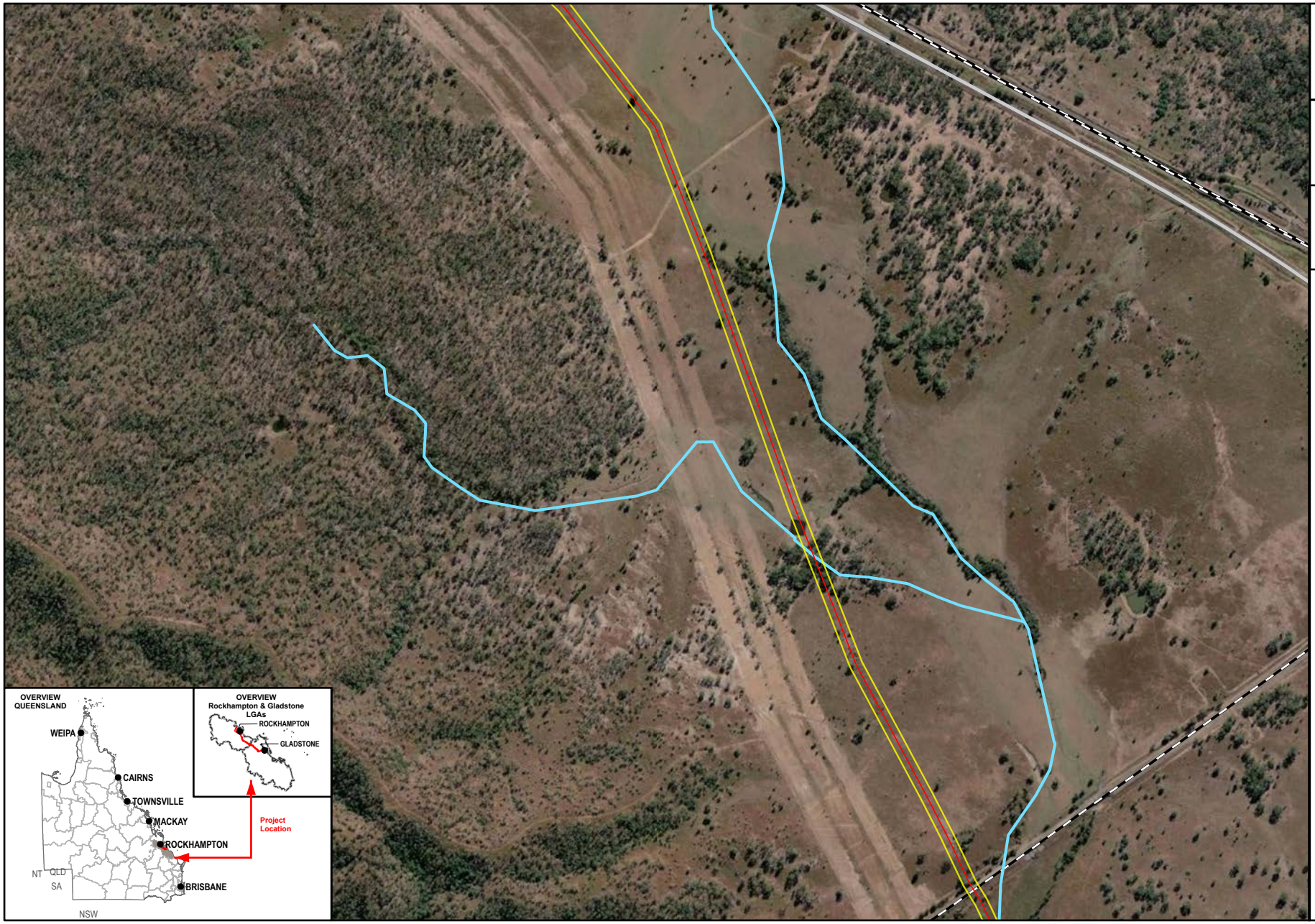
Figure 7-1e
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

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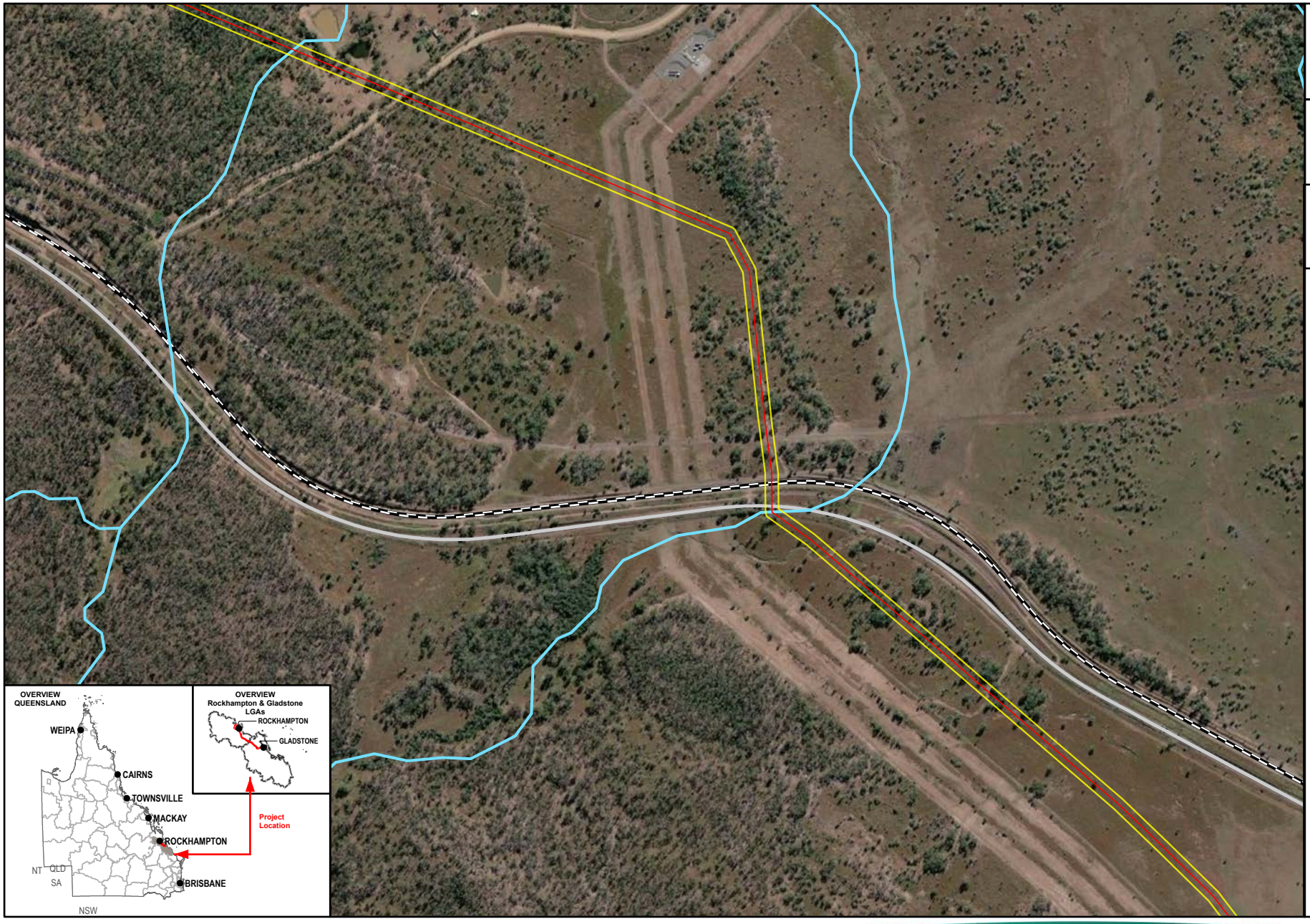
Figure 7-1f
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1g
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022

7.1.1.4 Squatter pigeon (southern)

Conservation status and species ecology

The squatter pigeon (southern) is listed as vulnerable under the EPBC Act and NC Act and was listed as an MNES at the time of the approval. Its current distribution extends from central Queensland, west to Longreach and Charleville, and south to New South Wales (DCCEEW 2022h). The species occurs in remnant and regrowth open forest and woodland dominated by *Eucalyptus*, *Corymbia*, *Acacia* and *Callitris* species with tussock grassy understorey with 3 km of water sources (DCCEEW 2022h). Soils are generally a good predictor of their foraging and breeding habitat, which is generally restricted to well-draining, gravelly, sandy or loamy soils. These typically have a patchy ground layer composed of native perennial tussock grasses or a mix of native perennial tussock grasses and low shrubs or forbs (Squatter Pigeon Workshop 2011).

Breeding habitats are typically on stony rises within 1 km of permanent water (Squatter Pigeon Workshop 2011). In Queensland, the Commonwealth listing advice specifically nominates RE Land Zone 5 (well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills) and RE Land Zone 7 (lateritic (duplex) soils on low 'jump-ups' and escarpments) as suitable foraging and breeding habitat for the species. Ground-level vegetation is typically patchy with vegetation cover rarely exceeding 33 percent (Squatter Pigeon Workshop 2011). Waterbodies that are suitable for the squatter pigeon (southern) occur on RE Land Zones 10, 3 and 4 (DCCEEW 2022h). Hence, where natural foraging or breeding habitat occurs (i.e. on RE Land Zones 5 and 7), the squatter pigeon (southern) may be found in vegetation types growing on the above soil types (DAWE 2022b).

The subspecies is unlikely to move far from woodland trees which provide protection from predatory birds (Squatter Pigeon Workshop 2011). Where scattered trees still occur, and the distance of cleared land between remnant trees or patches of habitat does not exceed 100 m, individuals may be found foraging in, or moving across modified or degraded environments (Squatter Pigeon Workshop 2011).

Field survey results and distribution of suitable habitat

The squatter pigeon (southern) was confirmed present during the 2022 field surveys. Two individuals were recorded along two waterways (unnamed tributary of Larcom Creek and unnamed tributary of Police Creek) within the western corner of the GSDA study area. The species has been historically recorded at 35 locations within the desktop search extent (10 km buffer), the most recent record recorded in 2018. A series of low hills and rises with stony soils, woody debris and tussocky native grasses were recorded within the GSDA study area as potentially suitable breeding habitat for the subspecies. Areas of potentially suitable foraging habitat was recorded in open eucalypt woodland with grassy understorey. The distribution of predicted squatter pigeon (southern) habitat is mapped in Figure 7-2

Significance of impact assessment

The project is likely to result in a significant residual impact on squatter pigeon (southern). A significance of impact assessment of the project on squatter pigeon (southern) (vulnerable under the EPBC Act and NC Act) is provided in Table 7-5.

Table 7-5 Significance of impact on squatter pigeon (southern)

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The squatter pigeon (southern) is abundant within the region. The species has been historically recorded at 35 locations within the desktop search extent (10 km buffer) and was confirmed present within the GSDA study area, with two individuals recorded in close proximity waterways. The local population is not an important population at a national level. Important populations of the squatter pigeon (southern) have been identified in the Commonwealth approved conservation advice as all of the relatively small, isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland (Squatter Pigeon Workshop 2011). Populations in the southern parts of the subspecies range have experienced dramatic declines due to land clearing and grazing by sheep, which tends to have more significant adverse impacts on the subspecies than cattle grazing (TSSC 2015). The subspecies is still locally abundant within cattle grazing areas at the northern parts of its range (TSSC 2015). The loss of 17.31 ha of potential foraging habitat and 5.05 ha of potential

Significant residual impact criteria	Assessment
	breeding habitat (collectively representing 0.31 % of habitat within a 5 km buffer) is not expected to lead to a decline in the local squatter pigeon (southern) population and the subspecies will likely continue to persist in large numbers within the local area and surrounding region. Due to their localised and relatively temporary nature, construction and operation impacts associated with the GSDA pipeline alignment are unlikely to have any permanent impacts on the persistence of local and regional squatter pigeon (southern) populations. Increased vehicular movements during construction will increase the risk of mortality and injury of squatter pigeons; however, this will be managed through implementing speed limits and signage in areas that may support the subspecies. The project is expected to be relatively benign in terms of operational impacts with negligible noise, vibration, land disturbance and vehicular movements. Permanent speed limits and signage on internal roads and education of staff during inductions will minimise the risk of direct mortality by operational vehicles. The loss of habitat within the GSDA pipeline alignment are unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources. As such, the project is unlikely to lead to a long-term decrease in the size of a local population of the species.
Reduce the extent of occurrence of the species	**Unlikely** As detailed above, the squatter pigeon (southern) is abundant within the region. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. The project will result in a loss of 17.31 ha of potential foraging habitat and 5.05 ha of potential breeding habitat for the squatter pigeon (southern). This represents only a small percentage of the predicted habitat available within a 5 km buffer (0.31 %). Suitable foraging habitat and resources will persist in the area immediately adjacent to the GSDA pipeline alignment, and the extent and magnitude of mortality during construction is such that the subspecies will continue to persist locally. Given the relatively benign nature of the project in its operation phase, and the continued presence of suitable habitat within the local area, the project is unlikely to result in a reduction in the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *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.*
Fragment an existing population	**Unlikely** Fragmentation of the existing squatter pigeon (southern) population is not expected, as the maximum width of clearing required for construction of the GSDA pipeline alignment (30 m) is narrow and linear. This is unlikely to present a permanent barrier to squatter pigeon (southern) movement. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. Habitat connectivity will be maintained among areas of habitat within and adjacent to the GSDA pipeline alignment, by maintaining ground-level substrates and vegetation, and by retaining existing unsealed tracks that provide important pathways for local squatter pigeon (southern) movement. The implementation of the Weed Management Plan is expected to maintain suitable ground-level habitat and continue to facilitate ground-level movement of the squatter pigeon (southern). Based on these considerations, the project is unlikely to fragment the existing squatter pigeon (southern) population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the subspecies' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any loss of gene transfer that would cause genetically distinct populations to form.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The project footprint is currently impacted by weed and pest species that could be harmful to the squatter pigeon (southern). The presence of these invasive species is unlikely to be exacerbated by the project, and any risks of their establishment will be managed via a site-specific CEMP and operational EMP.
Introduce disease that may cause the population to decline	**Unlikely** Recognised threats to the squatter pigeon (southern) do not include diseases. It is however, not expected that the project would result in the introduction of disease.

Significant residual impact criteria	Assessment
Interfere with the recovery of the species	**Unlikely** The project is unlikely to interfere substantially with the recovery of the species. The loss of habitat is unlikely to be significant, representing 0.31 % within a 5 km buffer. Implementation of a CEMP for the project has the potential to increase the value of local habitats through the control of weed and pest species. Local noise disturbance and mortality threats associated with the project are also expected to be low. Noting the above points relating to very limited if any effects on local populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the squatter pigeon (southern).
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Likely** The project will require the clearing of 17.31 ha of potentially suitable foraging habitat and 5.05 ha of potentially suitable breeding habitat for the squatter pigeon (southern). Although the GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared, the project will result in a loss of suitable foraging and breeding habitat. While the project is not expected to cause a long-term decline in the local population, reduce its extent of occurrence, cause adverse habitat fragmentation effects nor interfere with the recovery of the species, the loss of suitable squatter pigeon (southern) habitat within the GSDA pipeline alignment is likely to result in disruption to ecologically significant foraging and breeding locations.
Conclusion	The project is likely to result in a significant residual impact on the squatter pigeon (southern). Although the GSDA pipeline alignment has been located within areas that have been previously cleared for agricultural practices and linear infrastructure such as railways, roads, access tracks and pipelines, the project will require the clearing of 22.36 ha of suitable foraging and breeding habitat within the GSDA pipeline alignment.

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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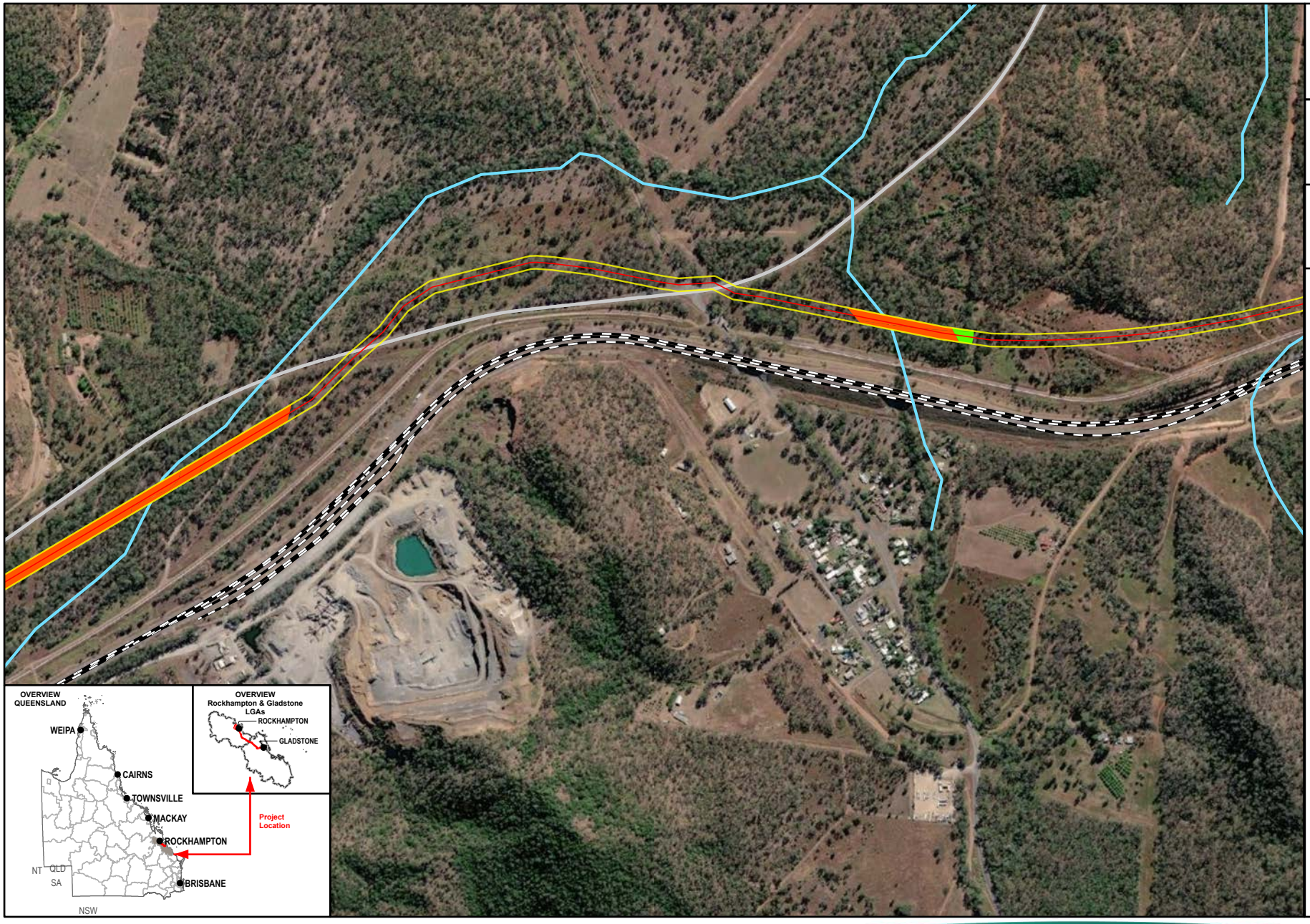
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-2a
Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area
000-G-MAP-2429 Version:4 Date:21/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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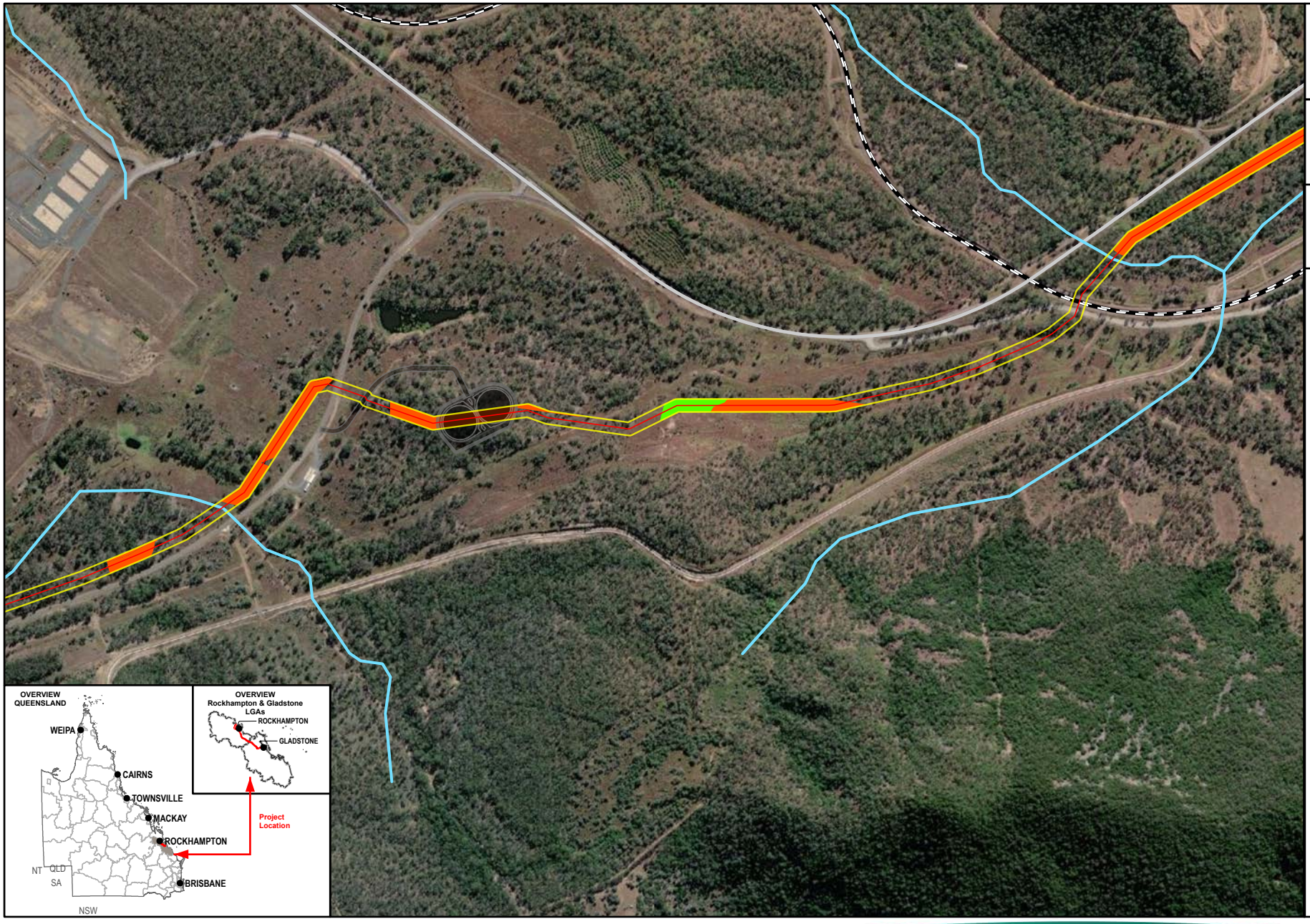
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-2b
Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area
000-G-MAP-2429 Version:4 Date:21/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
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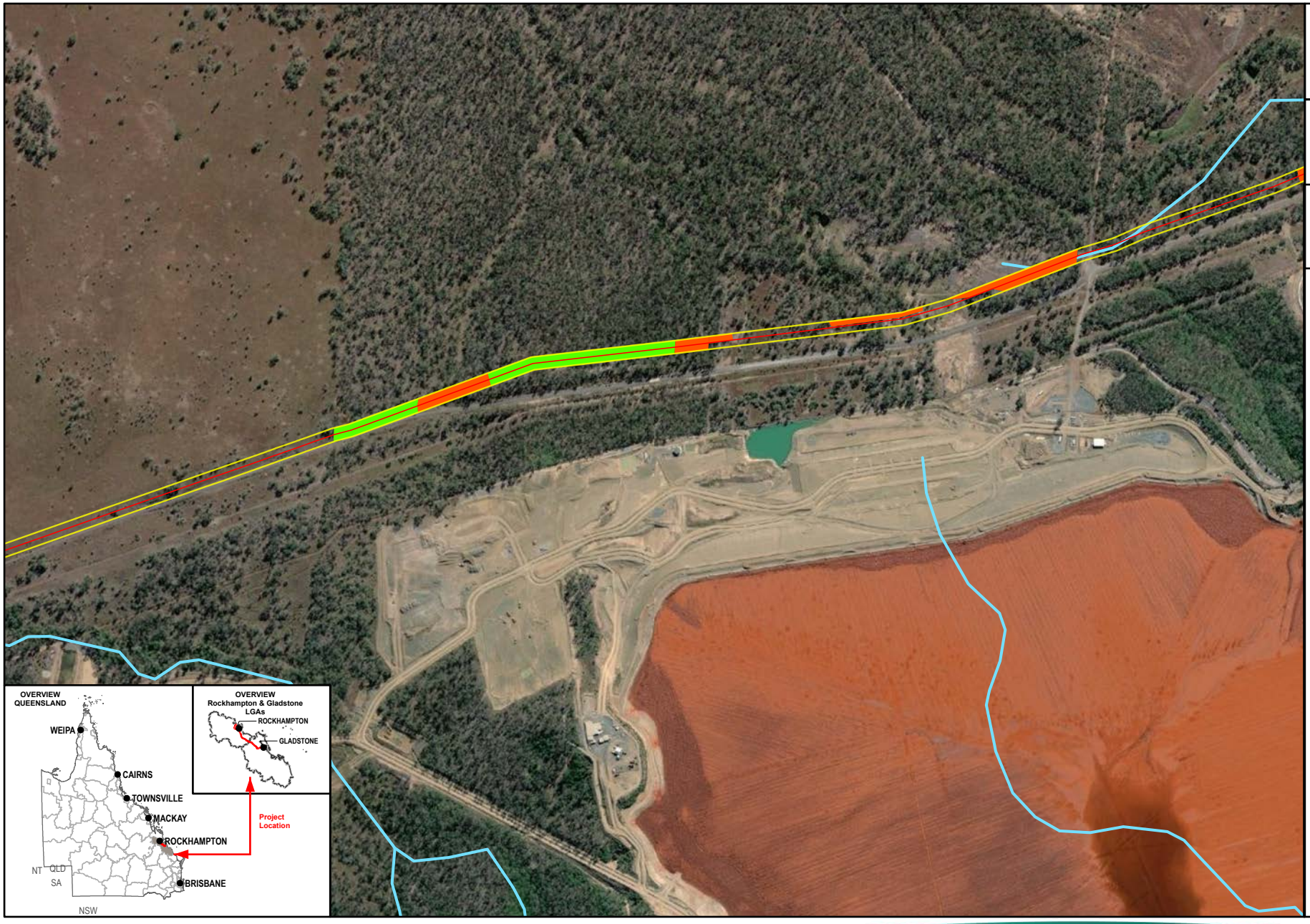
Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report

Figure 7-2c

Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area

000-G-MAP-2429 Version:4 Date:21/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Waterways

Data Sources:
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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-2d
Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area

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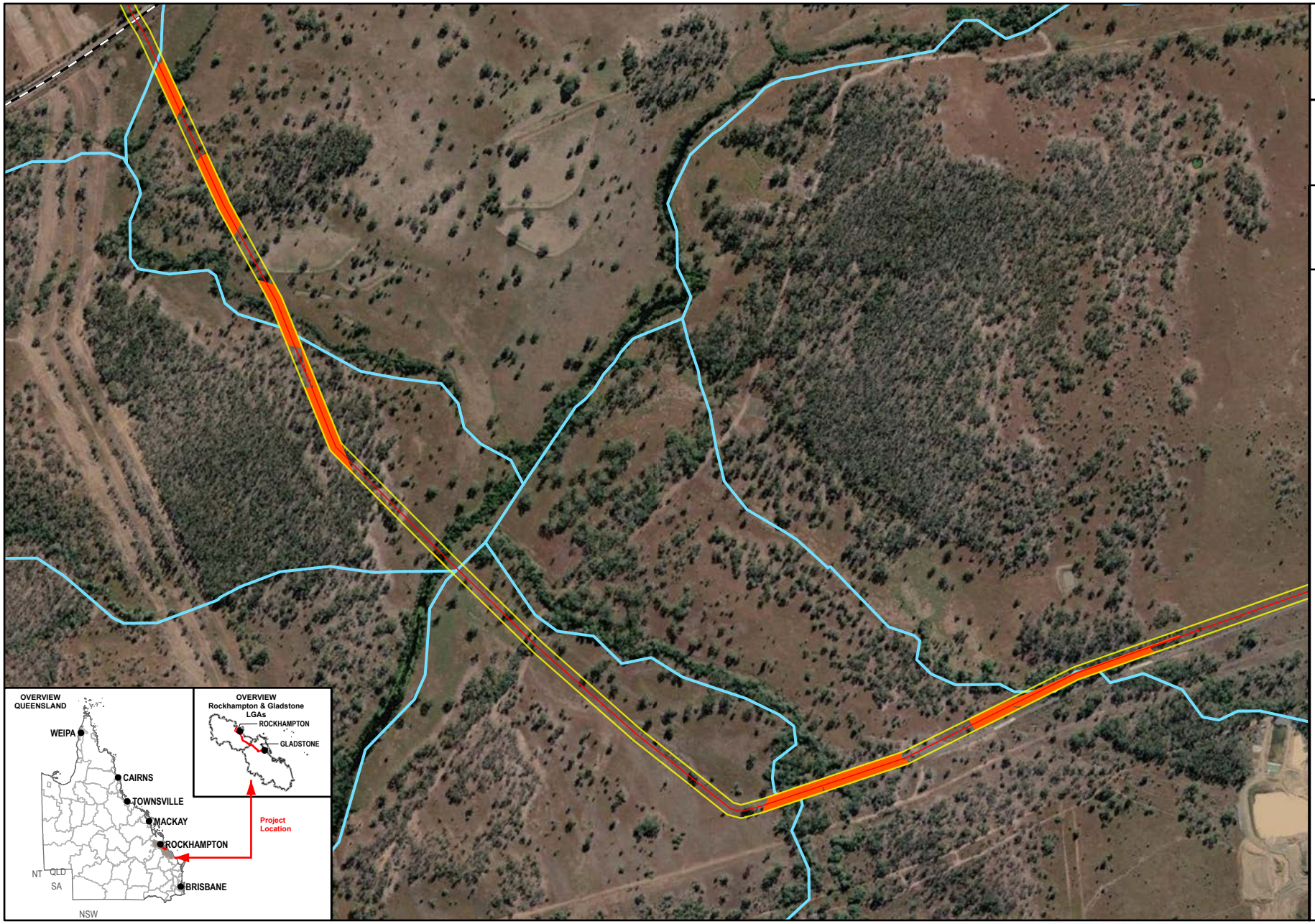

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Railways

Data Sources:
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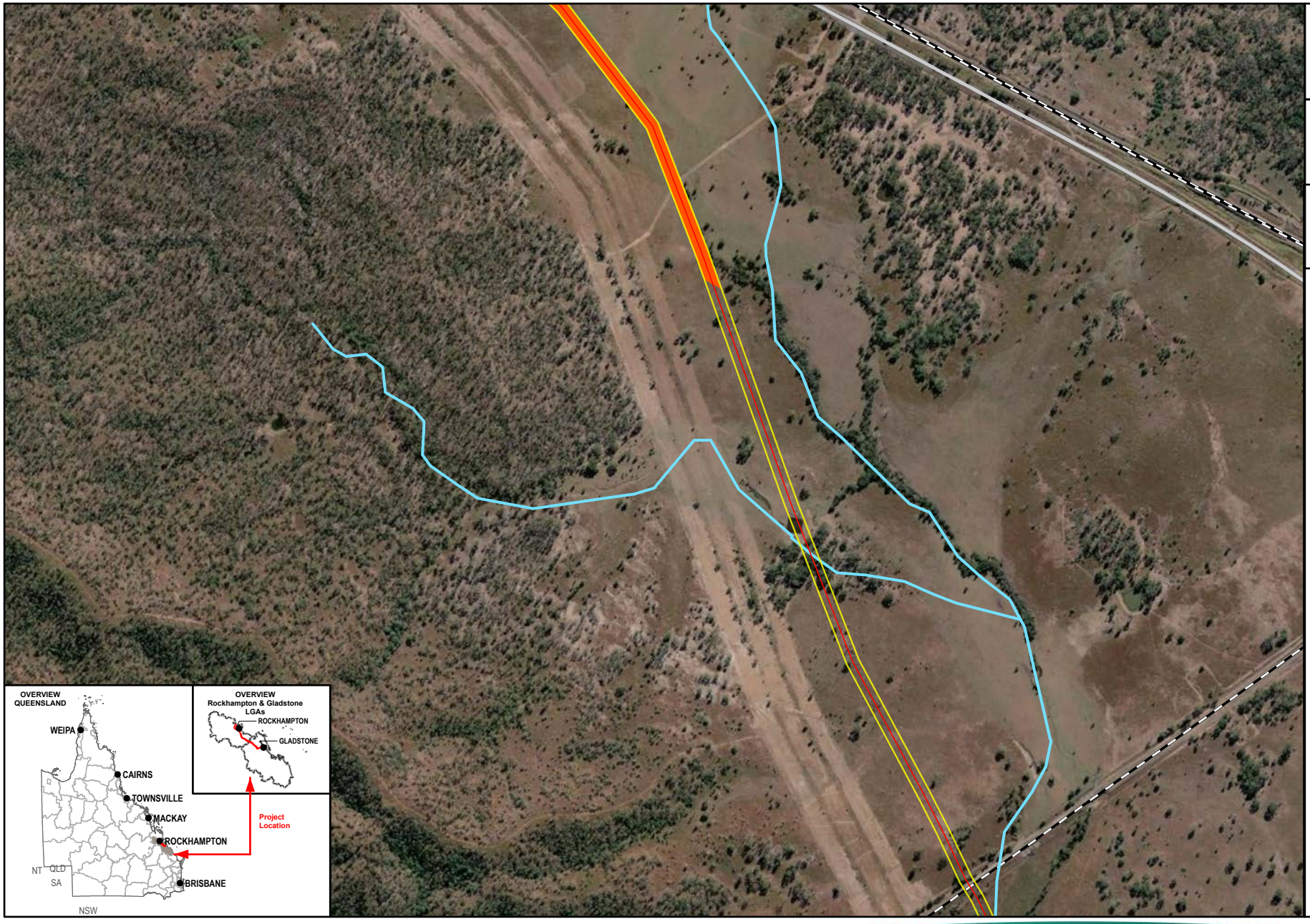

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Legend

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- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

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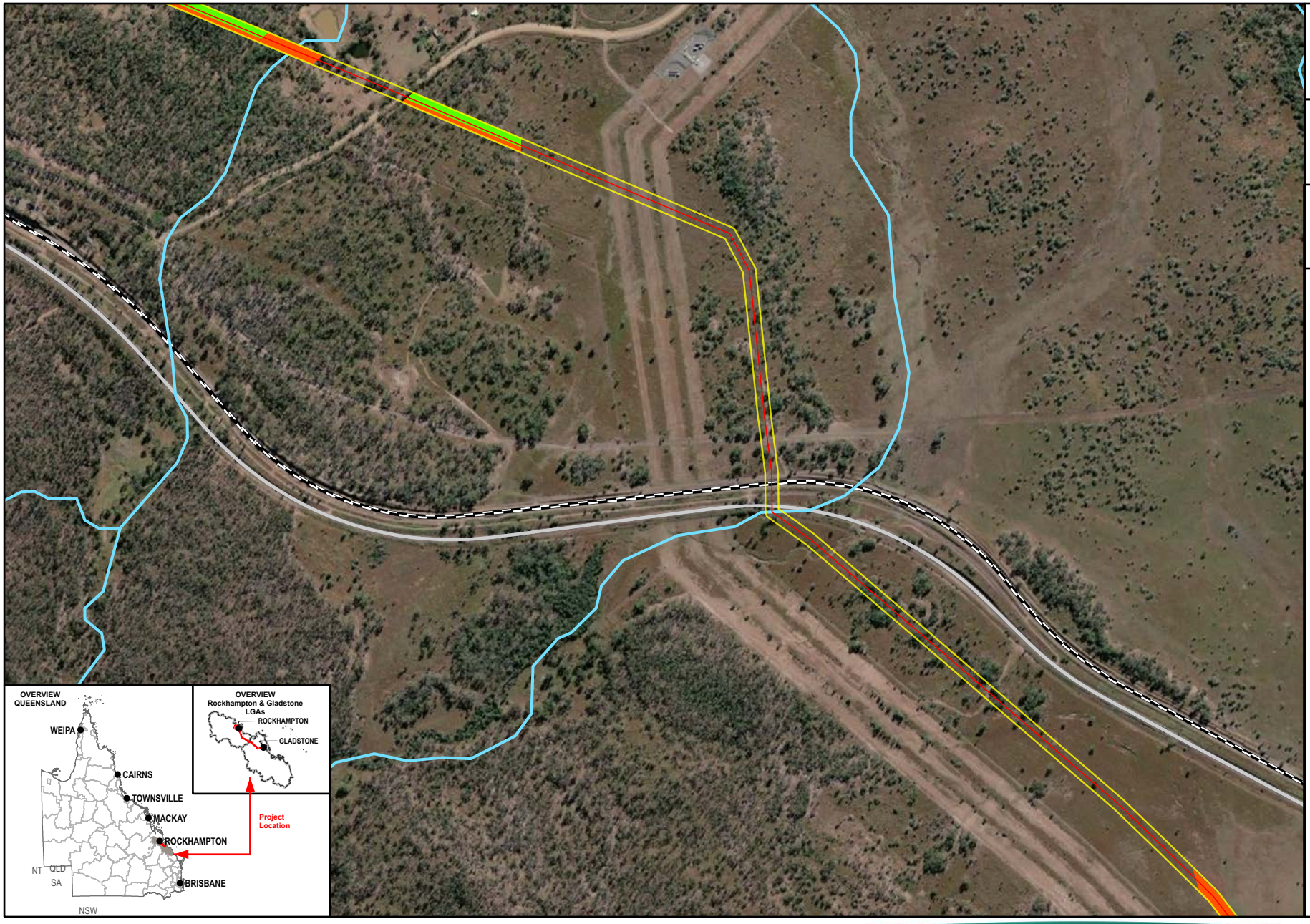
Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area
000-G-MAP-2429 Version:4 Date:21/09/2022



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Queensland Government

SMEC
Member of the Surbana Jurong Group

0 180 360
Meters

1:12,500 (when printed @ A4)

Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

SMEC Disclaimer:
Maps are for graphical purposes only. The information on this map is from a computer database accessed using a Geographic Information System (GIS). They do not represent a legal survey and the information provided includes inherent errors. SMEC cannot guarantee the accuracy of the information contained on this map. Each user of this map is responsible for determining its suitability for his or her intended use or purpose.

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PROJECTION UTM Zone 56
(Datum GDA2020)

Compiled by:YS16239

Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-2g
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7.1.1.5 White-throated needletail

Conservation status and species ecology

The white-throated needletail is listed as vulnerable and migratory under the EPBC Act and vulnerable under the NC Act, but not listed as an MNES at the time of the approval. The species is almost exclusively aerial, occurring from heights of less than 1 m up to more than 1000 m above the ground (TSSC 2019). Recent research has shown that while the species is predominantly aerial, the white-throated needletail does roost on land at least occasionally, with roosts typically located in tall woodland on ridgelines and clifftops, where the birds can easily alight (Tarburton 2021). The species forages at heights up to cloud height over a range of habitat types including woodland, open forest, rainforest, heathland and partly cleared pasture and agricultural land (TSSC 2019). The species does not breed in Australia but occurs widely throughout Australia during the non-breeding period (TSSC 2019).

Field survey results and distribution of suitable habitat

The species was not recorded in field surveys but is considered likely to occur due to the presence of nearby historical records and the species' wide-ranging nature. Substantial areas of potential roosting habitat are located on ridgetops adjacent to the GSDA study area. No suitable roosting habitat occurs within or immediately adjacent to the GSDA study area. The species has the potential to forage across the entire GSDA study area at heights between 15 m and 1000 m.

Significance of impact assessment

The project is unlikely to result in a significant residual impact on the white-throated needletail. A significance of impact assessment of the project on the white-throated needletail (vulnerable under the EPBC Act and NC Act) is provided in Table 7-6.

Table 7-6 Significance of impact on the white-throated needletail

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The white-throated needletail has been historically recorded at four locations within the desktop search extent (10 km buffer), the closest record occurring approximately 100 m from the GSDA pipeline alignment near Yarwun. The species is regarded as a transient visitor to the GSDA study area, moving through the region in response to climatic conditions (e.g. bushfires, wind fronts and storm fronts). Given the species' capacity for large-scale migration and its enigmatic patterns of movement and occurrence, the concept of 'localised populations' is difficult to ascribe to this bird. The species is predominantly aerial and is generally not reliant on terrestrial habitats (DCCEEW 2022i). While the species does occasionally utilise terrestrial roosting sites, all nearby terrestrial roosting habitats are located on ridgetops away from the project and is unlikely to be directly or indirectly impacted by the construction and operation of the project.
Reduce the extent of occurrence of the species	**Unlikely** No potential habitat for the white-throated needletail will be directly or indirectly impacted by the project. The species has an extensive capacity for movement and is unlikely to experience any localised decline that would cause the species to no longer persist within the area. The project is likely to be relatively benign in its impact on the species during the operational phase.
Fragment an existing population	**Unlikely** The white-throated needletail is highly nomadic and can form large, mixed-species feeding flocks. This near-exclusively aerial, migratory species is capable of long-distance flight. The species' movements are unlikely to be restricted by the project. As such, the project is unlikely to fragment the existing population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any loss of gene transfer that would cause genetically distinct populations to form.

Significant residual impact criteria	Assessment
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** No invasive species are identified as threats to the white-throated needletail. The extent of clearing for the GSDA pipeline alignment may increase the accessibility of introduced predators including dogs, foxes and cats into the site. Pest fauna management practices will be implemented throughout the construction and operations periods and are anticipated to decrease the abundance of invasive predators, further reducing the species' vulnerability within the GSDA pipeline alignment.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not identified as a key threat to the white-throated needletail. This species' almost exclusively aerial habit means it is unlikely to have many opportunities to contract diseases that could threaten the viability of individuals and populations. The project is therefore unlikely to introduce disease that cause the species to decline.
Interfere with the recovery of the species	**Unlikely** The proposed works are considered unlikely to negatively impact the species, let alone interfere with the recovery of the species.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** The species is predominantly aerial, foraging at heights up to cloud height over a range of habitat types (TSSC 2019). The white-throated needletail is a non-breeding visitor to Australia, and breeds between October and April throughout Siberia, China, Japan and Mongolia (DCCEEW 2022i). As such, habitats within the GSDA pipeline alignment are not considered ecologically significant.
Conclusion	The project is unlikely to result in a significant residual impact on the white-throated needletail. The species is predominantly aerial. All nearby terrestrial roosting habitats are located on ridgetops away from the project and are unlikely to be directly or indirectly impacted by the construction and operation of the project.

7.1.1.6 Powerful owl

Conservation status and species ecology

The powerful owl is listed as vulnerable under the NC Act. The species occurs in a range of habitats with mature hollow-bearing trees including mountain forests and woodlands, coastal forests, woodlands, pine plantations and urban areas (Higgins 1999). Preferred habitat includes forests and woodlands with a high abundance of large trees. Mating pairs occupy a large home range (Higgins 1999). The species typically nests in large hollow-bearing trees in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (Schodde and Mason 1980; Higgins 1999). The species typically roosts in dense groves of mid-storey vegetation within closed forest, including rainforest, wet sclerophyll forest, mangrove forest, *Melaleuca*, *Acacia* and *Casuarina* in sheltered gullies typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls. The species typically does not occur within fragmented forest remnants <200 ha (Kavanagh and Stanton 2002). The species relies on the presence of mature, hollow-bearing trees for nesting sites and also to provide den sites for the hollow-dwelling arboreal mammals which form the bulk of its prey (Davey 1993; Milledge *et al*.1991; Higgins 1999). Despite the species' reliance on old growth forest, it does appear to be tolerant of some levels of selective logging, with owls persisting in areas that have been exposed to light, moderate and heavy logging. Nesting appears to be restricted to unlogged areas (Kavanagh and Peake 1993; Kavanagh and Bamkin 1995; Kavanagh 1997).

Field survey results and distribution of suitable habitat

The powerful owl was not recorded during the field surveys within the GSDA study area. Survey effort for the powerful owl included two nights of 2-3 hours of spotlighting within potentially suitable habitat in the GSDA study area. The species is considered likely to occur due to the presence of suitable habitat within and adjacent to the GSDA study area and the species has been historically recorded at 15 locations within the desktop search extent (10 km buffer), the most recent recorded in 2011 approximately 100 m from the GSDA pipeline alignment. Suitable habitat for the species was observed within a large area of remnant vegetation immediately north of Aldoga Road. This area was identified as suitable habitat for the species as it retains large, mature hollow-bearing trees, and suitable nesting and denning habitat for the arboreal mammals upon which the powerful owl preys. However, within this area, the GSDA pipeline alignment is located along an existing fence line which has been previously cleared. Therefore, low densities of suitable hollow-bearing trees occur within the GSDA pipeline alignment. The distribution of predicted powerful owl habitat is mapped in Figure 7-3.

Significance of impact assessment

The project is unlikely to result in a significant residual impact on the powerful owl. A significance of impact assessment of the project on the powerful owl (vulnerable under the NC Act) is provided in Table 7-7.

Table 7-7 Significance of impact on the powerful owl

Significant residual impact criteria	Potential to occur
A long-term decrease in the size of a local population	**Unlikely** The project is not expected to result in a long-term decrease in the size of the local powerful owl population. The project will result in loss of 2.33 ha of potential nesting habitat. This represents 0.03 % of the potential nesting habitat available within a 5 km buffer. The powerful owl has been historically recorded at 15 locations within the desktop search extent (10 km buffer), the closest record occurring approximately 100 m from the GSDA pipeline alignment near Yarwun. Given the low density at which powerful owls typically occur, and the availability of potential habitat that will remain available within their home range, the impacts of clearing on the powerful owl are anticipated to be negligible. Clearing of vegetation has the potential to cause direct injury or mortality of roosting or nesting individuals. However, this risk will be mitigated by undertaking targeted pre-clearance surveys prior to construction to identify nesting habitat and engaging suitably qualified and experienced fauna spotter-catchers to supervise all clearing of predicted breeding habitat. This will reduce the risk of individual injury or mortality during construction. This species is not considered to be at risk of vehicle strikes. The loss of vegetation within the GSDA pipeline alignment is unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources (especially noting that the species is highly mobile and has ability to disperse over relatively cleared

Significant residual impact criteria	Potential to occur
	landscapes) Overall, the species is unlikely to experience a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** The loss of woodland habitat is seen as the primary factor influencing the decline of the powerful owl (Webster *et al*. 1999, NSW Scientific Committee 2008). Due to their nesting requirements, powerful owls are reliant on large patches of remnant woodlands with trees from 100 to 500 years old (Kavanagh 1997; Loyn *et al*. 2001). The GSDA pipeline alignment is proposed to traverse a small area of remnant vegetation that retains large, mature hollow-bearing trees. In contrast, much of the remainder of areas within GSDA pipeline alignment support regrowth vegetation or younger remnant vegetation that has been fragmented by linear infrastructure such as railways, roads, access tracks and pipelines. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. The project will result in a loss of 2.33 ha of potential habitat for the powerful owl. This represents only a small percentage of the predicted habitat available within a 5 km buffer (0.03 %). Clearing along the GSDA pipeline alignment is unlikely to impact the species' ability to move nor access resources in adjacent habitats, as the proposed clearing extent is narrow (30 m) and mostly linear, and unlikely to generate edge effects or impact ecosystem structure and functioning. The nature of the project is unlikely to result in substantial indirect disturbance to the species that would inhibit the species' capacity to utilise adjacent habitat areas. The powerful owl typically maintains large territorial home ranges and occurs in low local densities. The localised impacts experienced through loss of habitat or direct collision mortality is unlikely to result in a reduction in the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *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*.
Fragment an existing population	**Unlikely** Fragmentation of habitat throughout the east coast of Australia has meant the powerful owl has contracted from a single continuous population to a series of isolated residual populations (DSE 2004). While the powerful owl is reliant on large, interconnected remnants of woodland habitat, only utilising remnants larger than 200 ha (Kavanagh 1997; Kavanagh and Stanton 2002), the species can tolerate low level disturbances, persisting in disturbed woodland provided it is connected to more extensive woodland (Debus and Chafer 1994). Given the species' large home range, about 1,000 ha per pair (Schodde and Mason 1980), and ability to disperse over relatively cleared landscapes (NSW Scientific Committee 2008), the GSDA pipeline alignment is not expected to result in fragmentation of the local powerful owl population. The GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared. Within the area that is considered suitable habitat for the powerful owl, the proposed GSDA pipeline alignment follows an existing fence line which has been previously cleared and is located approximately 70 m from Aldoga Road. Habitat losses projected for the project represent 0.03% of the predicted habitat available within a 5 km buffer. As such, this represents a relatively localised impact within the context of the species' home range and is not anticipated to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any loss of gene transfer that would cause genetically distinct populations to form.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** Invasive pest species such as foxes, cats and dogs represent a potential threat to powerful owl fledglings (McNabb 1987) and are known to occur within the GSDA pipeline alignment. Implementation of the Pest Management Plan will help in limiting the impact that these species have on the local powerful owl population.

Significant residual impact criteria	Potential to occur
Introduce disease that may cause the population to decline	**Unlikely** Powerful owls are not subject to high disease risks (Debus 1997). Beak and feather disease virus, which causes psittacine beak and feather disease has been reported to occur within the species (Sarker *et al* 2015; DoE 2015). However, this has not been recorded within Queensland. Individuals have been known to have contracted botulism from ingestion of affected roadkill (CSIRO 1996). Regardless, the project is not anticipated to introduce new diseases that may cause the species to decline.
Interfere with the recovery of the species	**Unlikely** The project will remove 2.33 ha of potentially suitable habitat, equating to 0.03% of habitat available within a 5 km buffer. Adjacent remaining habitat is connected to an extensive network of suitable habitat well in excess of the 200 ha that is considered to be needed for the species. Targeted pre-clearance surveys will be undertaken by a suitably trained fauna spotter-catcher to identify and retain (where possible) trees with large hollows within the GSDA pipeline alignment. Therefore, the project is unlikely to cause a loss of habitat during the construction phase. Noting the above points relating to very limited if any effects on local populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the powerful owl.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** The project will require the clearing of 2.33 ha of potentially suitable nesting and foraging habitat for the powerful owl. While old-growth remnant woodland with mature hollow-bearing trees were identified within the GSDA study area, the GSDA pipeline alignment has been largely located along an existing fence line which has been previously cleared, and therefore, a large proportion of hollow-bearing trees will be avoided during clearing. Trees retaining large hollows within the GSDA pipeline alignment, will be identified and marked by a suitably trained fauna spotter catcher during the pre-clearance surveys. These marked trees will be retained (where possible) during the construction phase of the project to reduce the loss of potentially suitable breeding places. Provided this is undertaken, disruption to significant feeding and nesting sites is considered unlikely.
Conclusion	The project is unlikely to result in a significant residual impact on the powerful owl. The project will result in a loss (2.33 ha) of potentially suitable foraging and breeding habitat for the powerful owl; however, given the low density at which powerful owls typically occur, and the availability of potential habitat that will remain available within their home range, the impacts of clearing on the powerful owl are anticipated to be negligible. Pre-clearance surveys will be undertaken to retain (where possible) suitable nesting habitat, to further reduce the impact to potential breeding places within the GSDA pipeline alignment.