5. Nature Conservation

This section provides a summary of the terrestrial and aquatic ecology investigations undertaken, and the potential impacts identified, in regards to the Project (Rail) during construction and operation. The assessment was undertaken in accordance with the requirements of the Terms of Reference (ToR) and a table cross-referencing these requirements is provided in Volume 4 Appendix C ToR Cross Reference Table. A detailed ecology report is included in Volume 4 Appendix AA1 Rail Ecology Report.

5.1 Introduction

This chapter provides a summary of the nature conservation values that may be affected by the Project (Rail). Potential impacts are identified and measures to manage and mitigate potential impacts are summarised.

To describe the existing environmental values for sensitive environmental areas, terrestrial flora, terrestrial fauna and aquatic ecology, a combination of desktop assessments and field studies were conducted.

Potential impacts to the environmental values associated with the rail and infrastructure corridor component of the Project were identified and a suite of mitigation measures have been outlined to address these impacts.

Detailed descriptions of the environmental values and potential impacts and mitigation measures are provided in Volume 4 Appendix AA Rail Ecology Report.

5.1.1 Methodology

The description of the existing environmental values of the Study Area, encompassing the rail corridor and associated infrastructure areas, was achieved using a combination of desktop assessments and field studies. The desktop assessment comprised a review of relevant literature, database searches and existing technical reports. Field studies were conducted to obtain ecological information relevant to the Project (Rail) and to ground truth results from desktop assessments. Scientific and common names for flora and fauna described are consistent with those used in published sources (refer to Section 1.4.1 Nomenclature in Volume 4 Appendix AA1 Ecology).

5.1.1.1 Desktop Assessment

Information relating to the terrestrial and aquatic ecological values of the Study Area was obtained from a variety of literature and database sources, including numerous state databases as follows:

- The Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Protected Matters Search Tool and Environmental Reporting Tool, and Directory of Important Wetlands.
- The Queensland Department of Environment and Resource Management (DERM) Regional Ecosystem mapping (Version 6.0b), Essential Habitat mapping (V. 3) and regrowth vegetation mapping (V. 2), wetland mapping, Biodiversity Planning Assessment (BPA) mapping and expert panel reports, *Burdekin Natural Resource Management Region Back on Track Actions for*

Biodiversity report (DERM, 2010a), Wildlife Online database and HERBRECS Specimen Database.

- Queensland Museum Data Search
- Birds Australia Bird Atlas Data
- Publically available EIS documents for projects in the wider region surrounding the Study Area

5.1.1.2 Field Surveys

Field surveys were conducted to identify the existing terrestrial and aquatic ecological values of the Project (Rail) Study Area and to supplement and ground truth the information acquired from the desktop assessment, including verification of the likelihood of occurrence *of Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed flora and fauna species. Verification was based on direct observations of flora, fauna, fauna traces or suitable habitat for flora and fauna species. Desktop information was reviewed to identify areas to be targeted for field studies. Access and conditions (wet/dry) influenced location of field surveys.

Seasonal field surveys were conducted across the different geographies (i.e. topography, terrain, ecosystems, vegetation communicates, etc) of the Project (Rail) to identify the existing terrestrial and aquatic biodiversity. Table 5-1 summarises the survey effort.

Table 5-1 Temporal Survey Effort

Geography	Type of Survey	Survey Effort* (terrestrial, aquatic)	Time Completed
Rail Study Area	Terrestrial and aquatic flora	24 sites, 3 sites 24 sites, 1 site	Autumn: May 2011 Spring: September 2011
Rail Study Area	Terrestrial and aquatic fauna	2 sites, 3 sites 22 sites, 1 site	Autumn: May 2011 Spring: September 2011

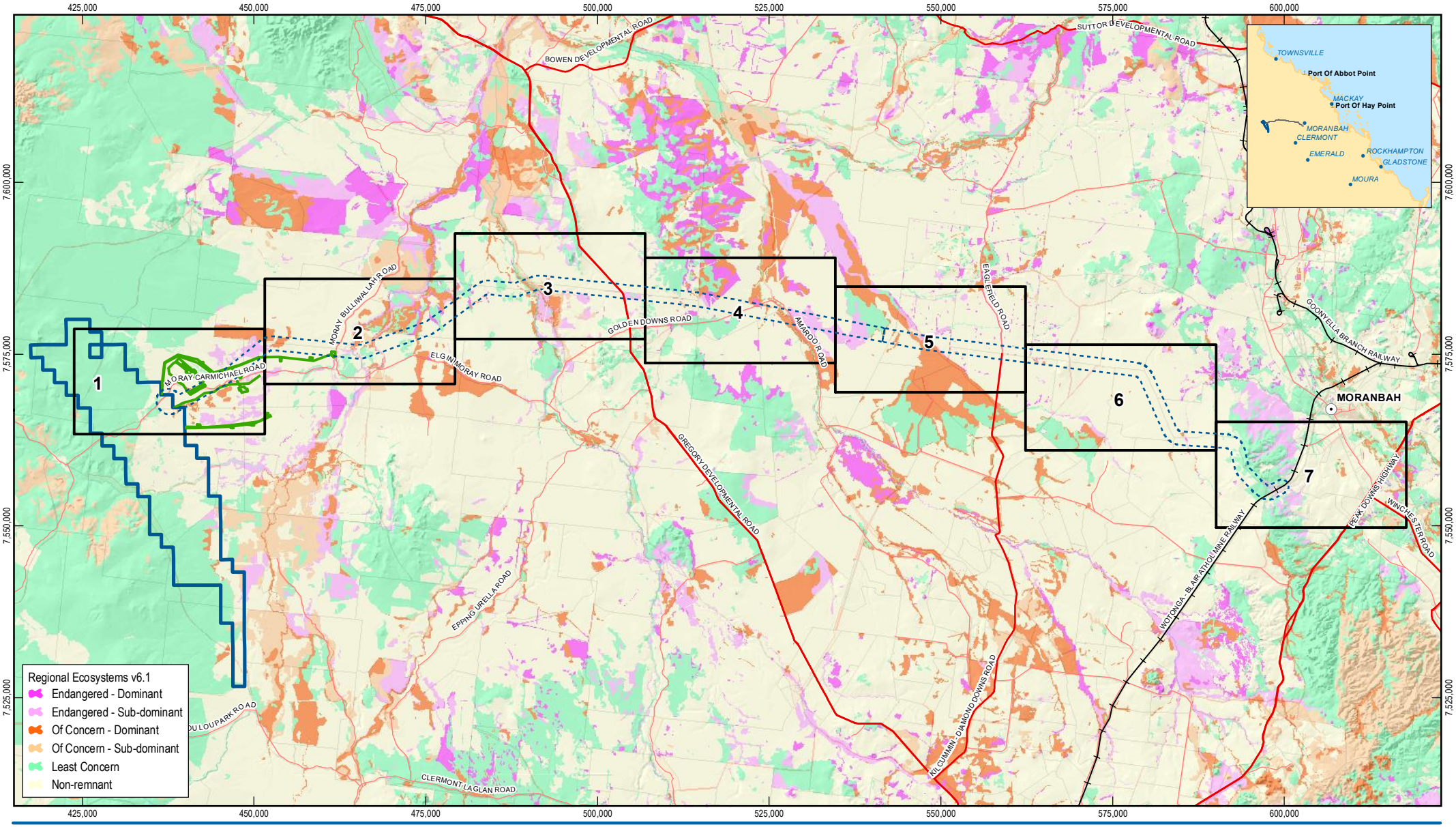
*A combination of rapid and comprehensive survey approaches were used across sites.

Terrestrial Flora Survey Techniques

A summary of flora survey methods is shown in Table 5-2. Figure 5-1 depicts the terrestrial flora and aquatic survey effort extents.

Table 5-2 Summary of Terrestrial Flora Survey Methods

Rapid Survey Sites	Targeted and Random Meander Searches
◗ Equates to a quaternary CORVEG site ◗ Plotless sampling technique ◗ Level of detail collected varies – at all sites, dominant species recorded ◗ Species lists generated ◗ Regional Ecosystem (RE) verification ◗ Brief notes recorded on landform, geology, soils, weeds	◗ Literature review to identify habitat requirements of rare and threatened species ◗ Targeted searches conducted at sites based on habitat requirements ◗ Random meander searches were also utilised



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

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Terrestrial Flora Survey Sites and Aquatic Survey Sites

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Figure 5-1
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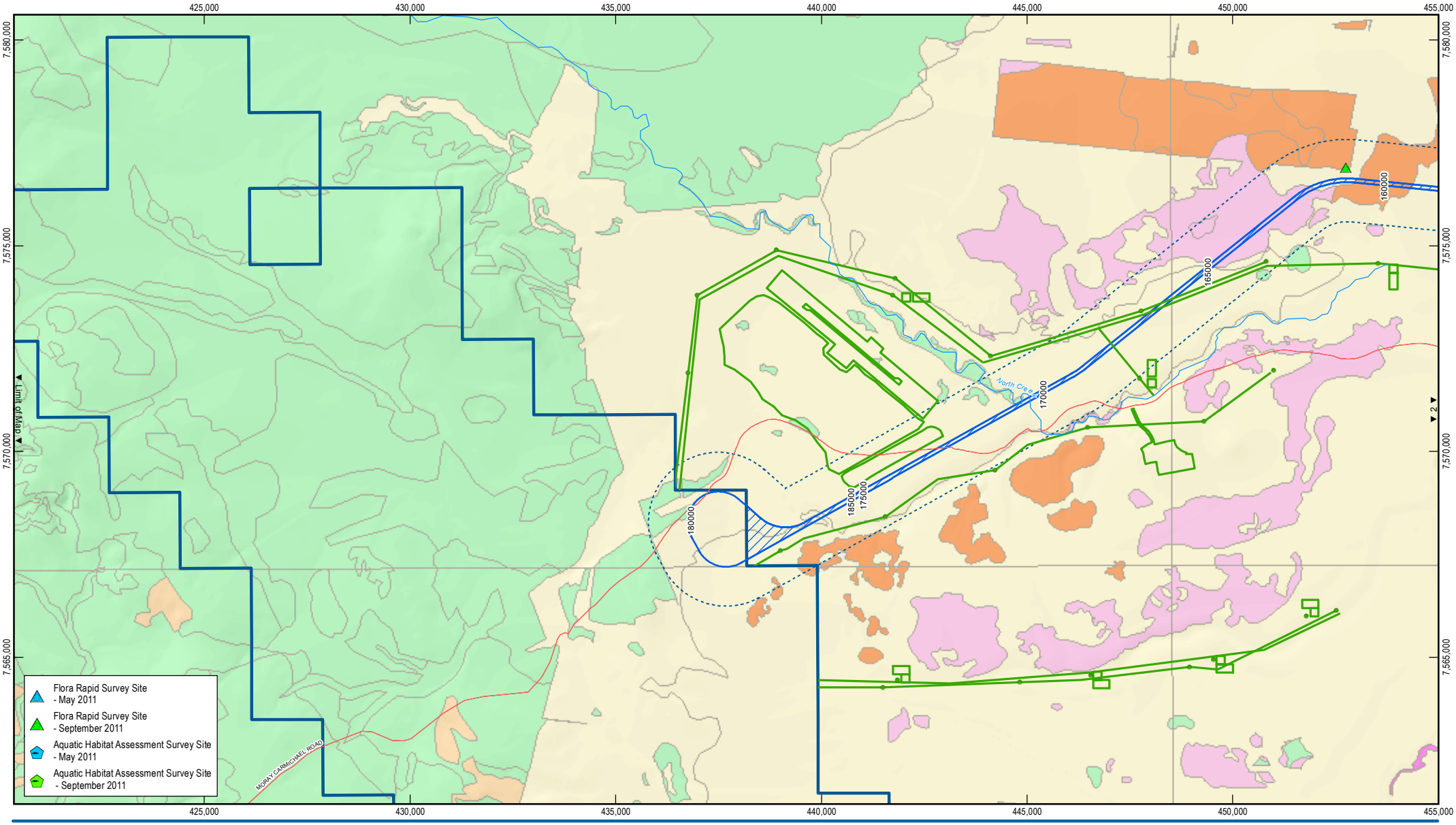

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Map Projection: Universal Transverse Mercator
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N

LEGEND

- State Road
- Local Road
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- Watercourse
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- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant

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Terrestrial Flora Survey Sites and Aquatic Survey Sites

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Figure 5-1
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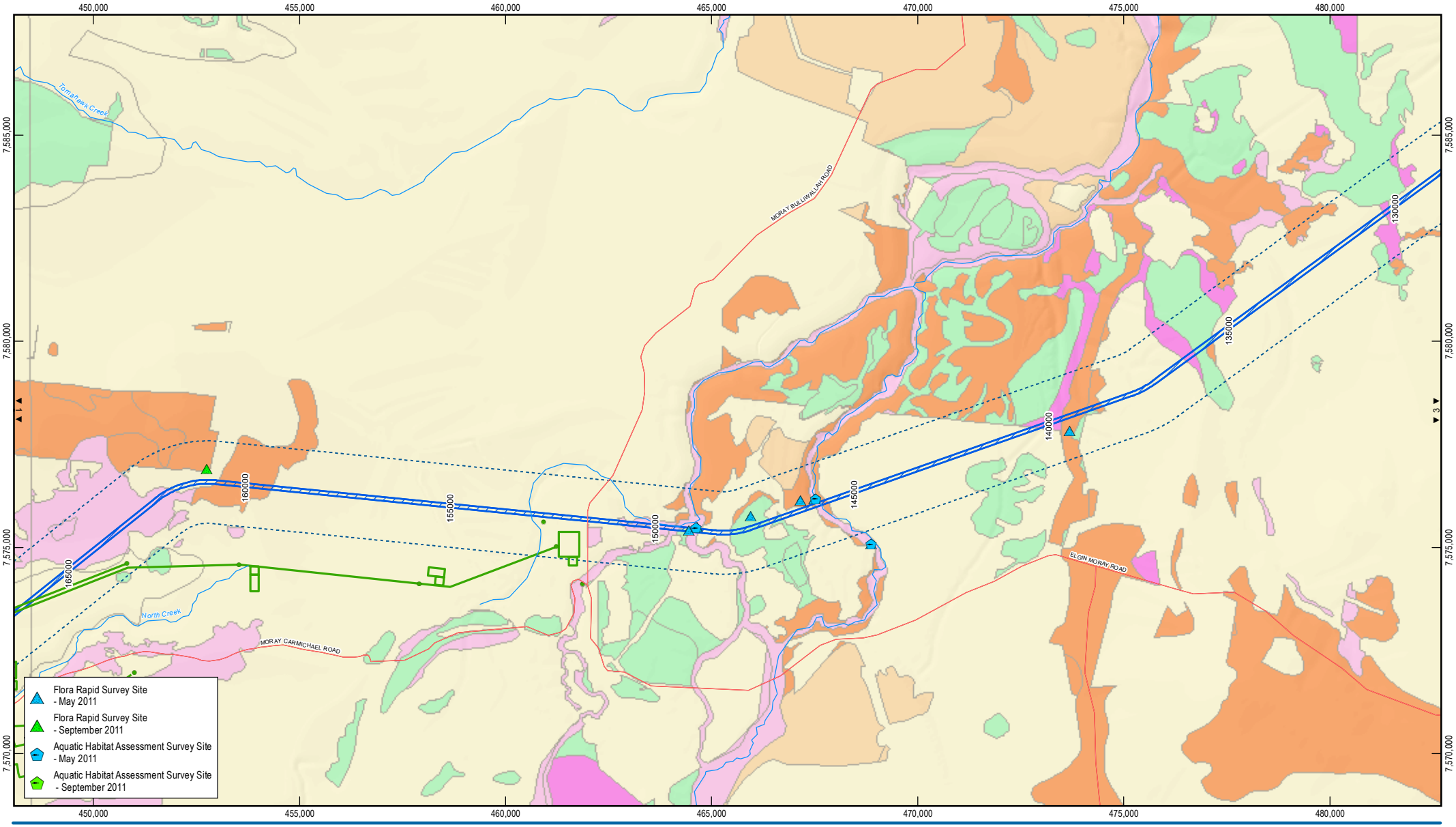

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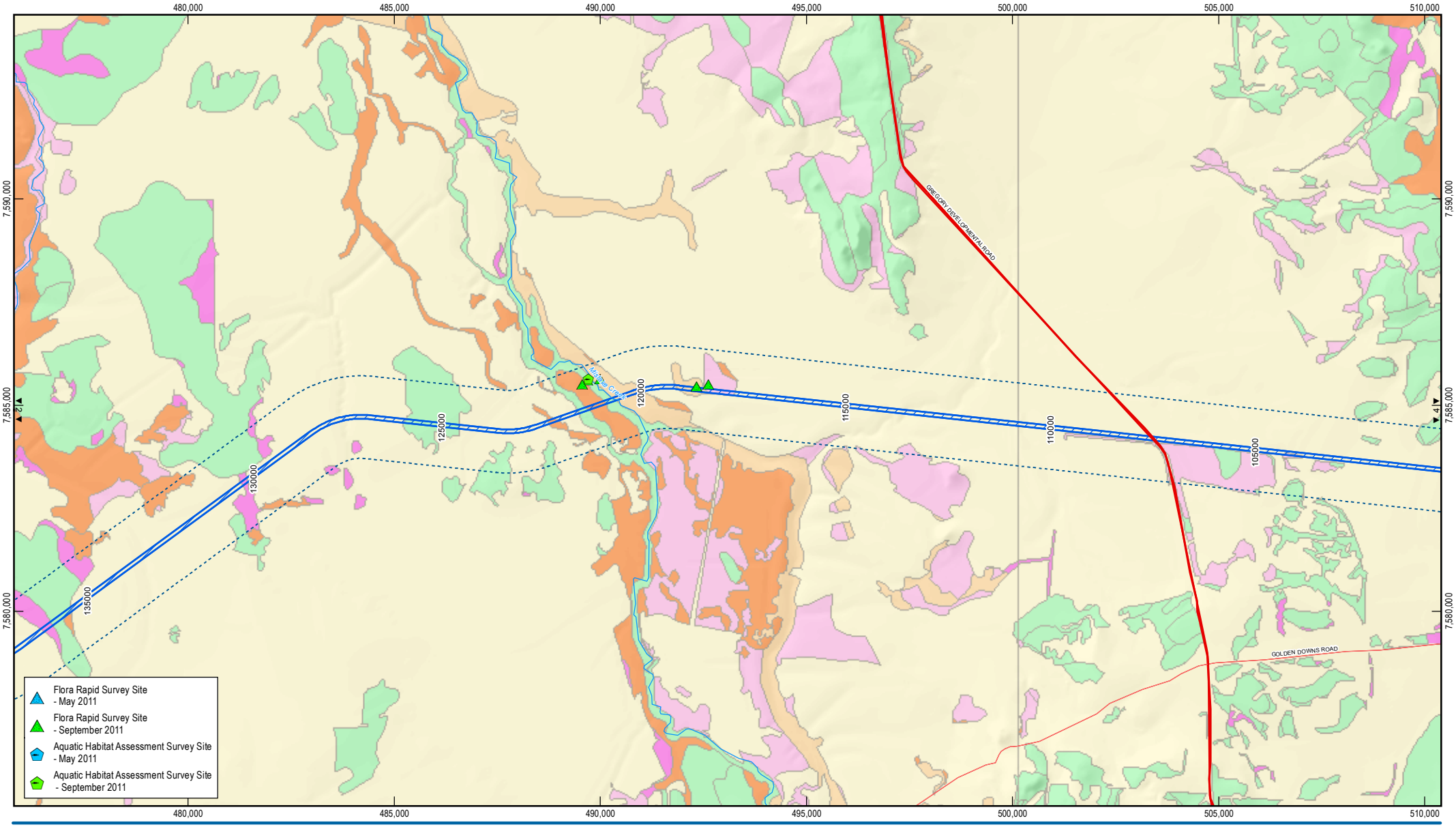

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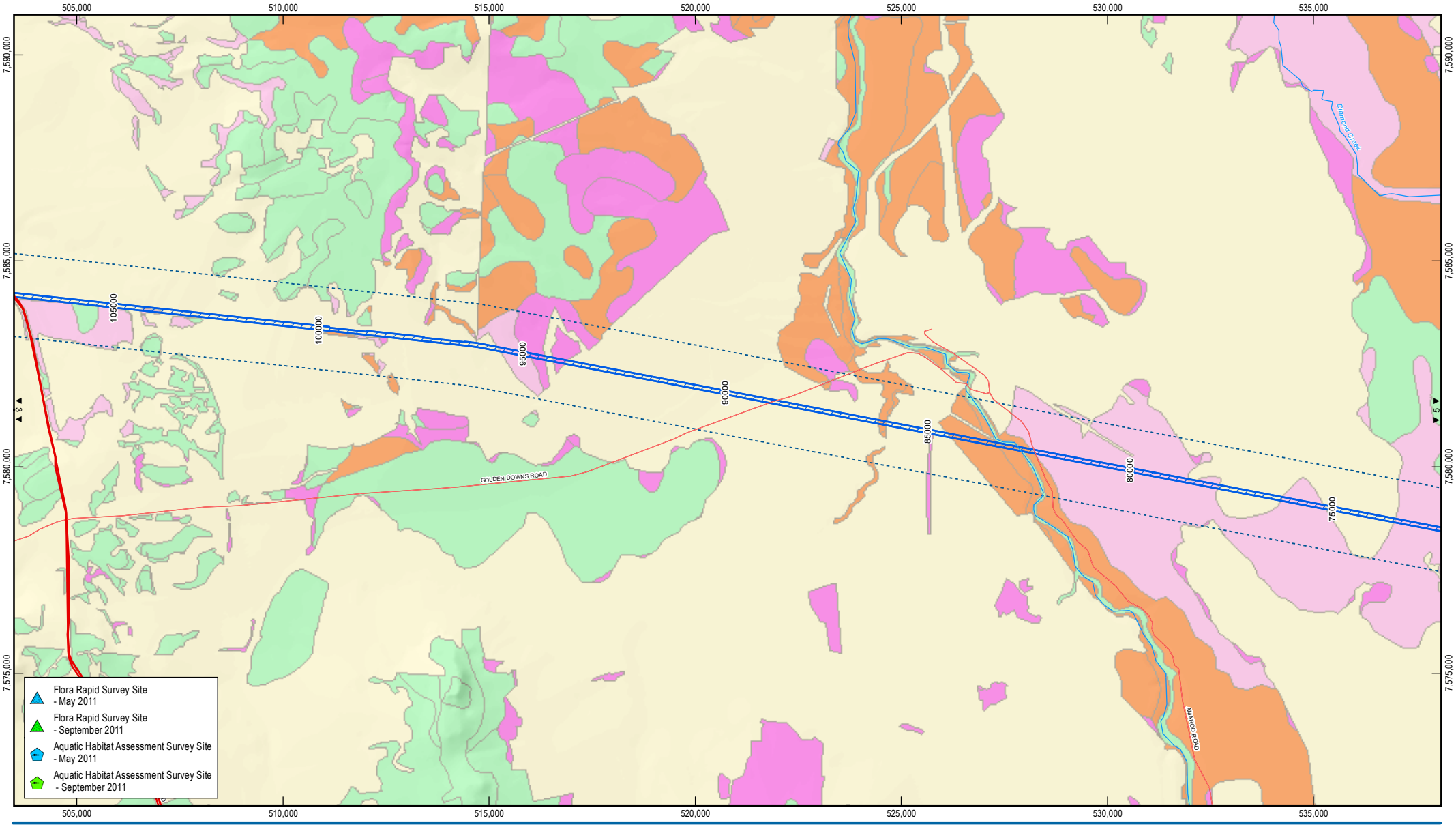

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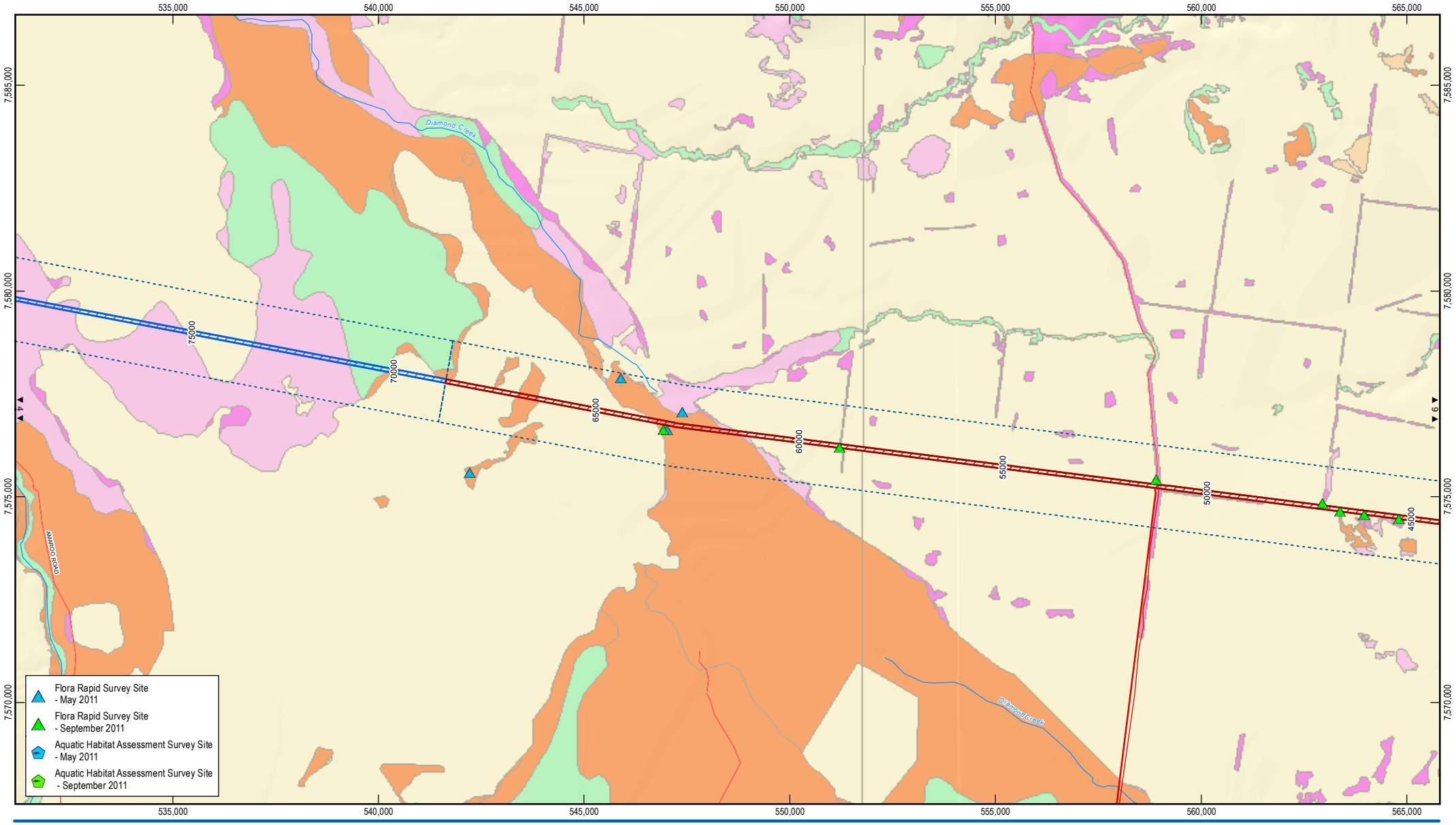

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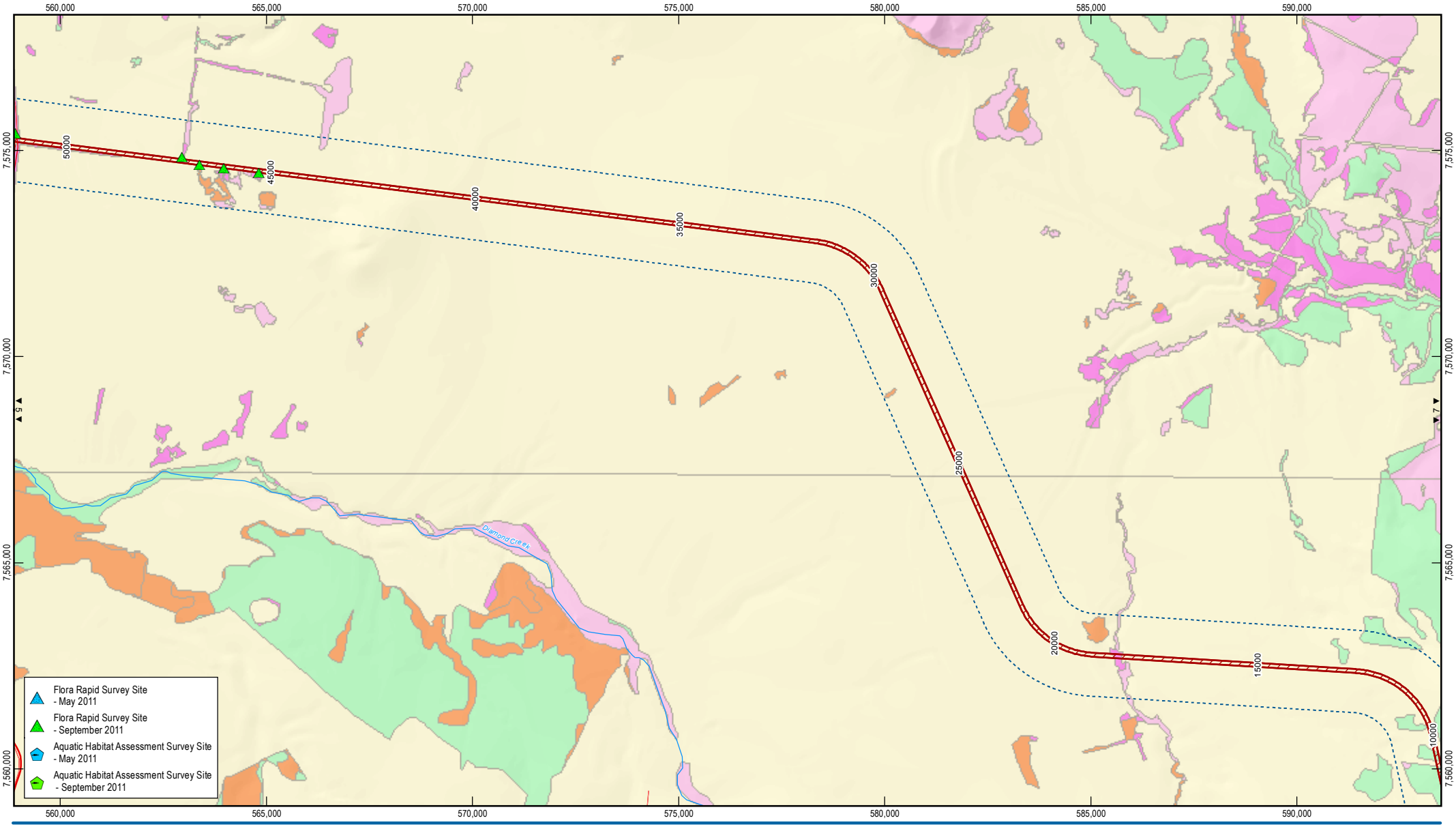

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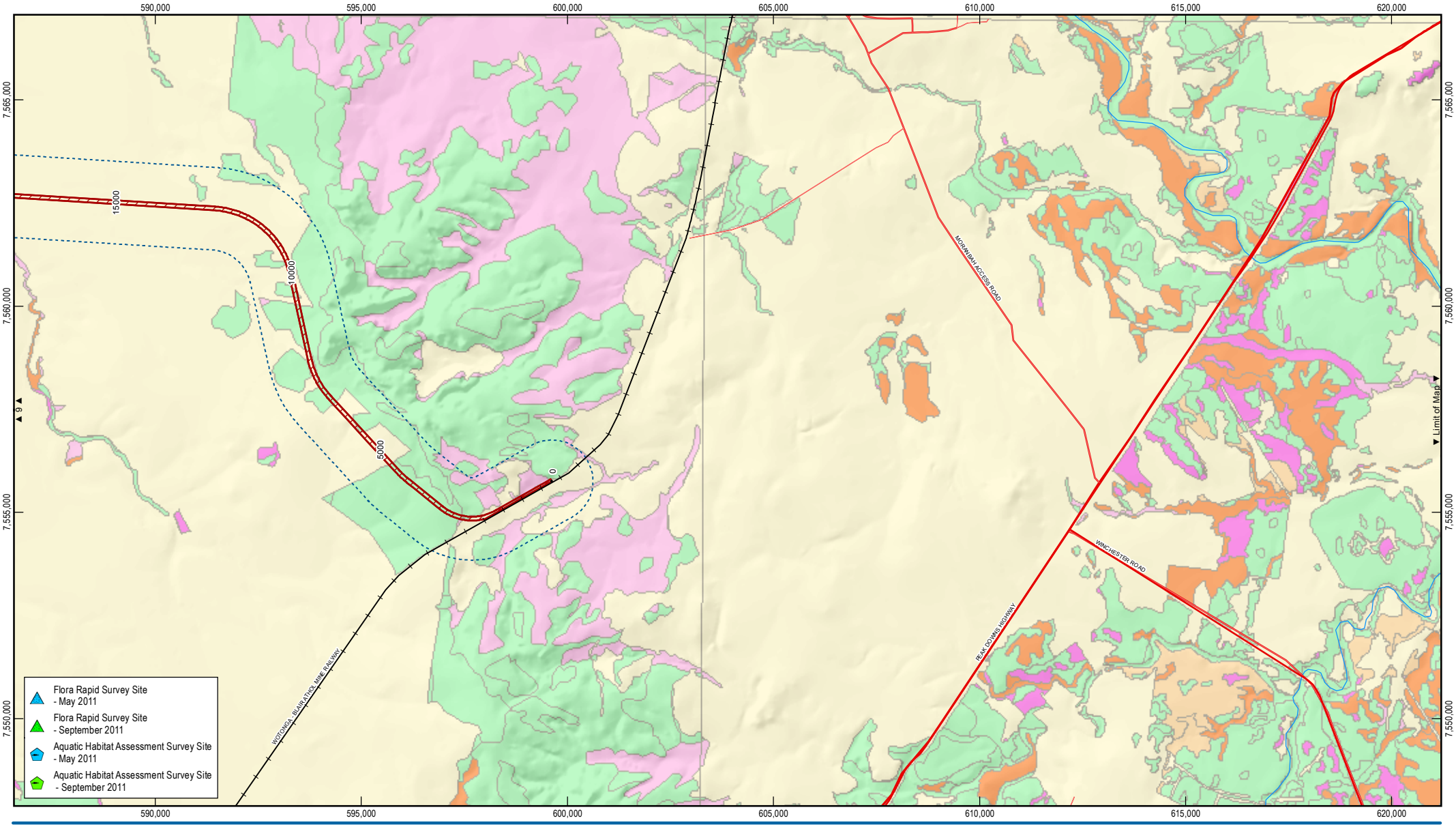

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Terrestrial Fauna Survey Techniques

All surveys were conducted in accordance with the Queensland *Animal Care and Protection Act 2001* and the following permits: GHD Queensland Department of Employment, Economic Development and Innovation (DEEDI) Scientific Users Registration Certificate (Registration Number 132), Queensland DERM Scientific Purposes Permit (Permit Number WISP06498409) and Queensland Primary Industries and Fisheries (QPIF) Animal Ethics Permits (Permit Number CA2009/11/398 and CA2008/07/280). Survey techniques were approved by the DEEDI-accredited GHD Animal Ethics Committee and undertaken by appropriately qualified ecologists.

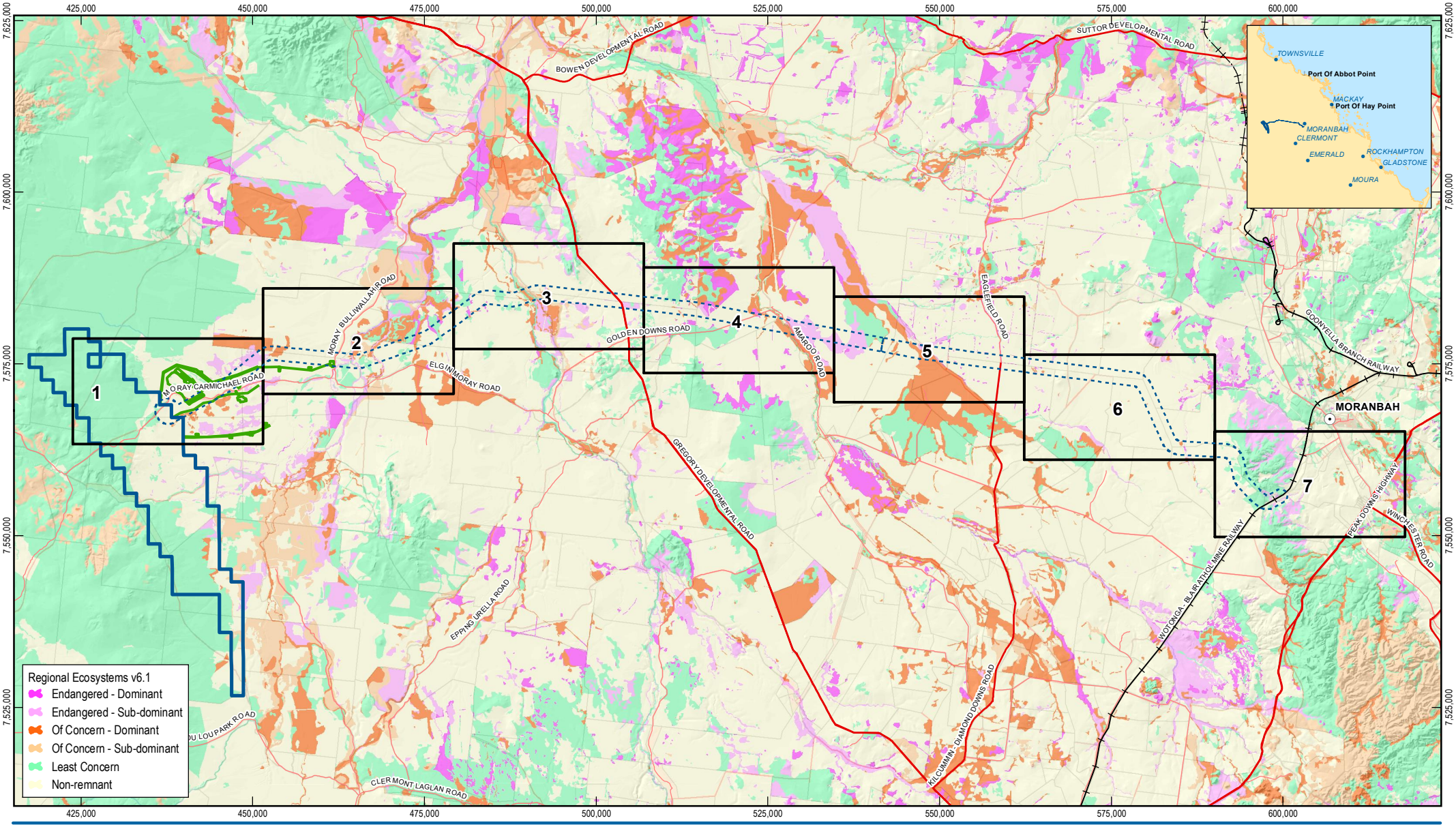
For the purposes of the assessment, terrestrial fauna are defined as animals that only spend limited periods of time in aquatic environments. This includes amphibians and semi-aquatic species such as water birds. Species considered as aquatic fauna include fish, freshwater turtles, aquatic macroinvertebrates and mammals that are entirely confined to or spend extended durations in aquatic environments.

Terrestrial fauna survey methods employed at two comprehensive and 22 rapid survey sites are summarised in Table 5-3. The distribution of fauna survey sites across the Study Area is presented in Figure 5-2.

Table 5-3 Summary of Terrestrial Fauna Survey Methods

Comprehensive survey sites	Rapid assessment sites	Additional areas throughout Study Area
◗ Systematic trapping (comprising Elliott 'A' traps, cage traps, funnel traps, pitfall traps) ◗ Remote cameras set for a series of night monitoring events ◗ Habitat assessment ◗ Opportunistic search for wildlife traces ◗ Standardised (20 minute) bird surveys ◗ Active searches for herpetofauna ◗ Ultrasonic bat detection (Anabat) ◗ Standardised spotlighting for nocturnal fauna ◗ Call-playback for owls and frogs	<u>All rapid assessment sites</u> ◗ Habitat assessment ◗ Opportunistic search for wildlife traces ◗ Standardised (20 minute) bird surveys ◗ Active searches for herpetofauna <u>Some rapid assessment sites</u> ◗ Ultrasonic bat detection (Anabat) ◗ Standardised spotlighting for nocturnal fauna ◗ Call-playback for owls and frogs	◗ Remote camera ◗ Waterbody watches ◗ Opportunistic wildlife records

Fauna habitat assessments (rapid assessments) were undertaken at each of the different vegetation communities encountered within the Study Area. Where possible, these sites coincided with the locations of rapid flora assessments. Habitat assessments were also undertaken at comprehensive survey sites. Habitat assessments provided information on vegetation characteristics, microhabitats, adjacent land uses, connectivity, evidence of faunal presence, and overall inferred value of habitat for fauna species.



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Kilometres

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N

LEGEND

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Carmichael Coal Mine and Rail Project

Terrestrial Fauna Survey Sites

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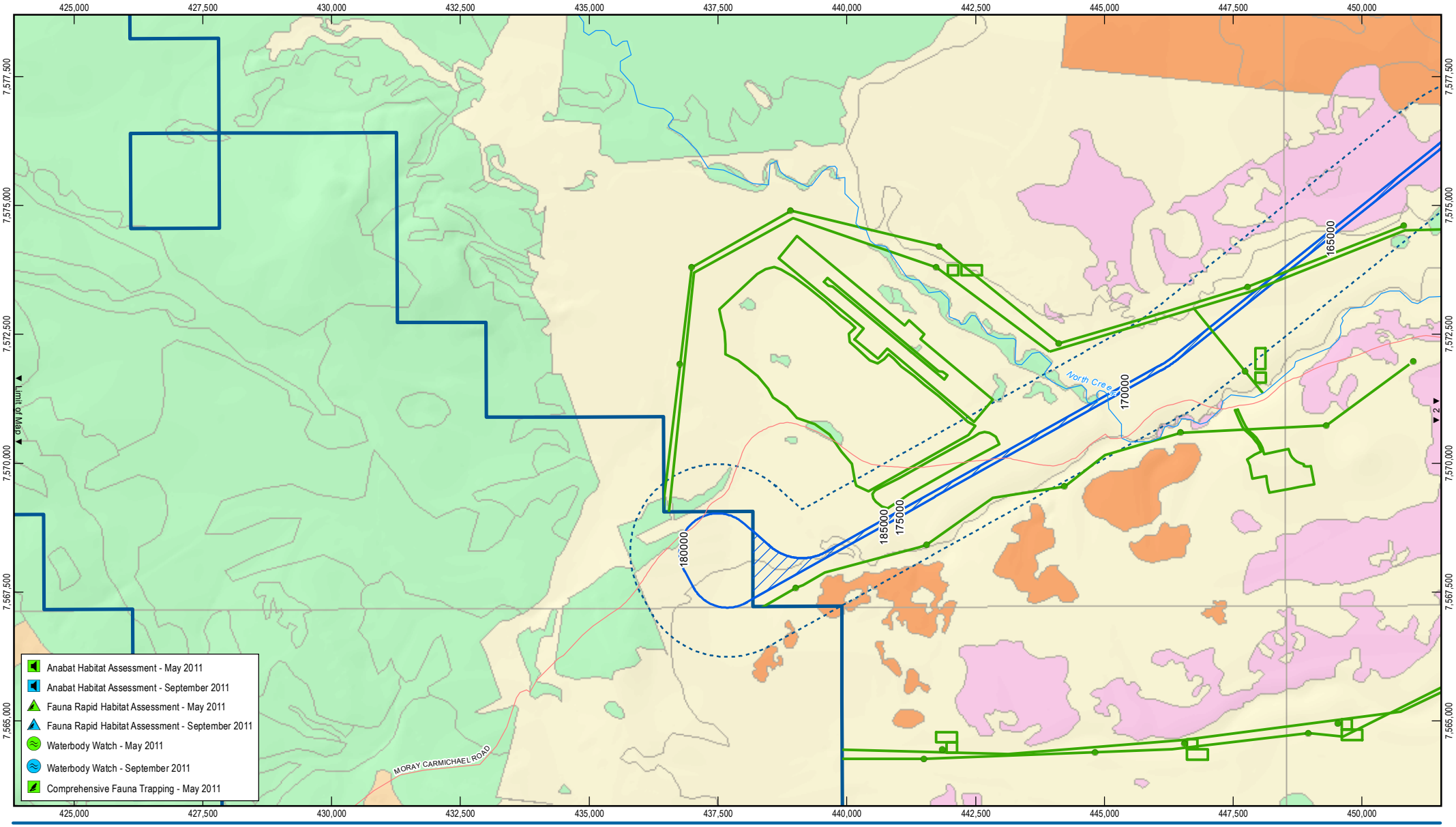

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Map Projection: Universal Transverse Mercator
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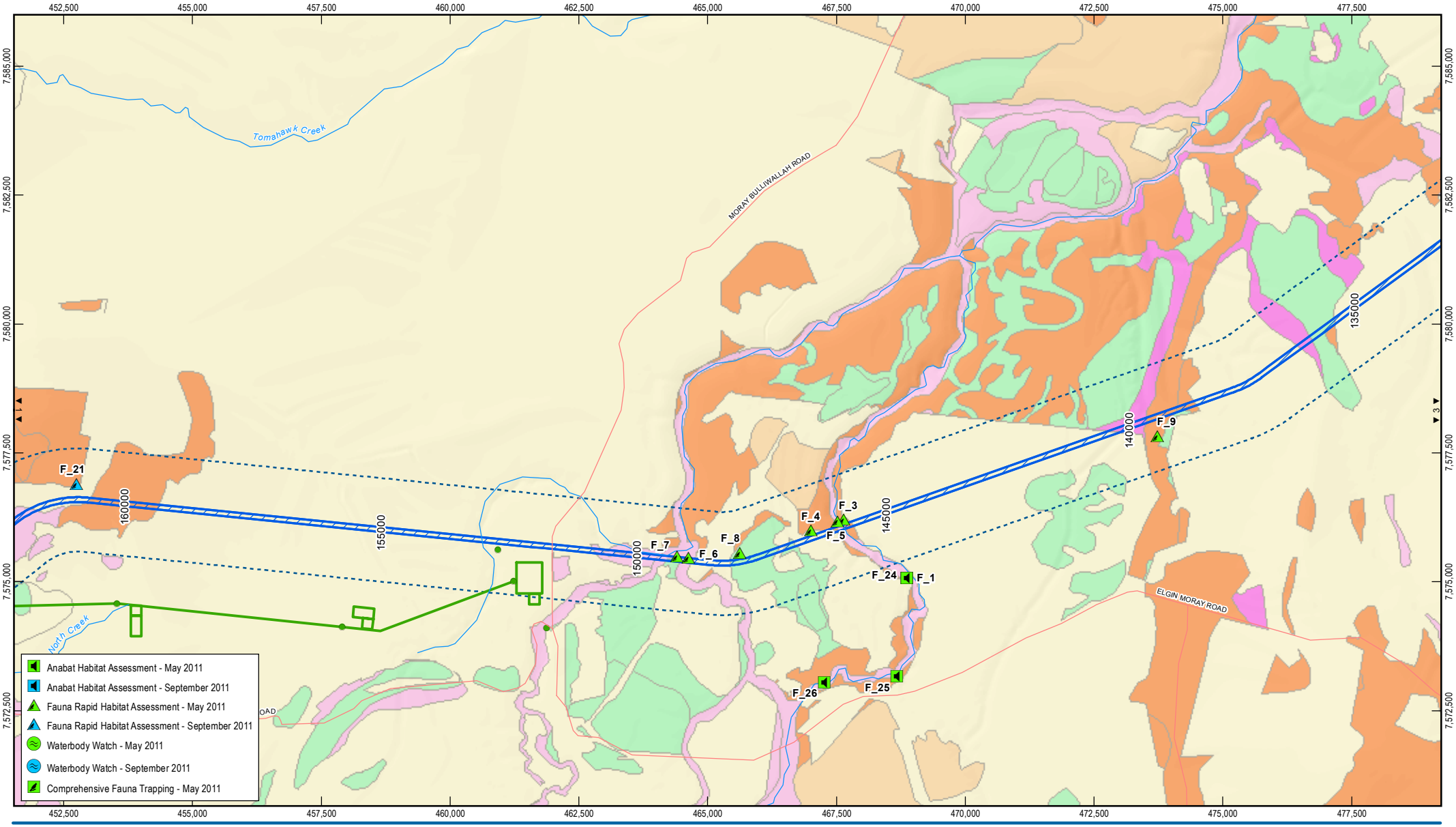

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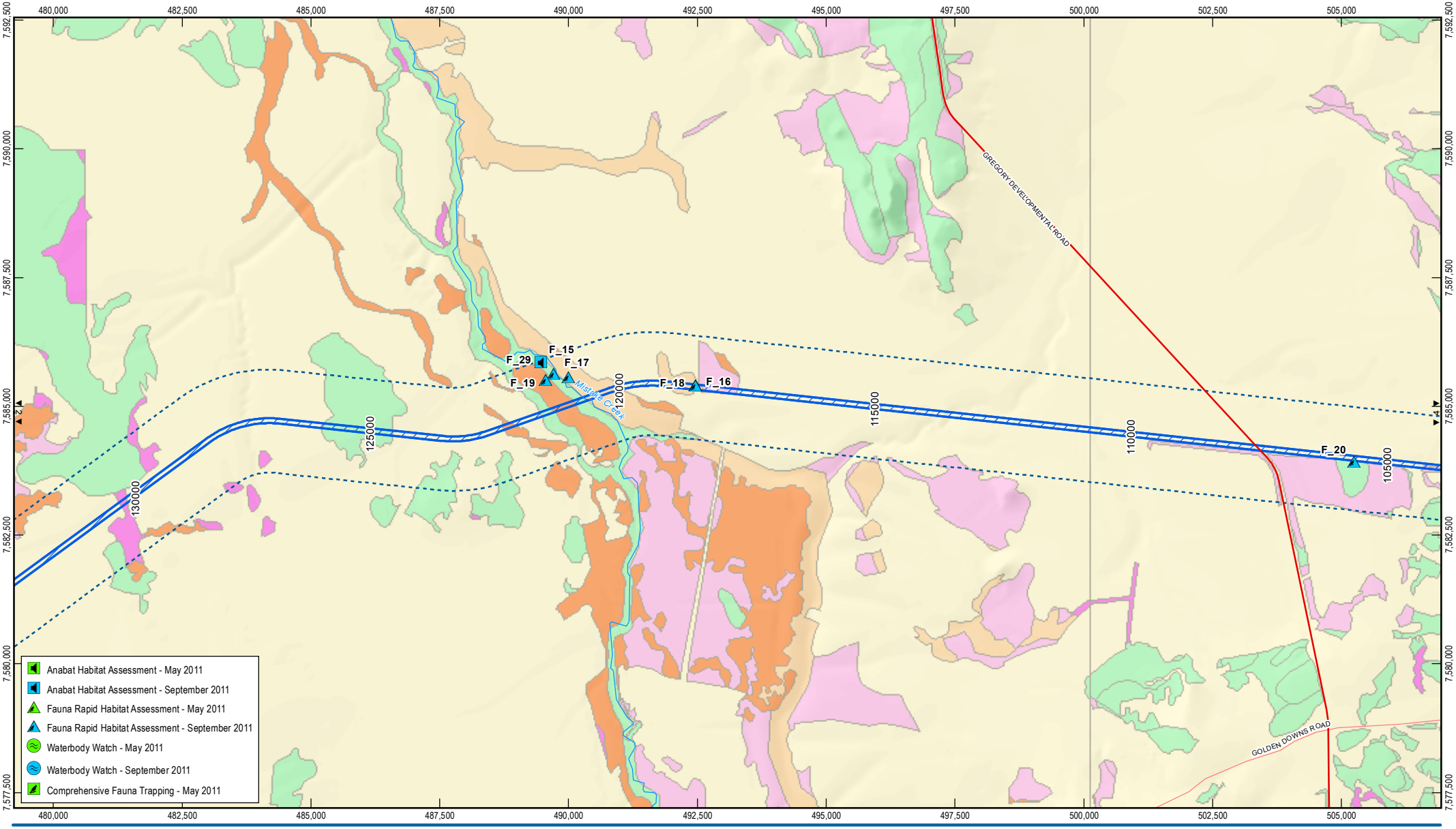

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LEGEND

- State Road
- Local Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), RE v6.1 (2011), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Terrestrial Fauna Survey Sites (2011);Gassman/Hyder: Mine (Offsite) (2012)
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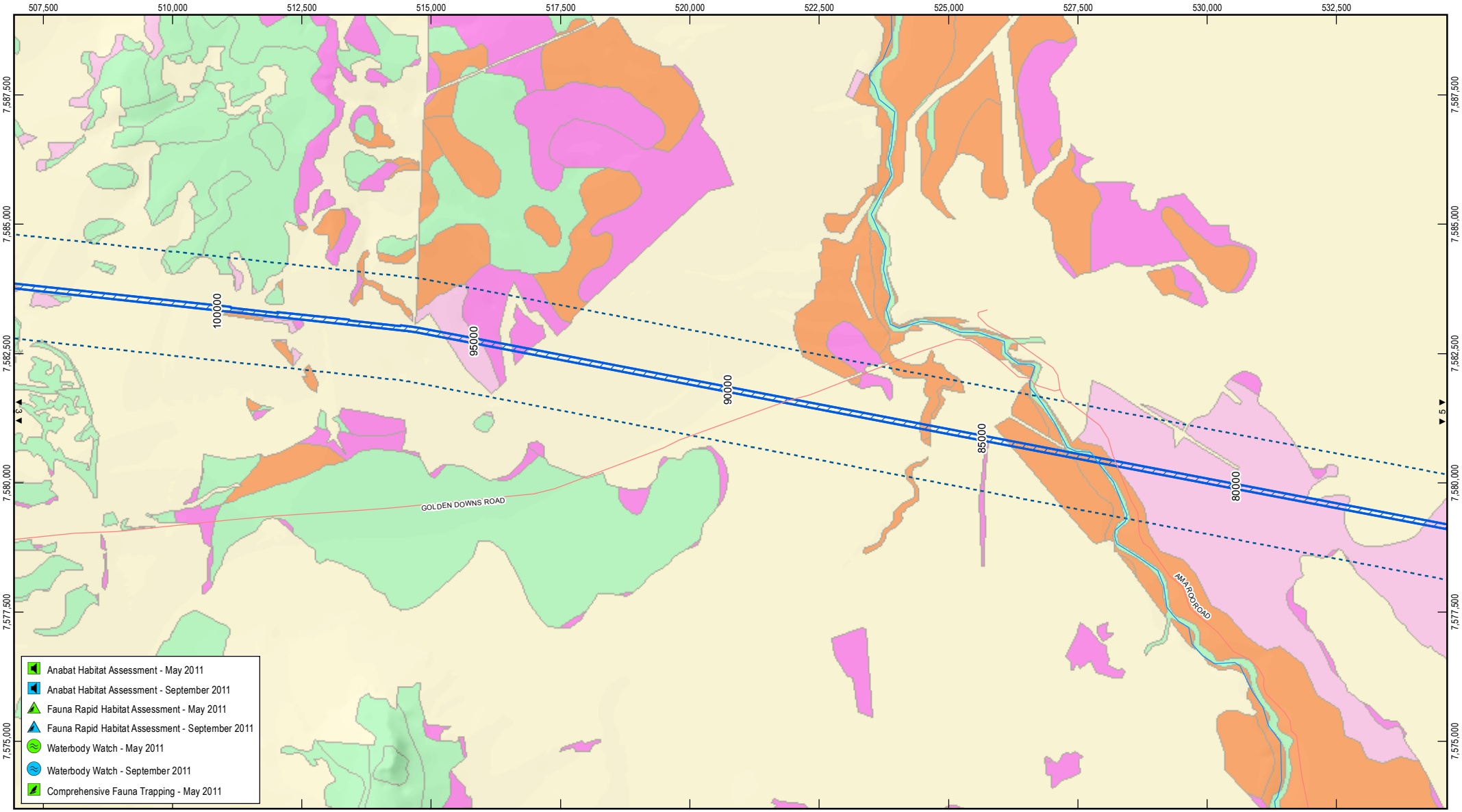

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Carmichael Coal Mine and Rail Project

Terrestrial Fauna Survey Sites

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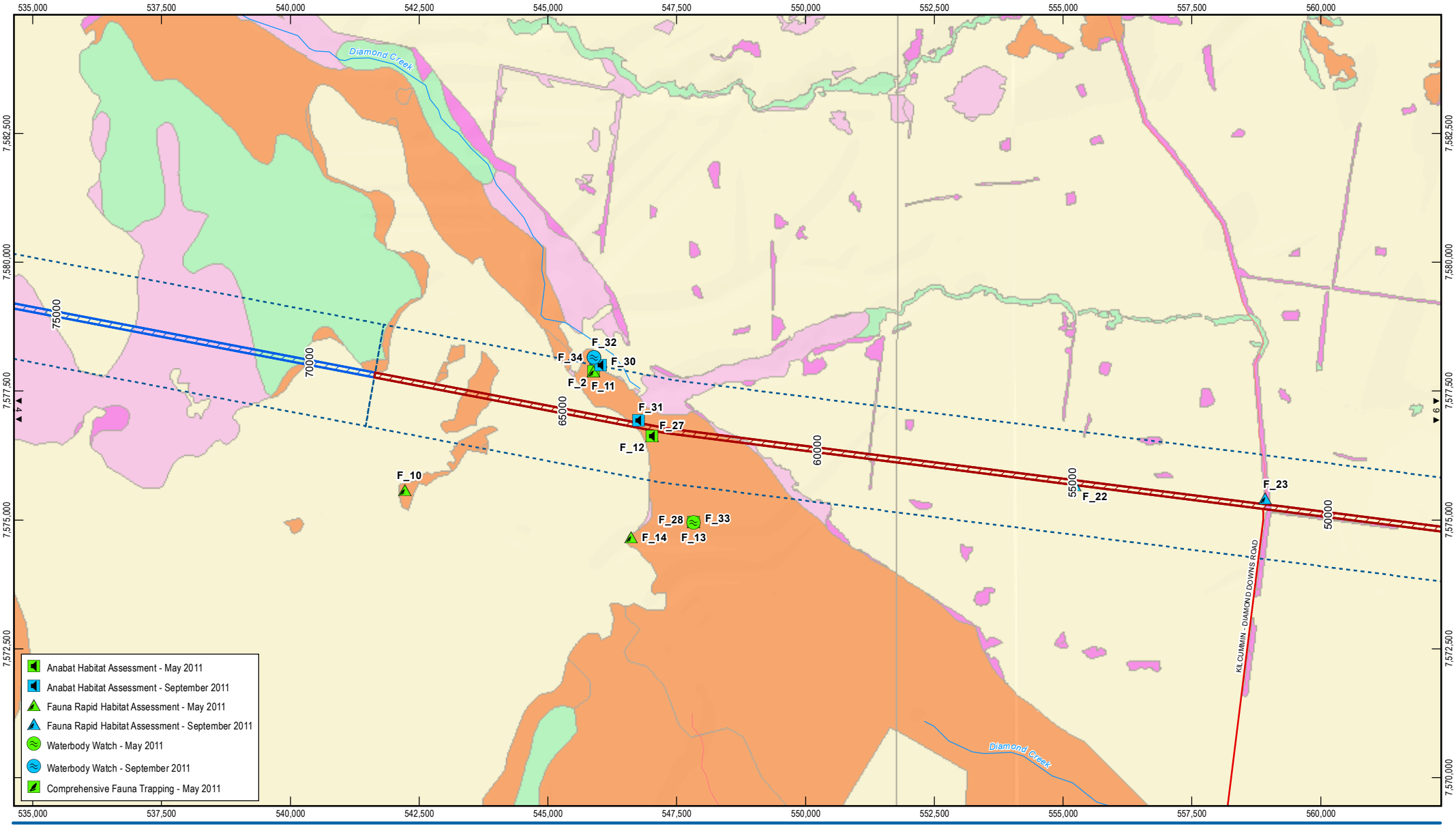

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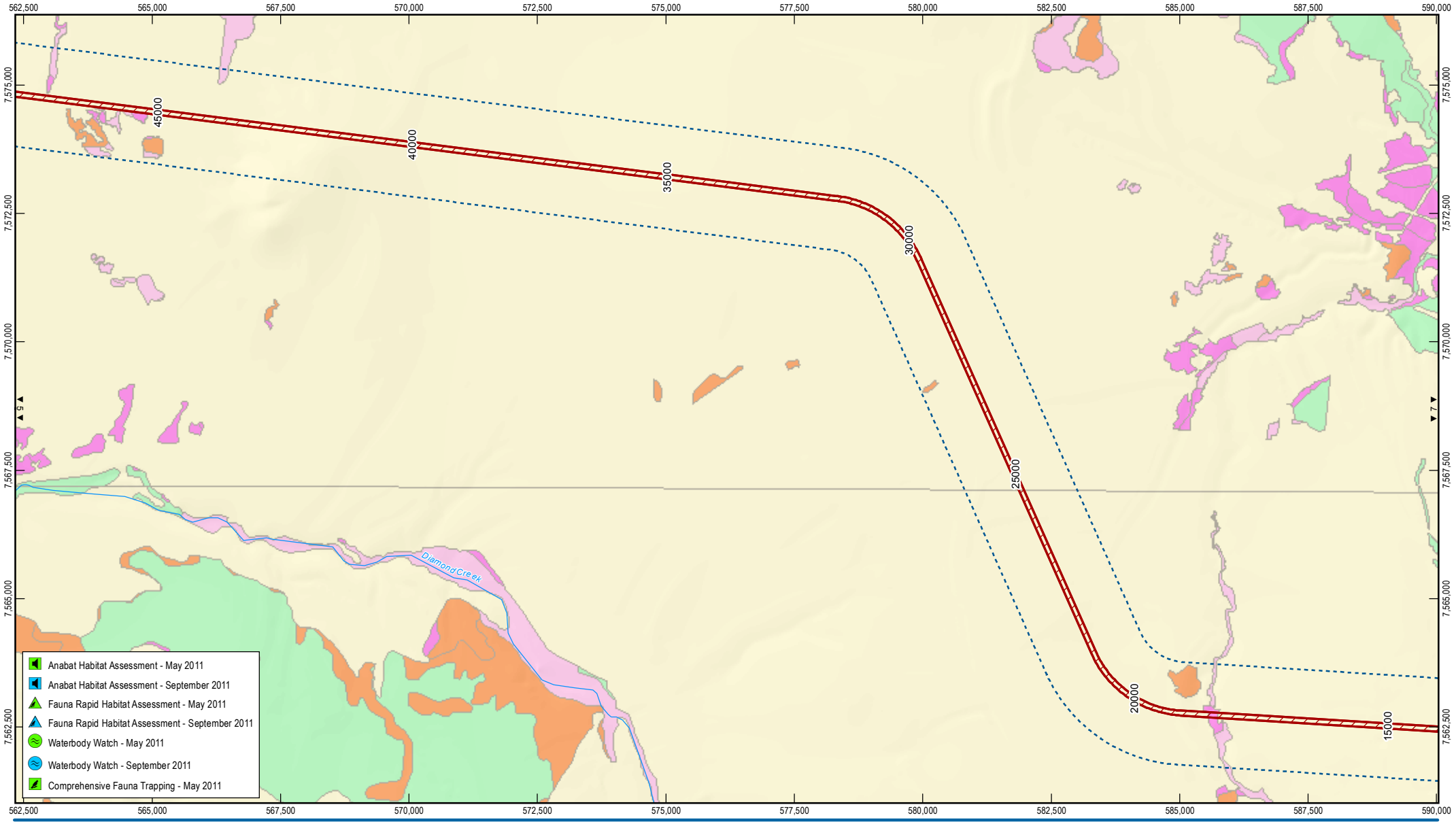

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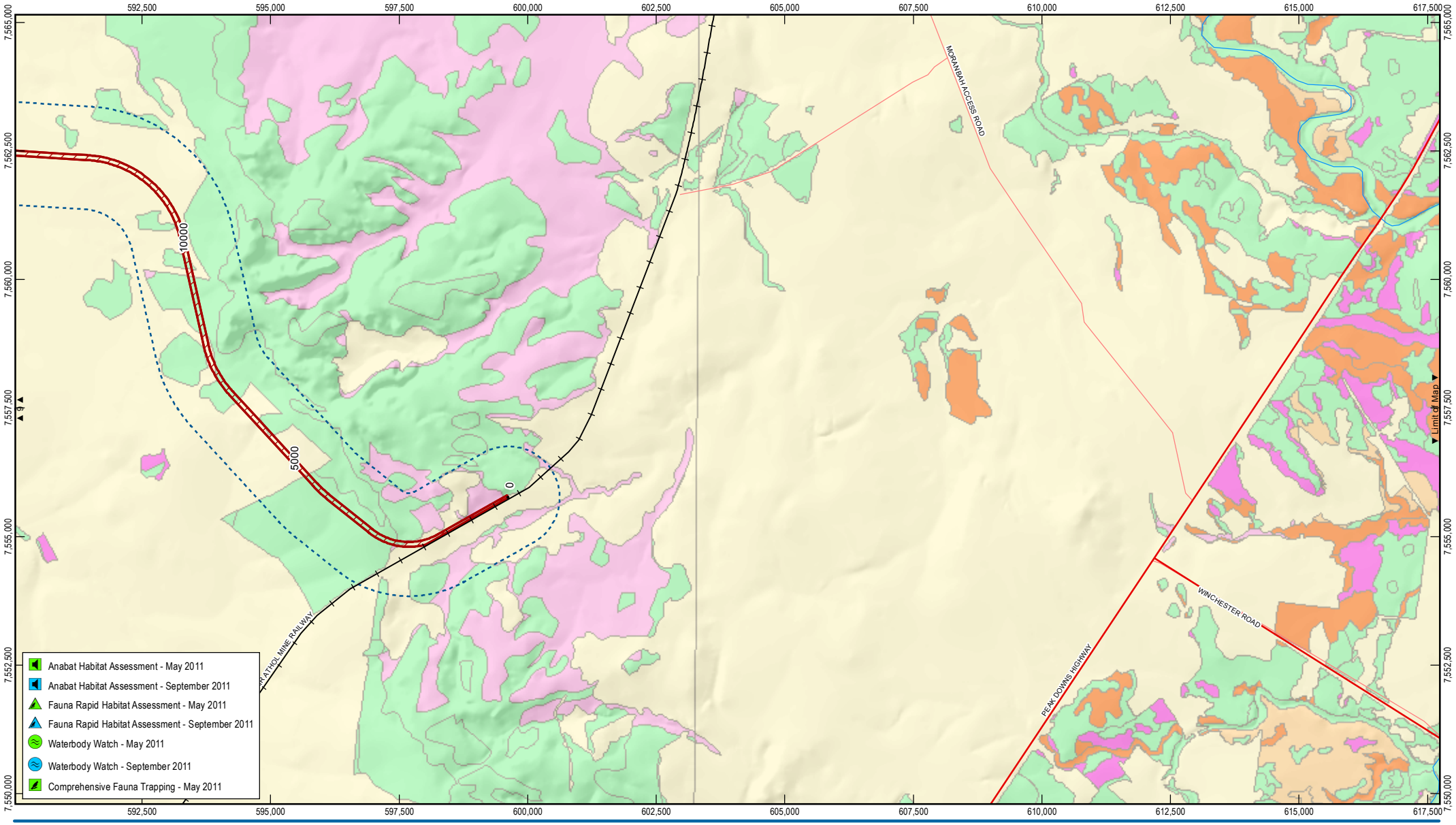

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Carmichael Coal Mine and Rail Project

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Figure 5-2
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Threatened Species Surveys

Targeted surveys for threatened species were incorporated into the sampling methodologies outlined above (i.e. ground-trapping and opportunistic searches for threatened reptiles, Anabat detection for threatened bats). Additional survey techniques were undertaken for the threatened species that were considered to have a potential to occur within the Study Area. The targeted species included:

- *Peophila cincta cincta* (black-throated finch (southern)
- *Paradelma orientalis (*brigalow scaly-foot*)*
- *Denisonia maculata (*ornamental snake*)*
- *Furina dunmalli (*Dunmall's snake*)*
- *Egernia rugosa (*yakka skink*)*

Targeted survey techniques for these species are detailed in Volume 1 Section 13 Matters of National Environmental Significance Report of this EIS.

Aquatic Ecosystems Survey Techniques

Aquatic habitat assessments were undertaken at sites within the Study Area to characterise water bodies with respect to ecological values for aquatic flora and fauna. Although not all sites held water during all survey events seasonal assessment was completed across the Study Area to confirm the presence or absence of aquatic habitat temporally. Figure 5-1 shows the aquatic survey sites.

Visual habitat assessments of the sites (100 m reach) were used to describe the aquatic ecosystems in terms of habitat diversity and extent, suitability for aquatic fauna groups, sensitivity to change, existing disturbances/modifications or barriers, riparian condition and flow characteristics. This was achieved using a standardised proforma approach modelled on the Queensland Australian River Assessment System (AusRivAs) assessment protocols.

Aquatic flora (macrophyte) assessment was undertaken in conjunction with habitat assessments. Riparian vegetation assessment was conducted across the Study Area as part of the dedicated terrestrial flora assessments.

5.1.1.3 Likelihood of Occurrence Assessment

The information acquired through the desktop and field assessments described above was used to characterise the existing terrestrial and aquatic ecological values of the Study Area. For conservation significant flora and fauna species, a likelihood of occurrence assessment was undertaken to filter listed threatened or migratory species that could potentially occur at the site to focus assessment on those taxa that are known, likely or may occur at the site, which was used to inform the impact identification process. A likelihood of occurrence ranking was attributed to each conservation significant species, namely:

- Unlikely to occur: species has not been recorded in the region (no records from desktop searches) and/or current known distribution does not encompass Study Area and/or suitable habitat is generally lacking from the Study Area.
- May occur: species has not been recorded in the region (desktop searches) although species' distribution incorporates Study Area and potentially suitable habitat occurs at the Study Area.

- Likely to occur: species has been recorded in the region (desktop searches) and suitable habitat is present at the Study Area.
- Confirmed present: species recorded during field surveys at the Study Area.

5.1.1.4 Potential Habitat Mapping for Threatened Species and Communities

In consideration of the extensive size of the Study Area and the inability to access many parts during the field surveys a mapping methodology has been adopted whereby potential habitat for threatened species and communities is mapped within the Study Area and in the adjacent wider landscape. Threatened species and communities that are mapped through this process are those considered as likely to occur or are confirmed as present within the Study Area based on the likelihood of occurrence assessment outlined above.

Currently, the mapping methodology has taken into consideration the known distribution, ecology and preferred habitat characteristics of each species and Threatened Ecological Community (TEC) to which it has been applied. The species and communities that have been mapped according to this methodology comprise:

- Black-throated finch
- Reptiles of the brigalow belt, including ornamental snake, Dunmall's snake, brigalow scaly-foot and yakka skink
- *Dasyurus hallucatus* (northern quoll)
- *Nyctophilus timoriensis* (greater long-eared bat)
- *Phascolarctos cinereus* (koala)
- *Geophaps scripta scripta* (squatter pigeon (southern))
- *Erythrotriorchis radiatus* (red goshawk)
- *Rostratula australis* (Australian painted snipe)
- Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin TEC (in the surrounding landscape)

5.1.2 Relevant Legislation

A detailed description of legislation, policies and regulations applicable to the Project is provided in Volume 4 Appendix D Project Approvals and Planning Assessment. The items relevant to the nature conservation values include:

- Matters of National Environmental Significance (NES) under the EPBC Act
- Commonwealth EPBC Act Environmental Offsets Policy (Consultation Draft)
- *State Development and Public Works Organisation Act 1974* (SDPWO Act)
- Queensland *Nature Conservation Act 1992* (NC Act) and Nature Conservation (Wildlife) Regulation 2006
- Queensland *Vegetation Management Act 1999* (VM Act)
- Queensland *Sustainable Planning Act 2009*

- Queensland *Land protection (Pest and Stock Route Management) Act 2002* (LP Act)
- Queensland *Environmental Protection Act 1994*
- State Planning Policy 4/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments (Wetlands SPP)
- Queensland Government Environmental Offsets Policy (QGEOP)

5.2 Description of Environmental Values

5.2.1 Overview

The Study Area occurs in central Queensland within the Burdekin and Fitzroy Basin Catchments and is located entirely within the Isaac Regional Council local government area. The vast majority of the Study Area is within the Brigalow Belt North bioregion save the extreme western extent of the Study Area which is within the boundary of the Desert Uplands bioregion.

5.2.1.1 Fitzroy Basin Catchment

The Fitzroy Basin is located in central eastern Queensland and is one of the largest basins in Queensland encompassing an area of approximately 142,600 km^2 (DERM, 2009a). It is the largest river basin draining to the east coast of Australia where it outflows into the southern end of the Great Barrier Reef (DERM, 2009a). The catchment is characterised by a sub-tropical, semi-arid climate with high rainfall variability. The main land use in the basin is grazing while the main water user is agriculture (DERM, 2009a). Only a small portion of the eastern extent of the Study Area (approximately 15 per cent or 30 km) is located within the northern region of the Fitzroy Basin Catchment. The proposed Project intersects minor tributaries of Grosvenor Creek (stream order 3), which flows into the Isaac River near Moranbah.

5.2.1.2 Burdekin Catchment

The Burdekin Catchment is the second largest catchment on the east coast of Australia, covering an area of approximately 130,057 km^2 within north-east and central Queensland (DERM, 2011a). The vast majority of the Study Area (approximately 85 per cent) is located within the Burdekin Catchment, of which all is located within the Belyando/Suttor sub catchment. Land use within the Burdekin Catchment is dominated by cattle grazing, which covers over 96 per cent of the catchment area (Dight, 2009). The Burdekin Catchment exhibits distinct seasonal climatic conditions with a pronounced wet summer and dry winter. The Belyando/Suttor sub catchment encompasses and area of approximately 73,335 km^2 and is the largest system within the Burdekin Catchment, comprising almost 60 per cent of the total area (DSEWPaC, 2009c). Topography within the Belyando/Suttor sub catchment is notably different from other sub catchments in the Burdekin Basin due to the lack of high mountain backdrops and its representation of a drier, typically semi-arid western landscape (DSEWPaC, 2009c).

5.2.1.3 Desert Uplands Bioregion

The Desert Uplands bioregion covers approximately 70,000 km^2 of central northern Queensland, between Blackall and Pentland (Morgan, 1999). The bioregion is dominated by sandstone ranges and sand plains, with soils that are typically of poor structure and low fertility (Morgan, 1999). The climate is semi-arid (Morgan, 1999). *Eucalyptus whitei, Eucalyptus similis* and *Corymbia trachyphloia* woodlands are the predominant vegetation communities in the Desert Uplands (DSEWPaC, 2009c).

The Study Area intersects the Alice Tableland subregion in the Desert Uplands. This subregion is characterised by sandstone ranges and deep red soils of intact Tertiary sand sheets (Morgan, 1999). The main vegetation communities of the Alice Tableland subregion include yellow jacket woodlands, White's ironbark woodlands and mixed bloodwood/ironbark woodlands (Morgan, 1999).

5.2.1.4 Brigalow Belt North Bioregion

The Brigalow Belt North bioregion occurs over 364,000 km^2 of central Queensland, from Townsville in the north, south to Narrabri in New South Wales (Young *et. al.*, 1999). Brigalow (*Acacia harpophylla*) forests and woodlands growing on clay soils are one of the major vegetation types that characterise the region (Young *et. al.*, 1999). Other ecosystems that typify the bioregion include eucalypt forest and woodlands, grasslands, dry rainforest, cypress pine woodland and riparian communities (Young *et. al.*, 1999).

The majority of the Study Area is located in the Brigalow Belt North bioregion. The Brigalow Belt North bioregion comprises 13 subregions, of which two are intersected by the Study Area, these being the Northern Bowen Basin and the Belyando Downs.

5.2.1.5 Land Use

The Study Area is located within the Regional Landscape and Rural Production Area (RLRPA) land use category under the Mackay, Isaac and Whitsunday Regional Plan 2011 (MIWRP) (DLGP, 2011). The RLRPA includes land with significant biodiversity values, good quality agricultural land (GQAL), cultural and landscape heritage values, extractive resources of economic significance (e.g. mining), water catchments, native forests, coastal wetlands, land unsuitable for urban/rural residential purposes and rural towns and associated activities (DLGP, 2011). Cattle breeding and fattening makes up the major use of land within the Study Area.

Much of the Study Area has been impacted through extensive grazing by cattle. Such impacts associated with grazing activities are evident in the form of vegetation clearing, the introduction and increased spread of exotic pasture grasses and subsequent displacement and reduction of native herbs and grasses, trampling and compaction of creek beds and subsequent erosion and reduced ground cover of creek banks.

5.2.2 Sensitive Environmental Areas

Conservation significant areas and species occurring within or of relevance to the Study Area include those classified as having Commonwealth, State and/or regional biodiversity significance. The conservation significant terrestrial and aquatic ecological values identified during desktop and field investigations of the Study Area are summarised in Table 5-4.

Table 5-4 Summary of Conservation Significant Ecological Values

Significance classification	Summary	Section discussed
Commonwealth		
Commonwealth EPBC Act – matters of NES (controlling provisions based on referral of Project (2010/5736))		
World Heritage properties (section 12 & 15A)	No World Heritage properties within or of relevance to Study Area. The eastern extent of the Study Area is located approximately 150 km due west and approximately 320 km upstream of the Great Barrier Reef World Heritage Area, and over 300 km south of the Wet Tropics World Heritage Area.	Volume 1 Section 13 Volume 4 Appendix AA1
National Heritage places (section 15B & 15C)	No National Heritage places within or of relevance to Study Area. The Tree of Knowledge and curtilage at Barcaldine is the closest National Heritage place to the Study Area. It is located approximately 200 km west.	Volume 1 Section 13 Volume 4 Appendix AA1
Wetlands (Ramsar) (section 16 & 17B)	No Wetlands of International Significance within or of relevance to Study Area. The closest wetland of international importance (Ramsar Wetland) is the Shoalwater and Corio Bays Areas, approximately 380 km south-east of the Study Area.	Volume 1 Section 13 Volume 4 Appendix AA1
Listed threatened species and communities (sections 18 & 18a)	No EPBC Act listed threatened flora species recorded during field surveys in Study Area. One EPBC Act listed threatened fauna species (squatter pigeon (southern)) recorded during field surveys in Study Area, a further three species considered likely to occur. Constituent REs of two EPBC Act listed TECs recorded during field surveys in Study Area, only one of which is intersected by rail corridor and infrastructure and construction camp footprints.	Section 5.2.2.1
Listed migratory species (section 20 & 20A)	Two EPBC Act listed migratory species recorded during field surveys in Study Area (a further two species considered likely to occur)	Section 5.2.2.1
Great Barrier Reef Marine Park (section 24B & 24C)	Not applicable to Study Area. The eastern extent of the Study Area is located approximately 150 km due west and approximately 320 km upstream of the Great Barrier Reef Marine Park	Section 5.2.2.1 Volume 1 Section 13 Volume 4 Appendix AA1

Significance classification	Summary	Section discussed
Other Commonwealth matters		
Places on the Register of the National Estate	Two Places on the Register of the National Estate occur within 50 km of the Study Area: ◗ Epping Forest National Park ◗ Wilandspey Conservation Park	Volume 4 Appendix AA1
Listed marine Species	11 EPBC Act listed marine species recorded during field surveys in Study Area including two birds also listed as migratory under the EPBC Act. A further 11 species considered likely to occur.	Section 5.2.2.1
State		
Queensland VM Act		
Regional ecosystems	Approximately 8652 ha of REs occur in Study Area, of which 367 ha occur in the rail corridor and infrastructure and construction camp footprints (based on RE mapping), comprising: ◗ 37 ha of endangered REs ◗ 201 ha of concern REs ◗ 129 ha of least concern REs	Section 5.2.3.1
Regrowth vegetation	Approximately 396 ha of mapped regrowth vegetation occurs in the Study Area, of which 19.7 ha occur in the rail corridor and infrastructure and construction camp footprints.	Section 5.2.3.1
Essential habitat	No Essential Habitat occurs within the Study Area. Essential Habitat for three EPBC Act species and four NC Act species occurs within 50 km of the Study Area.	Volume 4 Appendix AA1
Queensland NC Act		
Threatened flora species	No NC Act listed threatened flora species recorded during field surveys in Study Area.	Section 5.4.3
Threatened fauna species	Two NC Act listed threatened fauna species were recorded during field surveys in the Study Area (little pied bat and squatter pigeon (southern)). A further three NC Act listed threatened fauna species considered likely to occur.	Section 5.4.4

Significance classification	Summary	Section discussed
Protected areas	No protected areas occur within the Project or Study Area. Eleven protected areas occur within 50 km of the Study Area: Nairana National Park; Doongmabulla Mound Springs Nature Reserve; Wilandspey Conservation (formerly Environmental) Park; Bygana West Nature Refuge; Bygana Nature Refuge; Nibbereena Creek Nature Refuge; Eaglefield Creek Nature Refuge; Mazeppa National Park; Blackwood National Park; East Top Nature Refuge; and Epping Forest National Park (scientific)	Section 5.4
Great Barrier Reef Wetland Protection Areas	A total of 107 Wetland Protection Areas, totalling an area of approximately 3176 ha, occur within 50 km of the rail and infrastructure corridor.	Volume 4 Appendix AA1
Queensland Fish Habitat Areas	No Queensland Fish Habitat Areas occur within 50 km of the Study Area.	
Special Least Concern Species	Three special least concern species recorded within the Study Area	Section 5.4
Regional		
DERM Biodiversity Planning Assessment	Summary of BPA mapping	Section 5.2.2.3
Burdekin and Fitzroy Natural Resource Management (NRM) Region Back on Track Actions for Biodiversity reports priority taxa	Burdekin: Report identifies priority vertebrate fauna taxa for the Burdekin NRM region, including: ◗ Two plants ◗ Eight vertebrate fauna Fitzroy: Report identifies priority vertebrate fauna taxa for the Fitzroy NRM region, including: ◗ Three plants ◗ Five vertebrate fauna	Section 5.2.2.3

5.2.2.1 Commonwealth Matters of Conservation Significance

Great Barrier Reef World Heritage Area and Marine Park

The eastern extent of the Study Area is located approximately 150 km due west and approximately 320 km upstream of the Great Barrier Reef World Heritage Area. Activities associated with the Project (Rail) have the potential to impact upon the water quality of streams intersected by and downstream of the project (Rail). A variety of management and mitigation measures are proposed to address this. Adopting these controlling measures it is predicted that there will not be a substantial change in water quality downstream of the site that could adversely impact on the values for which the reef is recognised. Although aquatic habitat will be lost none of the site habitats are important for species important to the values of the Great Barrier Reef World Heritage Area. No onsite habitat impacts are expected to detrimentally affect the values for which the Great Barrier Reef is recognised. No impacts associated

with the Project (Rail) are expected to result in a substantial and measurable change in the hydrological regime of the Great Barrier Reef World Heritage Area waters and, therefore, no effects on the Marine Park are predicted either. The distance from the protected area and barriers (dam etc.) would impede site conditions from having an influence, directly or indirectly, on the protected values of the Great Barrier Reef World Heritage Area or Marine Park.

Listed Threatened Flora

The desktop assessment and Project Terms of Reference (ToR) indicated that eight EPBC Act listed threatened flora species have the potential to occur within the desktop search extent encompassing the Study Area (refer Section 5.2.3.4). Of these, none were confirmed present during field surveys in the Study Area.

Listed Threatened Fauna

The desktop assessment indicated that 13 EPBC Act listed threatened fauna species have been previously recorded or predicted to occur within the desktop search extent encompassing the Study Area. One species, namely the squatter pigeon (southern), was confirmed to be present during field surveys.

A likelihood of occurrence assessment for EPBC Act listed threatened fauna species was undertaken in accordance with the assessment guidelines and three species were considered likely to occur: ornamental snake, koala, and black-throated finch (southern) (refer Section 5.2.4).

Listed Threatened Ecological Communities

Three TECs listed as endangered under the EPBC Act were identified as having potential to occur in the Study Area from desktop results. The TECs are as follows:

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (natural Grasslands)
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT)

Constituent REs of the Brigalow and Natural Grasslands TECs were identified as occurring in the Study Area from desktop and field surveys. Those REs from the Study Area associated with the Natural Grasslands TEC do not occur in the Northern Bowen Basin subregion, and thus, this TEC is not applicable to the Project (Rail). The SEVT TEC is considered unlikely to occur as none of the constituent REs are mapped within the Study Area. TECs are discussed further in Section 5.1.1.4.

Listed Migratory Species

Two EPBC Act listed migratory birds were confirmed present at the Study Area:

- Great egret (*Ardea alba*) – migratory (JAMBA[1], CAMBA), marine EPBC Act; special least concern NC Act
- Rainbow bee-eater (*Merops ornatus*) - migratory (JAMBA), marine EPBC; special least concern NC Act

[1] Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment

The great egret and rainbow bee-eater are common and widespread species (Pizzey and Knight, 2007). Habitat at the Study Area is likely to be used on a temporary to permanent basis by these species. As these species are common and widespread, and suitable habitat is likely to occur over much of the surrounding landscape, habitat at the Study Area for the great egret and rainbow bee-eater is not considered to constitute 'important habitat' as defined in the Significant Impact Guidelines (DEWHA, 2009b).

The likelihood of occurrence assessment indicated that the satin flycatcher (*Myiagra cyanoleuca*) and white-bellied sea-eagle (*Haliaeetus leucogaster*) are listed migratory species likely to occur at the Study Area, based on distribution, presence of potentially suitable habitat and previous records from the region. These migratory species are common and widespread (Pizzey and Knight, 2007), and thus the Study Area is not considered to support 'important habitat' as defined in the Significant Impact Guidelines (DEWHA, 2009c) for these birds.

Listed Marine Species

A total of 11 EPBC Act listed marine species were recorded during field surveys. This includes the great egret and rainbow bee-eater also listed as migratory. The likelihood of occurrence assessment indicated that an additional 11 marine species are likely to occur. The EPBC Act listed marine birds detected from the Study Area are widespread, common, woodland and/or wetland species, and are likely to be occur across the landscape wherever suitable habitat is available. No wetlands serving as a localised resource where marine birds would occur in high densities is present within the Study Area.

5.2.2.2 State Matters of Conservation Significance

Regional Ecosystems

A total of six Desert Uplands REs and 25 Brigalow Belt North REs are mapped within the Study Area. Of these, 18 REs (all from the Brigalow Belt bioregion), occur within the rail corridor and associated infrastructure and construction camp footprints. The mapped Brigalow Belt REs include three endangered, five of concern and 10 least concern REs (refer Section 5.2.3.1).

Six REs with an endangered biodiversity status will be intersected by the proposed rail corridor. Descriptions of these REs are detailed within Section 5.2.3.1.

Mapped Regrowth Vegetation

Mapped regrowth vegetation regulated under the VM Act within the Study Area is discussed in Section 5.2.3.1.

Listed Threatened Flora

The desktop assessment indicated that nine NC Act listed threatened flora species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Study Area or the broader Project region. Of these, none were confirmed present during field surveys in the Study Area. In addition to the species listed under the EPBC Act and discussed in Section 5.2.2.1, *Solanum adenophorum* (endangered, NC Act) is considered likely to occur within the Study Area. A further six NC Act listed threatened flora species were identified in the Project ToR for consideration in the assessment. None of these species are considered likely to occur within the Study Area. Listed threatened flora species are discussed further in Section 5.2.3.5.

Listed Threatened Fauna

The desktop assessment indicated that 16 NC Act listed threatened fauna species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Study Area. Of these, two were confirmed present during field surveys in the area:

- Squatter pigeon (southern)
- Little pied bat (*Chalinolobus picatus*)

The NC Act listed threatened species greater long-eared bat (*Nyctophilus timoriensis*) was identified in the Project ToR for consideration. The greater long-eared bat was predicted to occur and was potentially recorded during field surveys but a positive identification to species level was unable to be made. While the species distribution incorporates the Study Area, and suitable habitat is present within the Study Area (within riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey and in Eucalypt open woodland with native grass understorey), it is considered only that the species may occur.

In addition to the ornamental snake and black-throated finch (discussed in Section 5.2.2.1), the following NC Act listed threatened fauna species are considered likely to occur at the Study Area, based on distribution, previous records and habitat suitability:

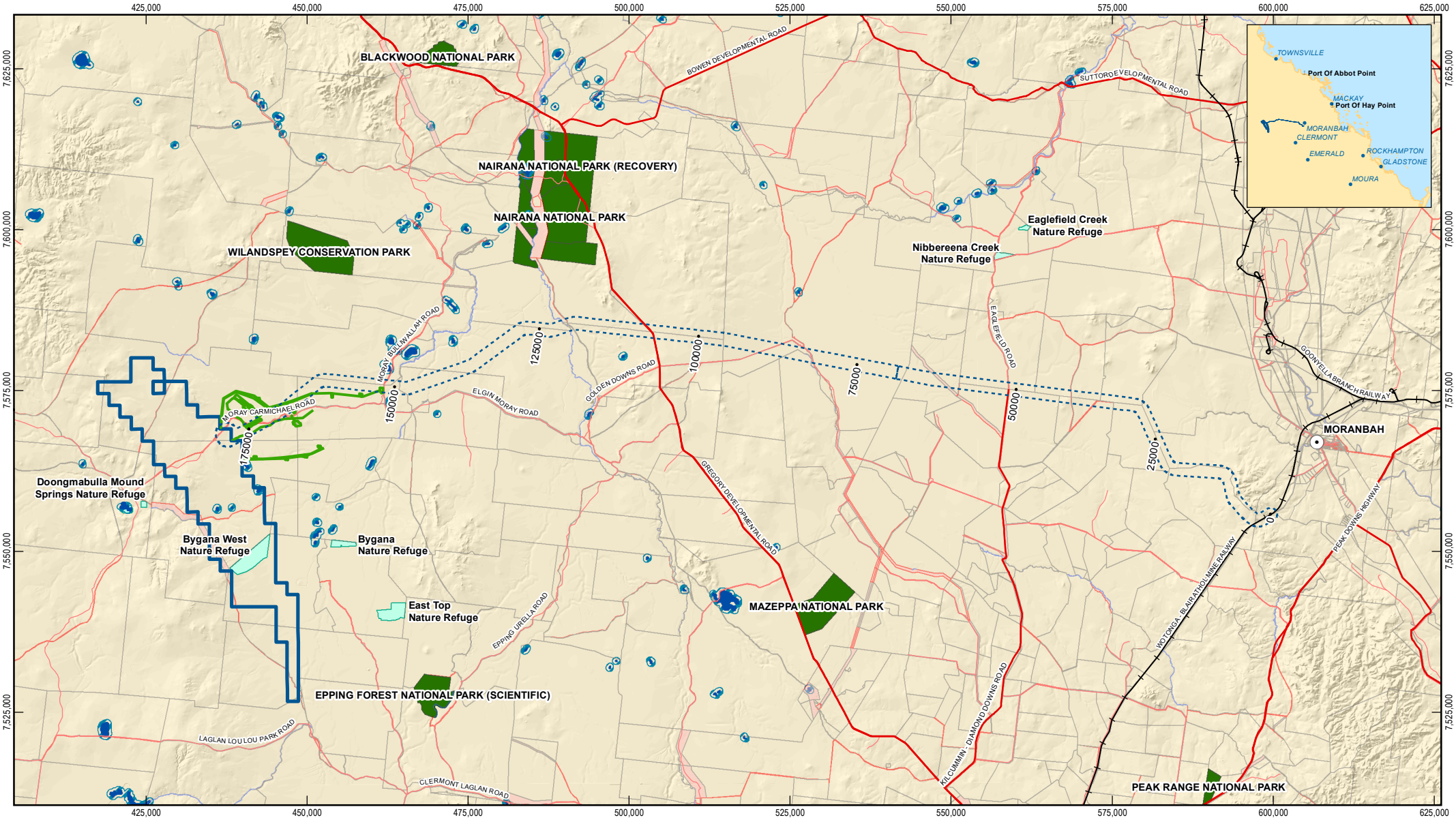
- Black-necked stork (*Ephippiorhynchus asiaticus*)
- Grey falcon *(Falco hypoleucos*)
- Cotton pygmy-goose (*Nettapus coromandelianus*)

Information regarding these species and their habitat availability within the Study Area is provided in Section 5.2.4.

Protected Areas

Eleven protected areas occur within 50 km of the Study Area boundary as listed in Table 5-4 and shown on Figure 5-3:

- Nairana National Park (10 km north)
- Doongmabulla Mound Springs Nature Reserve (14 km south-west)
- Wilandspey Conservation (formerly Environmental) Park (17 km north-east)
- Bygana West Nature Refuge (17 km south)
- Bygana Nature Refuge (23 km south)
- Nibbereena Creek Nature Refuge (20 km north)
- Eaglefield Creek Nature Refuge (25 km north)
- Mazeppa National Park (37 km south)
- Blackwood National Park (25 km north)
- East Top Nature Refuge (35 km south)
- Epping Forest National Park (scientific) (48 km south)



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- National Park
- Great Barrier Reef Wetland Protection Area
- Great Barrier Reef Wetland Protection Trigger Area
- Nature Refuge

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Great Barrier Reef Wetland Protetions Areas and Other Protected Areas within and adjacent to the Study Area

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Figure 5-3

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Data source: DERM: DEM (2008), DCDB (2010), GBR Wetland Protection Areas (2010), Nature Refuge (2010), National Park (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: JB, CA

Special Least Concern Species

Special least concern species under the NC Act includes the koala , echidna (*Tachyglossus aculeatus)*, platypus (*Ornithorhynchus anatinus*) and migratory least concern birds listed under JAMBA, CAMBA, and/or Bonn conventions.

Evidence of echidna was noted from the central part of the alignment in the September surveys. The echidna is a widespread, common, generalist species and is likely to occur across much of the Study Area where remnant vegetation is present.

No evidence of the koala was detected from the field surveys however the koala has been previously recorded in the region and has been recently identified within riparian vegetation along watercourses intersected by the Project (H. Jones *pers.comm* 07/09/2011). Potential habitat for the koala is considered to be open eucalypt woodland habitat and mature riparian woodland fringing watercourses.

Suitable habitat for the platypus is lacking across the Study Area. Watercourses within the Study Area are considered to be too ephemeral to support this species.

The great egret and rainbow bee-eater are migratory species under JAMBA and CAMBA, respectively. These species are special least concern migratory birds under the NC Act and considered likely to occur at the Study Area.

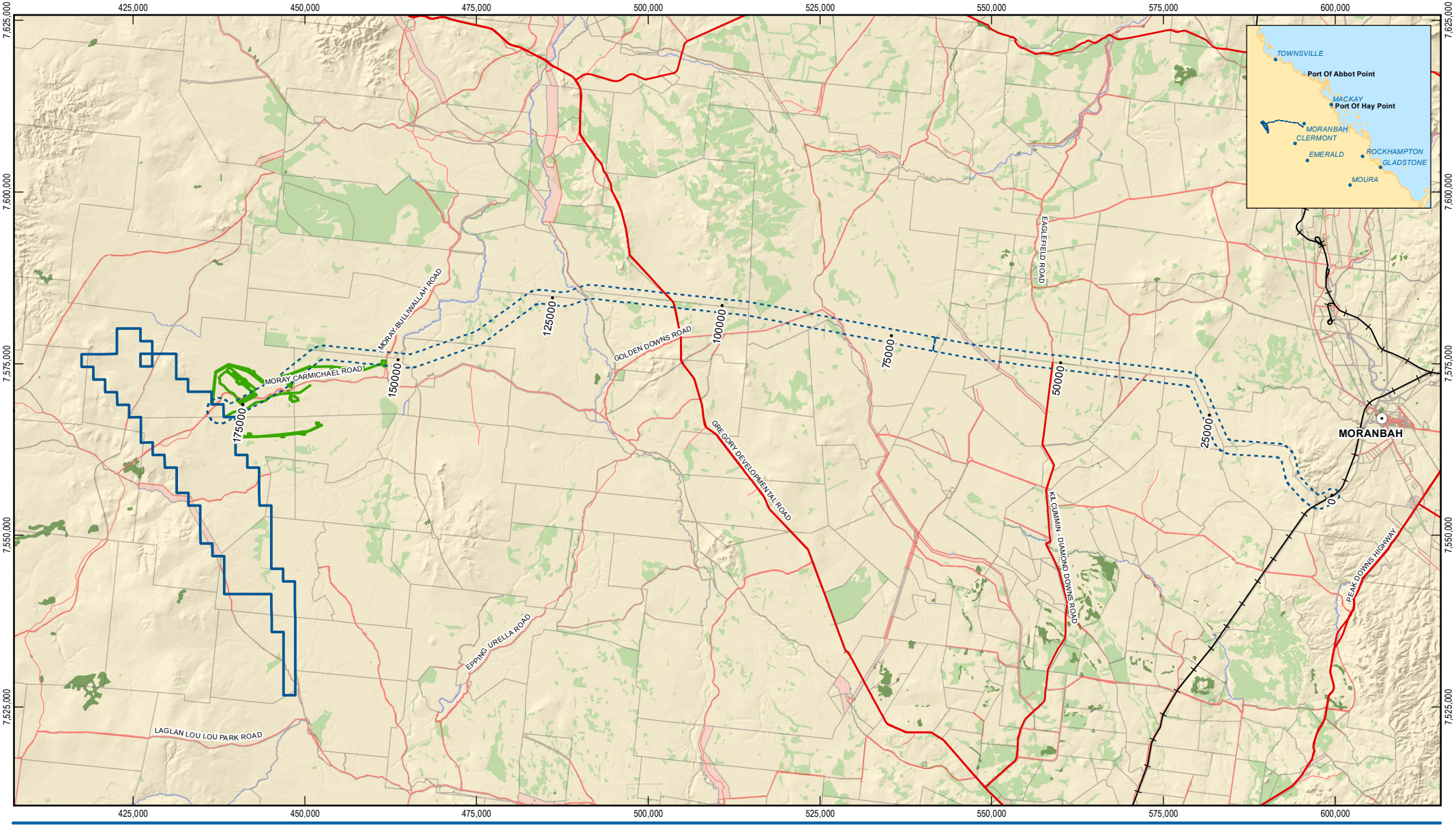
5.2.2.3 Regional Matters of Conservation Significance

DERM Biodiversity Planning Assessment Mapping

Three BPA mapping criteria were applied to the Study Area and surrounding landscape:

The criteria applied include:

- Criterion B2 – Ecosystem value at regional scale. Figure 5-4 shows a number of remnant vegetation patches considered to be regionally significant with respect to biodiversity value occur in the landscape around the Study Area. These areas typically correspond with of concern and endangered RE, particularly in association with the Belyando River and areas of remnant vegetation to the north and south of the Study Area. Several small patches occur within the Study Area.
- Criterion F – Ecosystem diversity. All of the remnant vegetation within the Study Area is categorised as having very high or high ecosystem diversity (Figure 5-5). Much of the landscape to the north, west and south of the Study Area is similarly ranked. Remnant vegetation coverage is patchy and fragmented across the majority of the Study Area, particularly in the east. However remnant vegetation ranked as having very high or high ecosystem diversity does form important east to west linkages from the Belyando River through to intact remnant vegetation north, south and west of the Belyando River flood plain. Further, very high or high ecosystem diversity linkages (between the north and the south of the wider landscape adjacent to the Study Area) occur associated with Logan and Diamond Creeks in the western half of the Study Area.
- Criterion G – Context and connection. Where it intersects with patches of remnant vegetation, the Study Area is mapped as a mixture of both high and very high as shown in Figure 5-6. Very high areas of mapped remnant vegetation are mapped largely uninterrupted to the north-west and south-west of the western extent of the Study Area and to the north-east and south-east of the eastern extent of the Study Area, whilst to the west it is more fragmented. Immediately to the south and north of the Study Area large tracts of non-remnant vegetation are present and are thus not mapped under this criterion.



1:750,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Biodiversity Planning Assessment - Criteria B2 Ecosystem Value at Regional Level
  - Very High
  - High

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Biodiversity Planning Assessment - Criteria B2
Ecosystem Value at Regional Level

Figure 5-4

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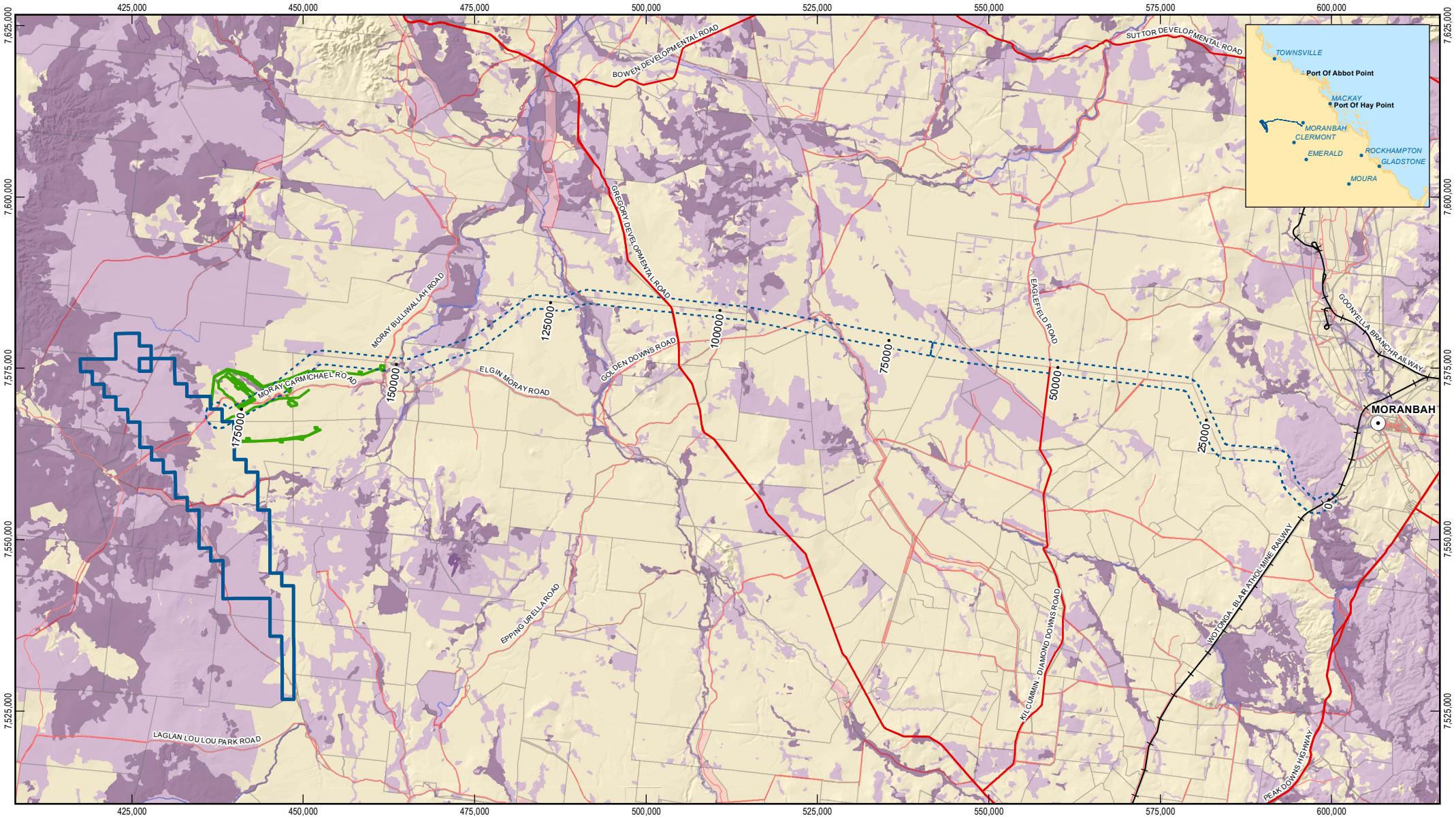
Data source: DERM: Biodiversity Planning Assessment (2010), DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Biodiversity Planning Assessment - Criteria F Ecosystem Diversity
  - Very High
  - High

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Biodiversity Planning Assessment - Criteria F
Ecosystem Diversity

Figure 5-5

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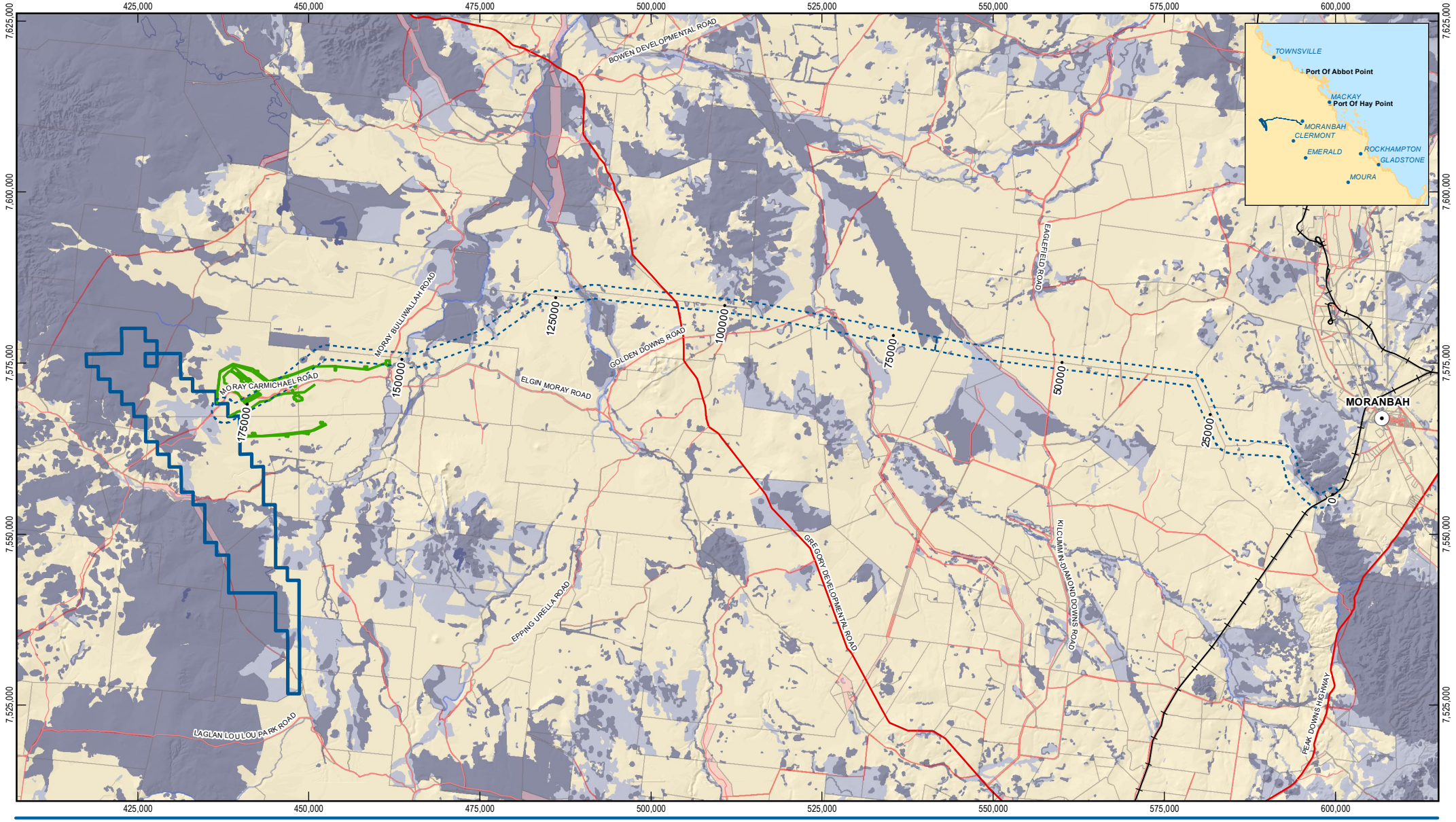
Data source: DERM: Biodiversity Planning Assessment (2010), DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve

Biodiversity Planning Assessment - Criteria G -Context and Connection

- Very High
- High

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Biodiversity Planning Assessment - Criteria G Context and Connection

Figure 5-6

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Data source: DERM: Biodiversity Planning Assessment (2010), DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA

Biodiversity Planning Assessment Expert Panel Reports

Two expert panel reports have relevance to the Study Area and findings have been considered in the assessment:

- Brigalow Belt North Landscape Expert Panel Report (EPA, 2008)
- Desert Uplands Flora, Fauna and Landscape Expert Panel Report (EPA, 2005) ('DEU report')

Burdekin and Fitzroy Natural Resource Management Regions Priority Taxa

The Burdekin and the Fitzroy NRM 'Back on Track Actions for Biodiversity' reports (the 'Back on Track report') (DERM, 2010a and 2010b) identify priority species in the Burdekin and the Fitzroy NRM regions, detail the regional threatening processes impacting upon these species, and propose a range of actions to address regional threats. Two priority plant species and eight priority vertebrate fauna species listed in the Burdekin Back on Track report have been historically recorded in the desktop search extent or the broader region for the Study Area. None of these species were recorded during field surveys at the Study Area. Three priority plant species and five priority vertebrate fauna species listed in the Fitzroy Back on Track report have been historically recorded in the desktop search extent or the broader region for the Study Area. None of these species were recorded during field surveys at the Study Area. Of the species listed in the two NRM Back on Track reports, four species were considered likely to occur, *Solanum adenophorum*, ornamental snake, yakka skink and black-throated finch (southern).

5.2.3 Terrestrial Flora

5.2.3.1 Regional Ecosystems

The majority of vegetation within the Study Area and the Project area is non-remnant, open cleared land with low native species diversity and cover and a high occurrence of weed species. REs cover approximately 20 per cent of the rail corridor and associated infrastructure and construction camp footprints and occur as fragmented patches in what is a predominantly cleared landscape. Within the Project (Rail) area mapped REs comprise in the order of 366 ha.

A total of 12 Brigalow Belt REs are mapped within the rail corridor and associated infrastructure and construction camp footprints as described in Table 5-5 and shown in Figure 5-7. The mapped Brigalow Belt REs include three endangered, five of concern and 10 least concern REs. The results of the flora and vegetation surveys indicated some inaccuracies in the mapped REs. Due to field survey limitations, a full comprehensive assessment of RE mapping inaccuracies was not able to be obtained. Further site assessments within the Project (Rail) corridor were undertaken subsequent to the May 2011 and September 2011 surveys. The objective of the site assessments was to map and define vegetation within the rail corridor into categories defined by the Queensland Herbarium in order to support the requirements of a properly made Property Map of Assessable Vegetation (PMAV) submission. Volume 4, Appendix AA2 and Appendix AA3 provide details.

Several patches of regulated regrowth vegetation occur within the Study Area, totalling 395.5 ha, with approximately 19 ha of regulated regrowth vegetation occurring in the rail corridor and associated infrastructure and construction camp footprints. This regulated regrowth comprises least concern (1.5 ha), of concern (6.6 ha) and endangered (11.6 ha) regrowth REs.

A large area of relatively intact remnant vegetation occurs to the west of the Study Area beyond where the Project (Rail) corridor enters the proposed Carmichael mine site EPC (1690) and extends in all directions, maintaining remnant coverage for some distance beyond the Project (Rail). The eastern

extent of the rail alignment also intersects with a relatively contiguous area of intact remnant vegetation associated with Peak Downs National Park which extends to the north and south of the Study Area.

Mapped remnant vegetation fringing the Belyando River and its tributaries forms a slightly fragmented north-south network of regionally interconnected habitat in the western extent of the Study Area. The landscape east of the Gregory Developmental Road is more fragmented and almost entirely devoid of remnant vegetation in some areas. Narrow bands of native remnant vegetation fringe Logan Creek and Diamond Creek (tributaries of Suttor River) which both cross the Study Area in a north-south direction. Each of these riparian corridors is likely to facilitate north-south movement of fauna within the wider landscape of the Study Area

Table 5-5 Regional Ecosystem Descriptions

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (inc. area (in ha) in rail corridor and infrastructure and construction camp footprints)
Brigalow Belt North Res				
11.3.1	endangered/ endangered	Associated soils are predominantly deep to very deep cracking clays, sometimes with gilgai or texture contrast soils with sandy surface (particularly where Eucalyptus populnea is present).	Open-forest dominated by *Acacia harpophylla* and/or *Casuarina cristata* (particularly in southern parts), with or without scattered emergent *Eucalyptus* spp. such as *E. coolabah*, *E. largiflorens, E. populnea, E. orgadophila,* and *E. woollsiana*. A low tree layer dominated by *Geijera parviflora* and *Eremophila mitchellii* is usually present. The vegetation sometimes occurs as low open-forest or woodland. Tree height generally about 11-15 m and the low tree (to tall shrub) understorey layer is between 2 and 8 m high (where present). Ground cover is generally sparse. Associated with Cainozoic alluvial plains which may be occasionally flooded. Landforms range from level to very gently sloping plains, alluvial flats, drainage floors, back-swamps and abandoned channels.	Present in small patches and along watercourses (North Creek, Mistake Creek, Grosvenor Creek, and Logan Creek) with gidgee and eucalypt communities, on alluvial plains associated with the Belyando River One site was assessed and was found to be dominated by Reid river box. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. Approximately 11 ha occur within the rail corridor.
11.3.3	of concern/ of concern	Occurs on Cainozoic alluvial plains or levees with clay or sometimes texture contrast soils.	*Eucalyptus coolabah* woodland to open-woodland with a grassy understorey. A mid layer is often absent but scattered tree or shrub species, such as *E. populnea, Melaleuca bracteata, Alectryon oleifolius, Terminalia oblongata* (in the north) and *Acacia pendula, A. cambagei,* and occasionally *Muehlenbeckia florulenta* may be present. The ground layer is dominated by a range of grass and forb species depending on season, soil and management conditions. Can include small areas of grassland with scattered trees.	Occurs in association with watercourses including Belyando River, Mistake Creek and Sullivan Creek. Other vegetation communities with which it exists include brigalow and gidgee woodlands, Reid river box and river red gum and forest red gum (when in mixed polygons fringing watercourses). This RE was the most comprehensively assessed across the Study Area and confirmed consistent with the certified mapping. Approximately 45.4 ha occur within the rail corridor. Approximately 1.2 ha occur within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (inc. area (in ha) in rail corridor and infrastructure and construction camp footprints)
11.3.5	least concern/ of concern	Occurs on levees on alluvial plains which are rarely flooded. Associated soils are often texture contrast with sandy surfaces	*Acacia cambagei +/- A. harpophylla low* woodland or open-forest sometimes clumped, on Cainozoic alluvial plains. *Acacia cambagei* dominates the canopy (8-16 m high) sometimes in association with *A. harpophylla* as a sub-dominant. *Eucalyptus coolabah, E. largiflorens* (subregion 35) or *Acacia harpophylla* may be present. Often *Eremophila mitchellii* is present as an open low tree layer (1.5-4 m high) or as scattered shrubs to small trees. *Psydrax oleifolia* and *Atalaya hemiglauca* are occasionally present. A small shrub layer sometimes occurs dominated by *Senna artemisioides* with or without suckers of *Acacia cambagei* or both species may occur as scattered shrubs. The ground layer is often poorly formed except under the canopy where there is usually a very sparse cover of dominants which include *Paspalidium caespitosum, Sporobolus actinocladus* and *Brachyachne convergens*. Other graminoids frequently present are *Bothriochloa ewartiana, Iseilema vaginiflorum, Eragrostis microcarpa* and *Aristida latifolia*.	Occurs adjacent to Belyando River and Mistake Creek and across the alluvium associated with these watercourses. Associated species include coolabah and Reid river gum. Sites were assessed within this RE which verified the presence of characteristic species (brigalow and gidgee) in small patches within mixed polygons. Approximately 20.4 ha occur within the rail corridor.
11.3.7	least concern/ of concern	Occurs on levees and plains formed from Quaternary alluvial deposits. Soils are usually deep uniform sands with minor areas of sandy red earths.	*Corymbia clarksoniana, C. tessellaris* and *C. dallachiana* tall woodland to open-woodland (12-17 m high). There is usually a low open-woodland tree layer (7-11 m high) dominated by species such as *Acacia salicina, Lysiphyllum hookeri* or *Grevillea striata*.	Present as two large mixed polygons in the western section of the Study Area. Coolabah was found to be the dominant species. Assessed and verified as 11.3.7, though coolabah was dominant in areas. Approximately 5.6 ha occur within the rail corridor.
11.3.10	least concern/ no concern at present	Occurs on Cainozoic alluvial plains.	*Eucalyptus brownii* grassy woodland. This unit usually occurs as a woodland of *Eucalyptus brownii*. There is usually a grassy ground layer of *Aristida* spp., *Chloris* spp., *Fimbristylis dichotoma, Eriachne* spp., *Eragrostis* spp. and *Chrysopogon fallax*. Areas subject to less intensive grazing or on better soils contain *Heteropogon contortus, Bothriochloa bladhii* and *Chrysopogon fallax*.	Occurs within alluvium associated with Belyando River and Mistake Creek. Associated vegetation communities include acacia woodlands and open forests and coolabah open woodlands. Some sites within this RE at the western extent of the Study Area were assessed and found to be consistent with the certified RE mapping. Approximately 10.0 ha occur within the rail corridor.

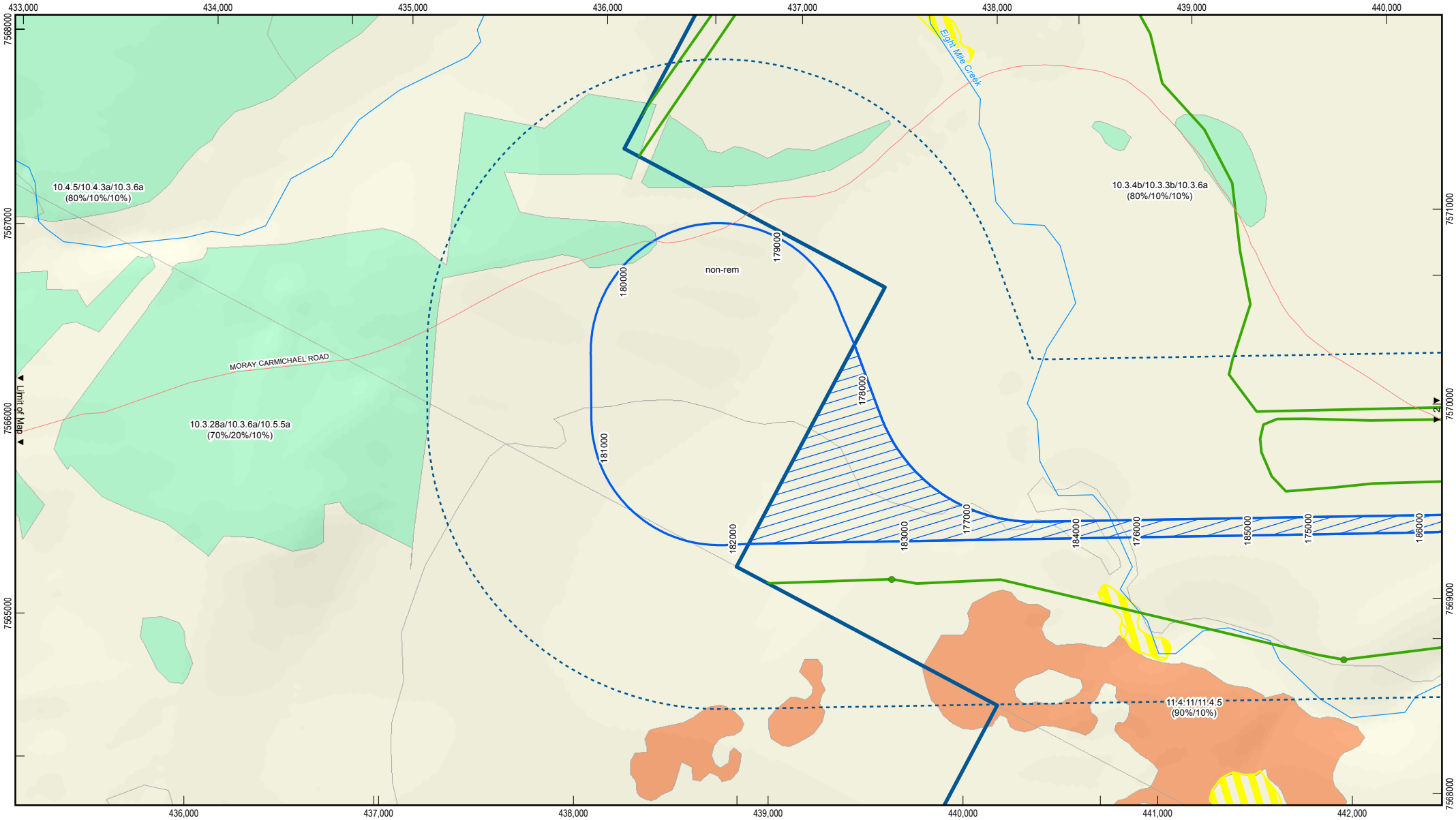
RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (inc. area (in ha) in rail corridor and infrastructure and construction camp footprints)
11.3.25	least concern/ of concern	Occurs on fringing levees and banks of major rivers and drainage lines of alluvial plains throughout the region. Soils are very deep, alluvial, grey and brown cracking clays with or without some texture contrast. These are usually moderately deep to deep, soft or firm, acid, neutral or alkaline brown sands, loams or black cracking or non-cracking clays, and may be sodic at depth (Burgess 2003).	*Eucalyptus camaldulensis* or *E. tereticornis* open-forest to woodland. Other tree species such as *Casuarina cunninghamiana, E. coolabah, Melaleuca bracteata, Melaleuca viminalis, Livistona* spp. (in north), *Melaleuca* spp. and *Angophora floribunda* are commonly present and may be locally dominant. An open to sparse, tall shrub layer is frequently present dominated by species including *Acacia salicina, A. stenophylla* or *Lysiphyllum carronii*. Low shrubs are present, but rarely form a conspicuous layer. The ground layer is open to sparse and dominated by perennial grasses, sedges or forbs such as *Imperata cylindrica, Bothriochloa bladhii, B. ewartiana, Chrysopogon fallax, Cyperus dactylotes, C. difformis, C. exaltatus, C. gracilis, C. iria, C. rigidellus, C. victoriensis, Dichanthium sericeum, Leptochloa digitata, Lomandra longifolia* or *Panicum* spp.	Present as fringing woodland along watercourses, including Belyando River, Mistake Creek, Grosvenor Creek and other minor watercourses. Often associated with coolabah and brigalow. Assessed at Mistake Creek and Belyando River. Approximately 9.8 ha occur within the rail corridor. Approximately 0.5 ha occurs within the infrastructure footprint.
11.3.37	least concern/ no concern at present	Occurs on fringing stream channels, usually braided. Soils are bed loads of clay or silt with cobbles and boulders in some areas. Predominantly western sub-regions of the Brigalow Belt North, for example the Suttor River catchment.	*Eucalyptus coolabah* with *Eucalyptus camaldulensis* form a distinct but discontinuous woodland to low woodland canopy layer (7-11 m high). Other scattered trees such as *Lysiphyllum gilvum, Melaleuca trichostachya, Melaleuca bracteata* and *Eucalyptus populnea* may occur. The mid layer varies from absent to a tall shrubland dominated by species such as *Acacia stenophylla* and *Acacia salicina*. Ground cover is variable composed of grasses and sedges. Includes larger waterholes within the stream channels.	Present as fringing woodland along watercourses, including Belyando River, Mistake Creek and Grosvenor Creek and is often associated with brigalow. Assessed at Mistake Creek and Belyando River. Approximately 2.2 ha occur within the rail corridor.
11.4.4	least concern/ of concern	Occurs on flat to gently undulating clay plains formed from Cainozoic or weathered basalt unconsolidated sediments. Soils are generally moderately to deep to very deep dark grey self-mulching cracking clays with linear gilgai. Gravel or stone may be present in some areas.	Tussock grassland dominated by *Dichanthium* spp. +/- *Astrebla* spp. (mainly *A. lappacea* and *A. pectinata).* Other grasses frequently present include *Thellungia advena, Panicum* spp. and *Aristida* spp. Forbs and annual grasses may become common with seasonal rains. Occasional shrubs and trees may be present in places.	Occurs in a single large expanse of remnant vegetation mapped as grassland at the centre of the Study Area. Part of the EPBC Act Threatened Ecological Community 'Natural Grasslands'. This RE was not assessed during field surveys. Approximately 8.8 ha occur within the rail corridor.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (inc. area (in ha) in rail corridor and infrastructure and construction camp footprints)
11.4.5	of concern/ endangered	Occurs on flat to gently undulating plains formed from unconsolidated Cainozoic deposits.	*Acacia argyrodendron* dominates the very sparse canopy (12-16 m high). There are usually scattered small trees (6-10 m high) including *A. argyrodendron, Terminalia oblongata, Owenia acidula, Lysiphyllum carronii* and *Eremophila mitchellii*. Grasses usually dominate the very sparse to mid-dense ground layer. *Dichanthium sericeum, Panicum decompositum* and *Aristida latifolia* can also be dominants.	Occurs in relatively large and intact areas of remnant vegetation, often in association with gidgee, and also coolabah. Occurs in association with grasslands south-west of North Creek at the western extent of the Study Area. One site within this RE was assessed and verified in the field. Approximately 2.9 ha occur within the rail corridor. Approximately 0.6 ha occurs within the infrastructure footprint.
11.4.6	of concern/ endangered	Occurs on gently undulating plains formed from Cainozoic sediments. Associated soils are texture contrast with thin sandy or loamy surface horizons and strongly alkaline clay subsoils.	*Acacia cambagei* dominates the tree canopy (10-13 m high). There is a sparse to open low tree layer (7-9 m high) dominated by *Lysiphyllum carronii, Geijera parviflora, Acacia harpophylla*, and sometimes *A. argyrodendron, Terminalia oblongata,* and *Eremophila mitchellii*. An open shrub layer (1 m high) dominated by species such as *Carissa ovata, Capparis lasiantha, Eremophila deserti, Apophyllum anomalum* and *Alectryon diversifolius* is also often present. The ground layer is sparse to open and dominated by grasses.	Present across much of the Study Area in small isolated patches on its own, and large and relatively continuous remnant patches in mixed polygon. Often associated with brigalow, blackwood, Dawson's gum and coolabah. Few sites within this RE were assessed and verified in the field. Approximately 20.4 ha occur within the rail corridor. Approximately 0.3 ha occurs within the infrastructure footprint.
11.4.8	endangered/ endangered	Occurs on level to gently undulating plains formed from Cainozoic deposits. Associated soils are usually deep texture contrast with thin loamy or sandy surface horizons overlying strongly alkaline clay subsoils. Surface or subsurface gravel is common	Woodland to open-forest dominated by *Eucalyptus cambageana* and *Acacia harpophylla* or, sometimes in the north, *A. argyrodendron. E. thozetiana* is sometimes present on shallower soils. There is a moderately dense low tree layer (5 m high) layer dominated by species such as *Eremophila mitchellii* and a low shrub layer (2 m high) dominated by species such as *Carissa ovata* and *Geijera parviflora..*	Occurs across the entire extent of the Study Area in small to large and continuous remnant vegetation patches. Often associated with eucalypt species, gidgee and blackwood. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. Several sites were assessed and verified as 11.4.8, specifically in the eastern section of the Study Area. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. Approximately 2.5 ha occur within the rail corridor. Approximately 0.01 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (inc. area (in ha) in rail corridor and infrastructure and construction camp footprints)
11.4.9	endangered/ endangered	Occurs on level to gently undulating Cainozoic plains, including weathered basalt. Associated soils are predominantly moderately deep to deep cracking clays that may be brown, red-brown or grey-brown, and with much surface gravel in some areas.	Open-forest, occasionally woodland, dominated by *Acacia harpophylla* usually with a low tree mid-storey of *Terminalia oblongata* and *Eremophila mitchellii*. *Casuarina cristata* sometimes replaces *Acacia harpophylla* in the overstorey and *Lysiphyllum cunninghamii* sometimes co-dominates. Other low tree or shrub species such as *Alectryon diversifolius, Carissa ovata, Pittosporum spinescens, Ehretia membranifolia, Geijera parviflora* and *Flindersia dissosperma* may occur in the mid-storey or low shrub layer. *Acacia harpophylla* trees have been recorded as 11- 17 m high, the mid-storey layer 2- 8 m high and the low shrub layer 1-2 m high.	Occurs across the entire extent of the Study Area in small to large and continuous remnant vegetation patches. Often associated with eucalypt species, gidgee and blackwood. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. One site within this RE was assessed and verified in the field. Approximately 14.8 ha occur within the rail corridor. Approximately 4.4 ha occur within the infrastructure footprint and approximately 4.6 ha occur within construction camp areas.
11.4.11	of concern/ of concern	Occurs in shallow open valleys and poorly drained Cainozoic clay plains with deep cracking clay soils.	*Dichanthium sericeum* and *Astrebla* spp. grassland with patches of low *Acacia harpophylla* or *Eucalyptus coolabah*. Grassland dominated by *Dichanthium sericeum* and forms a mosaic with clumps of *Acacia harpophylla, Lysiphyllum hookeri* and *L. carronii* (usually 8+/-3 m high). A wide range of other grass and forb species is usually present and may dominant depending on seasonal conditions and management regime. Frequently occurring species include the grasses *Aristida leptopoda, A. latifolia, Astrebla lappacea, Bothriochloa erianthoides, Digitaria brownii, D. divaricatissima, Eriochloa crebra, Panicum decompositum, P. queenslandicum, Paspalidium globoideum* and the forbs *Abelmoschus ficulneus, Boerhavia dominii, Corchorus trilocularis, Cyperus bifax, Glycine latifolia, Hibiscus trionum* var. *vesicarius, Ipomoea lonchophylla, Phyllanthus maderaspatensis, Tribulus micrococcus* and *Rhynchosia minima.*	Present commonly in association with acacia open woodlands and open forests. Patches are often large and/or attached to large tracts of remnant vegetation and occur predominantly in the eastern half of the Study Area. Part of the EPBC Act Threatened Ecological Community 'Natural Grasslands'. Assessments of this RE were undertaken at two locations where brigalow and gidgee were present and often dominant. Wet season surveys will be undertaken to determine the presence of natural grasslands, particularly in the western section of the Study Area, just west of Belyando River. Approximately 120.4 ha occur within the rail corridor. Approximately 7.8 ha occur within the infrastructure footprint.
11.5.3	least concern/ no concern at present	Occurs on flat to gently undulating plains formed from Cainozoic sediments. Associated soils are generally deep texture contrast with thick sandy surface horizons with some deep red earths.	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana +/- C. dallachiana* and occasionally *E. cambageana* or *E. brownii* dominate the tree layer (14 m median height and 11-15 m range) woodland. Localised areas may be dominated by *E. melanophloia*, occasionally *E. crebra* and other canopy species. There is generally a distinctive low tree layer (8, 6-11 m high) dominated by species such as *Eremophila mitchellii, Geijera parviflora, Archidendropsis basaltica, Erythroxylum australe, Cassia brewsteri, Ventilago viminalis* and occasionally *Allocasuarina luehmannii* or *Callitris glaucophylla*. A low shrub layer (2-6 m high) dominated by species such as *Carissa ovata, Erythroxylum australe, Capparis lasiantha* is also often present.	Present at the western extent of the Study Area commonly associated with 11.5.9c (*Eucalyptus* spp. woodland). Also present along adjacent to and above two minor watercourses near Moranbah where it is associated with river red gum and forest red gum. This RE was not assessed during field surveys. Approximately 37.6 ha occur within the rail corridor. Approximately 3.1 ha occur within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (inc. area (in ha) in rail corridor and infrastructure and construction camp footprints)
11.5.9c	least concern/ no concern at present	Occurs on plateaus and broad crests of hills and ranges which are formed by Cainozoic sandplains. Soils are generally deep red earths.	*Eucalyptus crebra* and/or *Eucalyptus melanophloia* woodland. Other tree species that may be present and locally dominant include *Corymbia citriodora* or *C. clarksoniana* sometimes in association with *C. intermedia, C. dallachiana, C. lamprophylla, E. tenuipes, E. exserta, E. cloeziana, E. acmenoides.* The mid layer ranges from absent to a sparse to dense shrubland typically dominated by Acacia spp. (such as *A. excelsa, A. leiocalyx), Petalostigma pubescens, Lysicarpus angustifolius, Alphitonia excelsa* and occasionally *Melaleuca nervosa* (on texture contrast soils).	Occurs as small mixed polygons associated with a range of communities as well as on its own adjacent to large areas of remnant vegetation in the eastern section of the Study Area near Moranbah. Present near two minor watercourses near Moranbah where it is associated with riparian vegetation, including river red gum and forest red gum. This RE was not assessed during field surveys. Approximately 27.1 ha occur within the rail corridor. Approximately 0.7 ha occur within the infrastructure footprint.
11.7.2	least concern/ no concern at present	Occurs on scarps and adjacent tops and slopes of dissected tablelands, mesas and buttes formed from chemically altered sediments and duricrusts. The soils are shallow to very shallow lithosols with surface stone and boulders. The vegetation is often growing in pockets of shallow lithosol soil between bare rock.	Monospecific stands of *Acacia* spp. forest/woodland on Cainozoic lateritic duricrusts. *Acacia shirleyi* and or *Acacia catenulata* usually predominate the woodland to low woodland to low open-forest tree canopy (7-12 m high). Other *Acacia* spp. that commonly occur and occasionally dominate the tree layer include *A. rhodoxylon, A. burrowii, A. sparsiflora, A. crassa* and *A. blakei*. Emergent eucalypt species such as *Eucalyptus thozetiana, E. crebra, E. decorticans* and *E. exserta* may be present. A low shrub layer is sometimes present and dominated by species such as *Acalypha eremorum, Croton phebalioides* and *Carissa ovata*. The ground layer is extremely sparse and dominated by grasses such as *Aristida caput-medusae, Paspalidium rarum, Urochloa foliosa*. Forbs are usually rare although *Sida filiformis* may be conspicuous.	Present in small isolated remnant patches and in mixed polygons adjacent to natural grasslands in the central section of the Study Area. Occurs with other vegetation communities dominated by Dawson's gum, *Eucalyptus persistens* and brigalow. This RE was not assessed during field surveys. Approximately 1.4 ha occur within the rail corridor. Approximately 0.2 ha occur within the infrastructure footprint.
11.9.10	of concern/ endangered	Occurs on Cainozoic to Proterozoic consolidated, fine-grained sediments. Occurs on lower parts of undulating plains often with deep texture-contrast soils. Occurs on sodic and saline soils which may act as a discharge area if adjacent to alluvium.	*Eucalyptus populnea* predominates forming a distinct but discontinuous canopy (15-18 m tall). *Acacia harpophylla* and sometimes *Casuarina cristata* usually forms a lower tree layer (8-14 m tall) which occasionally becomes the dominant layer. An open to moderately dense layer of tall shrubs is usually present and dominated by *Eremophila mitchellii* and *Geijera parviflora* with *Acacia excelsa, Atalaya hemiglauca, Psydrax oleifolia, Alectryon oleifolius* frequent. Scattered low shrubs such as *Carissa ovata* and *Eremophila deserti* are frequently present. The ground cover is usually sparse, and dominated by the grasses *Aristida ramosa, Enteropogon acicularis, Bothriochloa decipiens* and *Paspalidium* spp.	Present near the centre of the Study Area as both homogeneous and mixed polygons. Where mixed polygons occur this community is associated with Dawson's gum and brigalow. This RE was not assessed during field surveys. Approximately 1.4 ha occur within the rail corridor.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (inc. area (in ha) in rail corridor and infrastructure and construction camp footprints)
11.10.3	least concern/ no concern at present	Occurs on crests and ridge tops formed on consolidated, medium to coarse-grained sediments.	*Acacia catenulata* and/or *A. shirleyi* form a distinct but discontinuous low open-forest to open-forest canopy (8-12, rarely 18 m high). Other *Acacia* spp. such as *A. sparsiflora* and *A. rhodoxylon* may form part of the canopy and in places may predominate. Scattered *Eucalyptus* spp. emergents (up to 25 m high) occur, the most frequent being *E. decorticans. Eucalyptus exserta* is conspicuous in places. Scattered tall shrubs may occur. A low shrubby layer is usually conspicuous. The ground layer is sparse and composed of both grasses and forbs.	Present as a homogeneous polygon and a mixed polygon with spotted gum communities in the western-most extent of the Study Area, near Moranbah. This RE was not assessed during field surveys. Approximately 0.7 ha occur within the rail corridor. Approximately 0.4 ha occur within the infrastructure footprint.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- State Road
- Local Road
- Watercourse
- Other Railway
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- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
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Regional Ecosystems v6.1

- Endangered - Dominant
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Carmichael Coal Mine and Rail Project

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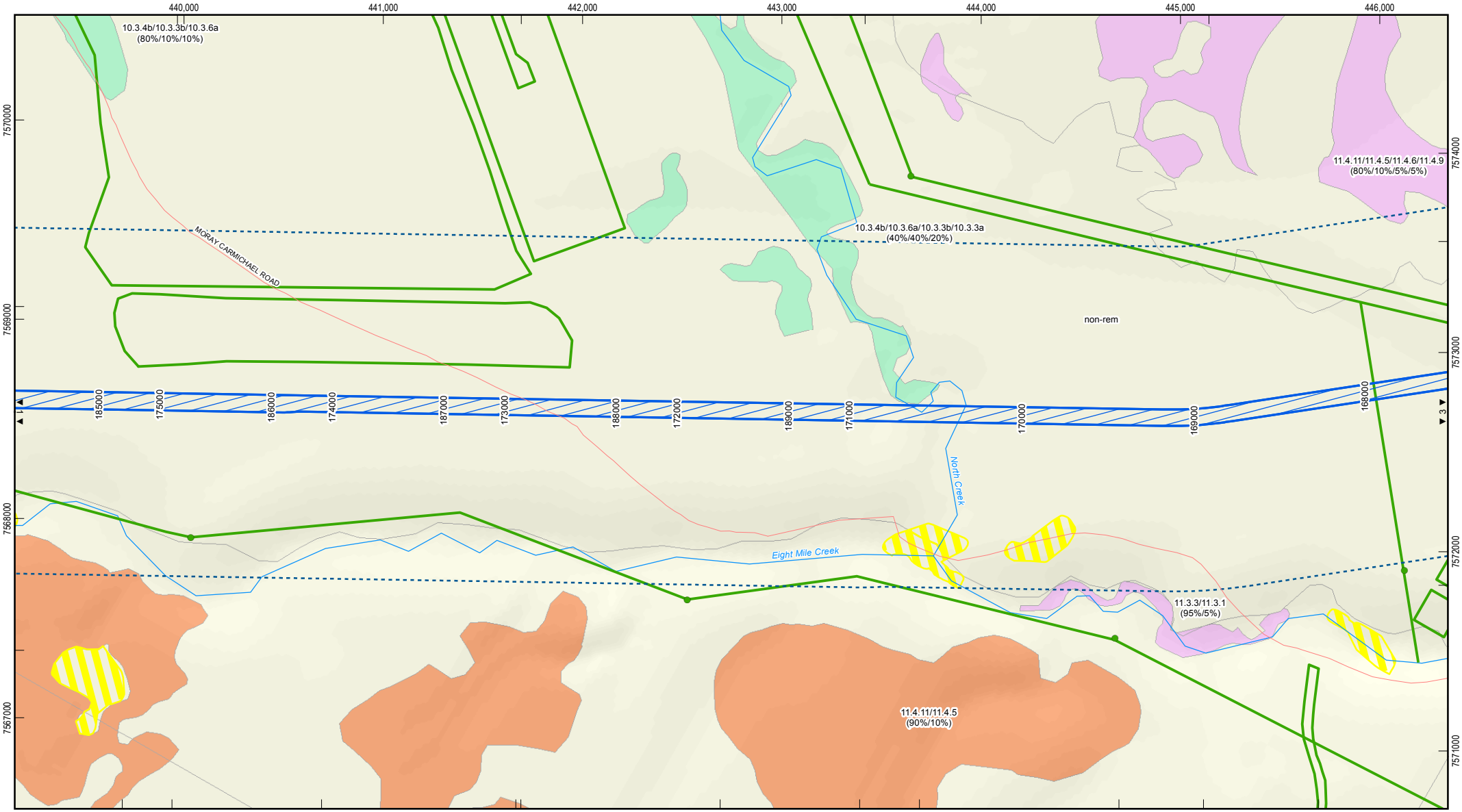

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Carmichael Coal Mine and Rail Project

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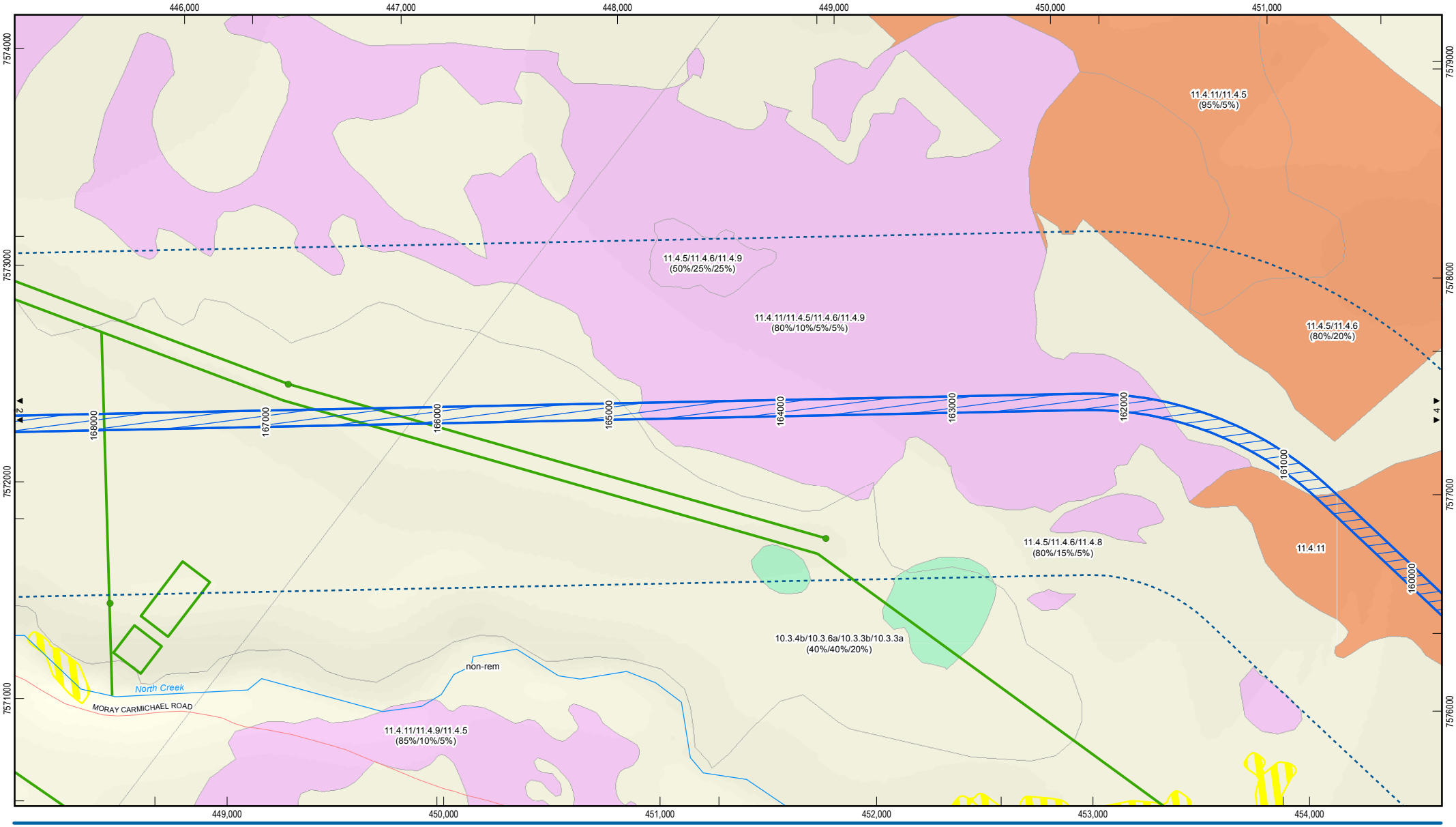

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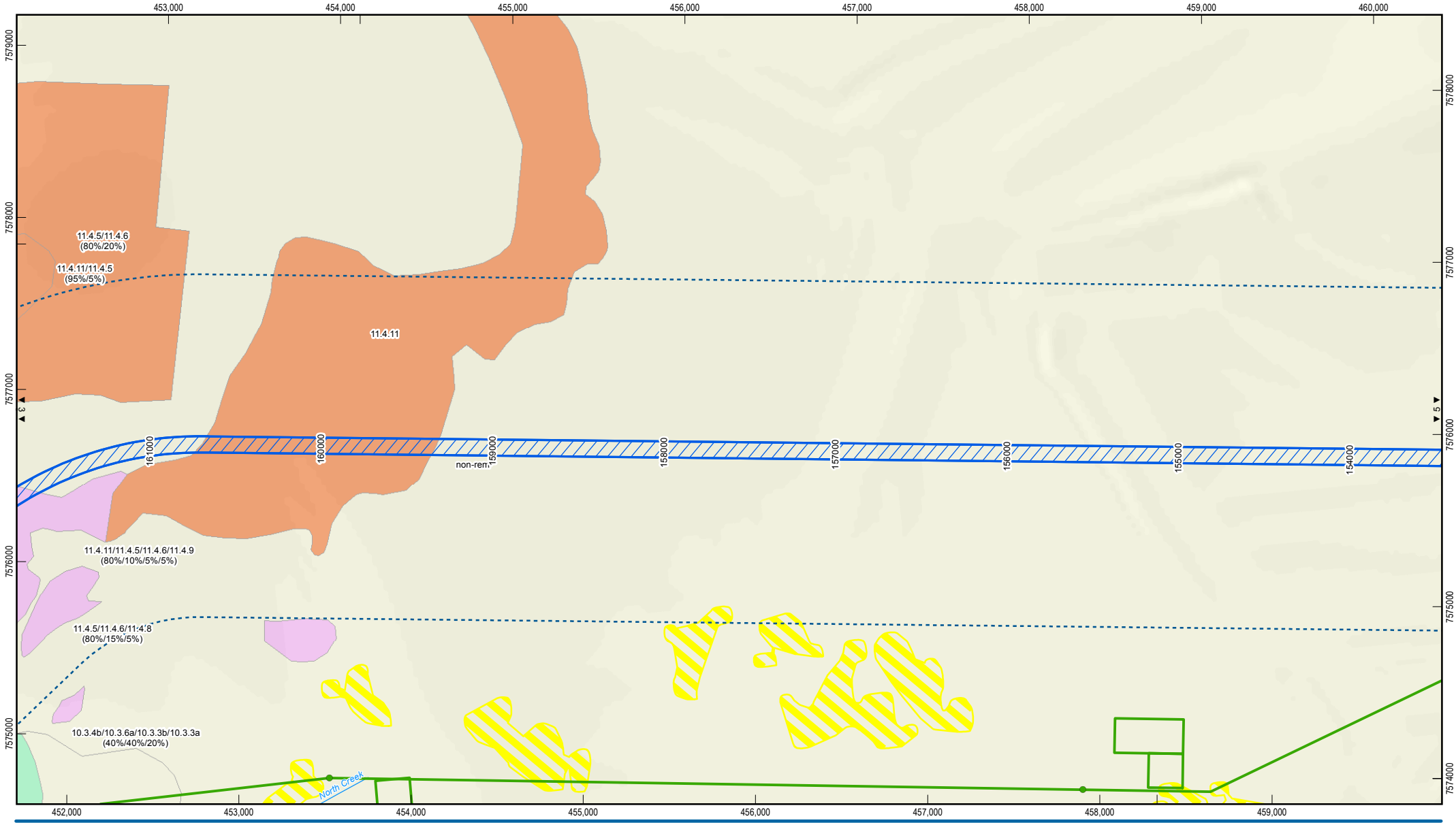

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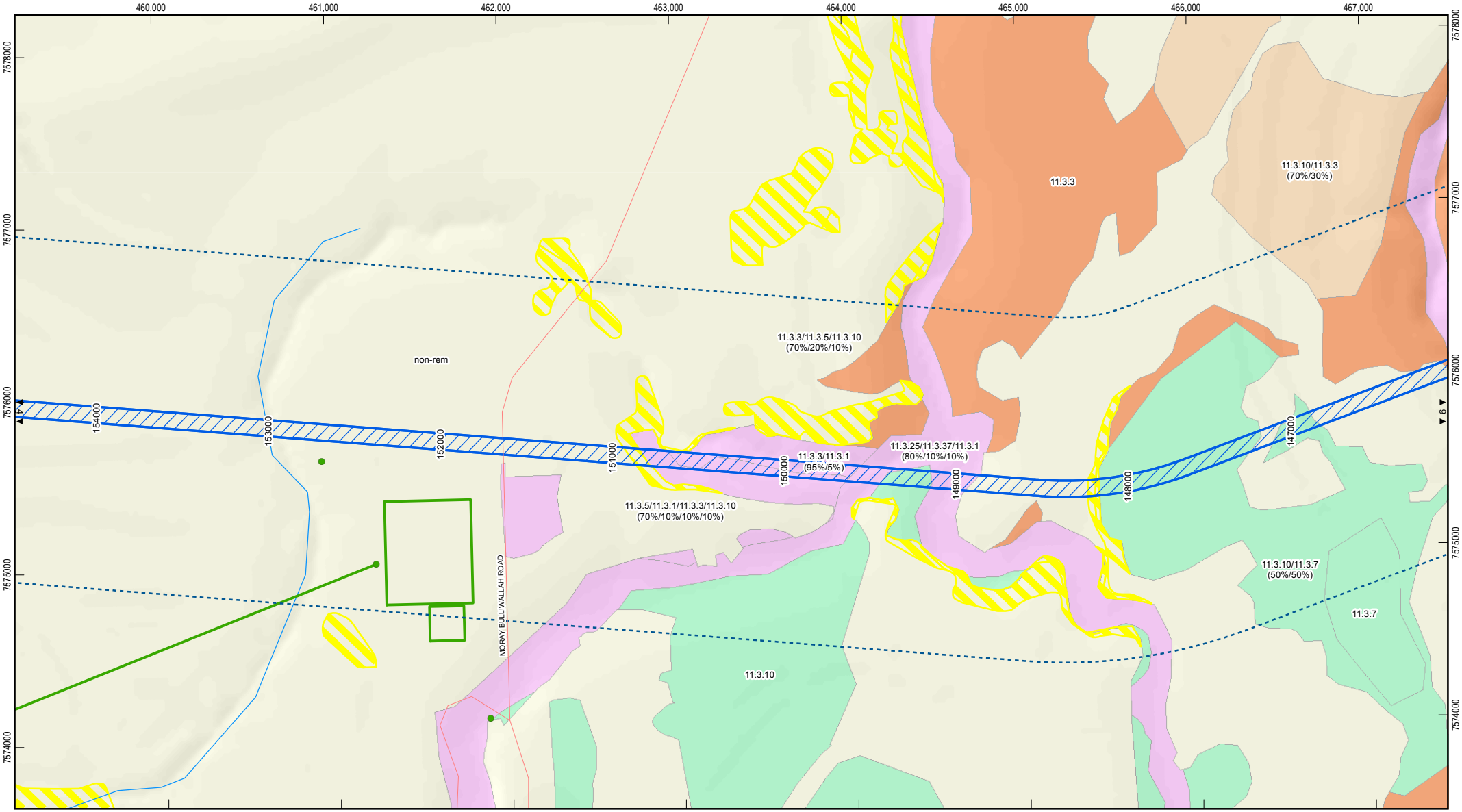

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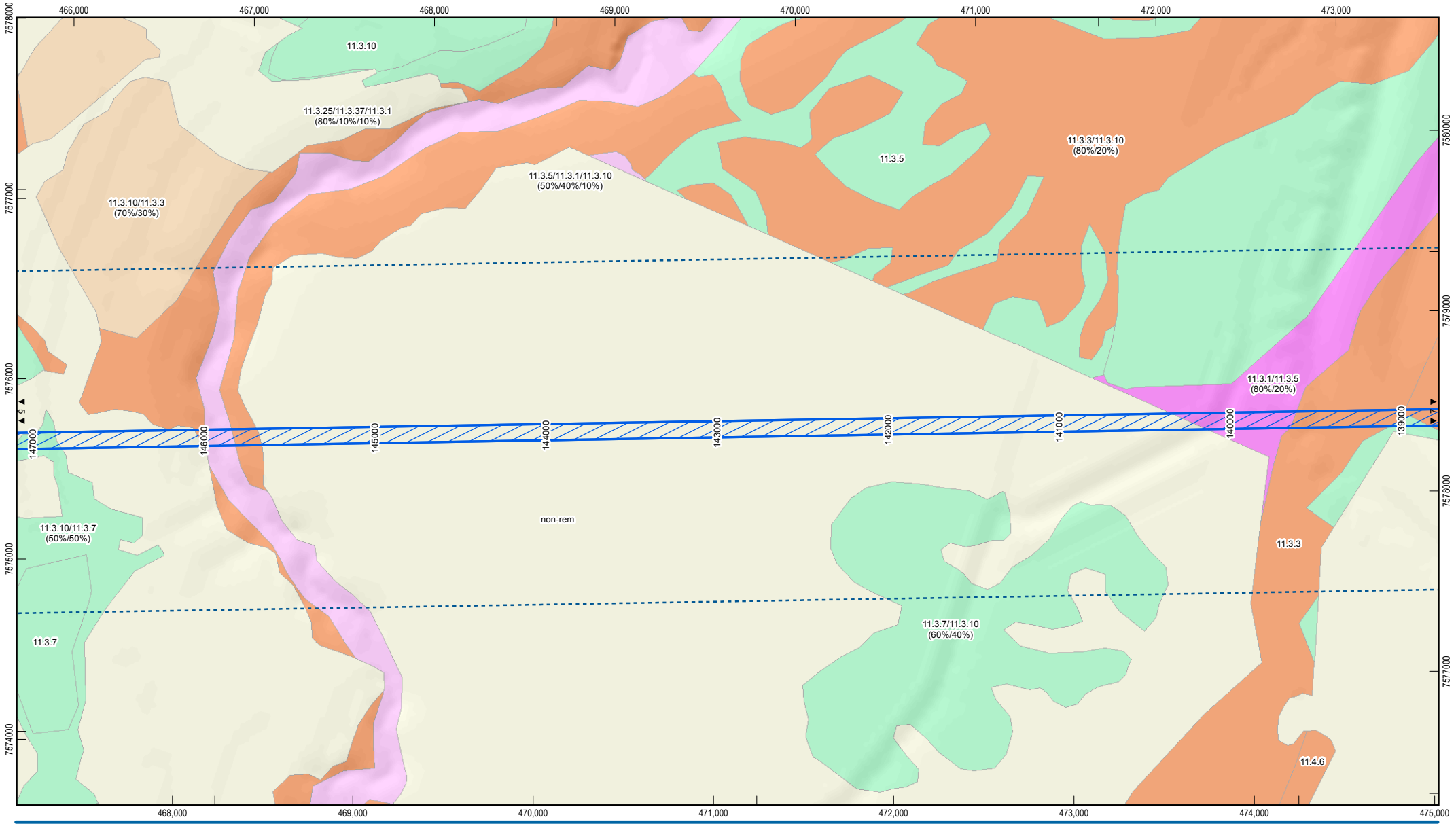

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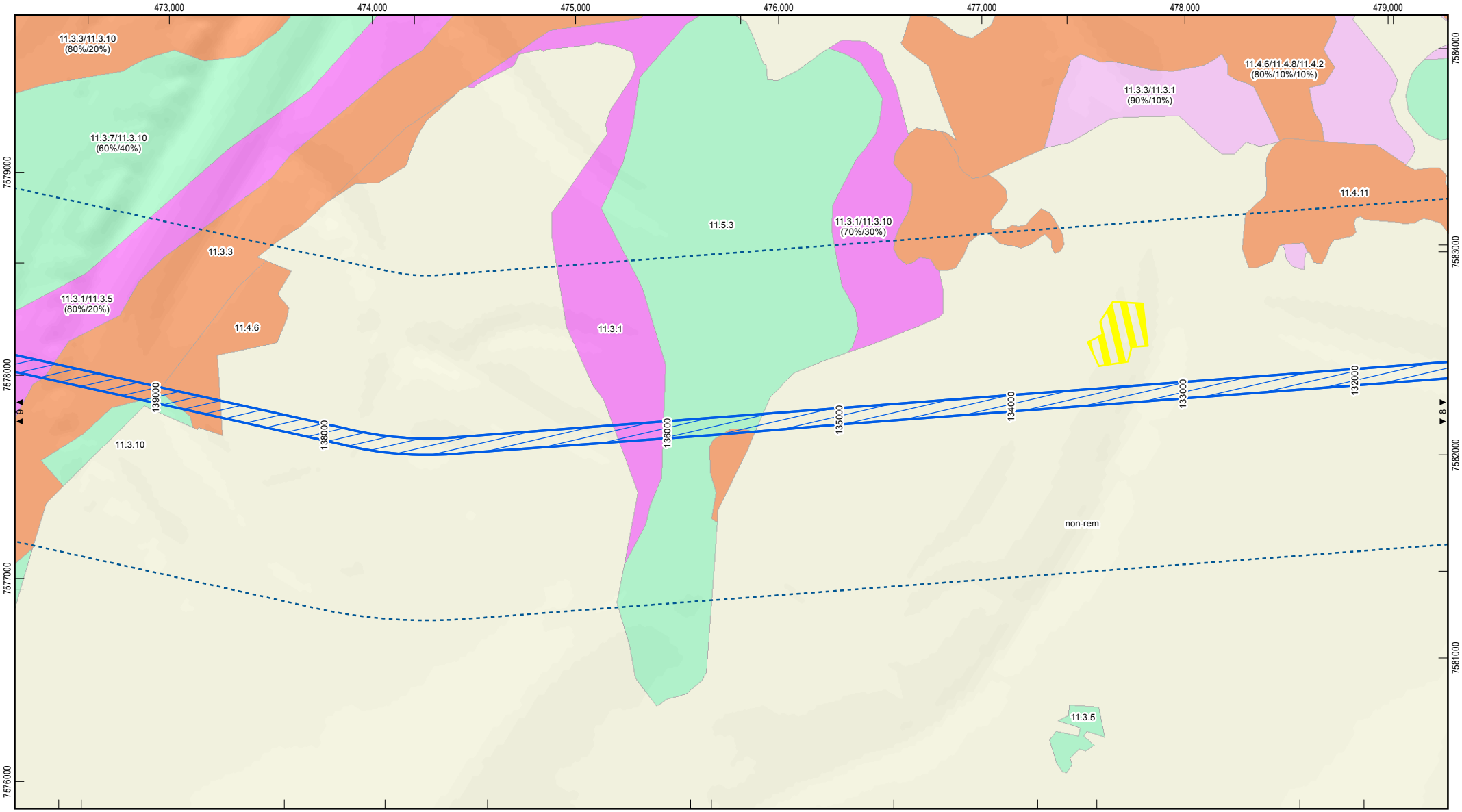

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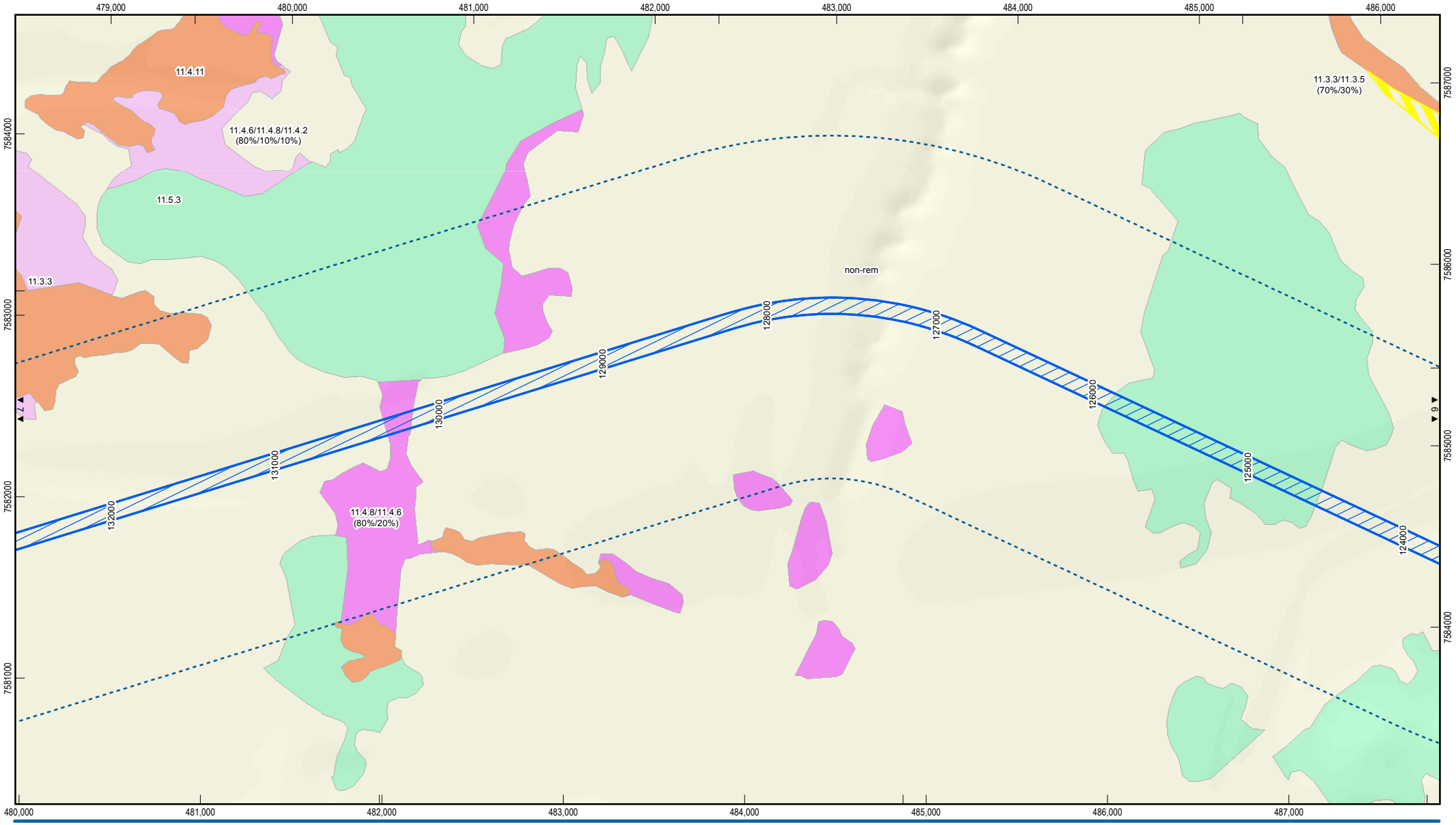

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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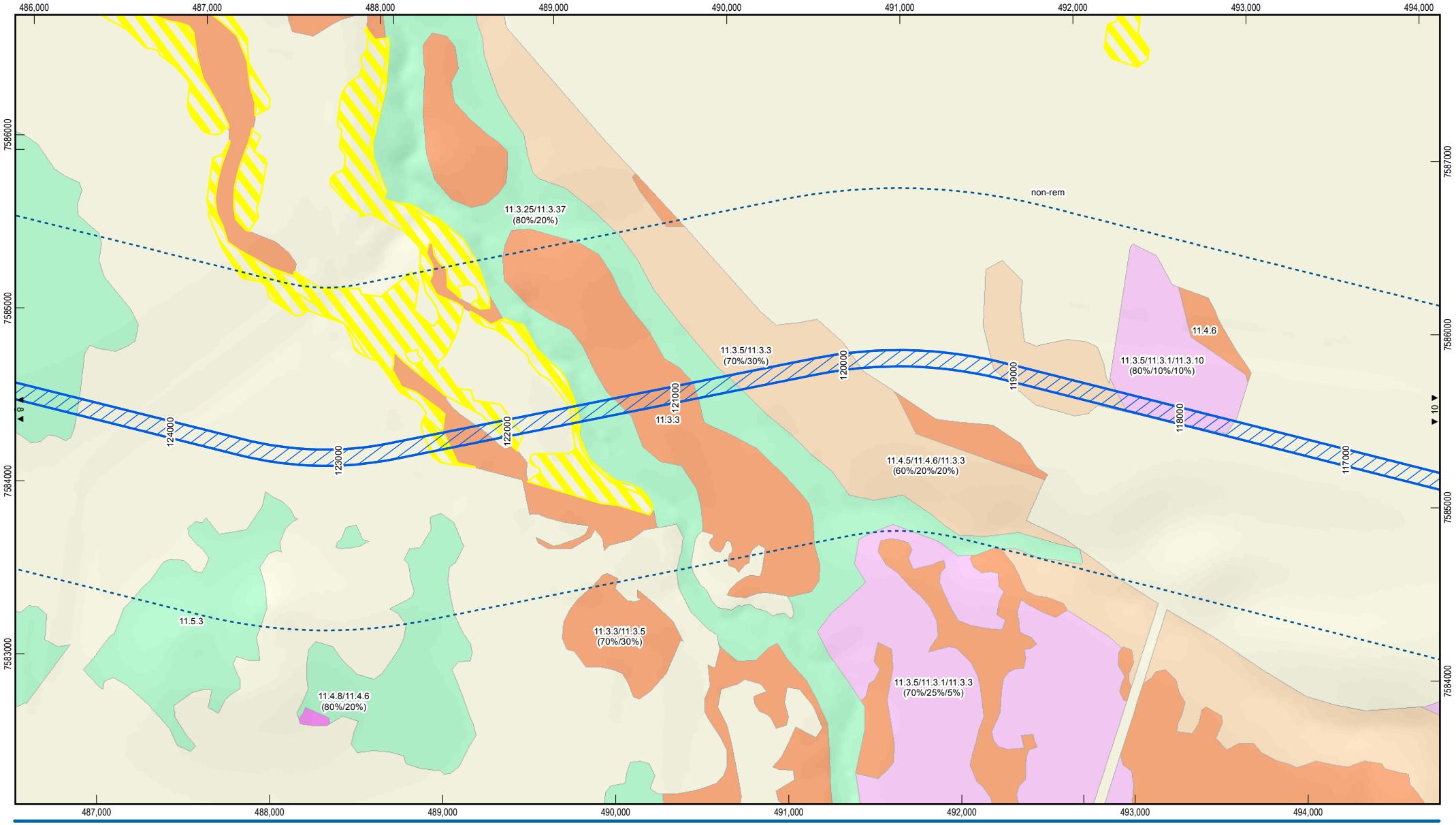

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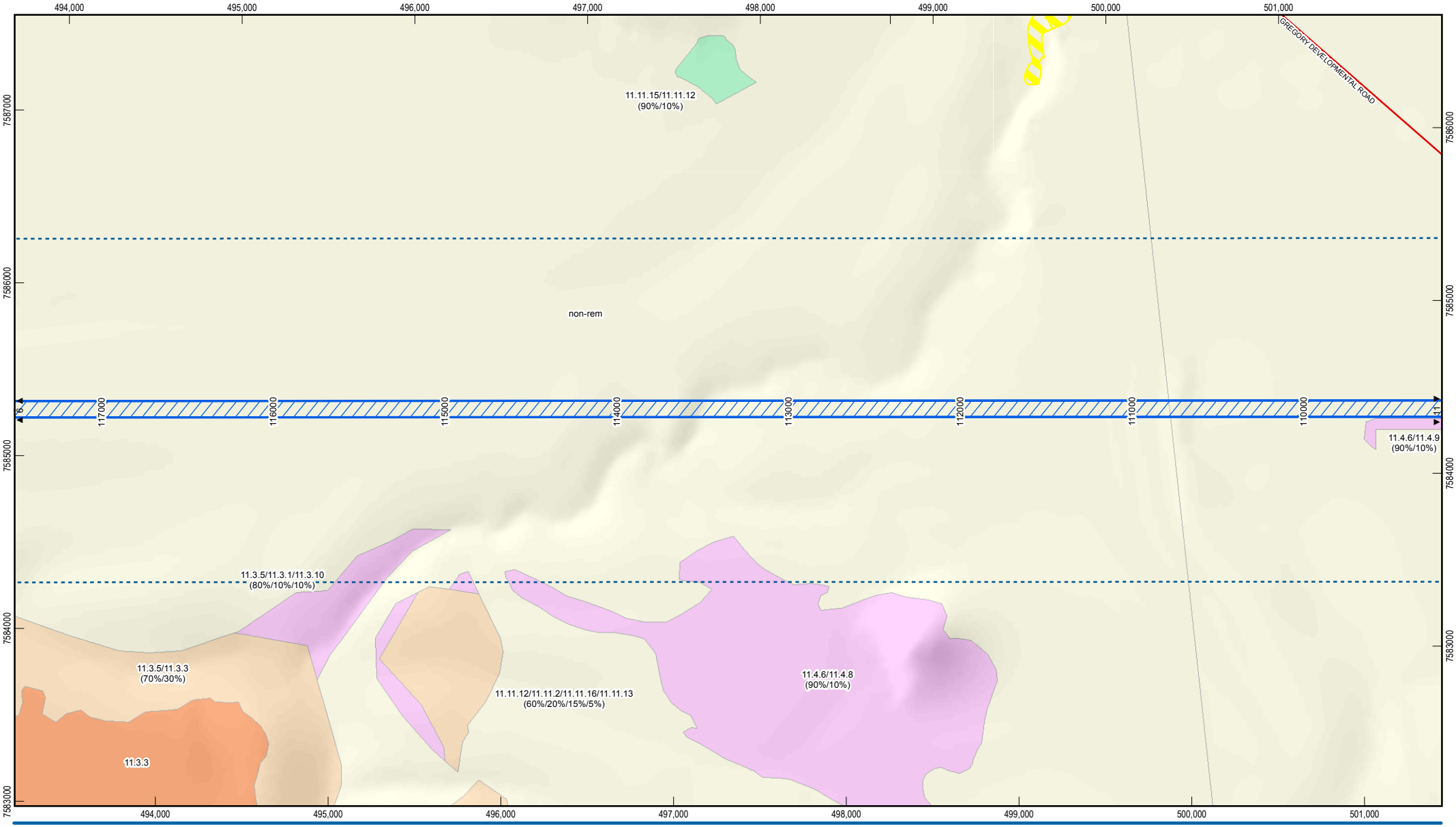
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), Regional Ecosystems v6.1 (2011), High Value Regrowth (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- State Road
- Local Road
- Watercourse
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- Mine (Onsite)
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Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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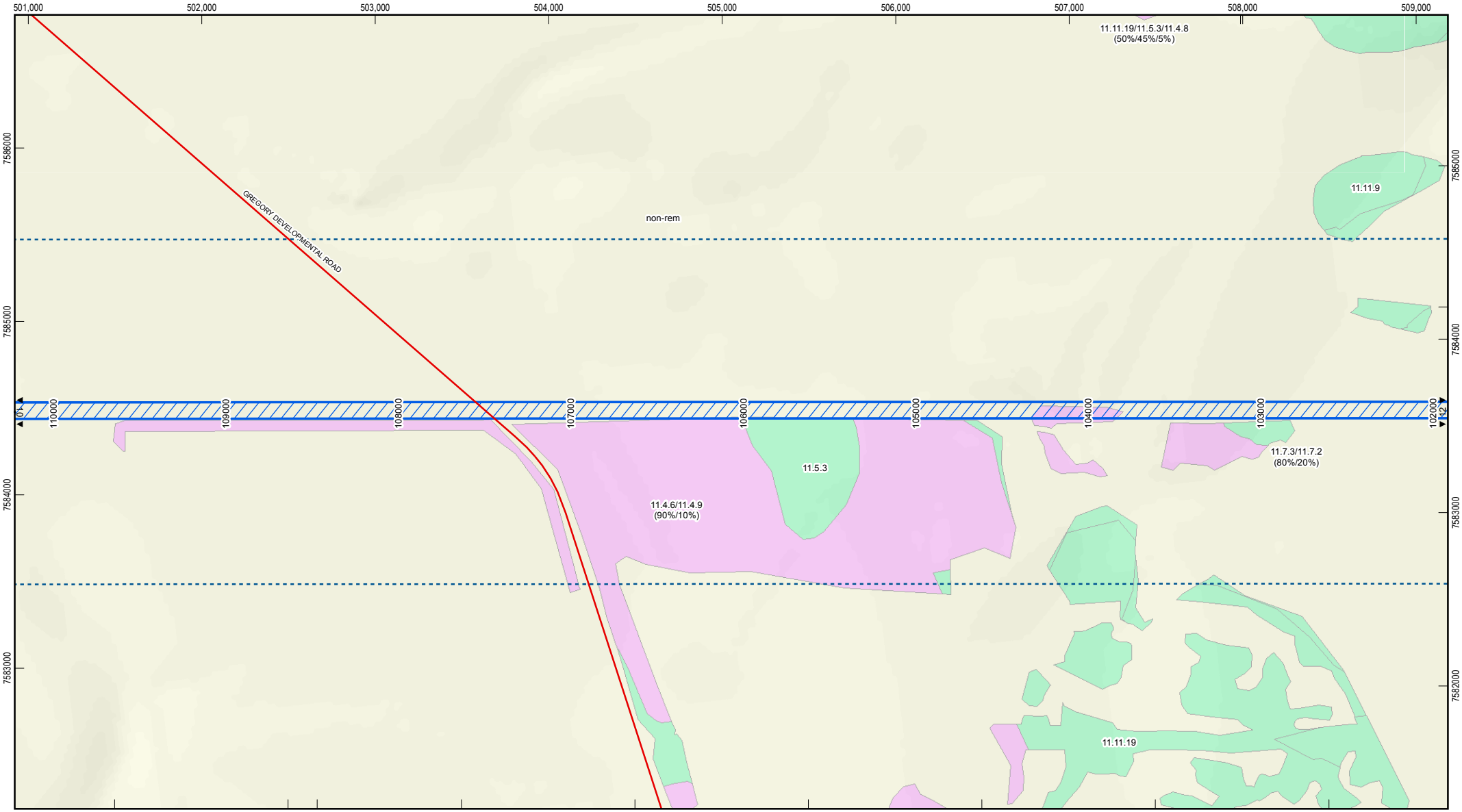

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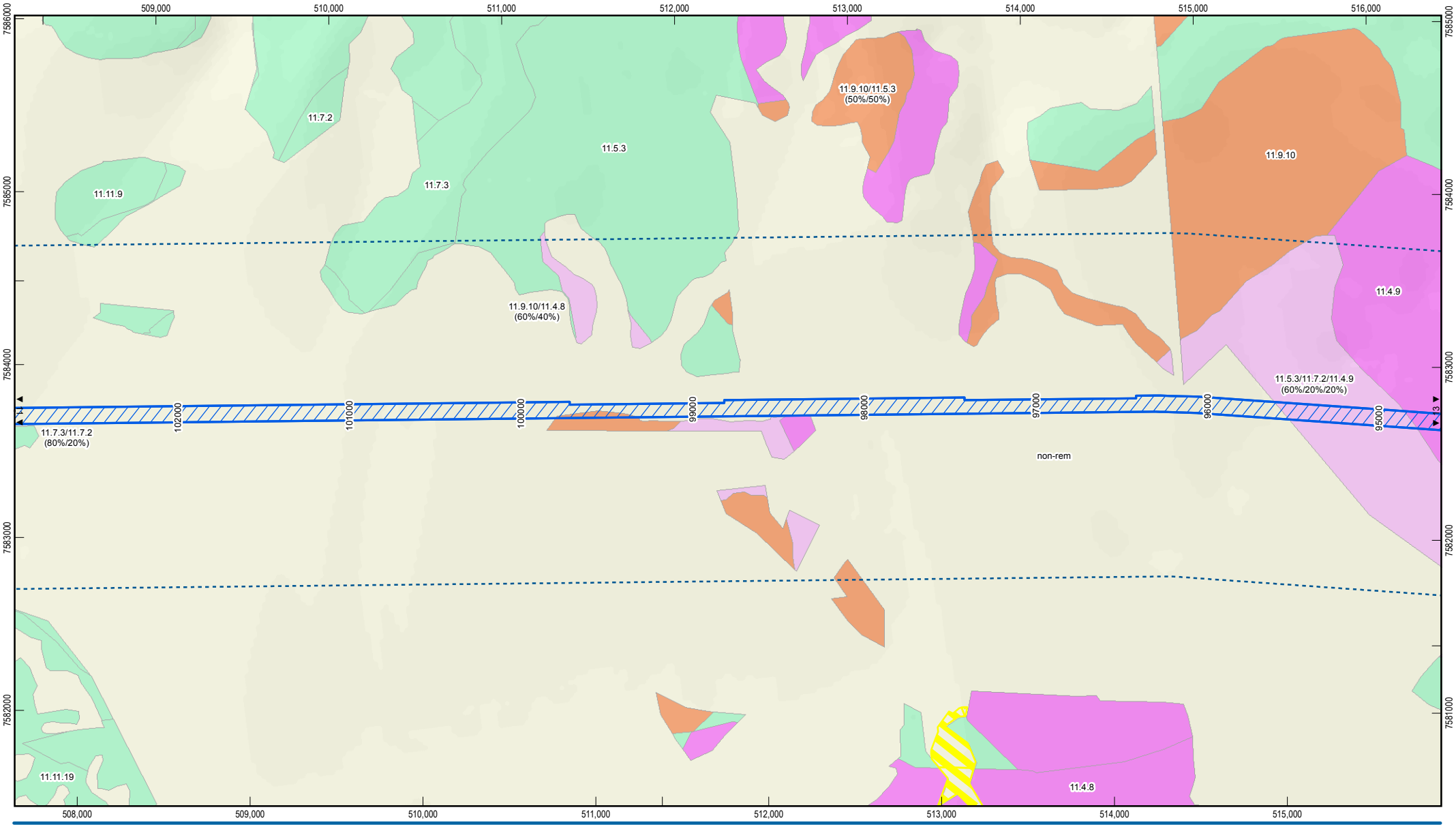

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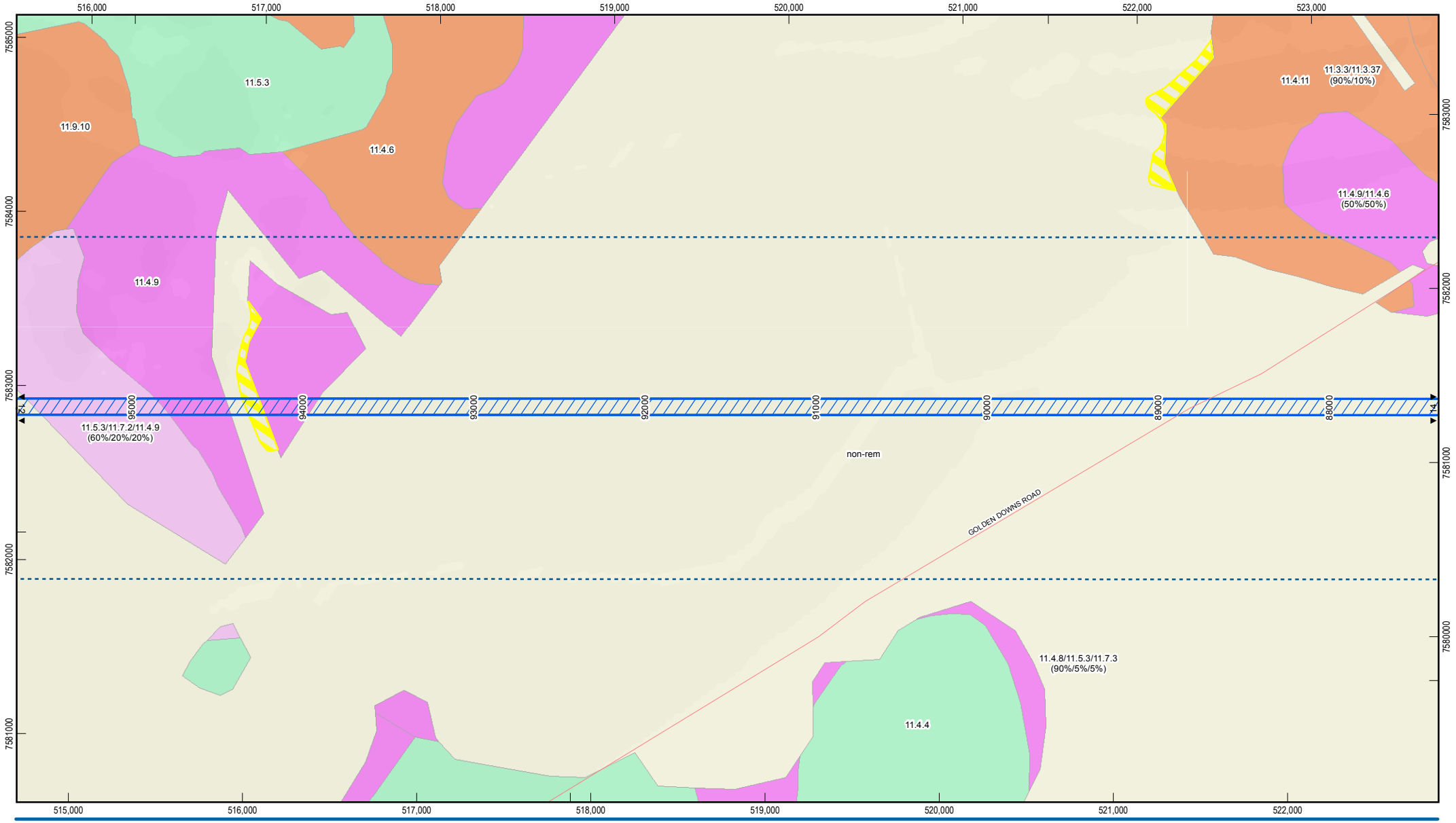

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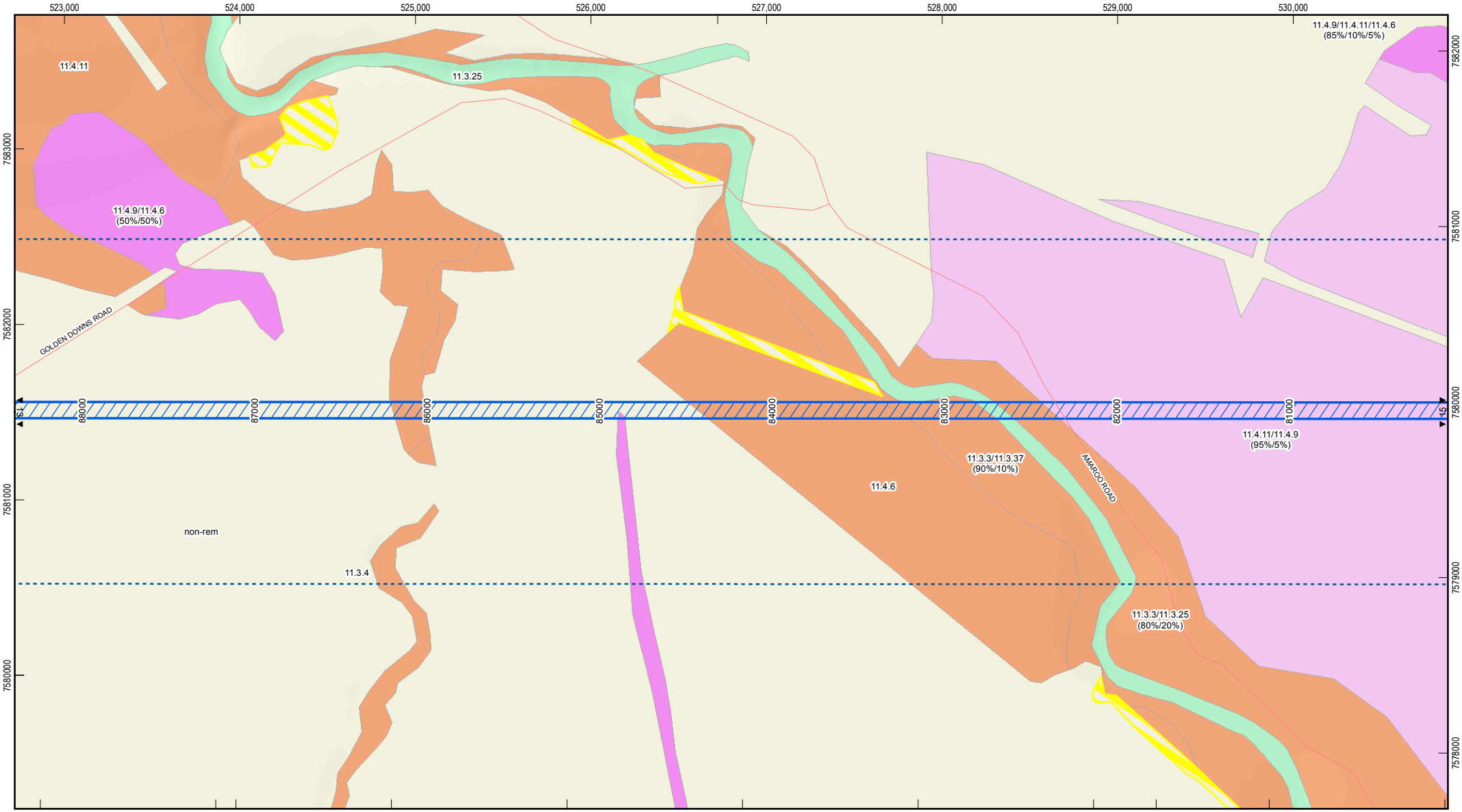

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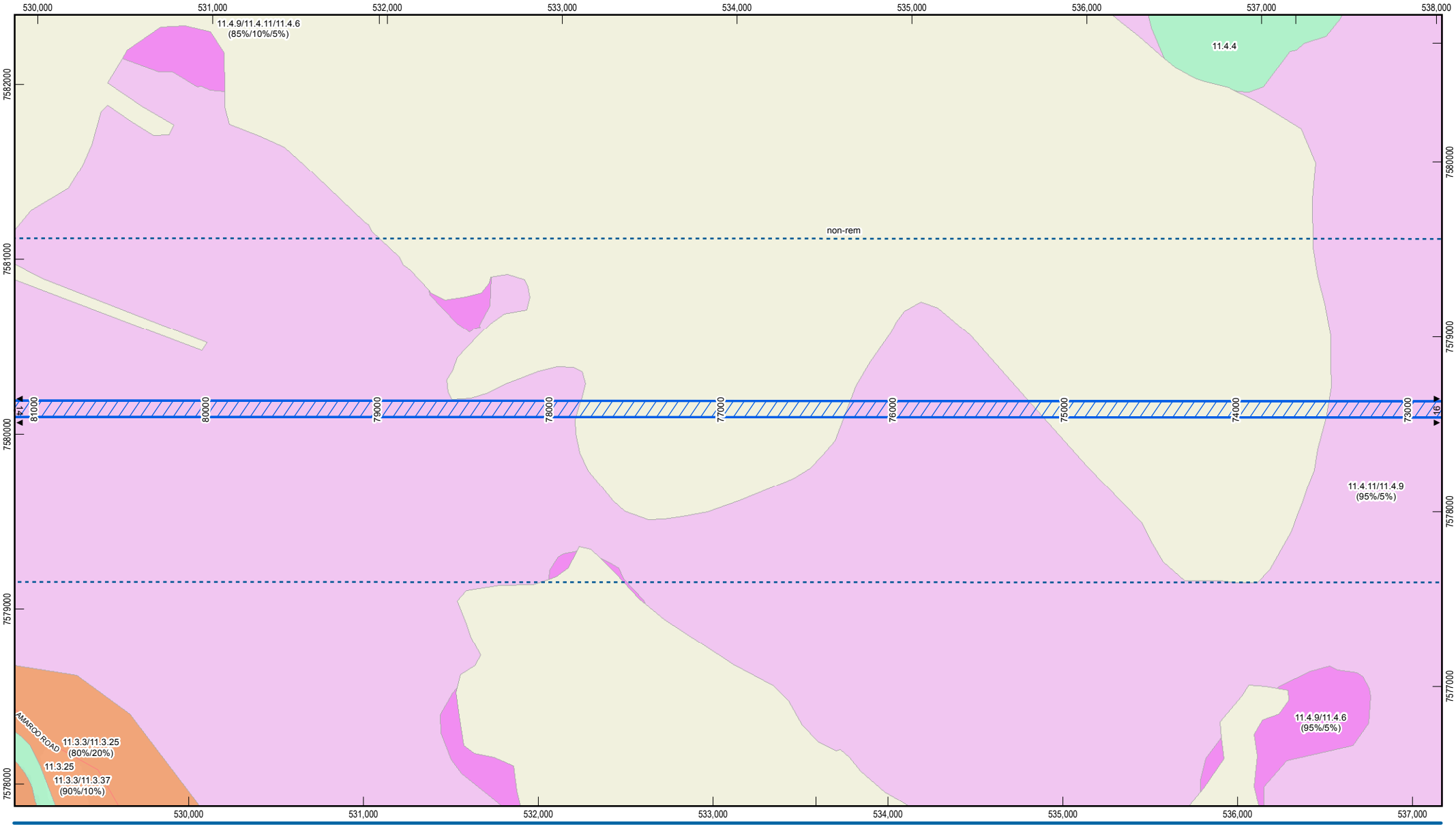

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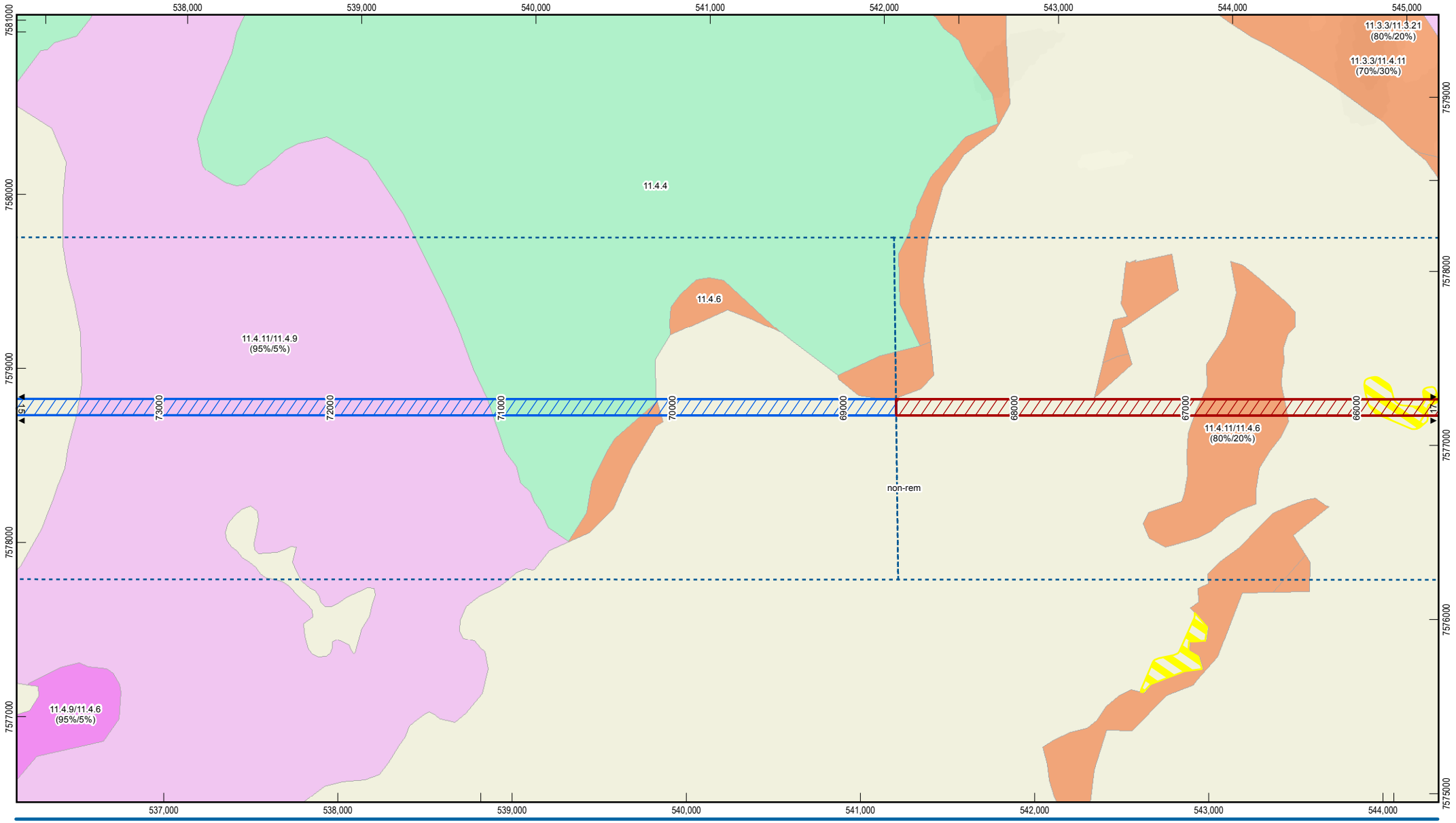

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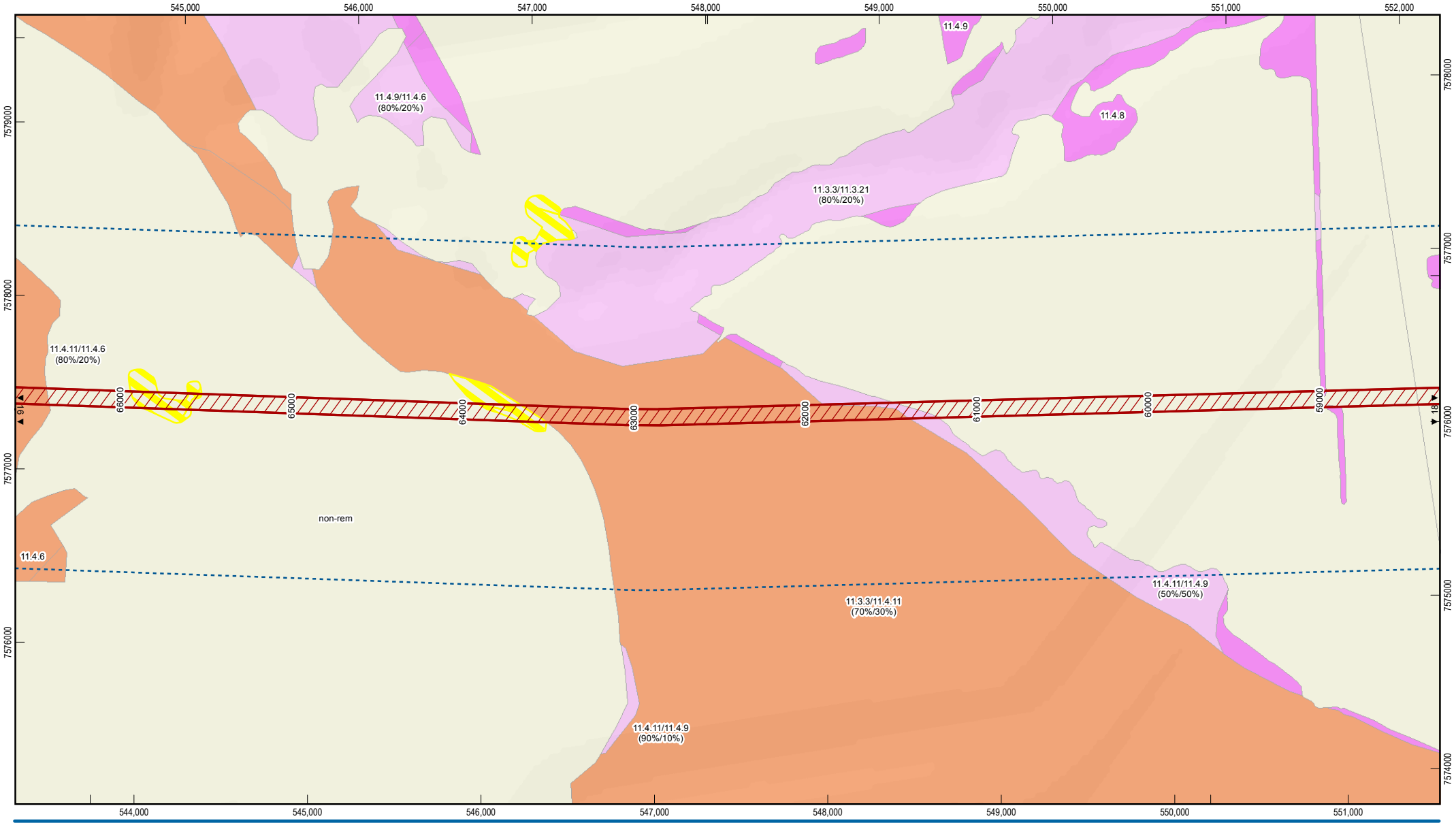

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Carmichael Coal Mine and Rail Project

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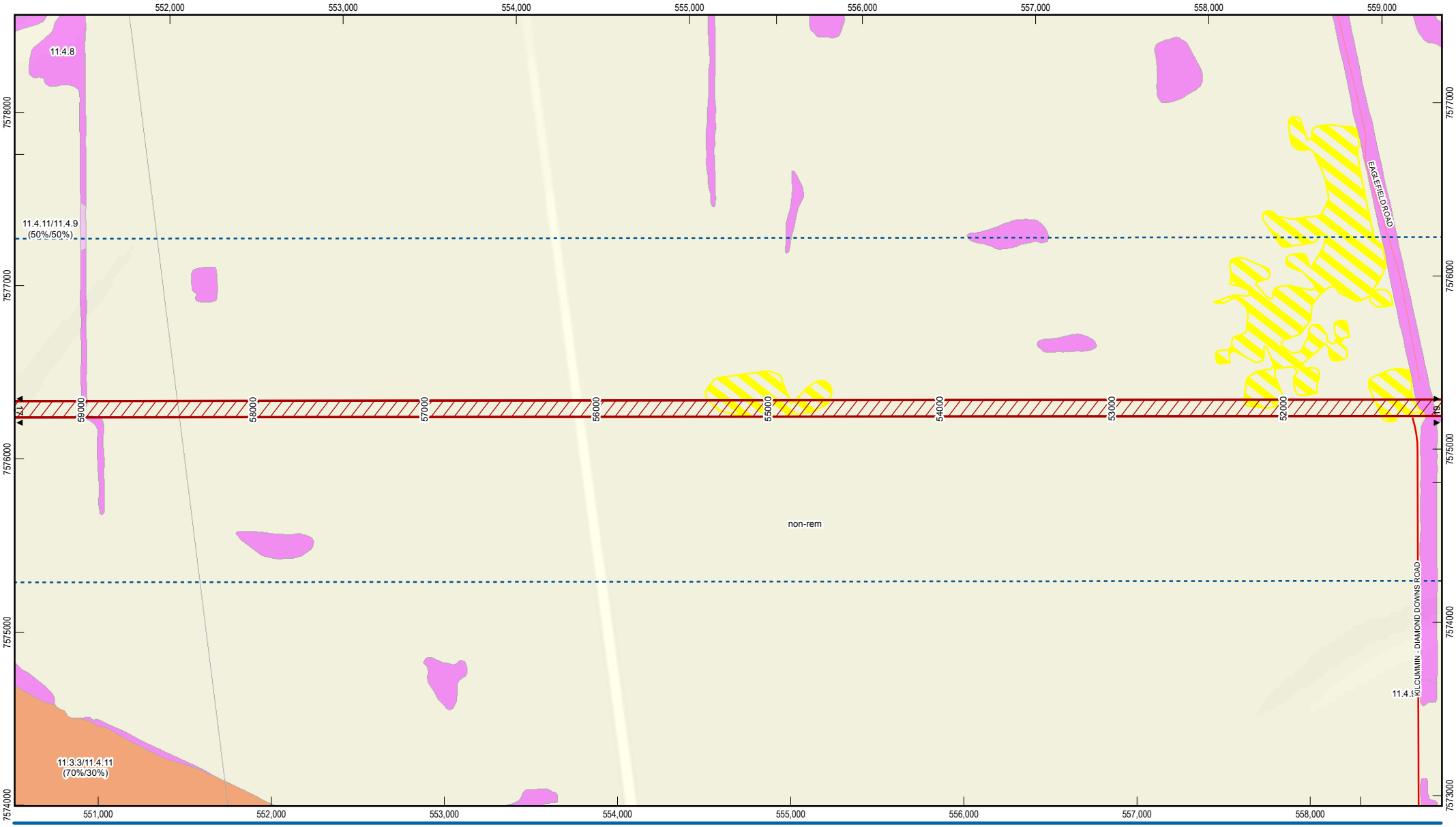

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Metres

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N

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Carmichael Coal Mine and Rail Project

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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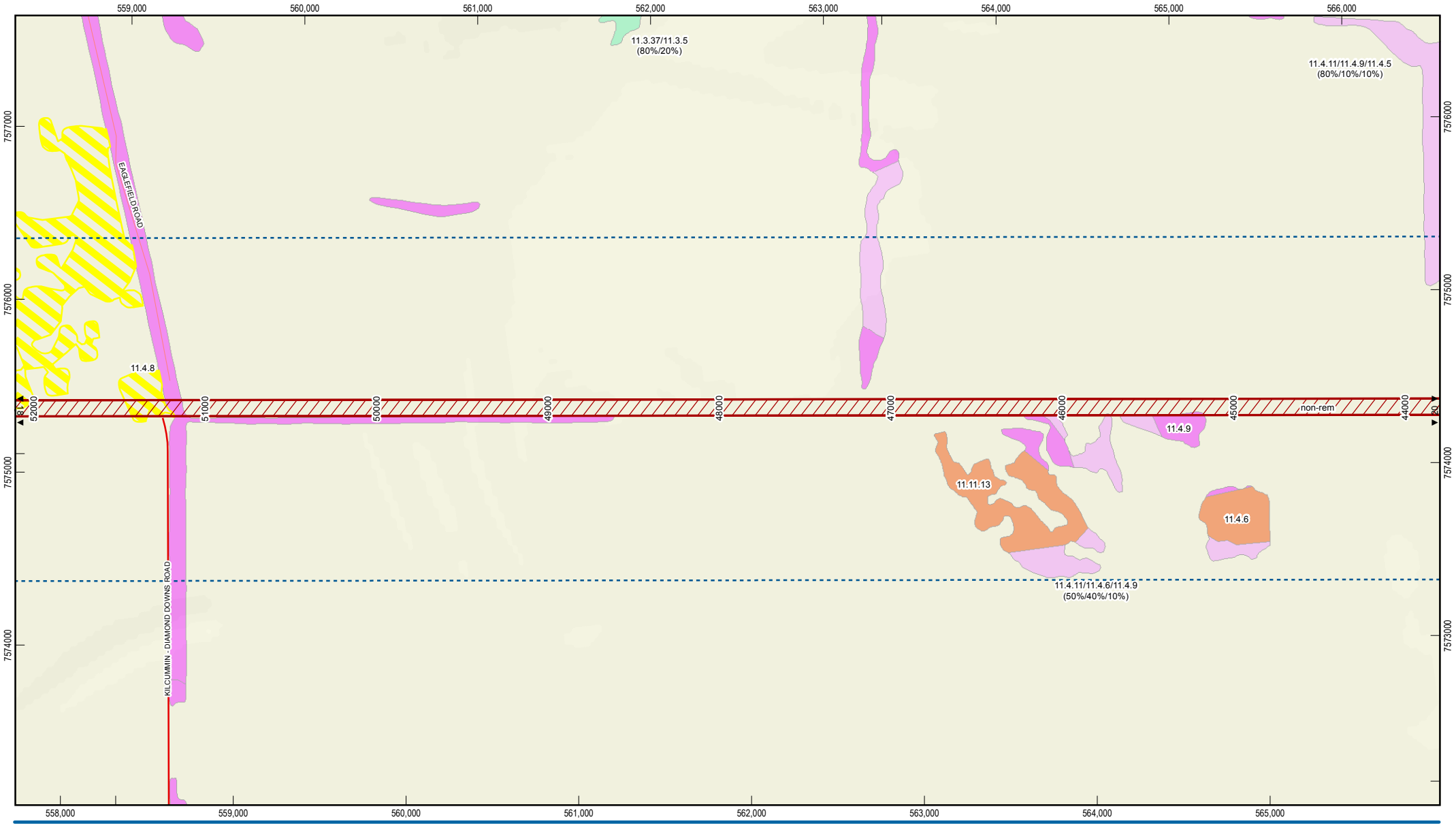

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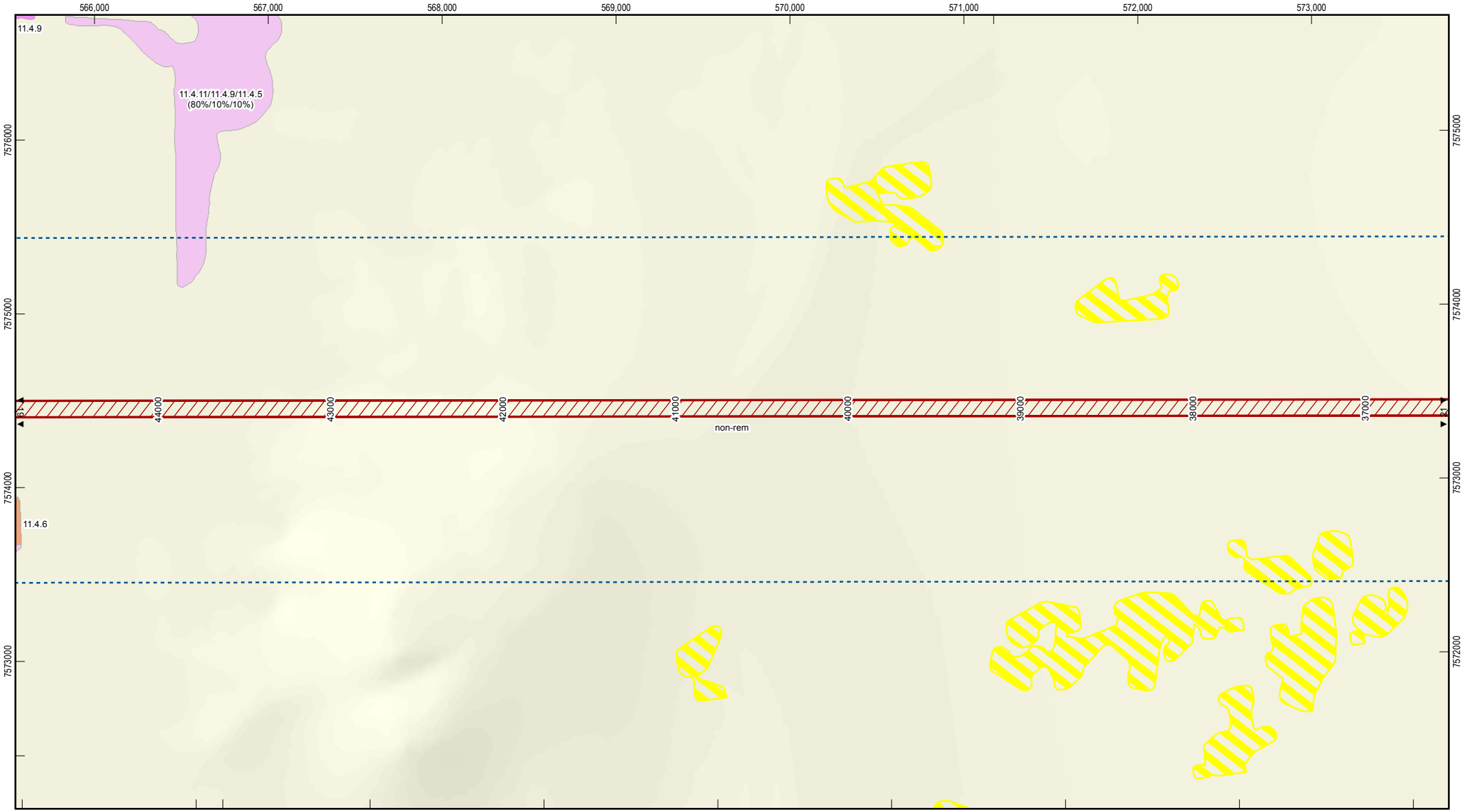

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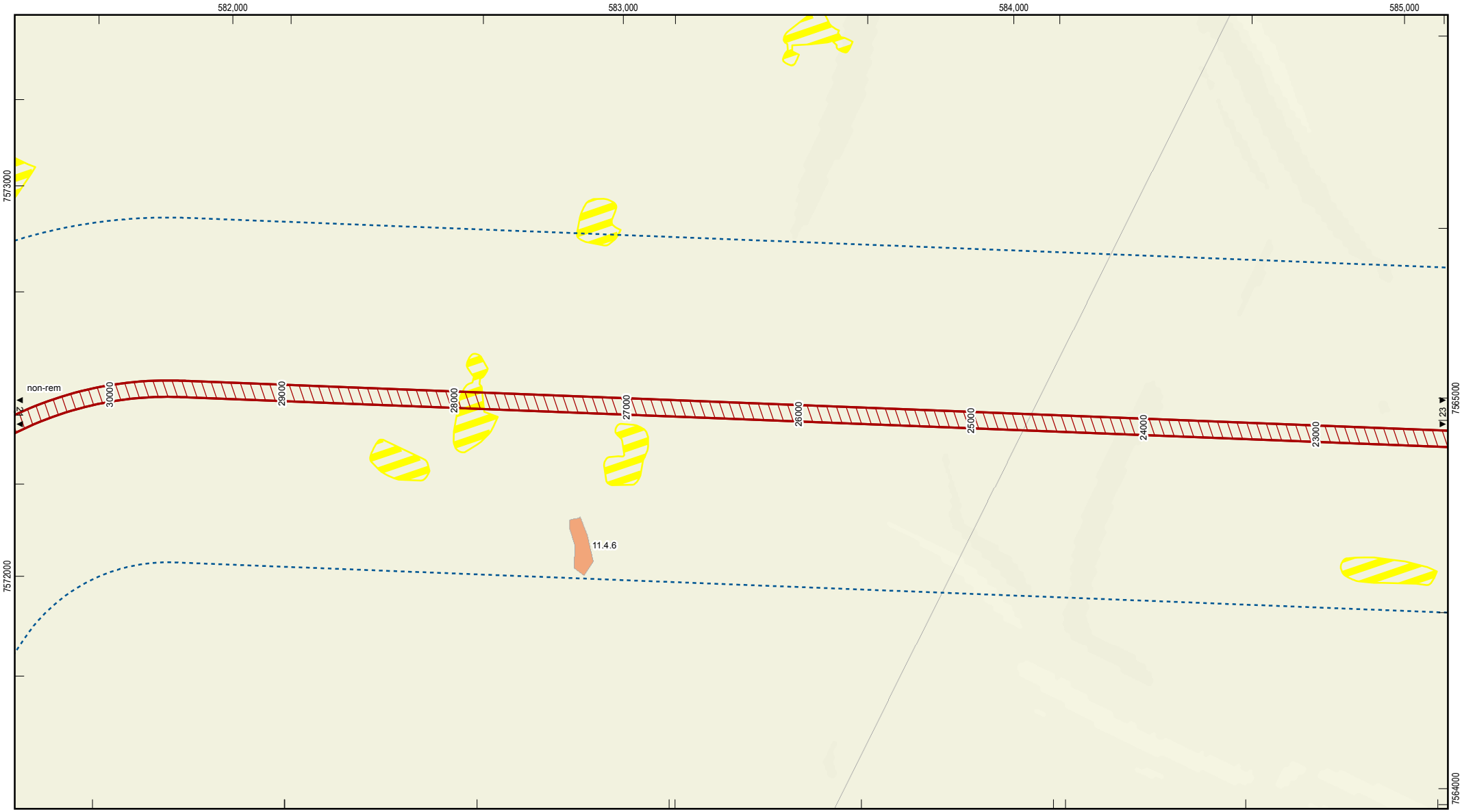

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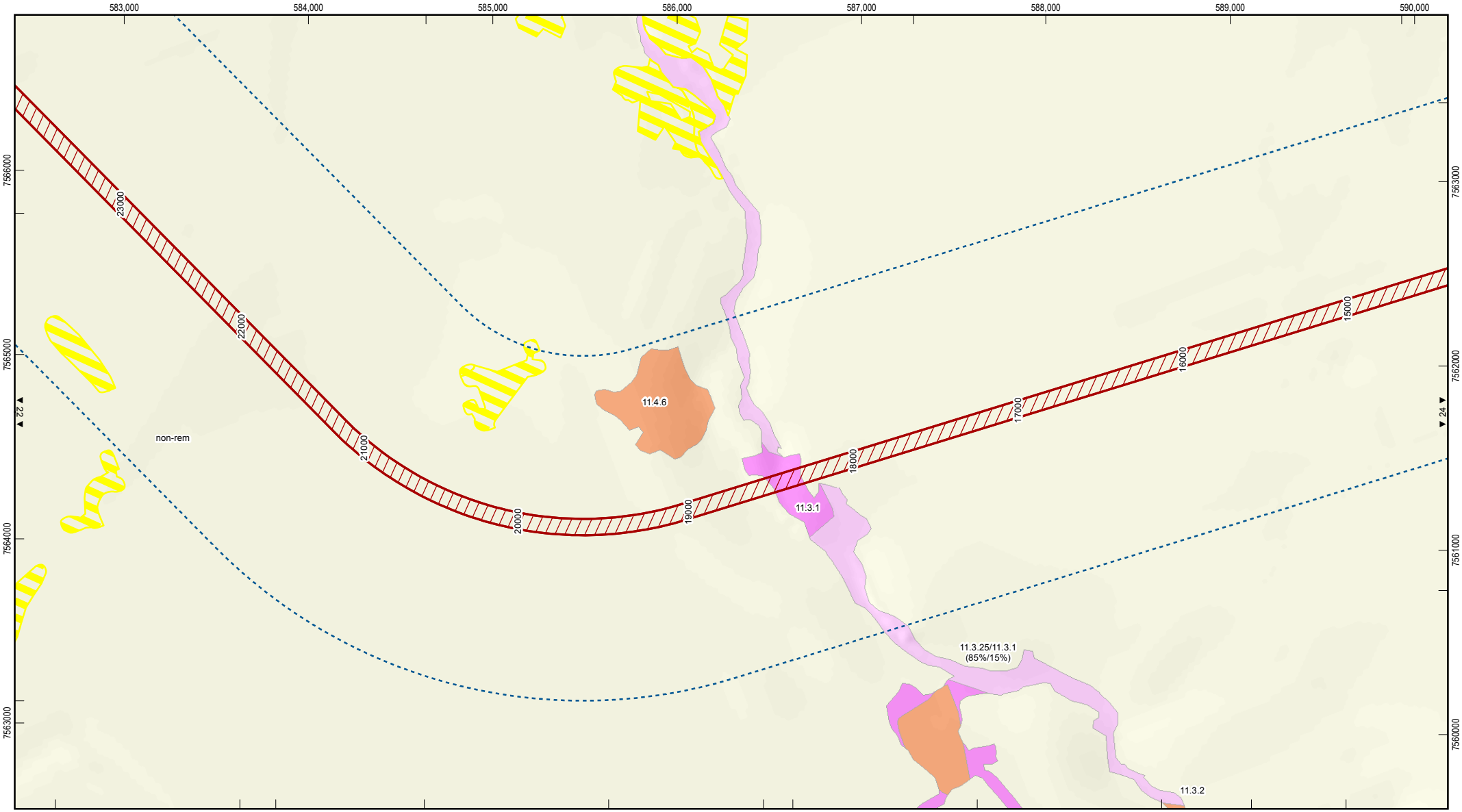

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Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision D
Date 11-09-2012

DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

Figure 5-7
Sheet 23 of 25

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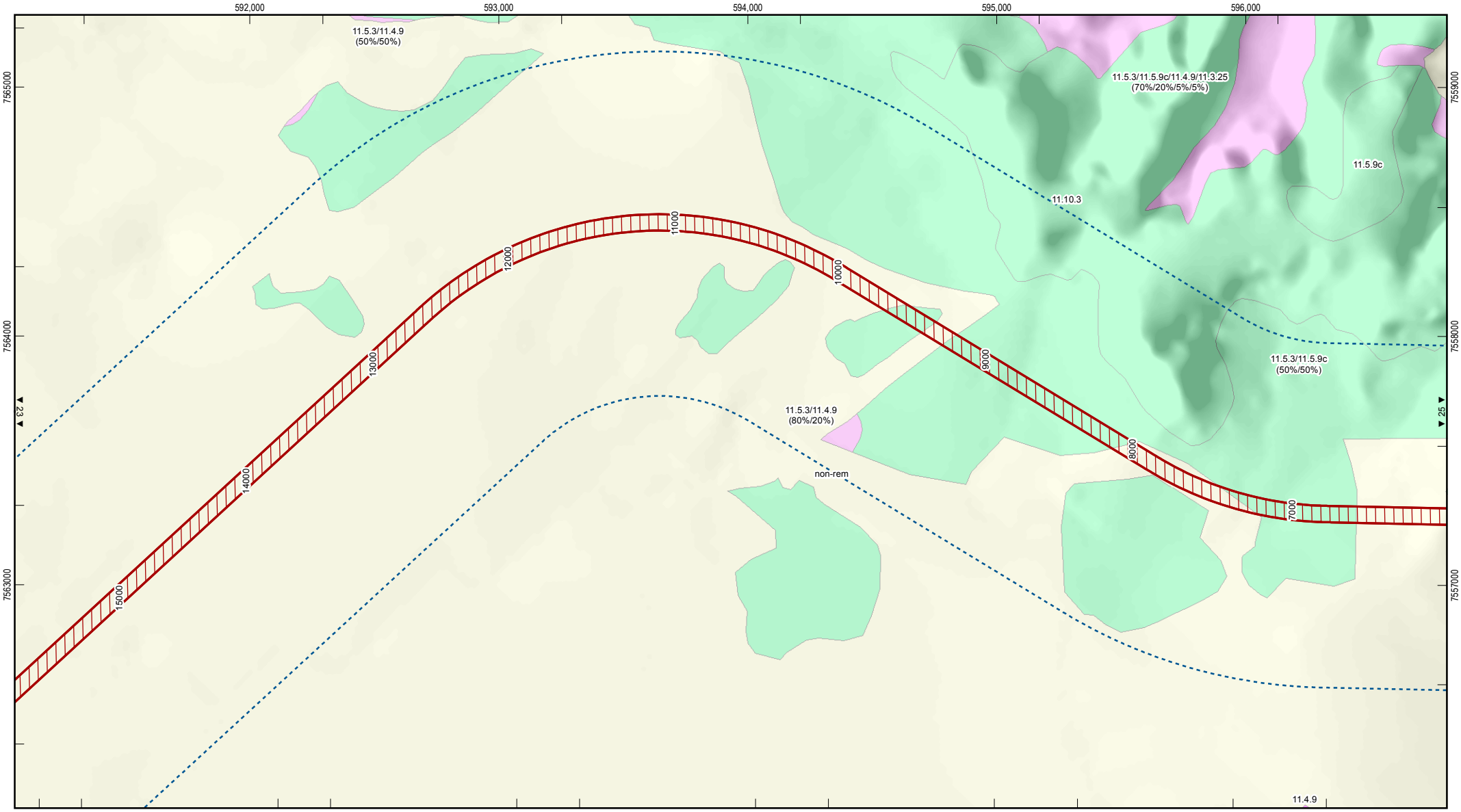

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant
- High Value Regrowth

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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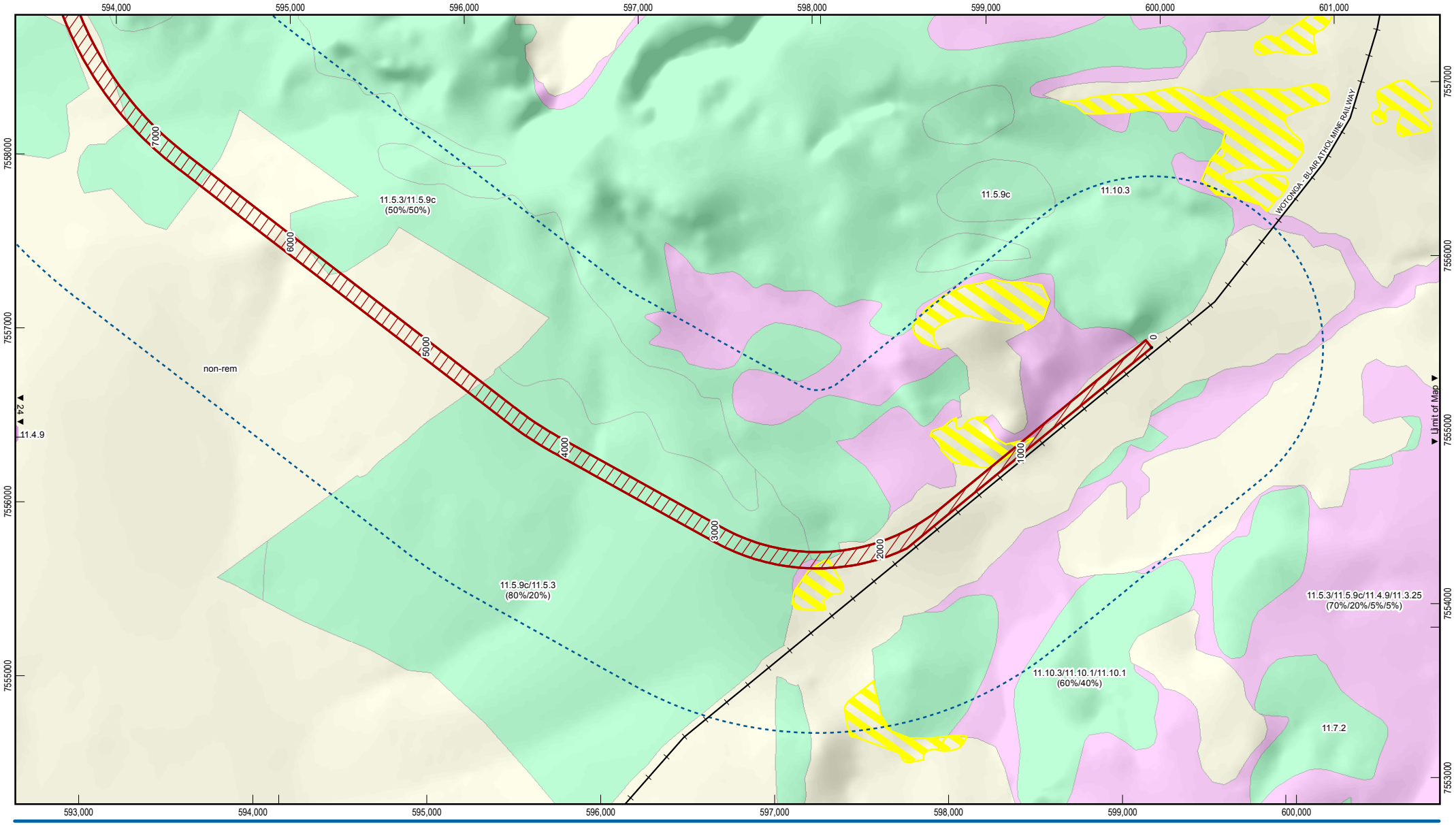

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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Figure 5-7
Sheet 25 of 25

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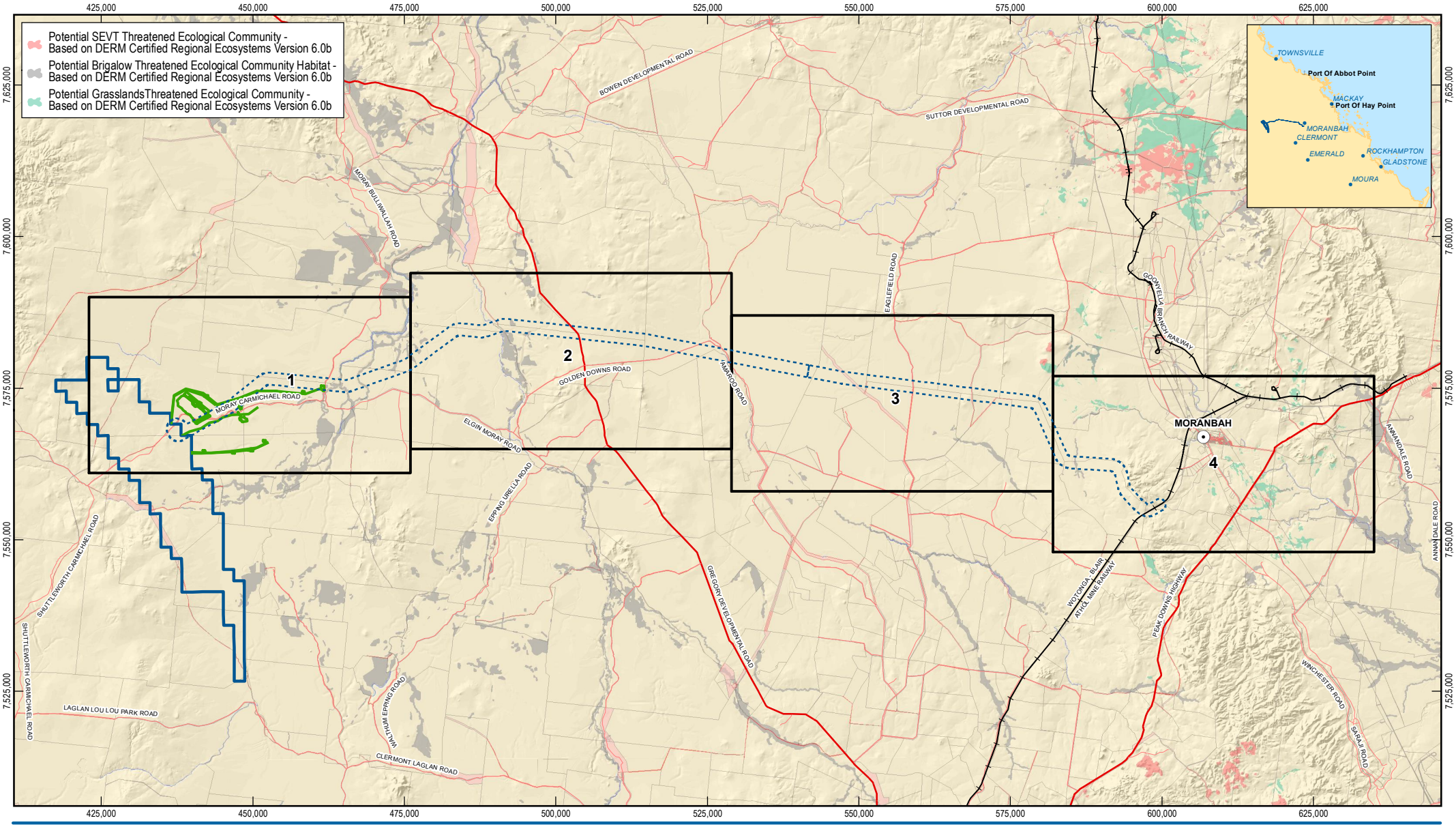
Data source: DERM: DEM (2008), Regional Ecosystems v6.1 (2011), High Value Regrowth (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA

5.2.3.2 Listed Threatened Ecological Communities

Three TECs listed as endangered under the EPBC Act were identified as having potential to occur in the Study Area from desktop results. The TECs are as follows:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) - Within Queensland, 16 REs are described as forming part of this TEC. The main threatening process is broad scale clearing undertaken to create grasslands for grazing, which are now dominated by exotic pasture grasses such as buffel grass and creeping bluegrass. Of the REs listed as forming part of the TEC, only the REs 11.3.1, 11.4.8 and 11.4.9 occur within the Study Area, representing 636 ha (1.8 per cent) of the total Study Area. Of this, approximately 37 ha occurs within the rail corridor and infrastructure and construction camps footprints. The majority of this brigalow is located west of the Gregory Developmental Road, with several small patches occurring close to Mistake Creek and approaching the Belyando River. Brigalow communities were generally found in small and fragmented patches within eucalypt communities. Thus, field surveys did not confirm the presence of brigalow TEC, although patches of brigalow were present. However, brigalow TEC may occur in the broader area of the Project, as is indicated in RE mapping. The distribution of Brigalow TEC within the Study Area and in the context of the wider landscape is based on RE mapping and is presented in Figure 5-8.
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (natural Grasslands) - The Natural Grasslands TEC is a tussock grassland community comprised of a number of native grass species throughout its range, depending upon factors such as rainfall, soil and geology. Seven REs are identified as forming part of this TEC. The Natural Grasslands TEC is currently restricted to smaller remnants that face continuing threats from grazing, conversion to cropping and pasture improvement, weeds and pest animals, mining activities, and the construction of roads and other infrastructure (TSSC, 2008). Of the REs listed as forming part of the Natural Grassland TEC, only the REs 11.3.21, 11.4.4 and 11.4.11 have been mapped as occurring within the Study Area. 2017 ha of these Res are mapped within the Study Area. However as none of these mapped REs occur within the Northern Bowen Basin subregion, where it is intersected by the Project (Rail), the Natural Grasslands TEC is not impacted by the Project (Rail). The distribution of mapped Natural Grasslands TEC in the landscape is presented in Figure 5-8.
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT) - Semi-evergreen vine thicket TEC comprises semi-evergreen vine thickets (SEVT) in eastern Queensland and northern New South Wales. It is an extreme form of dry seasonal rainforest characterised by trees with microphyll sized leaves and the presence of bottle trees (*Brachychiton* spp.) as emergents (DSEWPaC 2011n). Ten REs comprise the SEVT TEC in Queensland. As none of these REs are mapped within the Study Area nor were they identified during field surveys the TEC is not considered likely to be present within the Study Area and not considered further.

The Brigalow TEC was identified as occurring in the Study Area from field surveys. Constituent REs of the Natural Grassland TEC do not occur in the Northern Bowen Basin, and therefore this TEC is not triggered by the Project (Rail). The SEVT TEC is considered unlikely to occur as none of the constituent REs are mapped within the Project.



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities Within the Study Area and Surrounding Landscape

Job Number 41-25215
Revision C
Date 11-09-2012

Figure 5-8
Series Index

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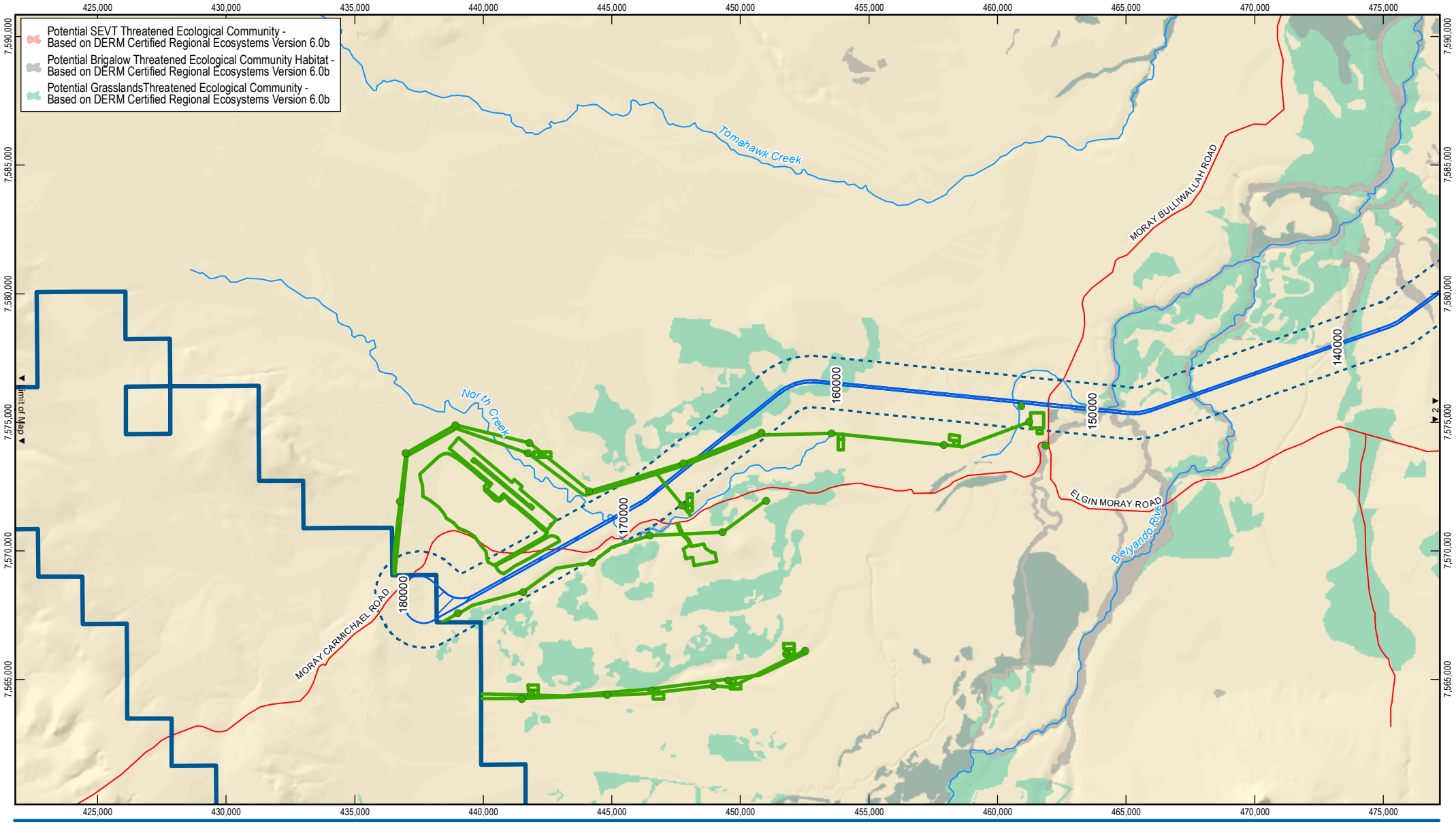
Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Corridors Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

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Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
Date 11-09-2012

Figure 5-8
Sheet 1 of 4

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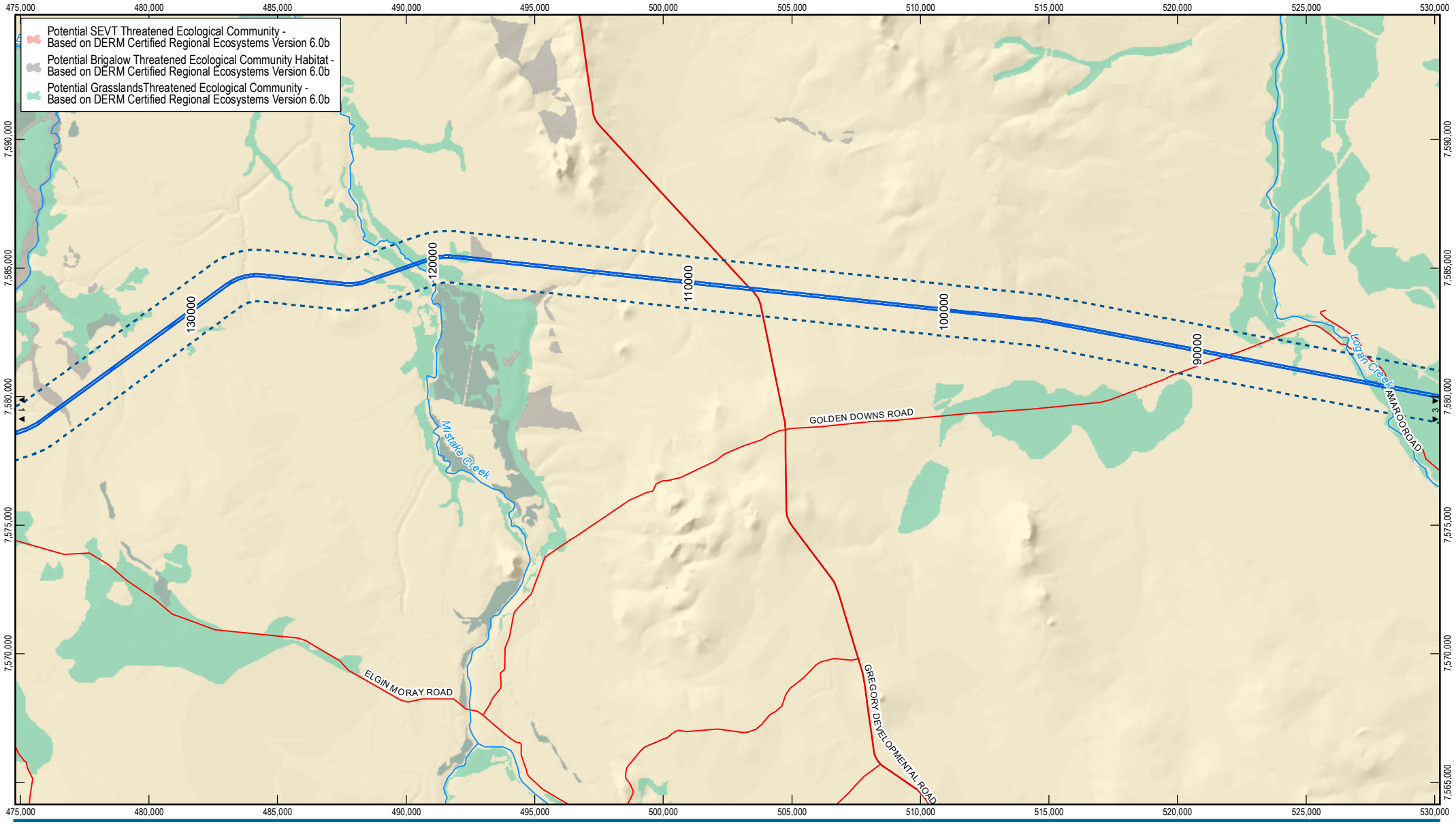
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

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Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number	41-25215
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Figure 5-8
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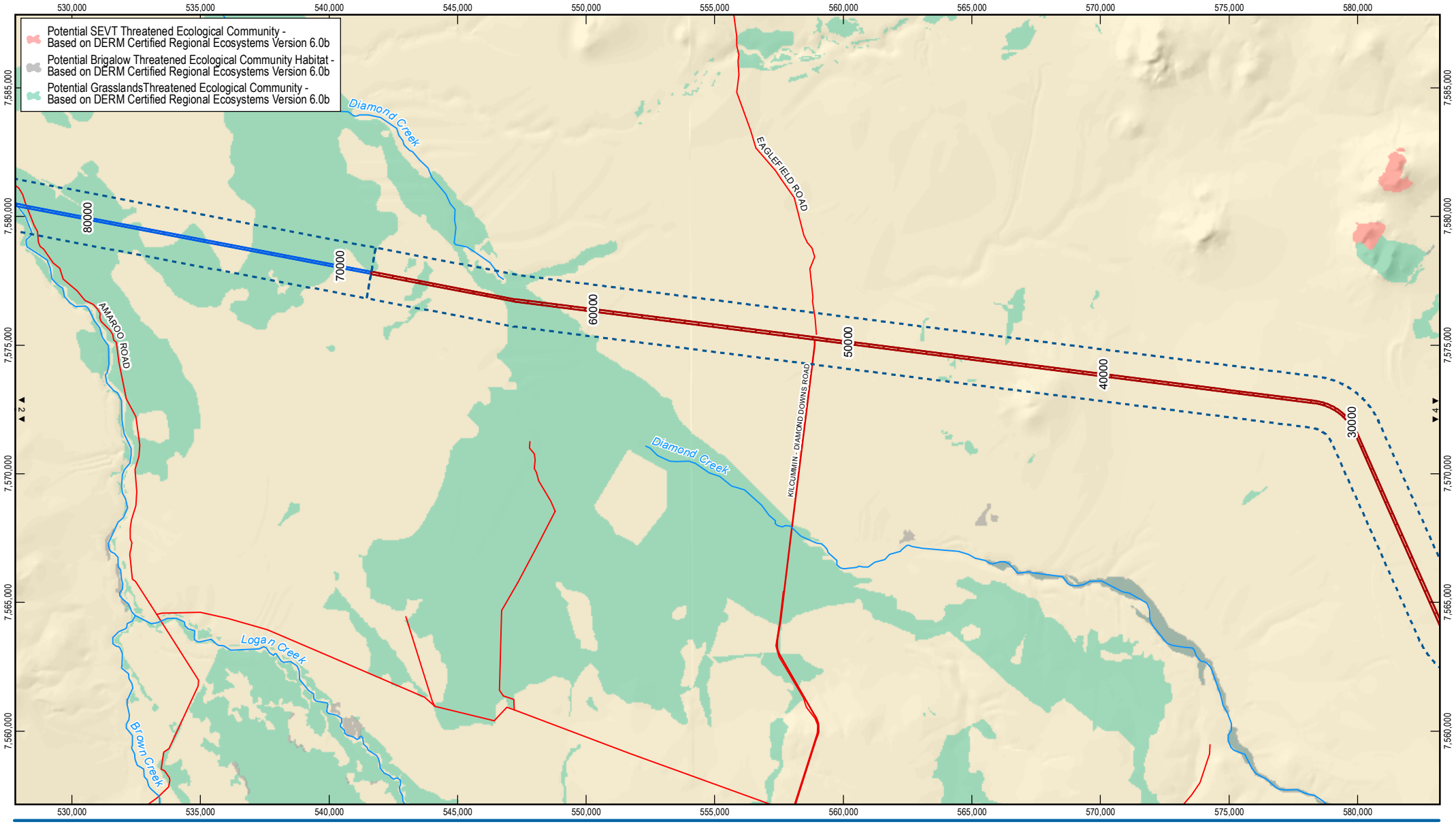

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
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Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
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Figure 5-8
Sheet 3 of 4

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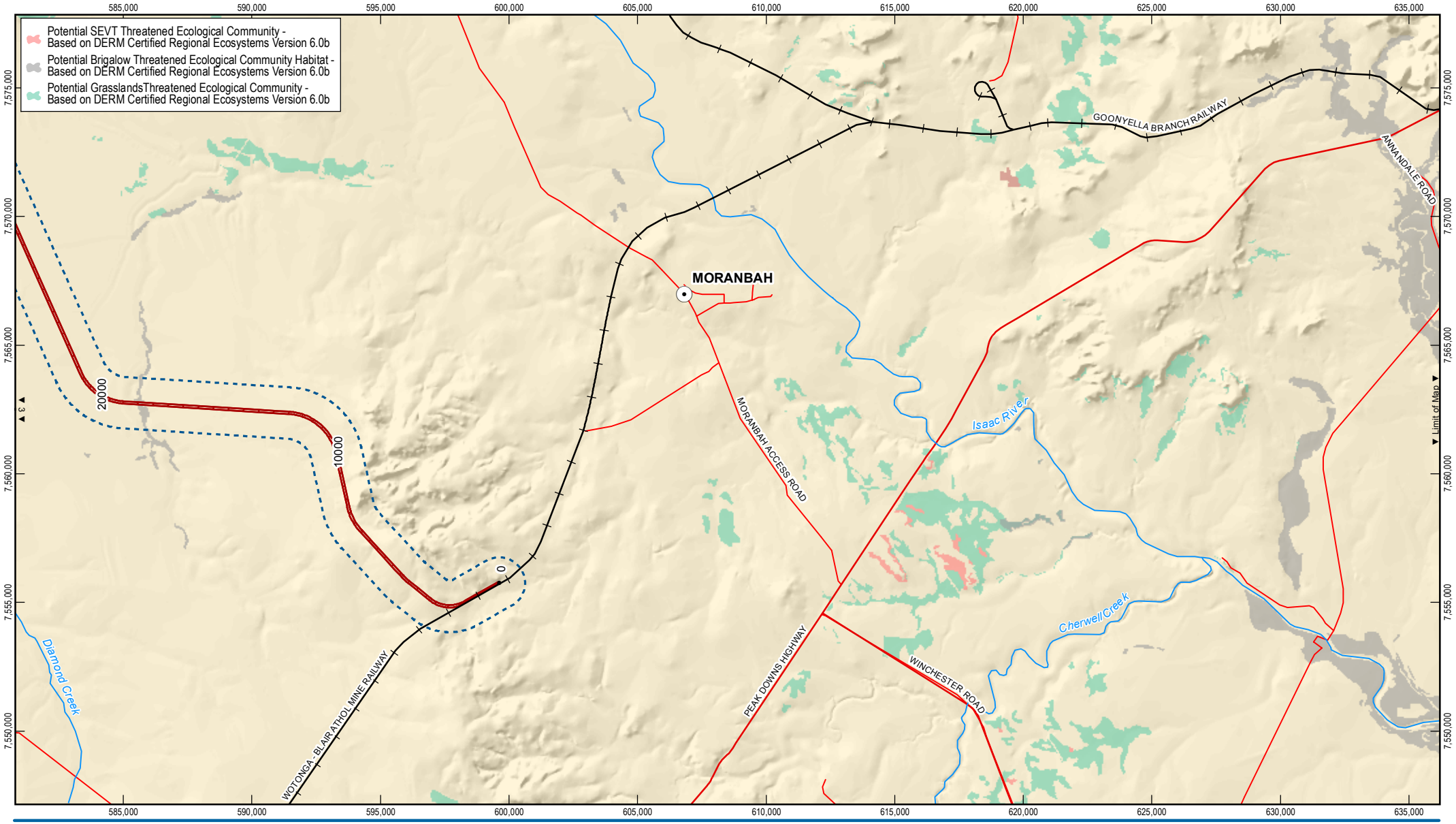

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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

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- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
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Figure 5-8
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G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_469_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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5.2.3.3 Vegetation Communities

In order to provide a broad understanding of the vegetation alliances within the Study Area, a unique (to the Project (Rail)) set of seven broad vegetation communities (BVCs) have been developed. These are based on the particular communities and land forms present within the Study Area. Table 5-6 presents these BVCs, in order of their area of representation within the rail corridor and associated infrastructure and construction camp footprints, and provides a description. Mapping of each BVC is shown in Figure 5-9.

5.2.3.4 Flora Species Diversity

Desktop Results

Searches of the relevant databases and existing reports for the area identified a broad diversity of flora species within the Study Area and broader region:

- Protected Matters Search Tool and Environment Reporting Tool: three threatened flora species, and seven Weeds of National Significance (WONS)
- Wildlife online: 311 vascular taxa of which 26 are introduced species
- HERBRECS: 378 vascular taxa of which 16 are introduced species

Field Survey Results

Field surveys recorded 125 plant taxa, of which 114 were native (91 per cent). Overall, 40 plant families were recorded in the Study Area. The most species rich plant families recorded in the Study Area were: Poaceae (29 taxa); Mimosaceae (9 taxa); Myrtaceae (8 taxa); and Asteraceae (8 taxa).

5.2.3.5 Listed Threatened Flora

The desktop review and Project ToR identified ten threatened flora species with the potential to occur within the desktop search extent encompassing the Study Area:

- *Acacia deuteroneura* - vulnerable EPBC Act and NC Act
- *Acacia ramiflora* - vulnerable EPBC Act
- Black ironbox (*Eucalyptus raveretiana*) - vulnerable EPBC Act and NC Act
- Finger panic grass (*Digitaria porrecta*) – endangered EPBC Act and near threatened NC Act
- King blue-grass (*Dichanthium queenslandicum*) - vulnerable EPBC Act and NC Act
- Marlborough blue cycad (*Cycas ophiolitica*) – endangered EPBC Act and NC Act
- Northern beard heath (*Leucopogon cuspidatus*) - vulnerable EPBC Act
- *Ozothamnus eriocephalus* - vulnerable EPBC Act and NC Act
- *Bonamia dietrichiana* – near threatened NC Act
- *Solanum adenophorum* - endangered NC Act

None of the threatened flora species were recorded within the Study Area and non are considered likely to occur. Threatened flora species are discussed further is Volume 1 Section 13 Matters of National Environmental Significance Report.

Table 5-6 Broad Vegetation Communities within the Study Area

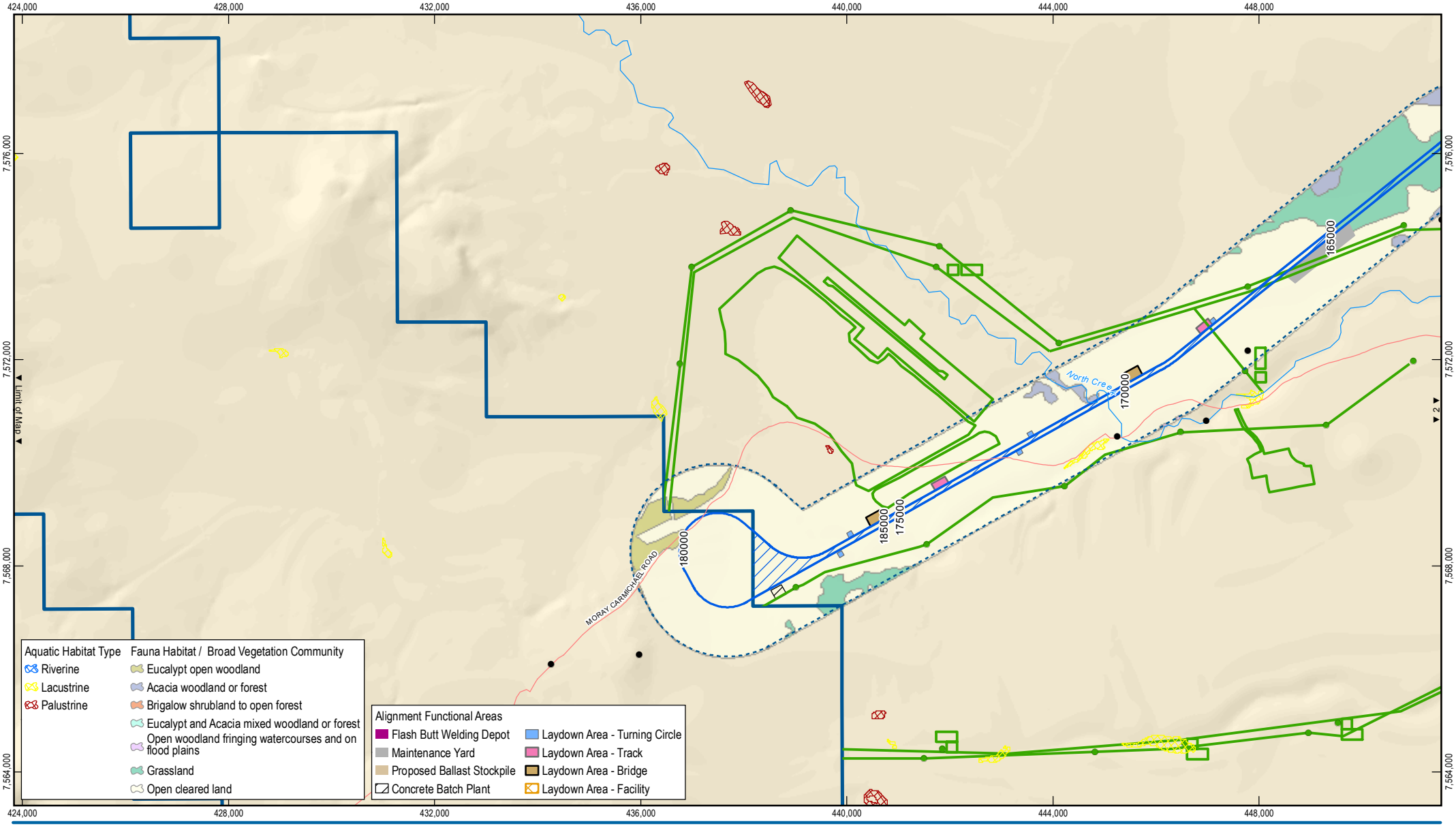
Community name	REs	Landform	Characteristic species	Sites	Comments
Eucalypt open woodland with native grass and shrubby understorey (Eucalypt open woodland)	10.3.28a, 11.3.10, 11.5.3, 11.5.9c, 11.7.3	Level to undulating Tertiary sand plains, sometimes derived from alluvium (10.3.28a, 11.3.10). Soils are cracking clays, clay loams and some sandstone cobble	*Eucalyptus coolabah*, *Terminalia oblongata, Eremophila mitchellii, Acacia salicina, A.excelsa, A. stenophylla, Carissa ovata, Panicum decompositum, Cenchrus ciliaris, Sporobolus* spp., *Aristida calycina.* Eucalypt open woodland BVC representative image: Study Area, May 2011	May Q1, Q2, Q3, Q5, Q6, Q8, Q10, Q11 September Q13, Q16, Q20 	◗ Present over 78.5 ha of the rail corridor and infrastructure and construction camps footprints. ◗ The most common remnant BVC present. ◗ Generally with high native grass species diversity.
Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer	10.3.4b, 11.3.5, 11.4.5, 11.4.6, 11.7.2, 11.10.3	Level to undulating Cainozoic clay plains, generally with heavy, cracking clay soils.	*Acacia cambagei, A. harpophylla, Eremophila mitchellii, Terminalia oblongata, Geijera parviflora, Carissa ovata, Sporobolus disjunctus, Panicum decompositum, Cenchrus ciliaris.*	May Q4 September Q14, Q17, Q18, Q21, Q22, Q23, Q24	◗ Present over 46.8 ha of the rail corridor and infrastructure and construction camps footprints. ◗ Generally in relatively high quality, intact large patches. ◗ Gidgee woodlands were the most dominant acacia woodland observed.

Community name	REs	Landform	Characteristic species	Sites	Comments
(Acacia woodland or forest)			Acacia woodland or forest BVC representative image: Study Area, September 2011.		
Brigalow shrubby woodland or open forest typically on clay and clay loam plains (Brigalow shrub land to open forest)	11.3.1, 11.4.9, 11.11.13,	Level to undulating Cainozoic clay plains, generally with heavy, cracking clay soils.	*Acacia harpophylla, Eucalyptus coolabah, A. cambagei, Flindersia dissosperma, Terminalia oblongata, Eremophila polyclada, Carissa ovata, Sporobolus disjunctus, Bothriochloa pertusa.* Brigalow shrubland to open forest BVC representative image: Study Area, May 2011	May No sites September Q15	◗ Present over 34.9 ha of the rail corridor and infrastructure and construction camps footprints. ◗ Observed at one site during surveys in small and discontinuous patches of moderate quality. 

Community name	REs	Landform	Characteristic species	Sites	Comments
Eucalypt and acacia mixed woodland or forest often on clay soils (Eucalypt and Acacia mixed woodland or forest)	11.4.8, 11.9.10, 11.11.19	Mostly level to undulating Cainozoic clay plains, generally with heavy, cracking clay soils. Occasionally found on sedimentary rocks with varying degrees of metamorphism and folding.	*Eucalyptus thozetiana, E. coolabah, Acacia cambagei, A. harpophylla, Eremophila* spp., *Enchylaena tomentosa, Cenchrus ciliaris, Panicum decompositum, Cyperus polystachyus* Eucalypt and Acacia mixed woodland or forest BVC representative image: Study Area, September 2011.	May Q9 September Q19	◗ Present over 3.9 ha of the rail corridor and infrastructure and construction camps footprints. ◗ Generally in relatively high quality patches 
Riparian woodland or forest fringing watercourses, and Coolabah open woodland on grassy floodplain often with weedy understorey	11.3.3, 11.3.4, 11.3.7, 11.3.25	Watercourse banks, meander plains and flood plains. Soils are sandy or clay alluvium.	*Eucalyptus camaldulensis, E. coolabah, Melaleuca* spp., *Terminalia oblongata, Acacia salicina, Eremophila bignoniiflora, Panicum decompositum, Paspalidium distans, Lomandra longifolia, Heteropogon contortus.*	May Q7 September Q12,	◗ Present over 164.7 ha of the rail corridor and infrastructure and construction camps footprints (along watercourses). ◗ ◗ Riparian zones of relatively high quality where weeds and localised disturbance (i.e. cattle crossings) not present ◗ This community was observed along the Belyando River and at Mistake Creek.

Community name	REs	Landform	Characteristic species	Sites	Comments
(Open woodland fringing watercourses and on flood plains)			Open woodland fringing watercourses and on flood plains BVC representative image: Study Area, May 2011. 		
Native grassland with absent woody canopy or shrub layer (Grassland)	11.4.4, 11.4.11	Generally located on clay plains in lower catchment positions	No species data Grassland BVC representative image: Study Area, September 2011. 	No sites though potential grasslands were noted during surveys	◗ Present over 137 ha of the rail corridor and infrastructure and construction camps footprints. ◗ Assessments not undertaken due to the timing of surveys (late post wet season), which was not ideal for obtaining maximum species diversity or identification of non-flowering plants when sampling.

Community name	REs	Landform	Characteristic species	Sites	Comments
Open, previously cleared areas lacking native remnant vegetative cover and/or with patchy regrowth (Open cleared land & regrowth)	Non-remnant	Generally located on clay plains in lower catchment positions across most of the Study Area, particularly in the eastern extent.	Buffel grass (*Cenchrus ciliaris*)	No sites	◗ Covers 1502 ha of the rail corridor and infrastructure and construction camps footprints , (primarily on the more fertile clay plains). ◗ Generally contains low habitat value for flora and fauna, and has high levels of disturbance (grazing, weed invasions) present. ◗ Dominant particularly at the eastern extent of the Study Area.  Open cleared land and regrowth representative image



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Kilometres

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Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Investigation Areas
- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Broad Vegetation Communities and Terrestrial and Aquatic Fauna Habitat Types

Job Number 41-25215
Revision E
Date 14-09-2012

Figure 5-9
Sheet 1 of 7

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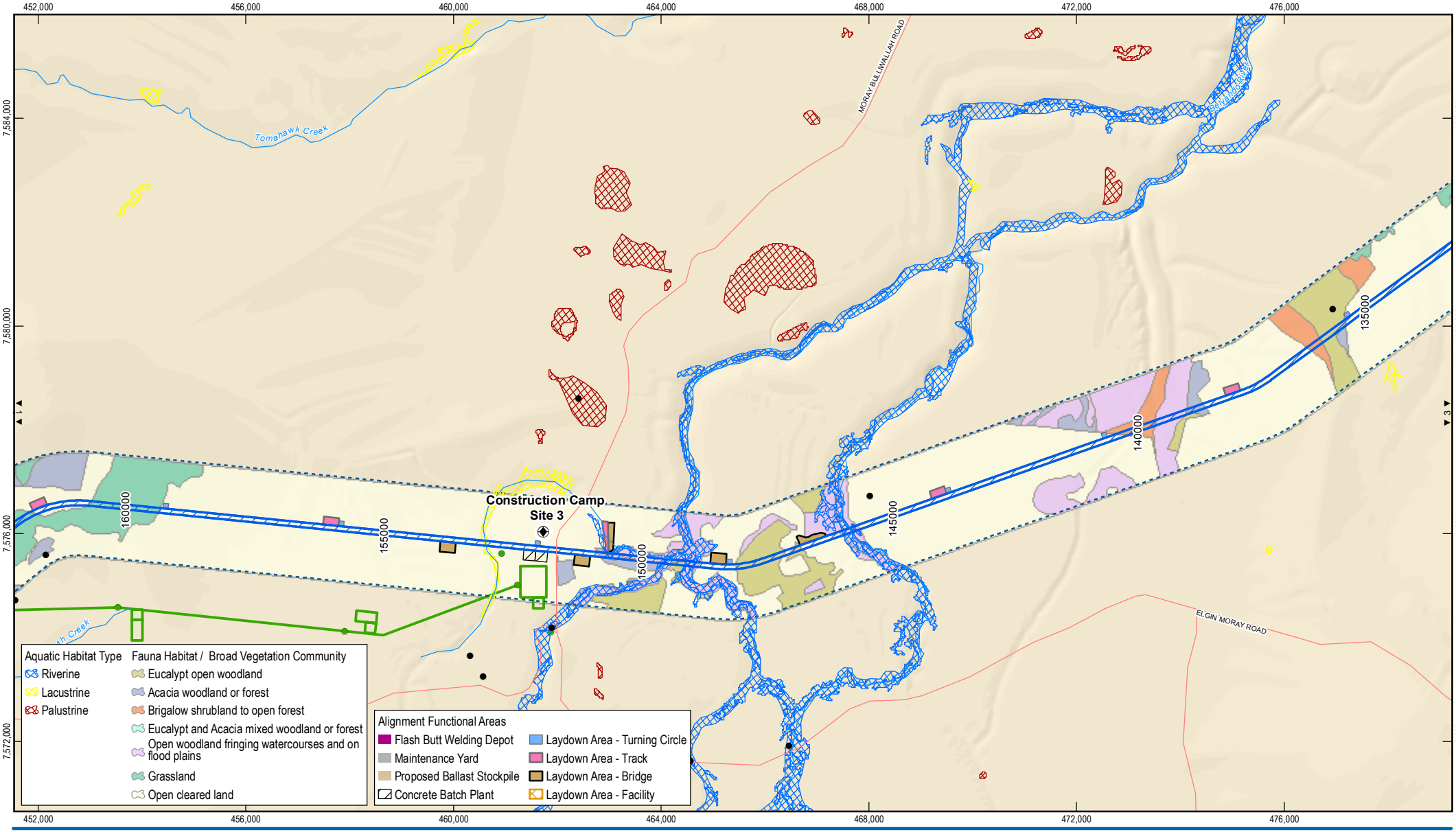
Data source: DERM: DEM (2008), Aquatic Habitat Type, Fauna Habitat / Broad Vegetation Type (2009); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Fauna Habitat Type (2011); Adani: Alignment Opt9 Rev3, Investigation Areas (2012); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010)/EPC 1080(2011). Created by: BW, MS, CA



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Kilometres

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Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Investigation Areas
- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Broad Vegetation Communities and Terrestrial and Aquatic Fauna Habitat Types

Job Number 41-25215
Revision E
Date 14-09-2012

Figure 5-9
Sheet 2 of 7

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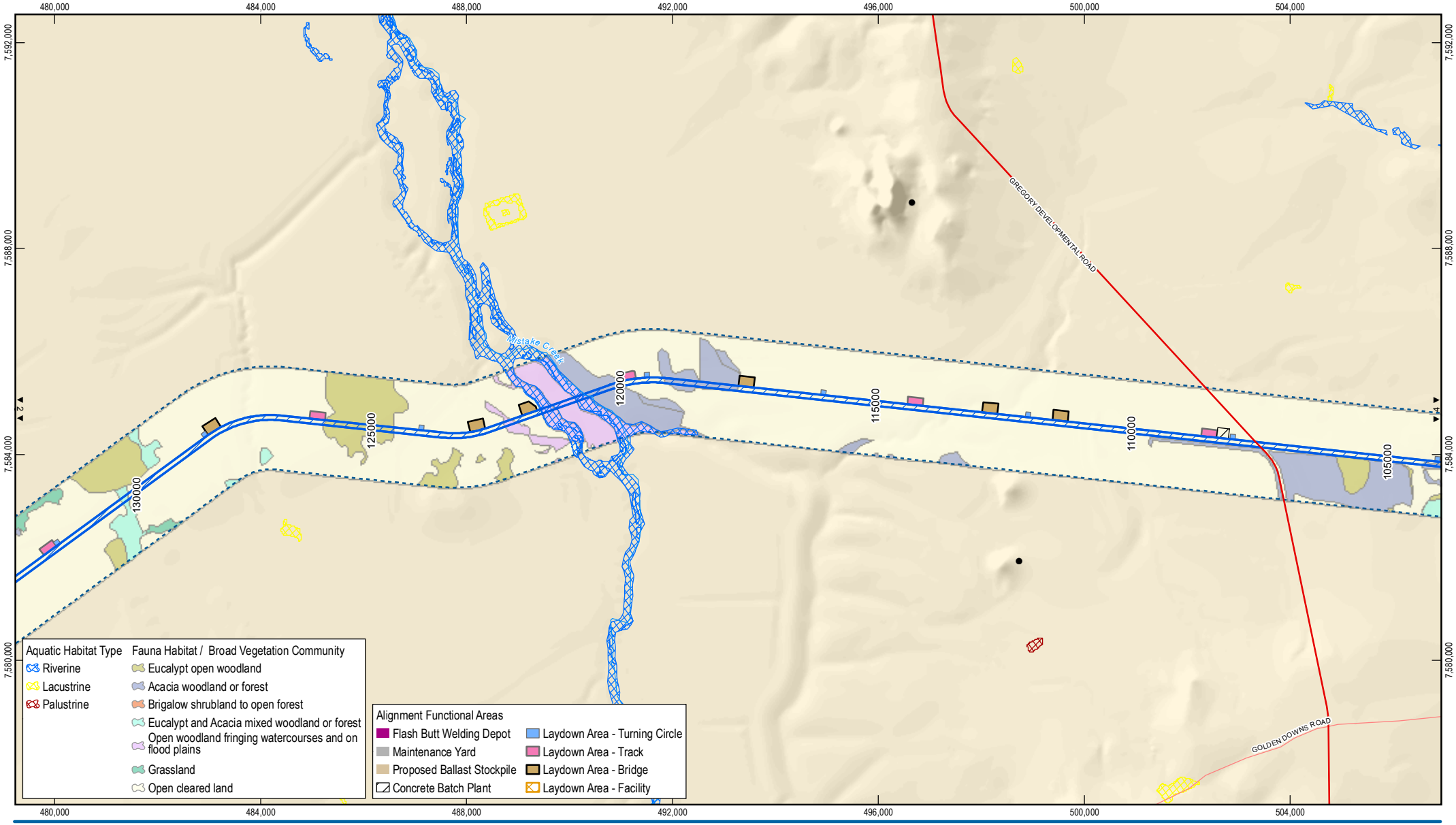
Data source: DERM: DEM (2008), Aquatic Habitat Type, Fauna Habitat / Broad Vegetation Type (2009); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Fauna Habitat Type (2011); Adani: Alignment Opt9 Rev3, Investigation Areas (2012); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010)/EPC 1080(2011). Created by: BW, MS, CA



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Investigation Areas
- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

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Broad Vegetation Communities and Terrestrial and Aquatic Fauna Habitat Types

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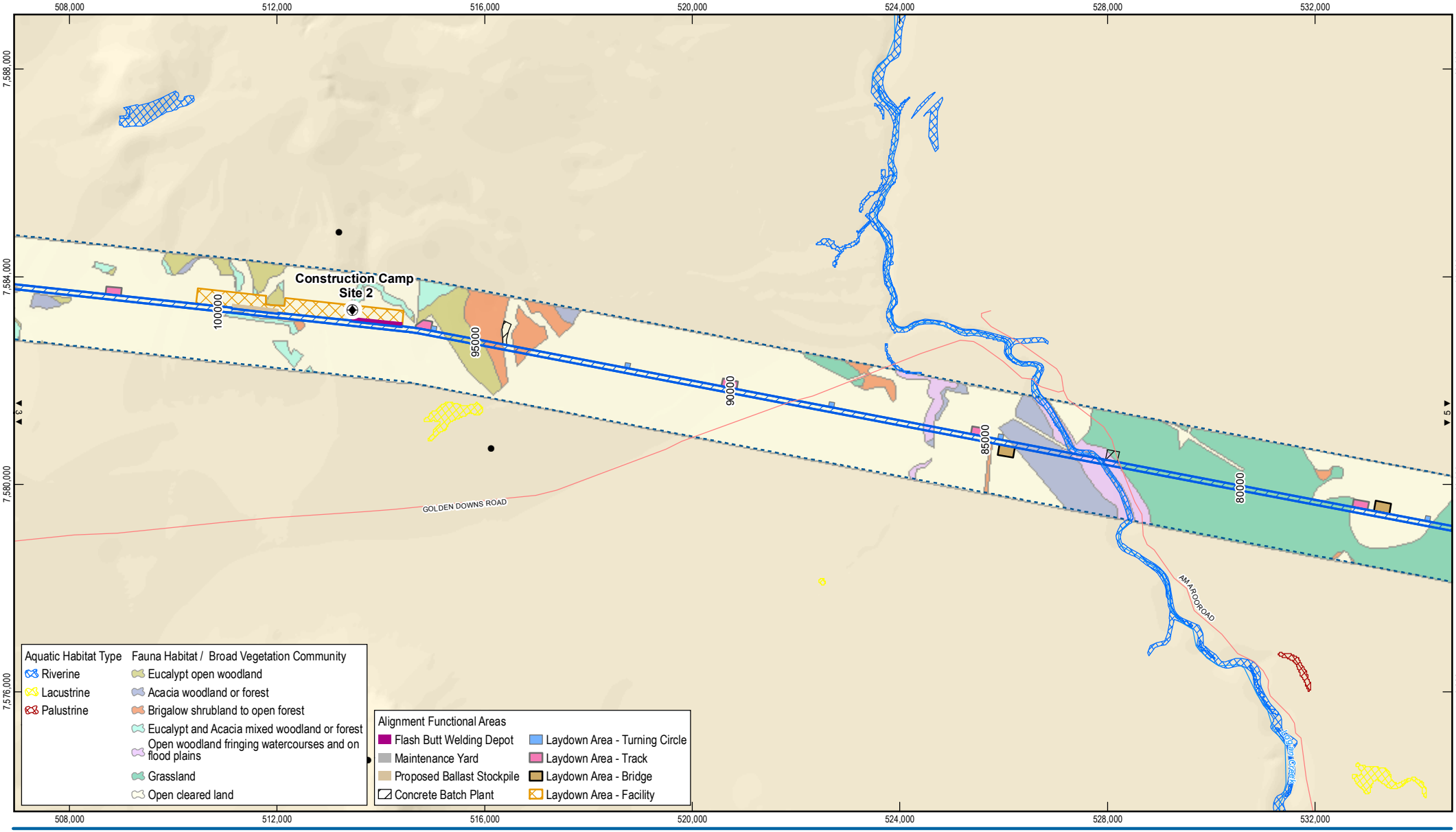

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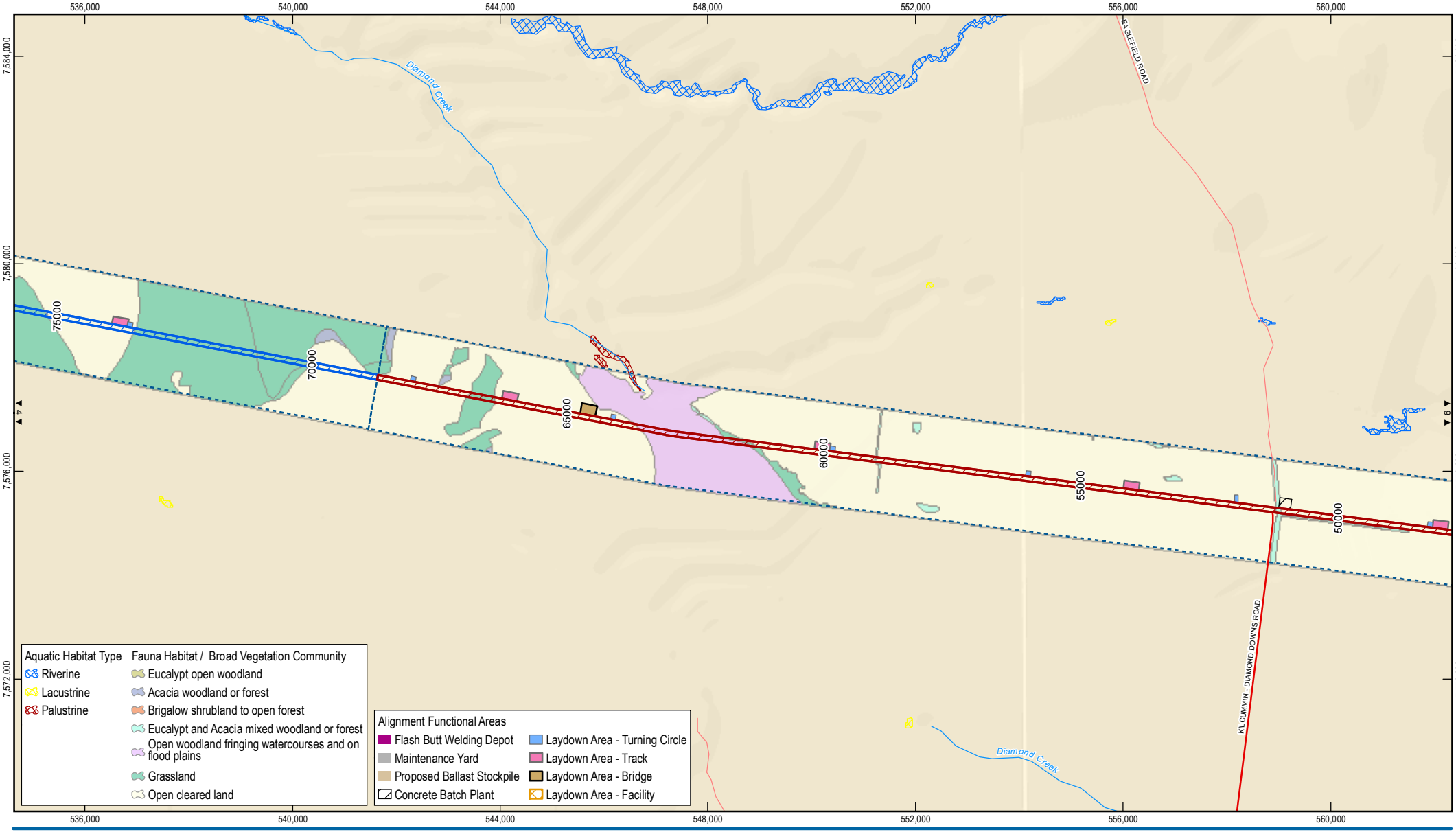

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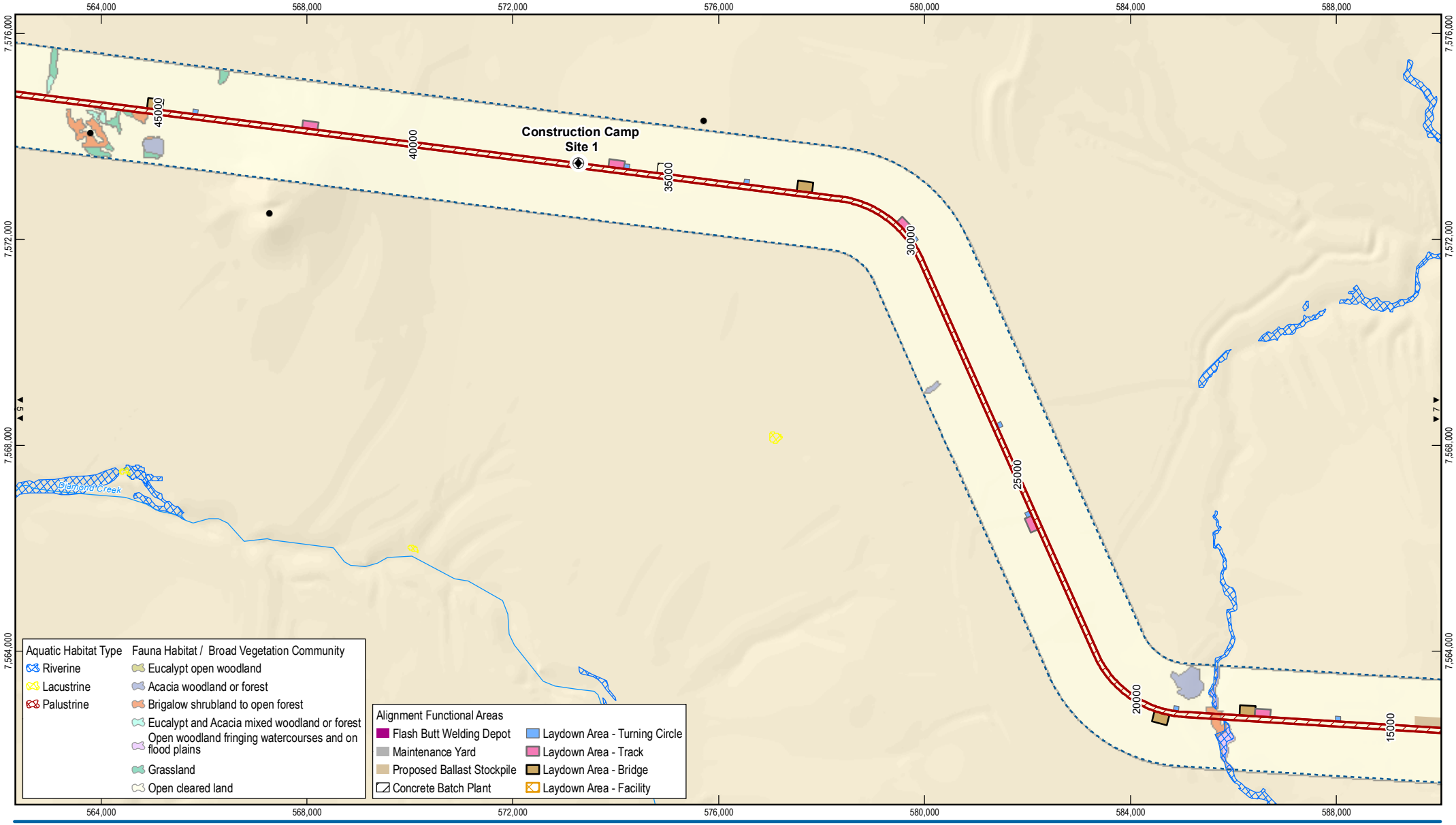

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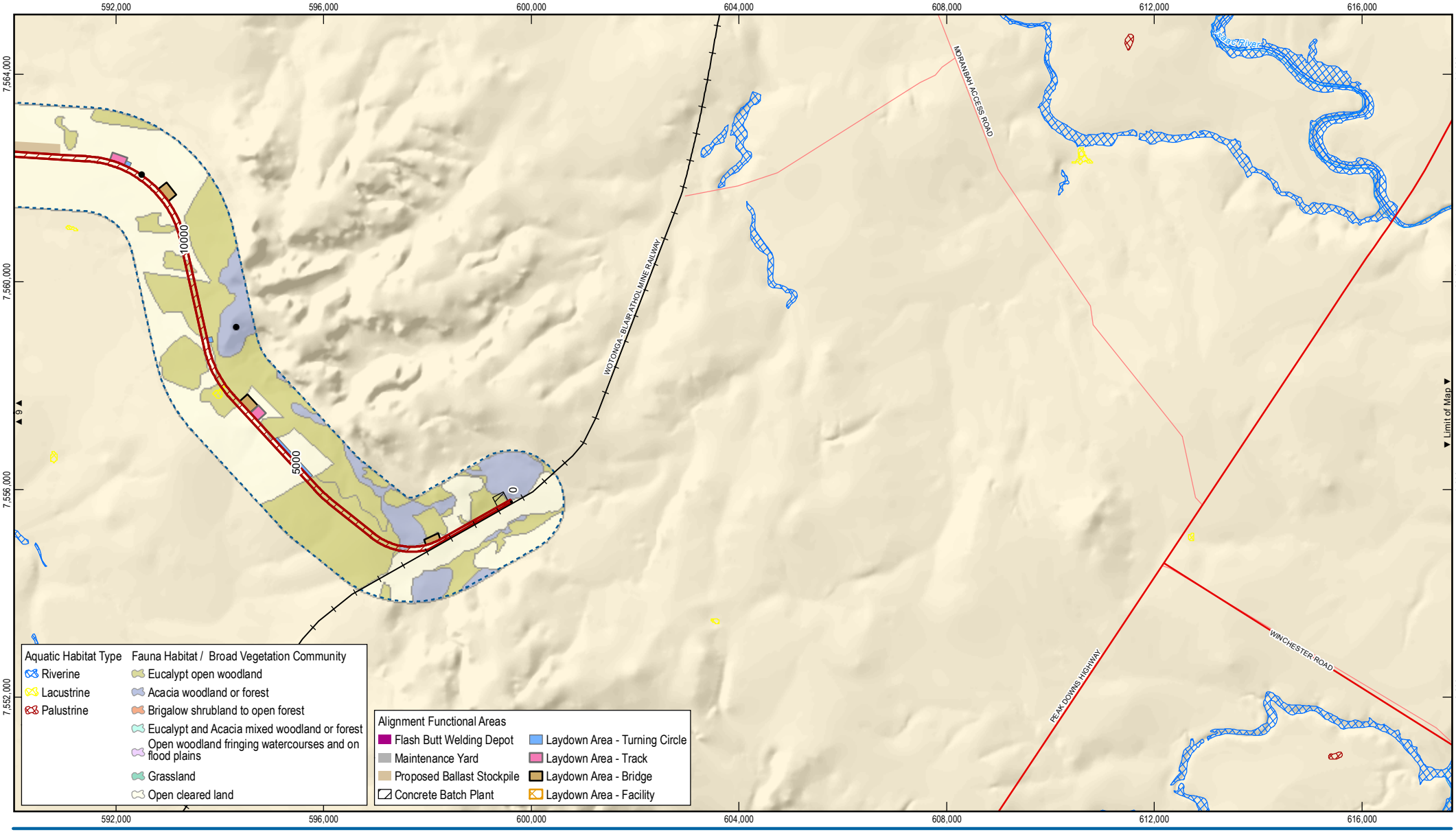

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5.2.3.6 Exotic or Weed Flora Species

The desktop review for weed species identified 15 species of 'declared plants' under the LP Act that have been previously recorded within the search extent or that have a species' distribution that overlaps with the Study Area.

During the field surveys 11 exotic species were recorded, of which three species are 'declared plants' under the LP Act. These species are listed in Table 5-7.

Table 5-7 Declared Plants recorded within the Study Area

Scientific Name	Common Name	Study Area Distribution
Class 2*		
Opuntia sp. (most likely *O. stricta* or *O. tomentosa*)	prickly pear	Brigalow and gidgee patches as single individuals
Harrisia martinii	harrisia cactus	Brigalow, gidgee and coolabah woodlands as single individuals
Parthenium hysterophorus	parthenium	Non-remnant areas, coolabah woodlands, brigalow, generally in mid-dense clusters

***** LP Act Class two declared plants

5.2.3.7 Communities of Cultural, Commercial or Recreational Significance

Strategic cropping land (SCL) is an important, finite resource that is subject to competing land uses from the agriculture, mining and urban development sectors. The government controls this land such that a balance is achieved between these sectors to help maintain the long-term viability of our food and fibre industries, and support economic growth for regional communities.

Field surveys did not identify any active horticultural activities within the Study Area. However, small areas of SCL (management area) have been mapped within the rail corridor (115 ha). The majority of SCL (management area) is located near the east end of the corridor. Refer to Volume 4 Appendix Y Rail Soils Assessment and Volume 4 Appendix Z Rail Land Use Report for detailed information on strategic cropping land within the Study Area. Additionally, 11 protected areas exist within 50 km of the Study Area. These areas have value for recreational activities (hiking, camping, etc.) as well as the potential to support culturally significant plant communities, such as grass trees.

5.2.4 Terrestrial Fauna

5.2.4.1 Fauna Habitats

In general, the Study Area occurs in a region in which native vegetation has been extensively cleared and fragmented by pastoral land-use. Field observations made in accessible areas of the Study Area were consistent with this assessment. Much of the Study Area investigated contains extensive areas of cleared grazing land which has relatively low ecological value for native wildlife (Hannah *et. al.,* 2007). Nonetheless, the Study Area retains a variety of intact stands of remnant native vegetation particularly in association with watercourses and creek lines. The area of remnant vegetation within the Study Area covers approximately 8,652 ha accounting for a total of 23.4 per cent of the Study Area.

Areas of remnant vegetation have typically moderate ecological value, providing refuges for native plants and animals. These remnants are subject to cattle grazing and their relative habitat value varies greatly depending on the intensity of local grazing pressure and weed infestation. In general, weeds and exotic pasture grasses were abundant and widespread throughout the Study Area with many of the surveyed remnants of native vegetation having moderate to high levels of disturbance. The riparian zones adjacent to creek lines and watercourses typically contained a moderate abundance and diversity of weeds and localised areas were subjected to damage from cattle trampling, soil compaction and erosion (refer Plate 5-1). Despite signs of disturbance (such as weeds and cattle trampling) this riparian habitat provides landscape connectivity that allows local movement of native fauna.

Plate 5-1 Watercourse Condition

Source: GHD, September 2011. Water course disturbance due to cattle trampling (left) and localised degradation (e.g. erosion) (right).

Areas of brigalow regrowth were encountered within the survey extent of the Study Area (refer Plate 5-2). At the time of survey these areas had relatively low habitat value. These areas have been subject to extensive clearing in recent years and therefore do not currently contain sufficient complexity to provide habitat for many native wildlife species. They have the potential to increase in value in future years as brigalow vegetation regenerates and structural complexity at the shrub and understorey layer increases (Bowen *et. al.*, 2009).

Plate 5-2 Patches of Brigalow Regrowth

Source: GHD, September 2011.

Marked seasonal variability in the structure and composition of fauna habitat types was not observed across the Study Area between the autumn and spring surveys (in May and September, respectively). Such changes would only be expected in grassland and riparian habitats. Both survey efforts exhibited dry conditions typical for the time of year which corresponds with the beginning and end of central Queensland's typical dry season.

In general, the ecological value of habitat types varied with the level of grazing pressure and weed infestation affecting the understorey. Eight broad fauna habitat types were identified during the May and September surveys. The general characteristics of these broad habitat types are summarised in Table 5-7. The spatial distribution of fauna habitats at the Study Area is presented in Figure 5-9. The fauna habitats generally correspond with the vegetation communities identified in Section 5.2.3.

With respect to fauna habitats, it is considered likely that:

- Availability of forage resources for herbivorous animals (i.e. grazers, nectarivores, grainivores and folivores) is likely to be seasonally variable, and driven by local climatic conditions. This may result in variable use of different habitats by resident and sedentary species during the year and temporary occupancy in response to availability of forage resources by nomadic and migratory species.
- Availability of prey for predators may change during the year in response to variable densities and diversity of herbivorous animals.
- The extent of habitat for semi-aquatic species (e.g. amphibians, water birds) is likely to fluctuate during the year in response to rainfall. Large water bodies (e.g. some farm dams) that retain water throughout the year may become localised nodes for water birds in response to regional reduction in extent of aquatic habitat during dry seasons.
- Microhabitats are likely to vary during the year in response to changes in climate (such as reduced ground cover during the dry season).
- Less predictable forces such as fire and flooding may alter the availability of important habitat resources for ground-dwelling/ground-foraging animals and arboreal animals.

Table 5-8 Fauna Habitat Types at Study Area

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Eucalypt open woodland with native grass understorey (Eucalypt open woodland*)	Eucalypt open woodland typically comprises a low to moderate density canopy layer, sparse to absent shrub layer and ground layer of typically native (sometimes mixed with non-native) grasses. These areas provide a diversity of microhabitats, particularly at the ground and understorey level and provide foraging resources for folivorous mammals, nectarivorous mammals and birds, granivores, insectivorous mammals, reptiles and birds, and grazing mammals. Species diversity was generally moderate, supporting a variety of woodland birds, possums, gliders, macropods and ground-dwelling reptiles and mammals (such as bandicoots and echidnas). Eucalypt open woodland provides potentially suitable habitat for predators including birds of prey, snakes and dingos. Shelter resources within Eucalypt open woodland include occasional hollows in mature eucalypts (density dependent on age of woodland and tree species), log piles, dense ground cover and leaf litter. Ephemeral waterways and drainage lines are often associated with this habitat type. Permanent water is present occasionally in the form of farm dams and troughs. Average tree hollow density* = 34 per cent (0 - 80) (n=7)	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ grey falcon ◗ black-throated finch ◗ greater long-eared bat ◗ northern quoll Confirmed habitat for: ◗ little pied bat ◗ squatter pigeon	 Eucalypt open woodland within Study Area, May 2011.  Eucalypt open woodland within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer (Acacia woodland or forest)* **<u>May sites</u>** **Rapid: 0** **<u>September sites</u>** **Rapid: 4**	Isolated remnants of mixed acacia woodland occur in a number of locations within the Study Area, can comprise a sparse to dense canopy layer. Typically it comprises a sparse shrub layer, with a ground layer of native (sometimes introduced) grasses. This habitat type supports a high diversity of wildlife including canopy, shrub and ground-dwelling birds, macropods, echidnas, bandicoots, tree-frogs and a range of reptiles. Good foraging resources are available for nectarivorous mammals and birds, granivores and insectivores Acacia woodland or forest provides suitable habitat for predators including birds of prey, snakes and dingos. Shelter resources within Acacia woodland or forest includes log piles and shed bark, decorticating bark and cracking soils. There are few hollows. Gilgais are often associated with this habitat type – seasonal and localised water habitat resource Average tree hollow density* = 0 per cent (n= 2)	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ Dunmall's snake	 Acacia woodland or forest within Study Area, September 2011.  Acacia woodland or forest within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Brigalow shrubby woodland or open forest typically on clay and clay loam plains (Brigalow shrubland to open forest*) **<u>May sites</u>** **Rapid: 0** **<u>September sites</u>** **Rapid: 0**	Patches of brigalow forest occur in a number of locations within the Study Area and typically comprise a mid-dense to dense canopy layer. The shrub layer is often sparse, if not entirely absent, with a ground layer of typically introduced grasses. This habitat type supports a diversity of wildlife including canopy, shrub and ground-dwelling birds, macropods, echidnas, bandicoots and a range of reptiles. Suitable habitat is provided by this habitat type for predators such as snakes and dingos. Shelter resources within brigalow shrubland to open forest include log piles and shed bark, decorticating bark and cracking soils. No hollows are present. Gilgais and/or drainage channels are often associated with this habitat type – seasonal and localised water habitat resource Average tree hollow density* = 0 per cent (n=1)	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ Dunmall's snake	 Brigalow shrubland to open forest within Study Area, May 2011.  Brigalow shrubland to open forest within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Eucalypt and Acacia mixed woodland or forest often on clay soils (Eucalypt and Acacia mixed woodland or forest*) **<u>May sites</u>** **Rapid: 0** **<u>September sites</u>** **Rapid: 1**	This habitat type comprises an open to mid-dense canopy layer with a sparse shrub layer often with regrowth *Acacia* spp. It has a ground layer of native (less often introduced) grasses. These areas provide a diversity of microhabitats, and provide foraging resources for folivorous mammals, nectarivorous mammals and birds, granivores, insectivorous mammals, reptiles and birds, and grazing mammals. Predators within Eucalypt and Acacia mixed woodland or forest include birds of prey, monitors, snakes and dingos. Shelter resources in this habitat include log piles and shed bark, decorticating bark and cracking soils and to a small degree leaf litter. There are few hollows typically present in eucalypt trees. Gilgais are sometimes associated with this habitat type which can provide a seasonal water source and localised habitat. Small drainage lines also occasionally present Average tree hollow density* = 15 per cent (0 – 30) (n=2)	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ black-throated finch ◗ greater long-eared bat ◗ northern quoll Confirmed habitat for: ◗ little pied bat ◗ squatter pigeon	 Eucalypt and Acacia mixed woodland or forest within Study Area, September 2011.  Eucalypt and Acacia mixed woodland or forest within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey (Open woodland fringing watercourses and on flood plains*) **<u>May sites</u>** **Comprehensive: 2** **Rapid: 8** **<u>September sites</u>** **Rapid: 1**	This habitat type is restricted to the riparian zone and the adjacent floodplain of rivers and major creeks. The canopy layer is open with a sparse or absent shrub layer. Ground cover is often dense immediately adjacent to creek lines with a mix of grasses and sedges and patches of weed infestation. The substrate is typically sandy. This habitat type provides nesting and feeding sites for woodland birds, hollows and blossoms for possums and gliders and shelter and food for macropods. The abundance of weeds and seasonal inundation reduces the diversity of microhabitats available in the understory. Forage resources are available for folivorous mammals, nectarivorous mammals and birds, granivores, insectivorous mammals, reptiles and birds, and grazing mammals. Predators include birds of prey, snakes and dingos Mature *Eucalyptus coolabah* support a relatively high density of hollows. Other shelter resources include log piles (flood debris), shed bark and in places, dense ground cover. Average tree hollow density* = 44 per cent (13 – 69) (n=3)	Potential suitable habitat for listed species including: ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ grey falcon ◗ black-throated finch ◗ greater long-eared bat ◗ black-necked stork Confirmed habitat for: ◗ little pied bat ◗ squatter pigeon	 Open woodland fringing watercourses and on flood plains habitat within Study Area, May 2011.  Open woodland fringing watercourses and on flood plains habitat within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Native pastures or grassland with absent canopy or shrub layer (Grassland*) **<u>May sites</u>** **Rapid: 1** **<u>September sites</u>** **Rapid: 0**	A large patch of native grassland occurs within the central portion of the Study Area. Native grasses provide suitable habitat for grass-dwelling birds such as quails and pipits, as well as snakes and reptiles and larger fauna such as macropods, birds of prey, emus and bustards Foraging resources suitable for some granivores and insectivores, and grazing mammals are available. Predators include birds of prey, snakes and dingos Shelter resources are limited, although log piles resultant from historic clearing are likely to shelter grassland reptile species Average tree hollow density* = NA	Potential suitable habitat for listed species including: ◗ squatter pigeon ◗ black-throated finch	 Grassland within Study Area, September 2011.  Grassland within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Open, previously cleared areas lacking native remnant vegetative cover and/or with patchy regrowth (Open cleared land and regrowth*) **<u>May sites</u>** **Rapid: 0** **<u>September sites</u>** **Rapid: 1**	Grazing areas are the dominant habitat type within the Study Area. These areas are characterised by the absence of canopy and shrub-level vegetation and the presence of a pasture grass-dominated ground layer, typically dominated by introduced buffel grass. Forage resources are limited, although habitat supports some granivores and insectivores, and grazing mammals. Predators include birds of prey, snakes and dingos. Shelter resources are limited, although log piles resultant from historic clearing are likely to shelter grassland reptile species. Average tree hollow density* = NA	Potential suitable habitat for listed species including: ◗ squatter pigeon	 Open cleared land and regrowth habitat within Study Area, May 2011.  Open cleared land and regrowth habitat within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Natural and artificial water bodies (Natural and artificial water bodies) **<u>May sites</u>** **Rapid: 2** **<u>September sites</u>** **Rapid: 1**	Natural waterways include rivers, wetlands, creeks and gilgai while artificial water bodies include numerous small to large farm dams. Water bodies (and adjacent vegetation) provide a drinking resource for numerous animal species and breeding habitat for some (i.e. amphibians, some birds). Natural waterways in some places contained emergent and submerged macrophytes which provide food and nesting sites for aquatic birds, calling substrates for frogs and shelter for fish and crustaceans. This habitat type provides foraging habitat for predatory species including some birds of prey and some snakes. Average tree hollow density* = NA	Potential suitable habitat for listed species including: ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ little pied bat ◗ squatter pigeon ◗ black-throated finch ◗ Australia painted snipe ◗ black-necked stork ◗ cotton pygmy-goose	 Natural and artificial water bodies habitat within Study Area, May 2011.  Natural and artificial water bodies habitat within Study Area (farm dam), May 2011.

* Average tree hollow density = number of trees with hollows/number of trees counted during a random meander throughout the site (range of values presented) (n = number of sites where hollows counted).
[#]indicates the BVC (refer Table 5-6) that coincides with the broad habitat type.

5.2.4.2 Fauna Species Diversity

Desktop Results

A review of the Wildlife Online, Queensland Museum and Birds Australia databases revealed that 238 terrestrial fauna species have been previously recorded from the Study Area and broader region, comprising:

- 13 amphibian species (12 native least concern species, one pest species)
- 49 reptile species (48 native least concern species, one pest species)
- 35 mammal species (27 native least concern species, two threatened species, six pest species)
- 141 bird species (136 native least concern species, four threatened species, one pest species)

Field Survey Results

The number of fauna species detected in field surveys was low and, in general, the fauna recorded were relatively common species. The number of species recorded should be considered a conservative estimate of the total number of fauna species potentially present Cool, dry and windy conditions are likely to have subdued the activity of birds, amphibians, bats and reptiles and reduced the number of species detected.

A total of 92 fauna species were identified in the May field survey and a total of 91 identified in the September field survey. The results of the field studies across the Study Area are presented in Table 5-9.

Table 5-9 Summary of Terrestrial Fauna Field Assessment Results

		Amphibians	Reptiles	Mammals	Birds	Total
May 2011 Survey	Total species	2 (4)*	8 (5)	18 (12)	64 (70)	92 (91)
	Pest species	1 (1)	-	4 (1)	-	5 (2)
	Threatened species	-	-	1	- (1)	1 (1)
	EPBC Act migratory	-	-	-	- (1)	- (1)
	EPBC Act marine	-	-	-	5 (9)	5 (9)
		Amphibians	**Reptiles**	**Mammals**	**Birds**	**Total**
Total (both surveys)	Total species	5	10	20	94	129
	Pest species	1	0	4	-	5
	Threatened species	-	-	1	1	2
	EPBC Act migratory	-	-	-	2	2
	EPBC Act marine	-	-	-	11	11

*Bracketed numbers indicate September survey results

Fauna diversity by fauna habitat type across both survey events is summarised in Table 5-10. It is important to note that this data only includes species records from comprehensive survey sites (two sites in 'open woodland fringing watercourses and on floodplains' habitat type), habitat assessment sites and Anabat survey sites and does not include data collected from opportunistic recordings. Additionally, only five of the eight described habitat types were sampled during survey events.

A low diversity and abundance of species was recorded from non-remnant vegetation. This is likely due to the low quality and low diversity of microhabitat available within non-remnant vegetation (e.g. pasture grasslands). Additionally, eucalypt and acacia mixed woodland and forest habitat recorded low diversity and abundance of fauna species, comparable to non-remnant habitats. These communities frequently appeared as regrowth or young growth forests with minimal structural diversity and an absence of tree stags and hollow logs.

Open woodland fringing watercourses and on floodplains recorded the greatest number of each group of fauna species. This habitat is often diverse in terms of the flora species available, and hence, structural diversity and habitat availability. Additionally, tree stags may be abundant in old eucalypts and litter on the ground can be abundant from past flood events. These factors provide habitat for a range of fauna species (e.g. owls (stags) and lizards (litter)).

Table 5-10 Fauna Diversity by Habitat Type

	Eucalypt open woodland	Grassland	Open woodland fringing watercourses and on floodplains	Acacia woodland	Eucalypt and acacia mixed woodland or forest	Non-remnant
Amphibians	1	0	3	0	0	0
Reptiles	1	1	10	0	0	0
Mammals	2	1	14	1	3	0
Birds	30	19	65	26	8	7
Total species	**34**	**21**	**92**	**27**	**11**	**7**

Fauna species recorded during the field survey included:

- Amphibians - Five amphibian species from three families were recorded from the Study Area over both field surveys. No species of conservation significance were detected. One pest species (cane toad (*Rhinella marina*) was recorded. Species encountered included three common tree frogs (genus *Litoria*) from the family Hylidae, and one ground-dwelling frog from the family Myobatrachidae, the spotted grass frog (*Limnodynastes tasmaniensis*). Plate 5-3 shows the green tree frog (*Litoria caerulea*) recorded during the field surveys.
- Reptiles - A total of ten reptile species from four families were recorded from the Study Area during field investigations. No reptiles of conservation significance were detected. No pest species were recorded. Skinks dominated the reptile diversity, with six species from the family Scincidae recorded.

Of these, the most commonly encountered species were *Carlia munda* and wall skink (*Cryptoblepharus virgatus*). Other reptile species encountered included the dubious gecko (*Gehyra dubia*) (Plate 5-4), blue-tongue (*Tiliqua scincoides*), Tommy round-head (*Diporiphora australis*), black-headed python (*Aspidites melanocephalus*) and yellow-faced whip-snake (*Demansia psammophis*).

- Mammals - A total of 20 mammal species from nine families were recorded from the Study Area during field investigations. Two species of State significance were detected, namely, the near threatened little pied bat and the echidna which is listed as special least concern. Other ground-dwelling mammals observed included the red kangaroo (*Macropus rufus*) and eastern-grey kangaroo (*Macropus giganteus*). Although, hollow-bearing trees were recorded across much of the Study Area, the only arboreal mammal recorded during the field surveys was the brushtail possum (*Trichosurus vulpecula*). Anabat detectors positively identified 12 species of microchiropteran bats. Five mammal pest species were recorded from the Study Area: the pig (*Sus scrofa*) (Plate 5-5), dog (*Canis familiaris*), cat (*Felis catus*), European fox (*Vulpes vulpes*), and European rabbit (*Oryctolagus cuniculus*).
- Birds - A total of 94 bird species were recorded from the Study Area during field investigations. A number of conservation significant bird species were detected in the Study Area, namely:
  - Squatter pigeon (southern) listed as vulnerable under the EPBC and NC Act
  - Great egret listed as marine and migratory under the EPBC Act and as special least concern under the NC Act
  - Eleven birds listed as marine and / or migratory under the EPBC Act.

  In general, the avian fauna of the Study Area comprised a mix of common and widespread woodland, grassland and waterbirds. Species that were abundant and commonly observed in grazed areas were Australasian pipit (*Anthus novaeseelandiae*), brown quail (*Coturnix ypsilophora*) and crested pigeon (*Ocyphaps lophotes*) with emu (*Dromaius novaehollandiae*). Birds commonly encountered in woodland areas included the brown treecreeper (*Climacteris picumnus*), pale-headed rosella (*Platycercus adscitus*), double-barred finch (*Poephila bichenovii*), galah (*Cacatua roseicapilla*), Torresian crow (*Corvus orru*) and variegated wren (*Malurus lamberti*). Ducks such as the plumed whistling duck (*Dendrocygna eytoni*) (Plate 5-6), were commonly observed at farm dams and waterbodies throughout the Study Area.

Plate 5-3 Green Tree Frog

Source: GHD, September 2011

Plate 5-4 Dubious gecko

Source: GHD, September 2011

Plate 5-5 Pig

Source: GHD May 2011

Plate 5-6 Plumed Whistling Duck

Source: GHD September 2011

5.2.4.3 Commonwealth Listed Threatened Fauna

The desktop assessment indicated that 13 EPBC Act listed threatened fauna species have been previously recorded or predicted to occur within the desktop search extent encompassing the Study Area. Of these, one species was confirmed to be present during field surveys, this being the:

- Squatter pigeon (southern)

The squatter pigeon (southern) is a ground-dwelling pigeon, listed as vulnerable under both the EPBC Act and NC Act. This species distribution extends from central Queensland as far north as the Burdekin-Lynd divide to the south-east of the state (DSEWPaC, 2011j). Squatter pigeon (southern) were recorded on one occasion during the September survey event. A group of three individuals was observed. This subspecies was encountered on a track within open woodland habitat featuring a complex grassy and rocky understorey.

Figure 5- 10 provides an indication of habitat that may be utilised by the squatter pigeon (southern) within, and adjacent, to the Study Area. REs characterised by open woodland and forest vegetation were identified and mapped based on known habitat preferences for the squatter pigeon (southern). The limiting factor to utilisation of this potentially suitable habitat is likely to be availability of water. Where water is present (i.e. farm dams, stock troughs, natural waterbodies (i.e. gilgais, Belyando River and Creeks)) it is considered likely that the squatter pigeon (southern) will be present.

Based on the availability of similarly suitable habitat in the landscape surrounding the Project Area, and the stable nature of the subspecies' population at present, it is not considered that the Project Area represents *habitat critical to the survival of the (sub) species*. The squatter pigeons (southern) at the Study Area are not considered part of an 'important population' as defined in the Significant Impact Guidelines (DEWHA (now DSEWPaC), 2009b).

A likelihood of occurrence assessment for EPBC Act listed threatened fauna species was undertaken in accordance with the assessment guidelines and three species were considered likely to occur:

- Ornamental snake
- Koala
- Black-throated finch (southern)

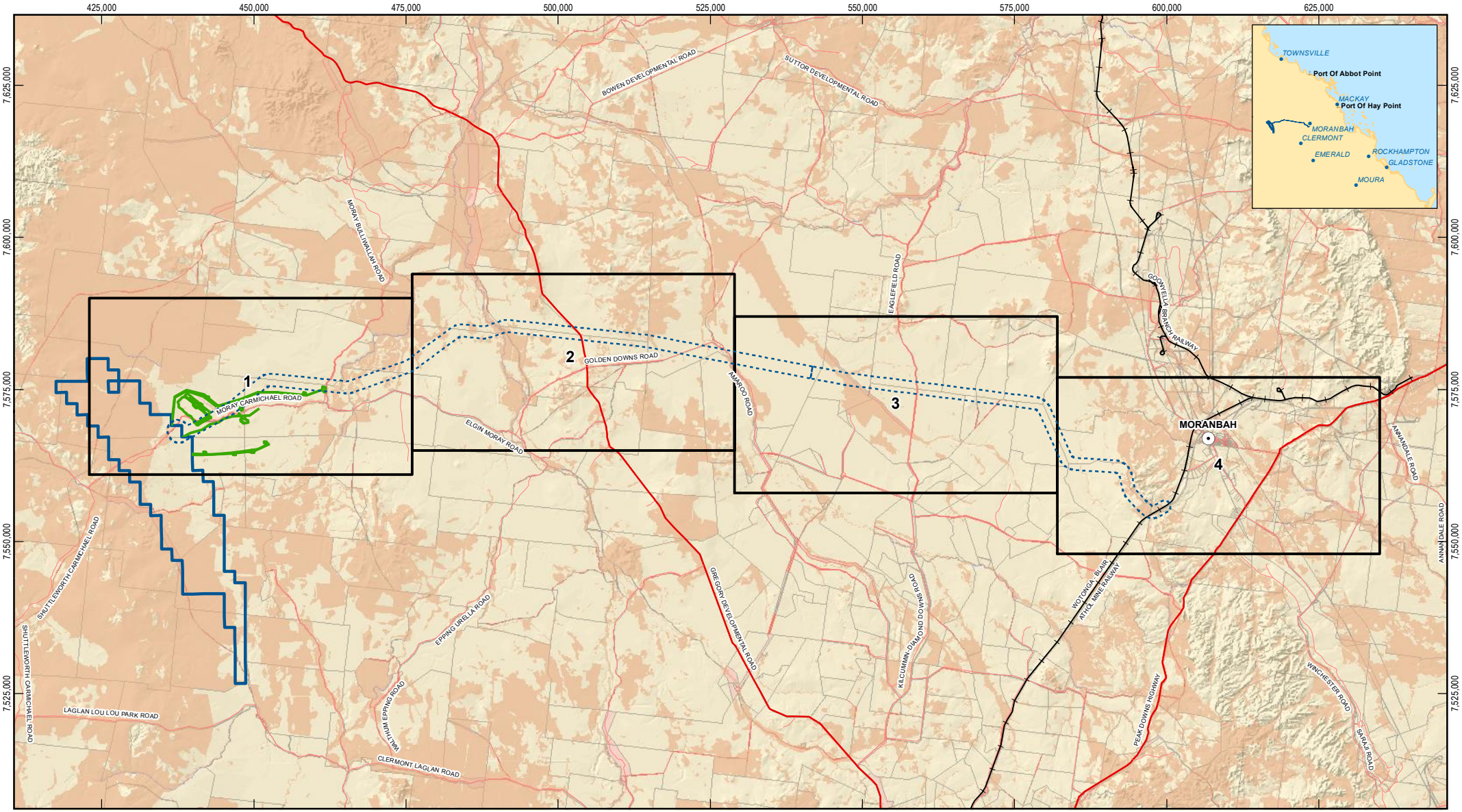
Bird surveys and trapping for ground-dwelling mammals and reptiles failed to detect the threatened species listed above. These species occur in low densities and failure to detect their presence is not necessarily indicative of their absence throughout the Study Area. The broad vegetation communities and habitats that may provide habitat for these listed threatened species are detailed in Table 5-8.

Ornamental Snake

The ornamental snake is listed as vulnerable under the EPBC Act and the NC Act. The species occurs in the Brigalow Belt North bioregion, where the majority of natural vegetation has been cleared for agriculture, mining and urban development, and has been degraded by overgrazing by stock. This has resulted in a decline in abundance in the past few decades (Cogger *et. al.*, 1993). Ornamental Snakes are nocturnally active, sheltering during the day under fallen timber, rocks, bark and in deep soil cracks.

The ornamental snake prefers habitat within, or close to, habitat that is favoured by its prey (namely frogs). Preferred habitat includes woodlands and open forests associated with moist areas, particularly gilgai (melon-hole) mounds and depressions in Queensland RE landzone 4 (DSEWPaC, 2011c). The most common habitat of ornamental snake is brigalow, gidgee, blackwood or Coolabah dominated vegetation communities, or pure grasslands associated with gilgais (DSEWPaC, 2011c).

No ornamental snakes were detected during either the May or September field surveys. However, potential habitat for this species within the Study Area and broader surrounding landscape exists. Figure 5-11 shows the extent of potential habitat for the ornamental snake in both the Study Area and the surrounding landscape. The main limiting factor determining the utilisation of identified potentially suitable habitat (see Figure 5-11) by the ornamental snake is likely to be related to the density of frog populations, which in turn may be driven by the localised availability of frog breeding sites (i.e. standing water associated with gilgais, ephemeral creeks and rivers).



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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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LEGEND

- Town
- State Road
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- Other Railway
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- Study Area
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Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat Within the Study Area and Surrounding Landscape

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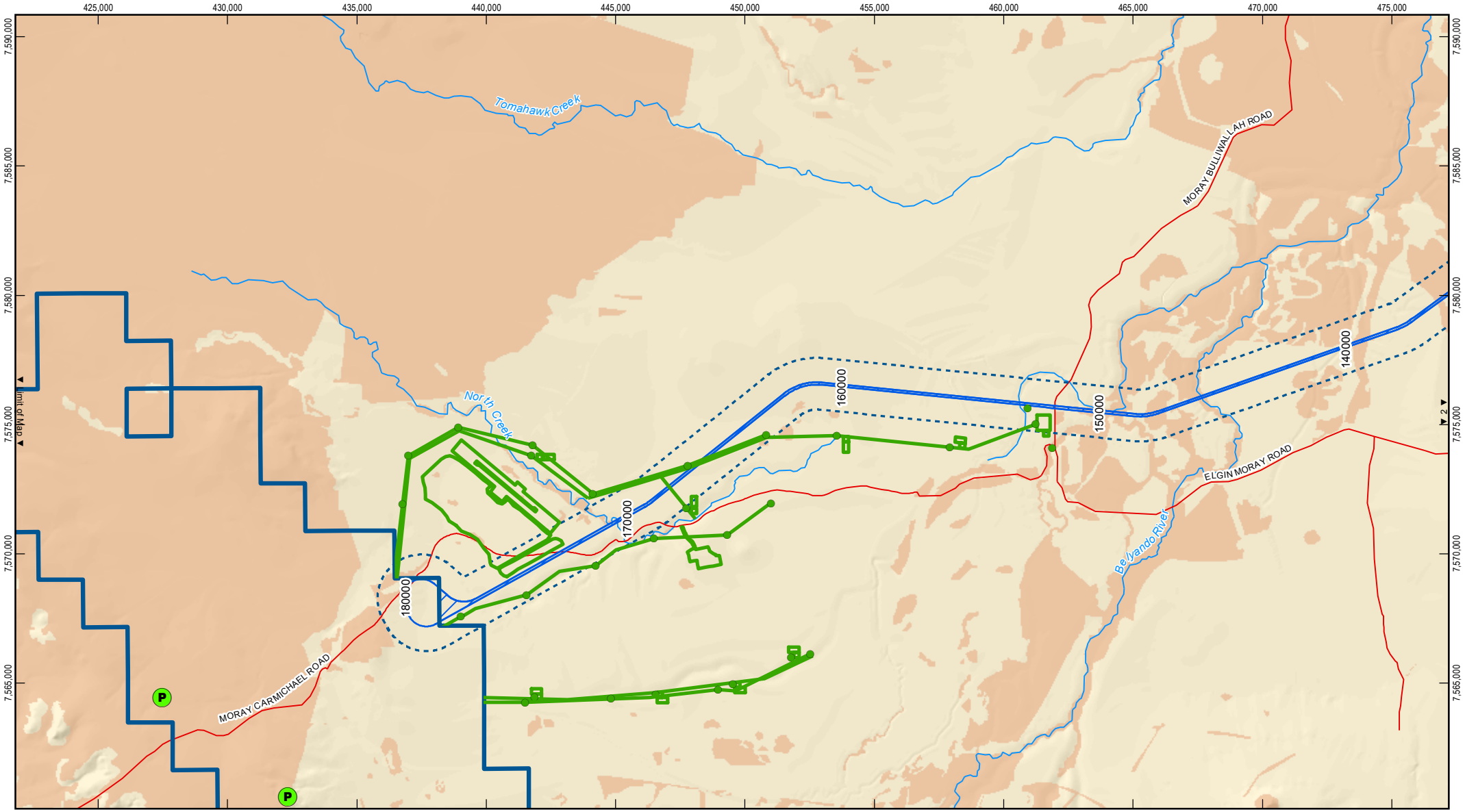

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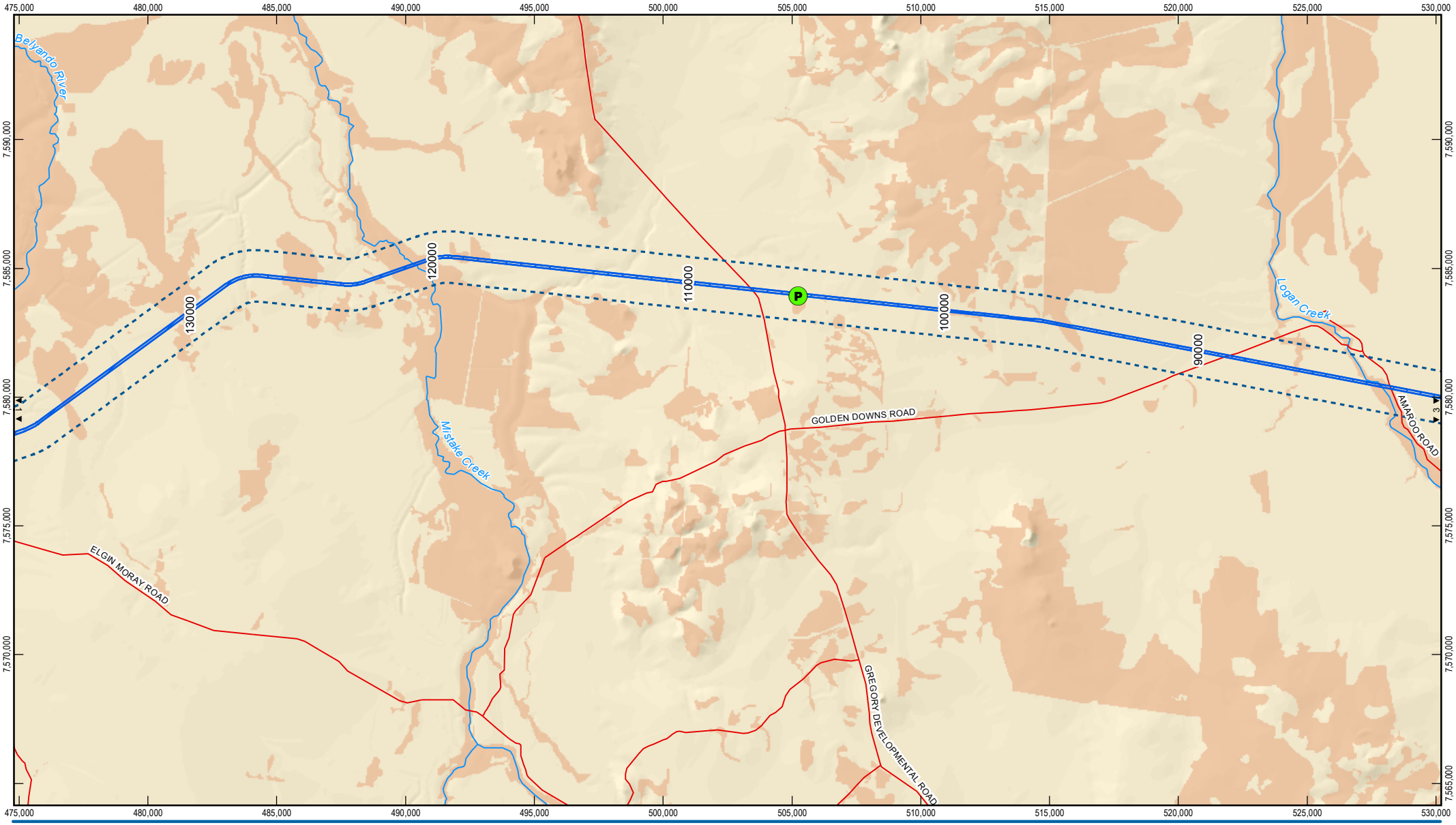

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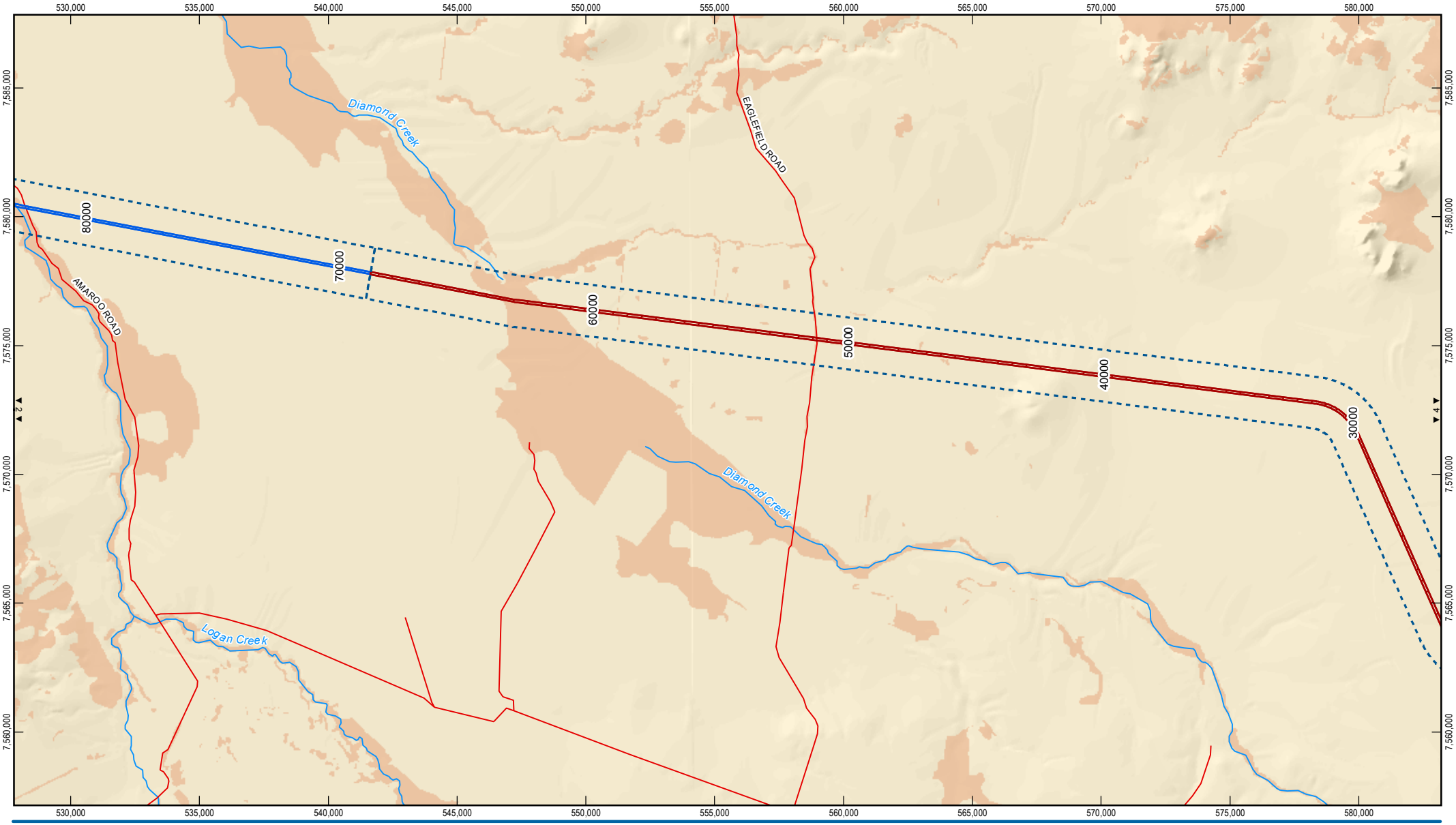

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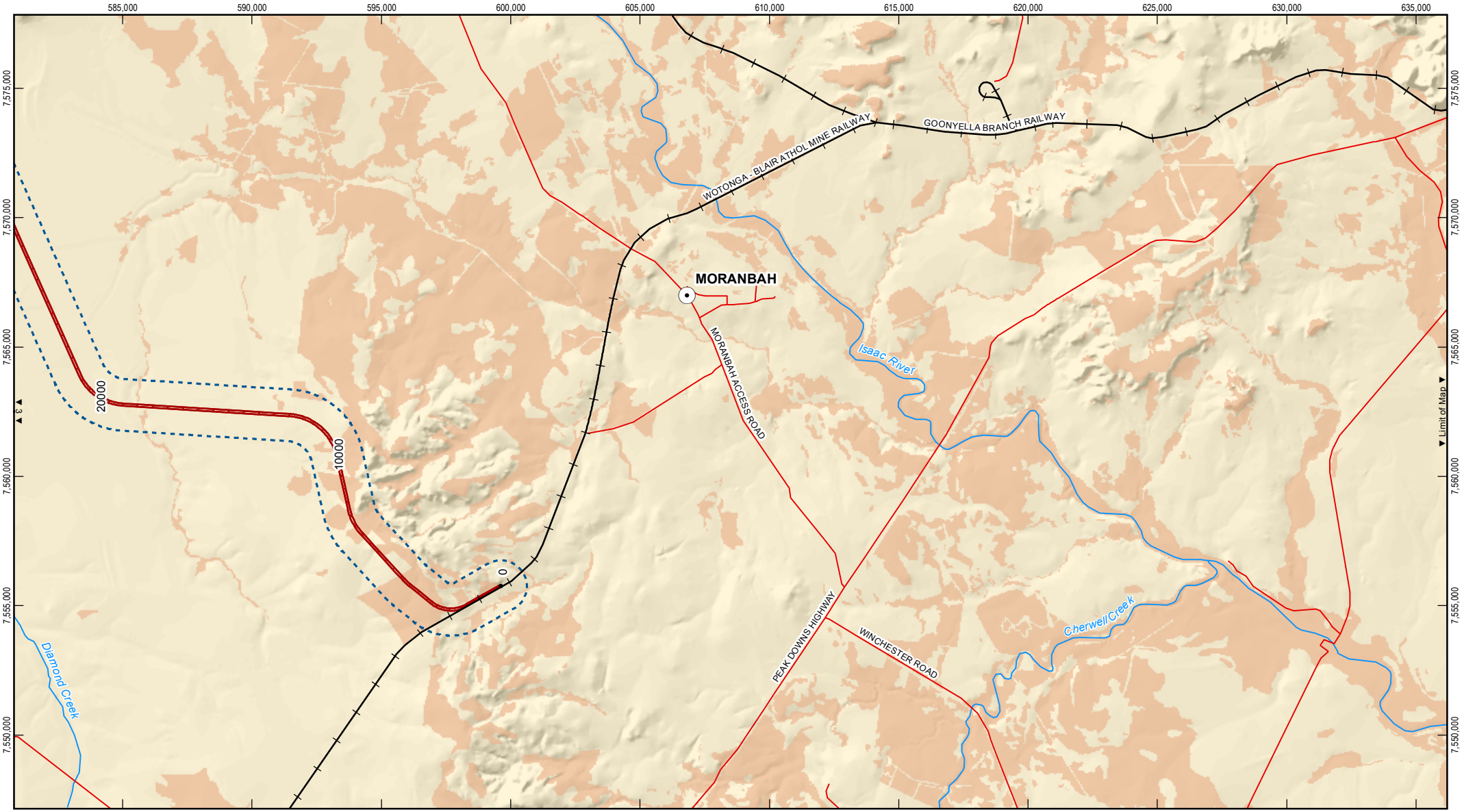

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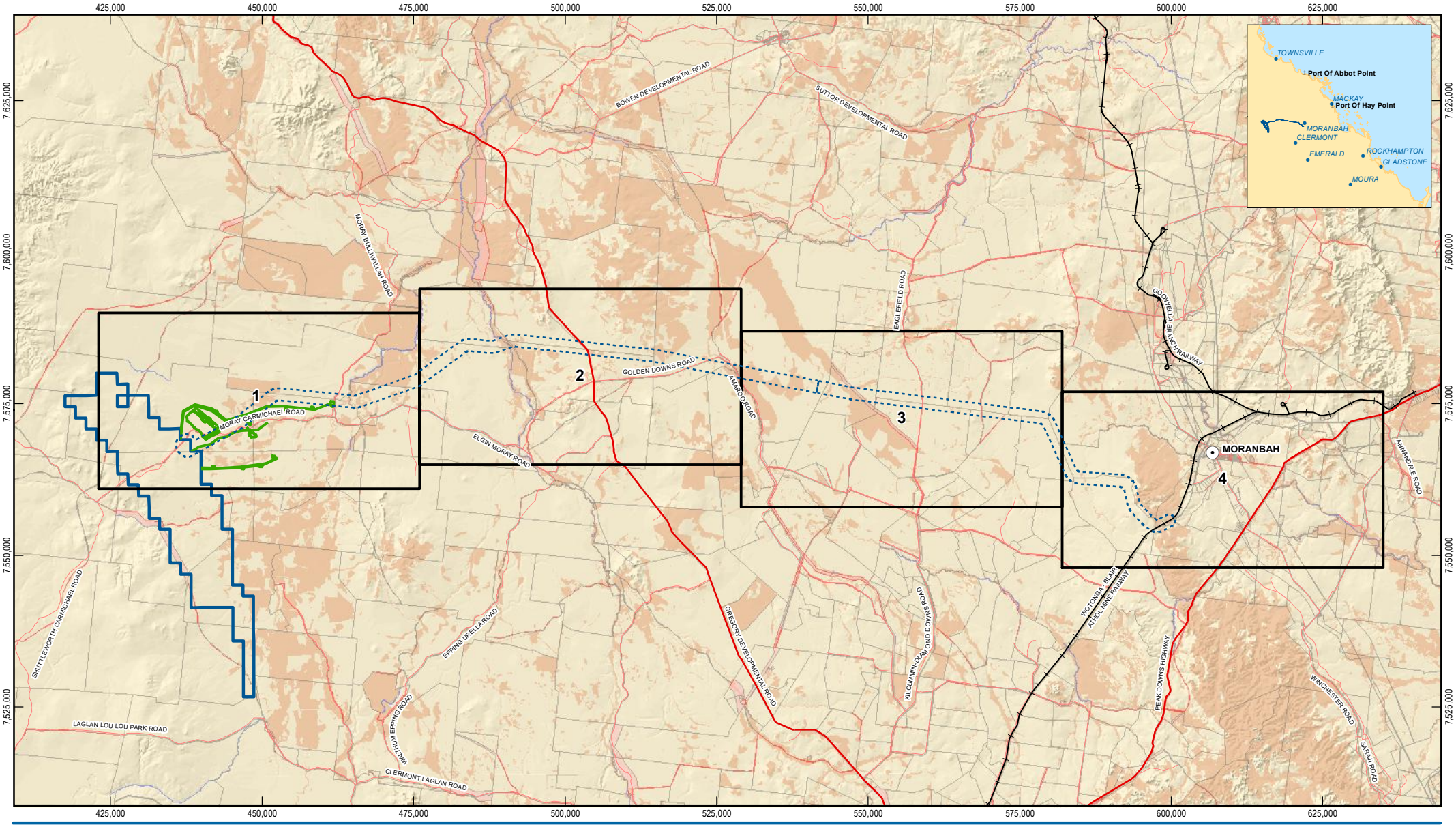

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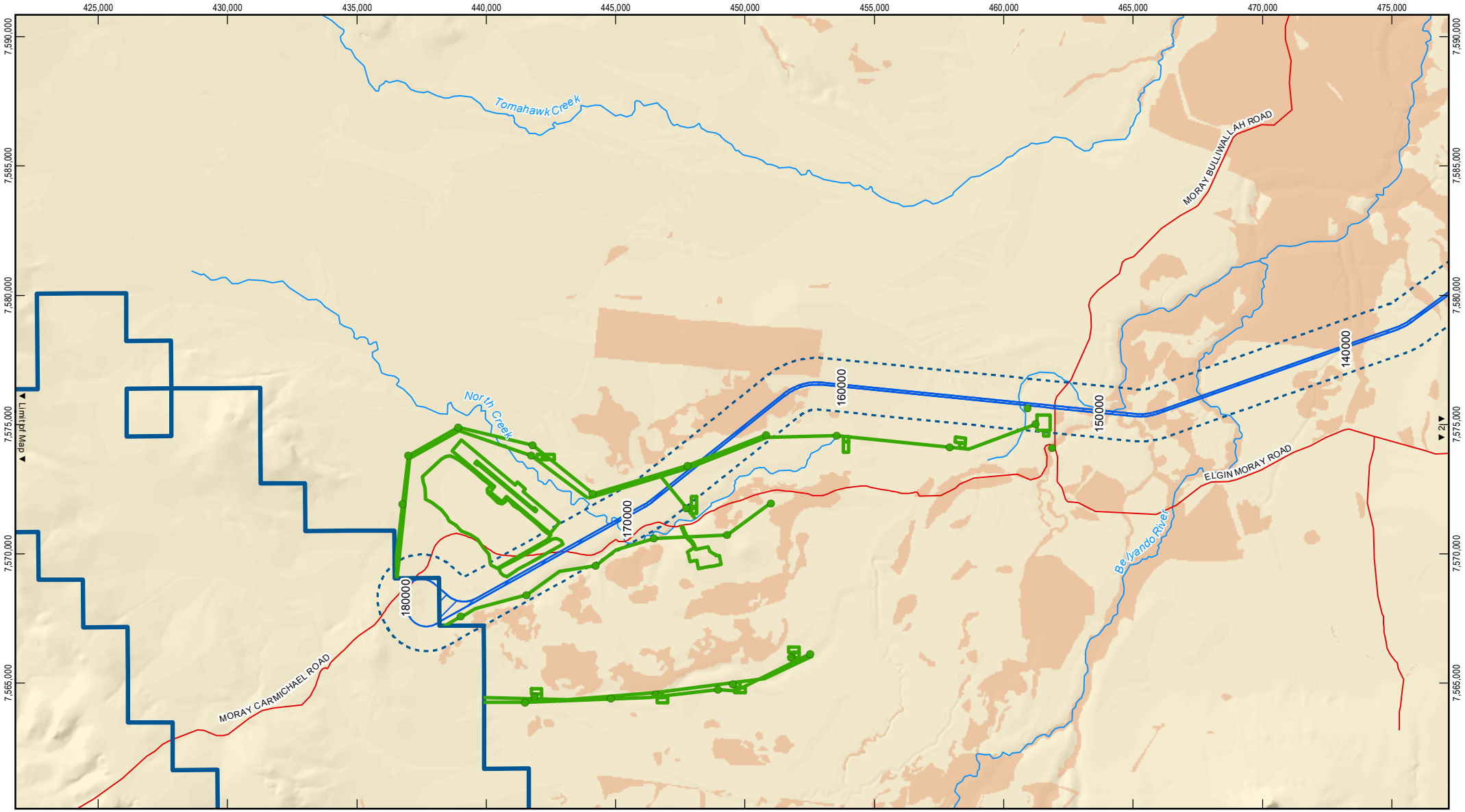

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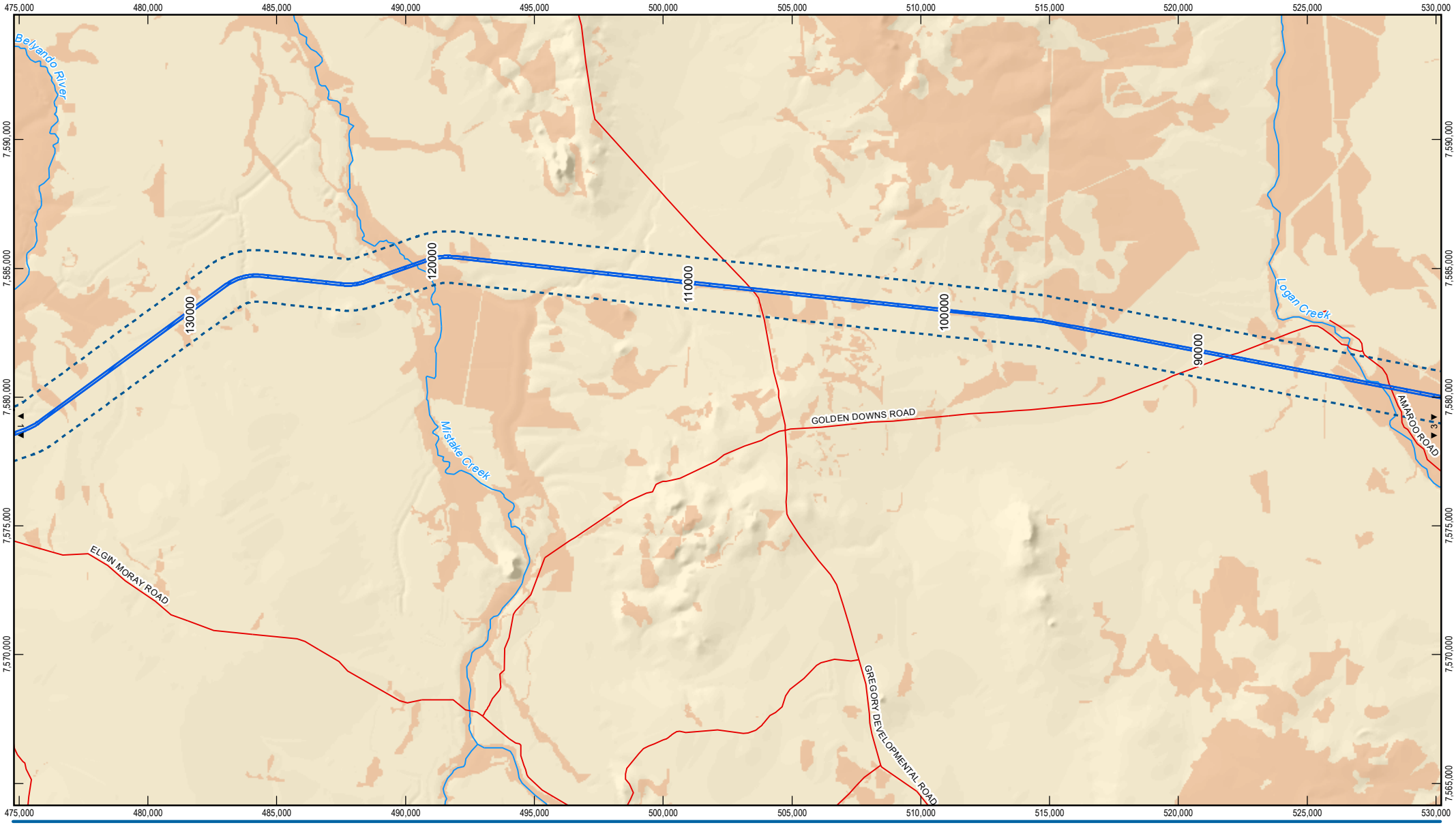

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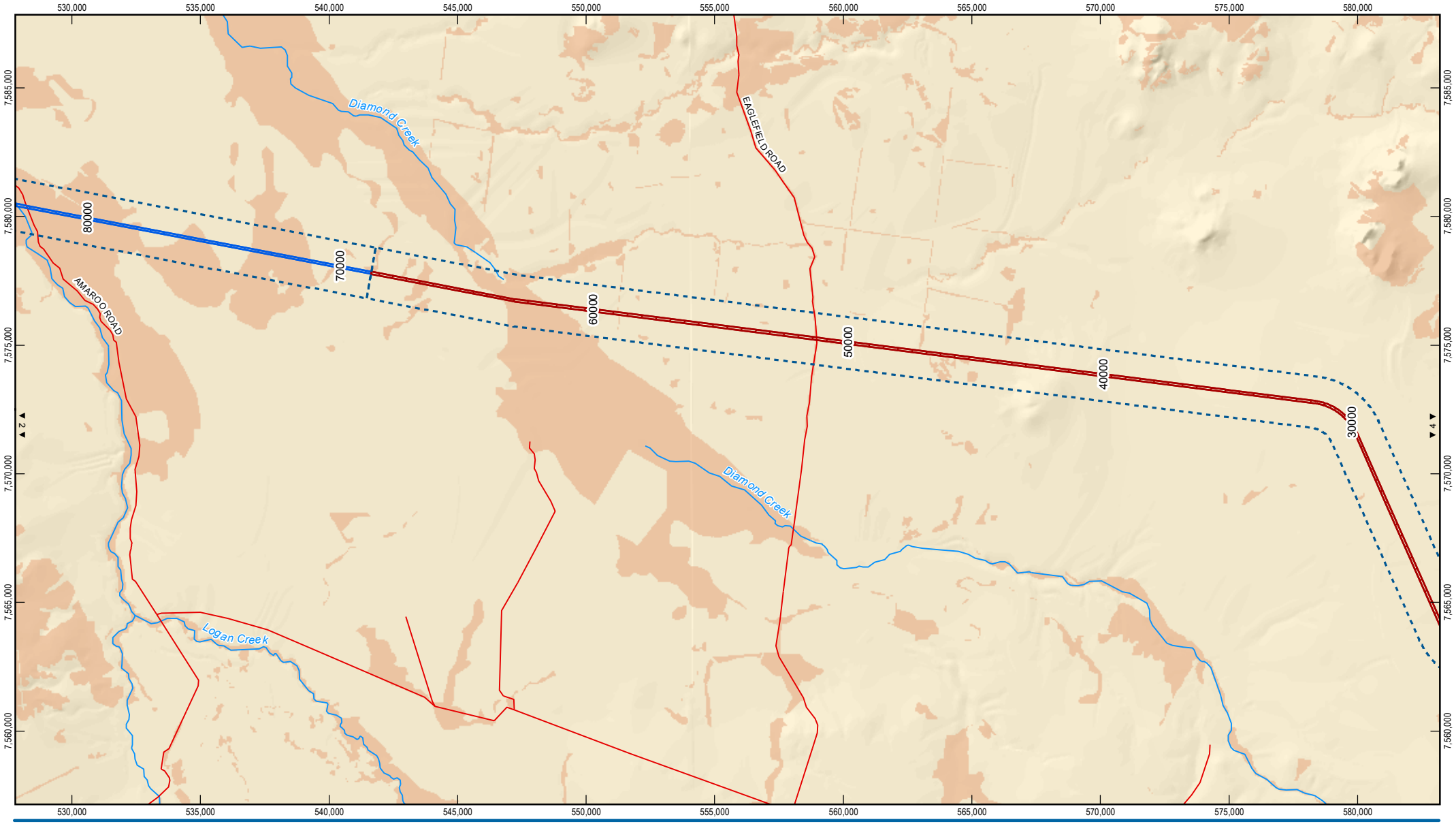

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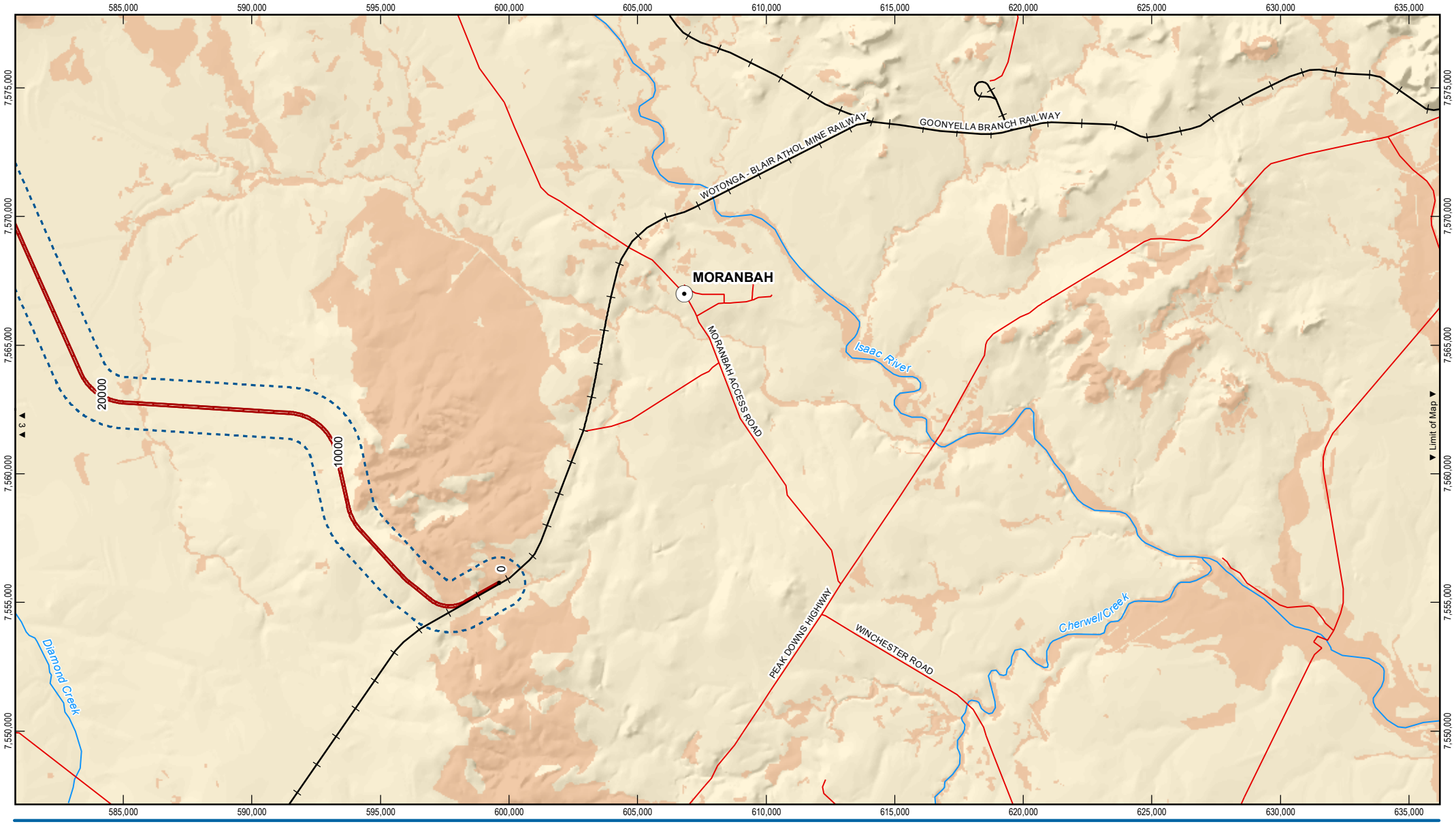

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Koala

The koala (combined populations of Queensland, New South Wales and Australian Capital Territory) is listed as vulnerable under the EPBC Act. The natural range of this species extends from north-east Queensland to the south-east corner of South Australia. However, the koala's distribution is not continuous across this range and it occurs in a number of populations that are separated by cleared land or unsuitable habitat (DSEWPaC 2012c). Koalas occupy a range of habitats including temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated eucalypt species (DSEWPaC 2012c). In central Queensland, the species occurs in scattered populations within eucalypt woodlands generally along watercourses. Koalas in the Brigalow Belt bioregion also typically occur in low densities and have large home ranges (DSEWPaC 2012c). Six main threats identified by DSEWPaC (2012c) that have influenced the decline of this species include:

- Habit loss, fragmentation and/or degradation
- Encounter mortality - dogs and cars
- Disease
- Climate change and drought
- Habitat degradation due to over browsing
- Low genetic variability

No koalas were detected during either the May or September field surveys. However, the koala has been previously recorded in the region, particularly within riparian vegetation along watercourses intersected by the Project (Rail) (H. Jones *pers. comm* 07/09/2011). Potential habitat for the koala is considered to include open eucalypt woodland and mature riparian woodland fringing watercourses habitats. Within the rail corridor and infrastructure and construction camps footprints, these habitat types include the following RE types:

- 11.3.3 *Eucalyptus coolabah* woodland on alluvial plains
- 11.3.7 *Corymbia spp*. woodland on alluvial plains. Sandy soils
- 11.3.10 *Eucalyptus brownii* woodland on alluvial plains
- 11.3.25 *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines
- 11.5.3 *Eucalyptus populnea* and/or *E. melanophloia* and/or *Corymbia clarksoniana* on Cainozoic sand plains/remnant surfaces
- 11.5.9c *Eucalyptus crebra +/- Corymbia intermedia +/- E. moluccana +/- C. dallachiana* woodland.

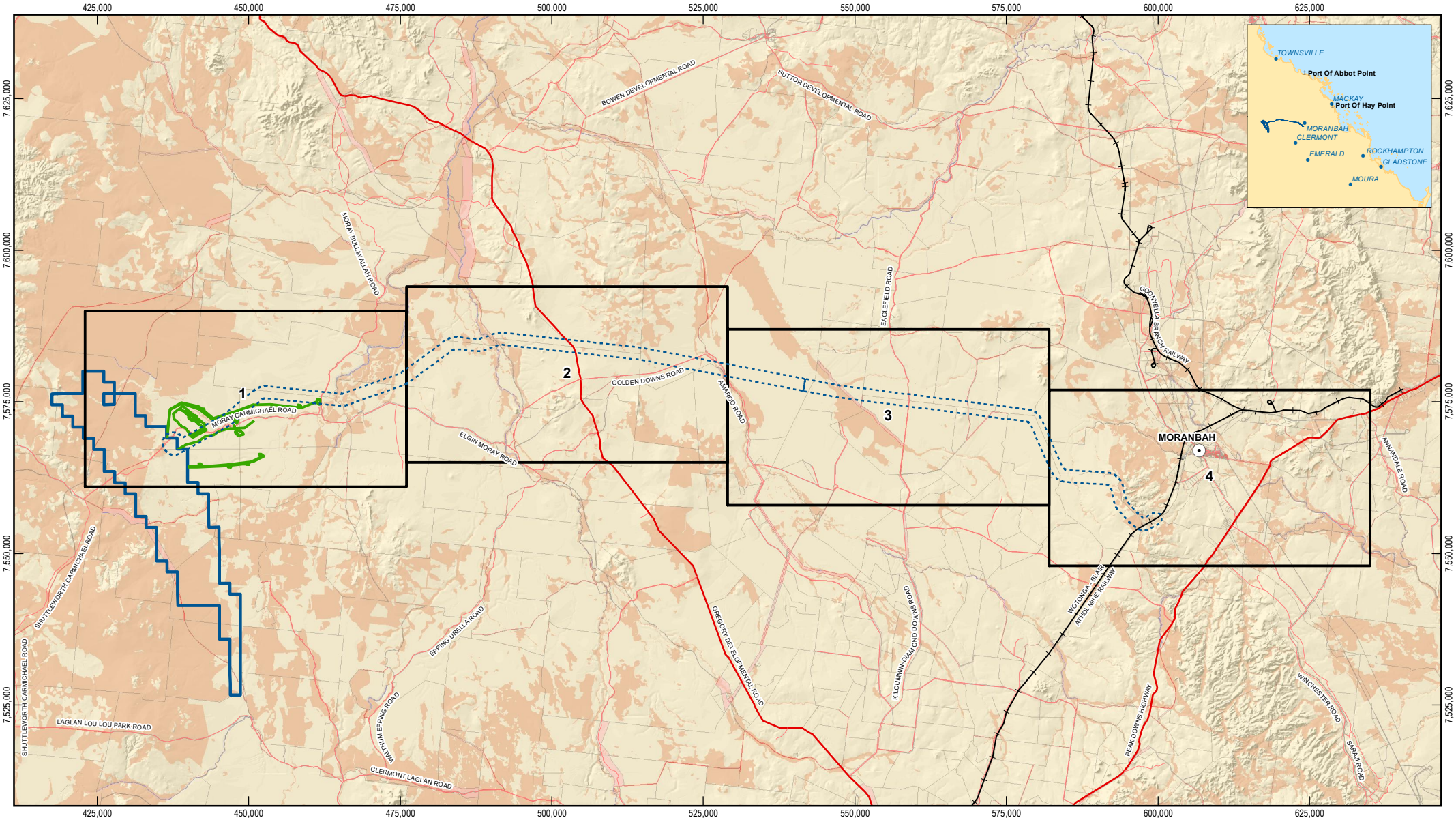
Potential habitat for the koala within the Study Area and broader landscape surrounding the Study Area is mapped in Figure 5-12. Mapping of suitable habitat for this species was based on habitat types considered to be potentially suitable to support the koala.

Black-throated finch (southern)

The black-throated finch (southern) (Plate 5-5) is listed as endangered under the EPBC Act and the NC Act. Where it was once previously found throughout eastern and central Queensland north of the New South Wales border, it is now only known from the Townsville region and scattered sites in central Queensland (DSEWPaC, 2011l). The extent of occurrence of the species (i.e. *Poephila cincta*) has declined by approximately 80 per cent since the 1980s, with the majority of this decline in the range of the endangered southern subspecies (DSEWPaC, 2011l).

The subspecies inhabits grassy open woodland and open forest habitats characterised by trees belonging to the genera *Eucalyptus, Corymbia, Acacia* and *Melaleuca* (DSEWPaC, 2011l). Generally it occurs in habitats near watercourses or waterbodies - almost all recent records of the subspecies south of the tropics have been in riparian areas (DSEWPaC, 2011l). Three critical habitat resources are required to support the subspecies:

- Water sources (both natural and artificial)
- Grass seeds (a mosaic of species that provide forage throughout the year (particularly during the wet season). Grass species that are considered to be important forage species for the black-throated finch (southern) include *Urochloa mosambicensis, Enteropogon acicularis, Panicum decompositum, Panicum effusum, Dichanthium sericeum, Alloteropsis semialata, Eragrostis sororia* and *Themeda triandra* (DEWHA, 2009a).
- Trees that provide suitable nesting habitat (DEWHA, 2011a)



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Koala Habitat - Based on DERM Certified Regional Ecosystems Version 6.1b

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Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

Job Number 41-25215
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Figure 5-12
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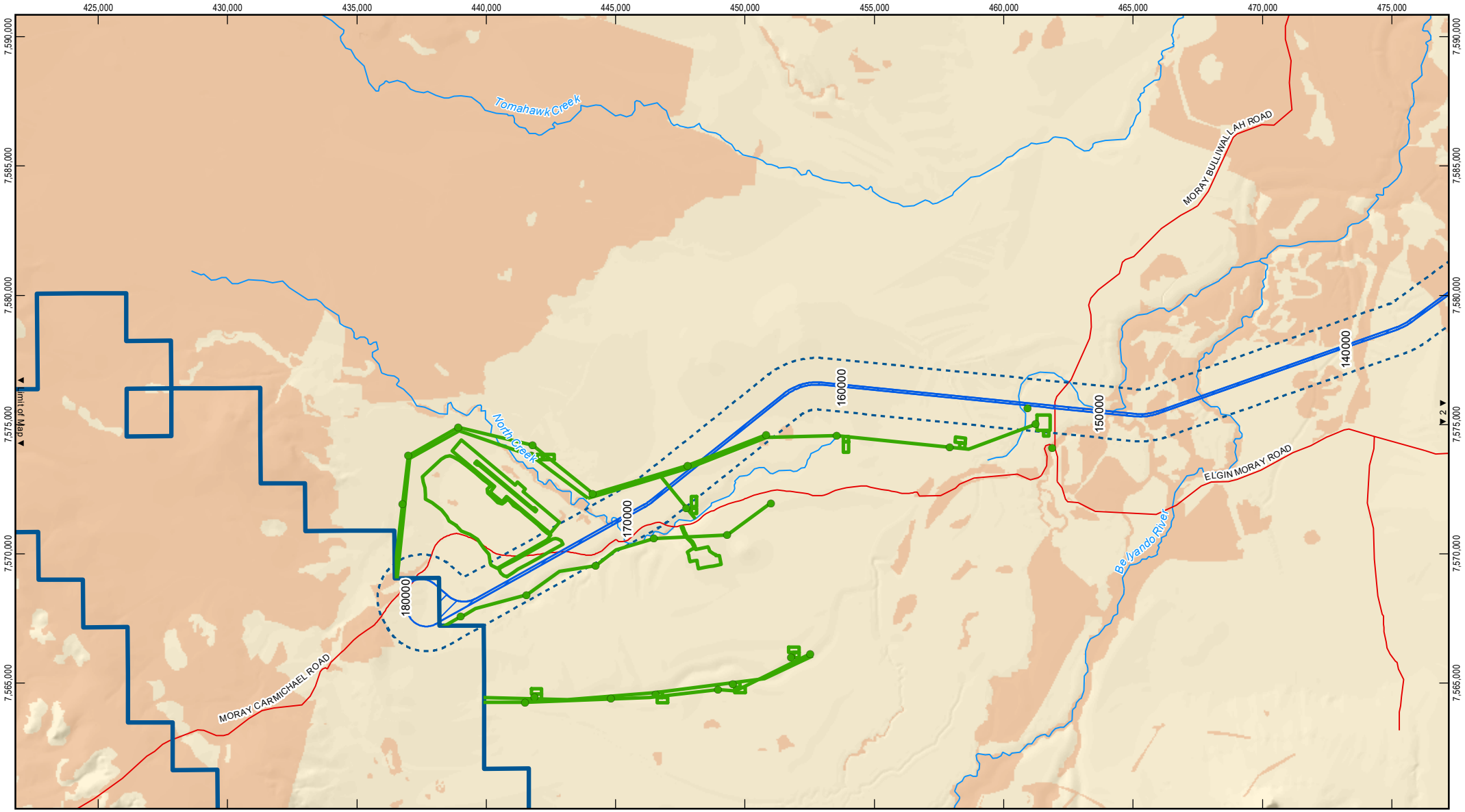
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Potential Habitat (2012). Created by: BW, CA



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- Watercourse
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- Rail (East)
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Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

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Figure 5-12
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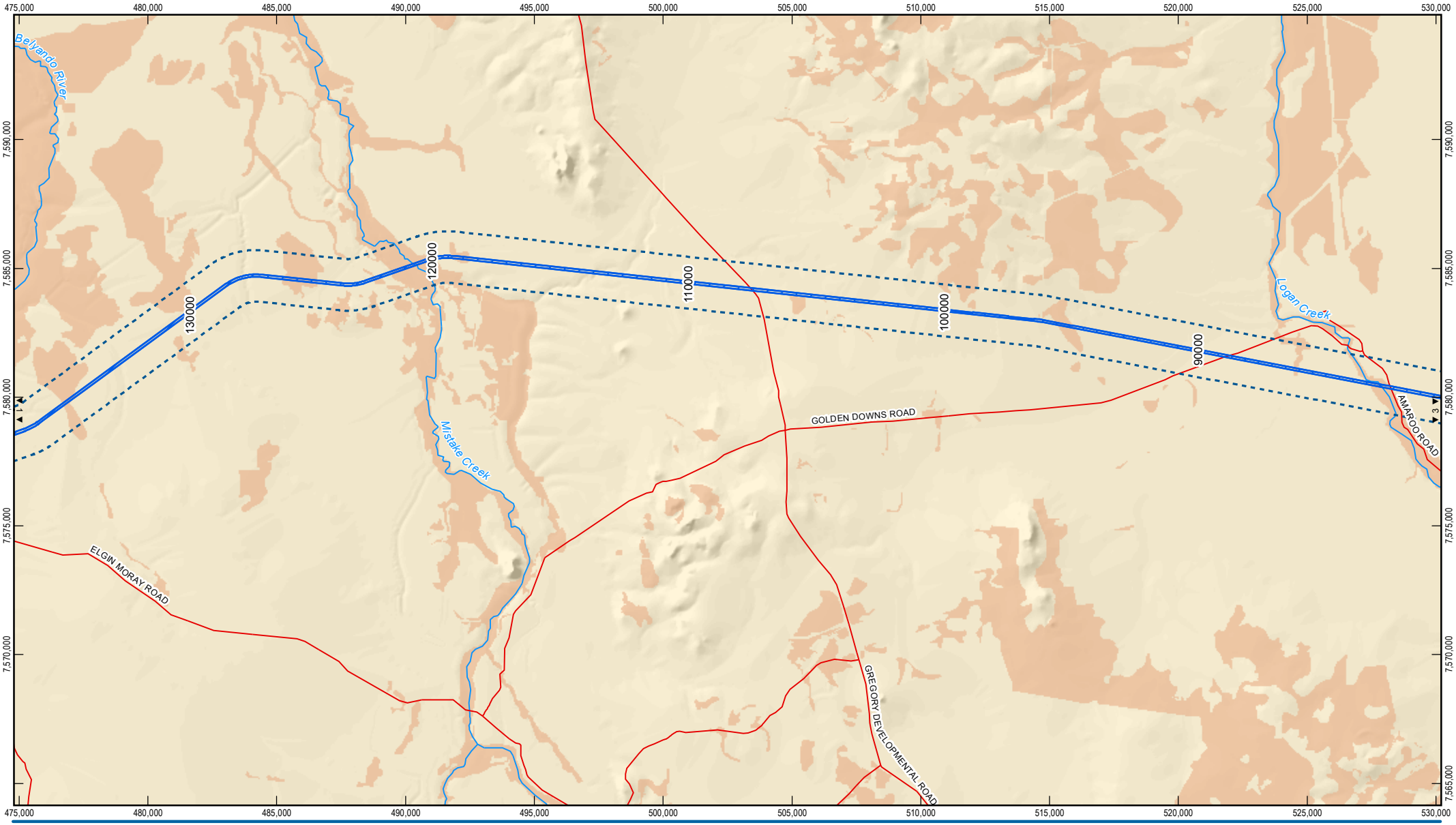

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Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

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Figure 5-12
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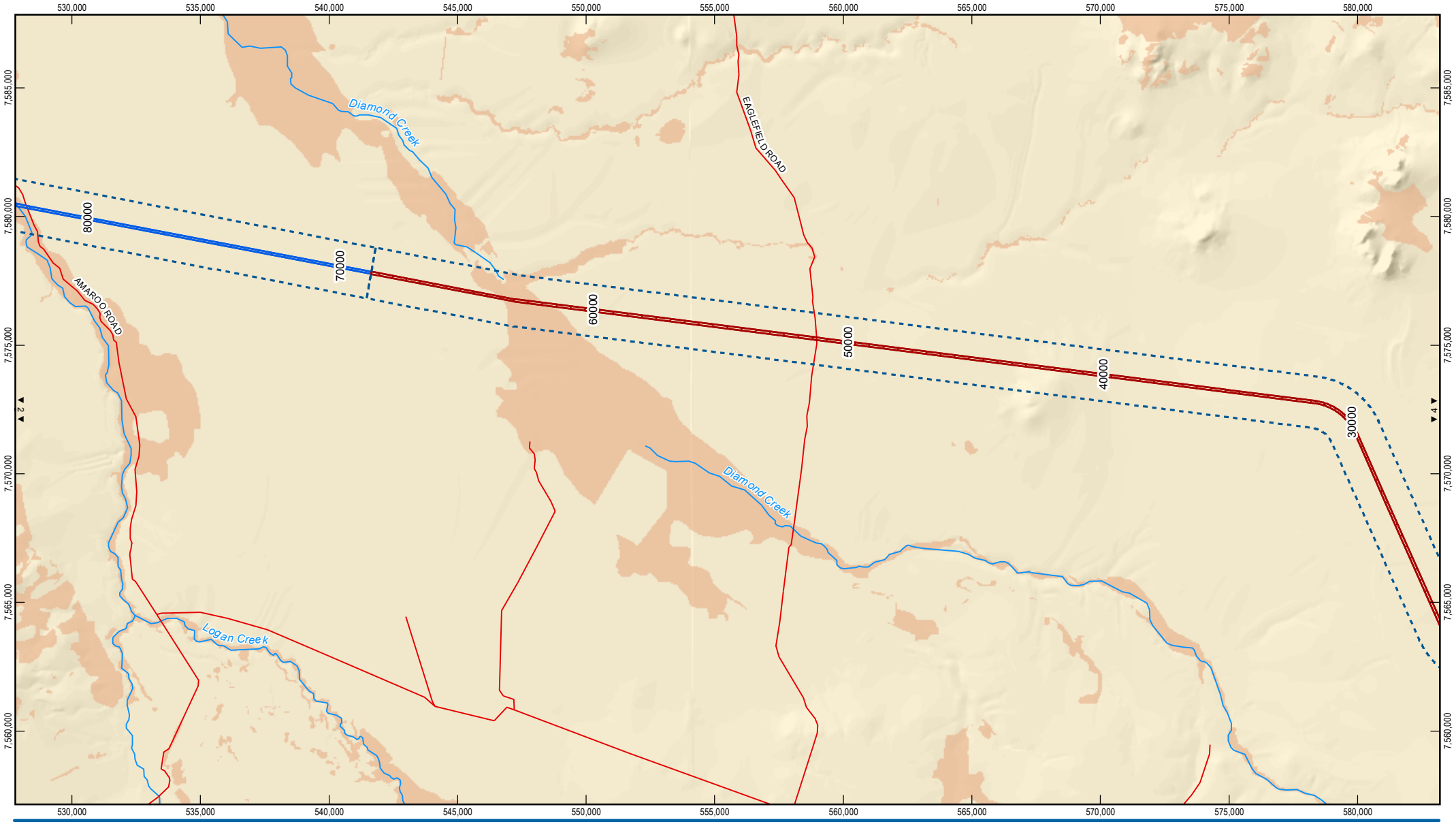

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Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

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Figure 5-12
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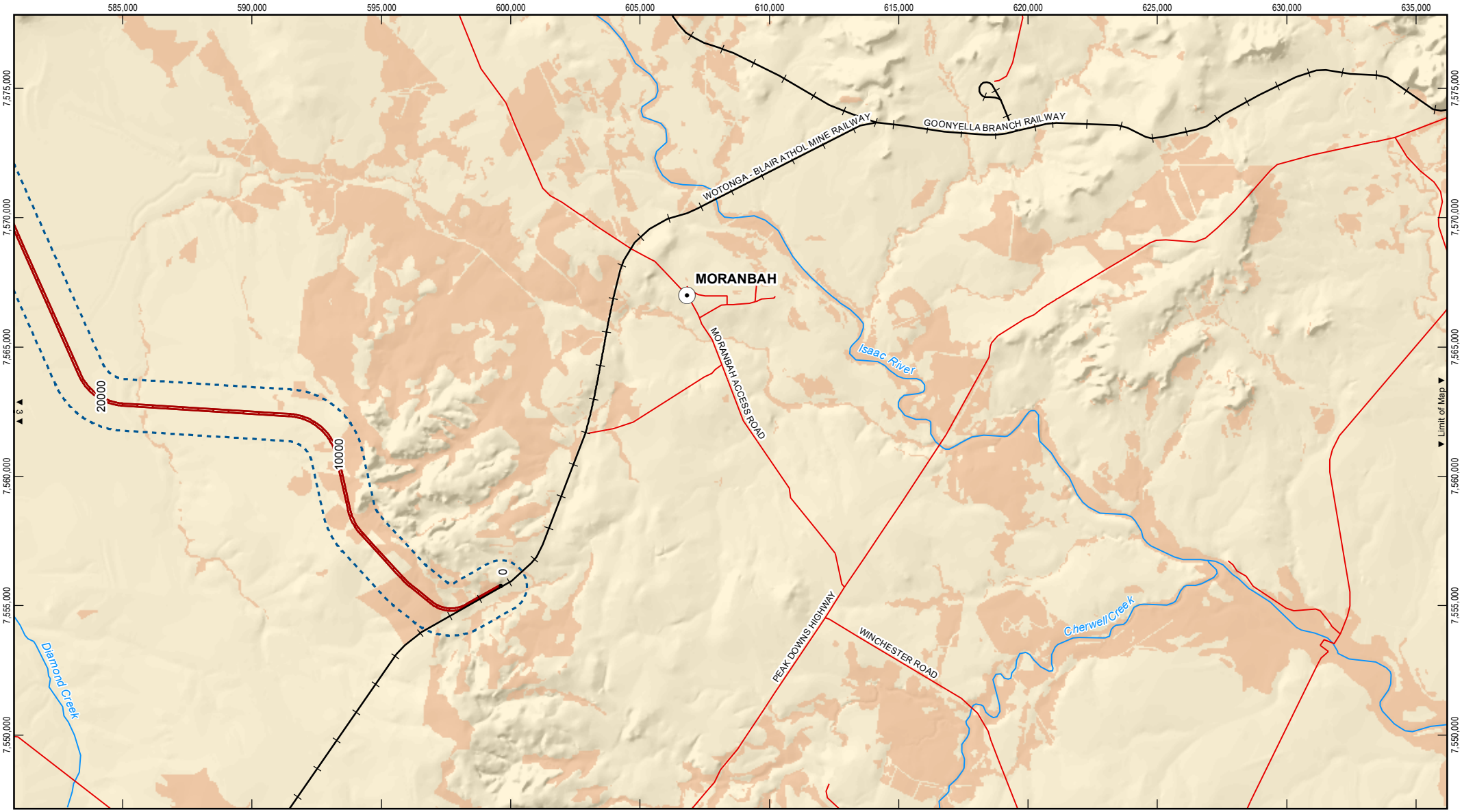

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Potential Koala Habitat Within the Study Area and Surrounding Landscape

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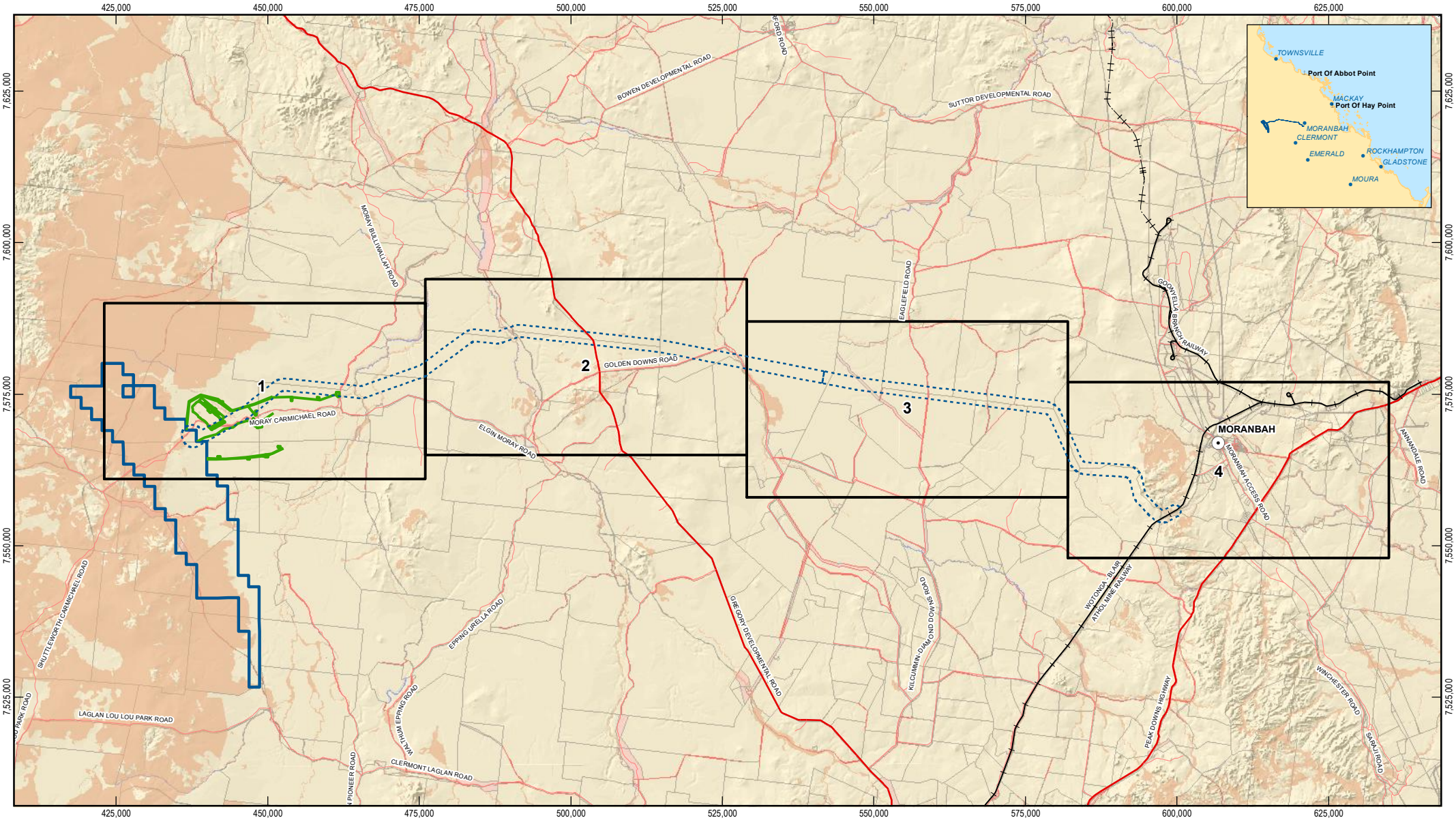
Existing populations of the black-throated finch (southern) are thought to be highly fragmented (DSEWPaC, 2011a). As such, the *Significant Impact Guidelines for the Endangered Black-throated Finch (southern) (Poephila cincta cincta)* (hereafter, the 'Black-throated Finch (southern) Significant Impact Guidelines') (DEWHA, 2009a) define any habitat within five km of a post-1995 sighting as an 'important area' for the subspecies.

No black-throated finches (southern) were detected during the May and September field surveys and potential suitable habitat observed within the Study Area was of low quality. However, suitable habitat occurs at the western extent of the Project, near the Mine Site, and the species was recorded on 27 separate occasions during autumn surveys undertaken for the Project (Mine) (refer Volume 4 Section 5.1). Records of sightings of black-throated finches (southern) were concentrated at the northern and southern parts of the Project (Mine) and not in close proximity (within 5 km) to where the proposed rail connects to Mine Site. The subspecies has also been recorded (post-1998) by the black-throated finch (southern) recovery team within approximately 10-20 km of the Study Area (at Doongmabulla Station) (DSEWPaC, 2011l).

Plate 5-5 Black-throated finches (southern)

Source: GHD 2011 – photos from Project (Mine) Study Area

Within the Study Area suitable habitat for the species is concentrated in the remnant vegetation associated with the Desert Uplands Bioregion (Figure 5-13). Much of the fragmented patches of remnant vegetation to the north, east and south of the Study Area provides limited potentially suitable habitat for the black-throated finch (southern), based on the underlying RE mapping. Habitat utilisation within the Study Area and beyond will be largely influenced by the degree of connectivity/fragmentation of potential habitat patches, and the presence of the three critical habitat resources required by the subspecies i.e. mosaic of native grasses, nesting trees and access to water such as farm dams, stock troughs, and natural water bodies.



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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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- Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Carmichael Coal Mine and Rail Project

Location of Black-throated Finch Sightings and Potential Black-throated Finch (southern) Habitat within the Study Area and the Surrounding Landscape

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Figure 5-13
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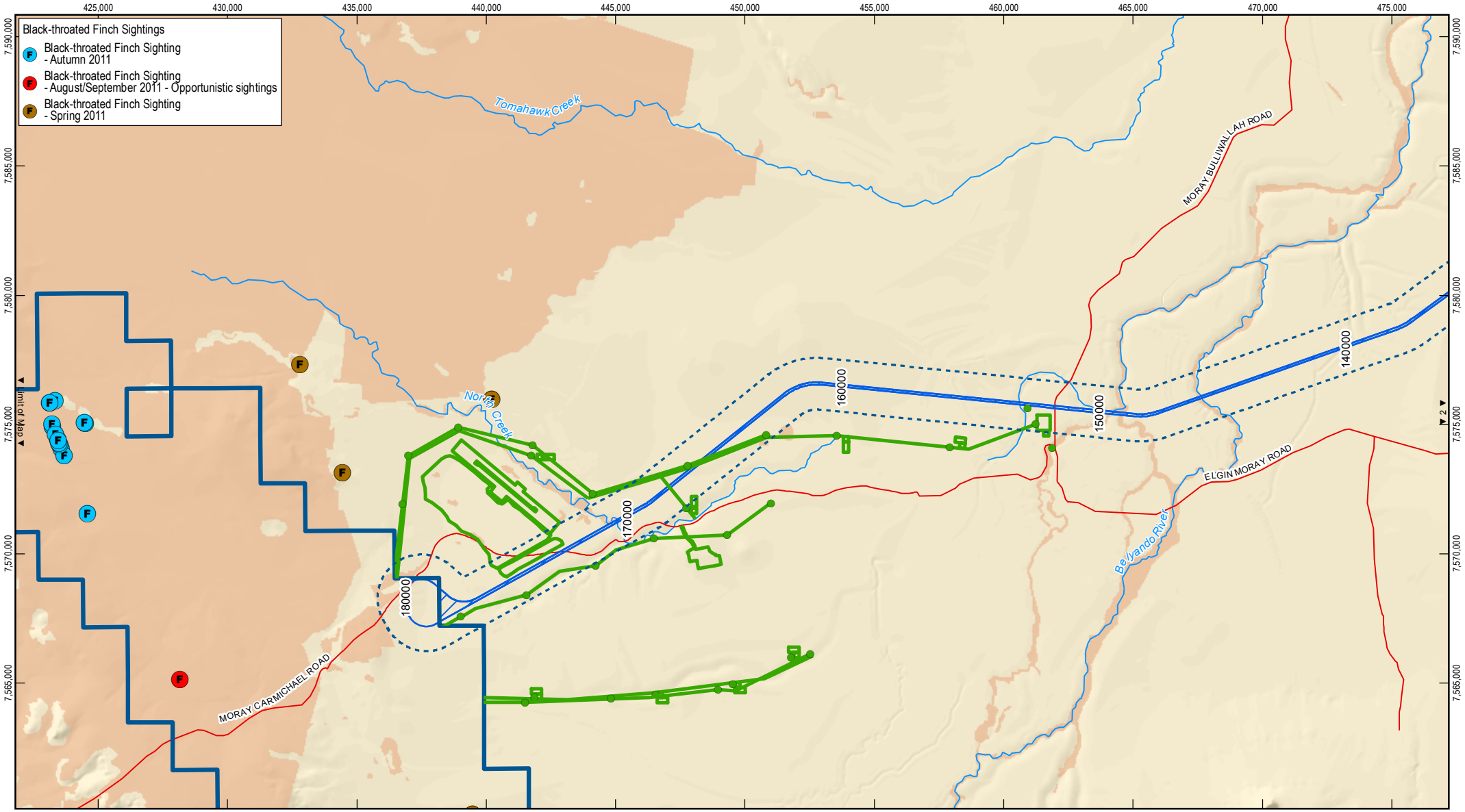
Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); GHD: Potential Black-throated Finch Habitat, Sightings (2011); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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Carmichael Coal Mine and Rail Project

Potential Black-throated Finch (southern) Habitat at the Rail Study Area and the Surrounding Landscape

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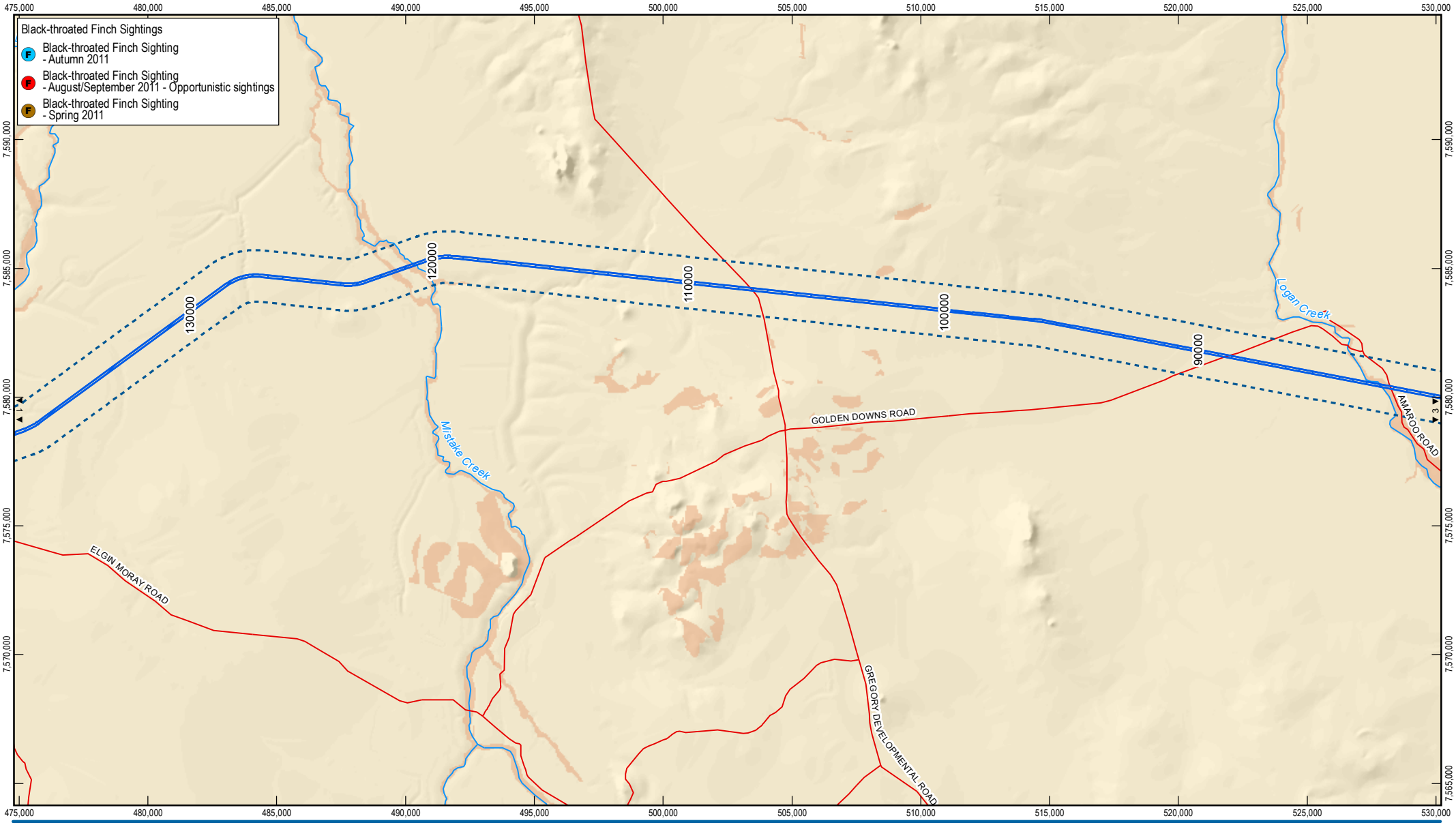

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Carmichael Coal Mine and Rail Project

Potential Black-throated Finch (southern) Habitat at the Rail Study Area and the Surrounding Landscape

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Figure 5-13
Sheet 2 of 4

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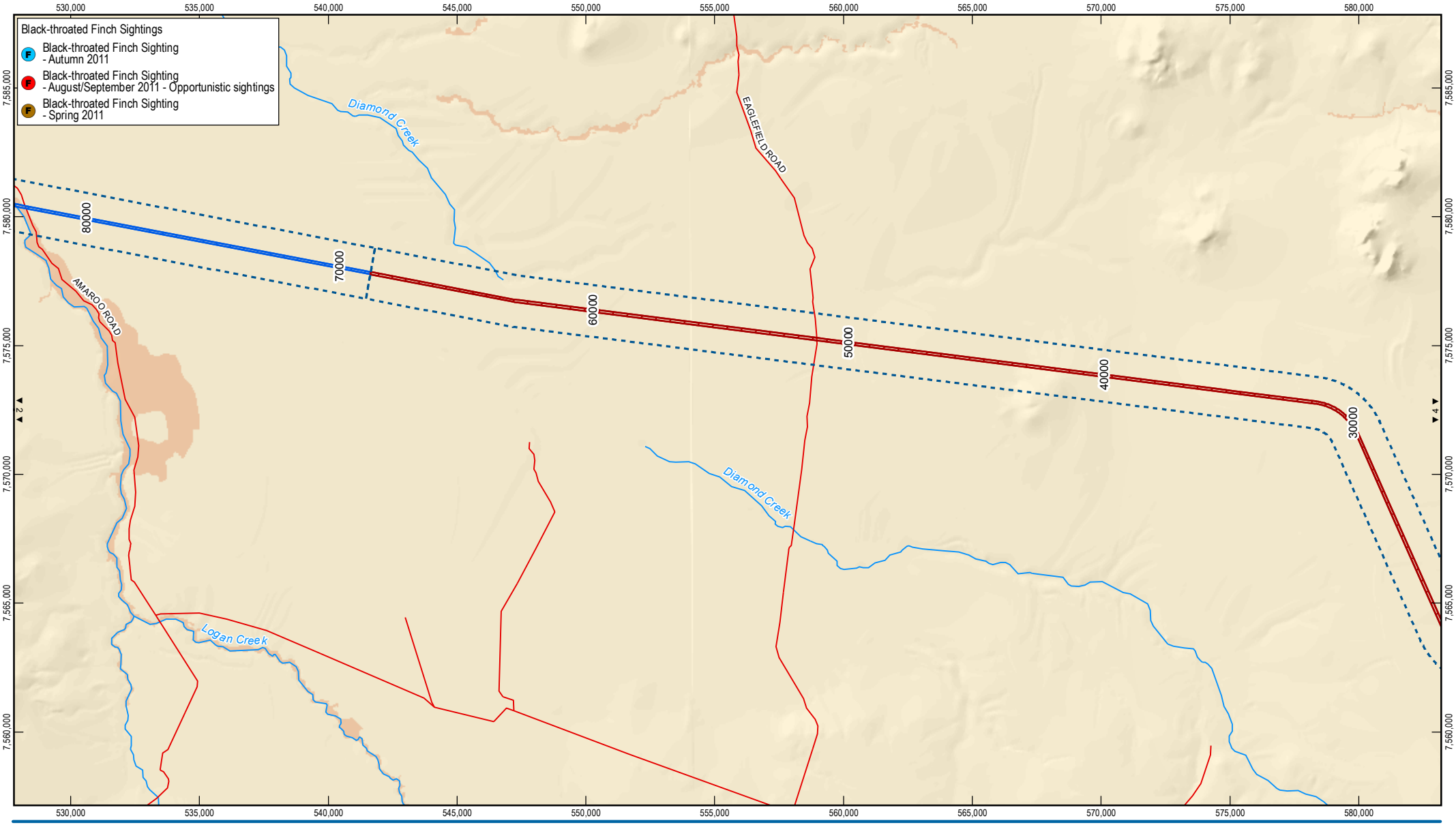

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Black-throated Finch (southern) Habitat at the Rail Study Area and the Surrounding Landscape

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Figure 5-13
Sheet 3 of 4

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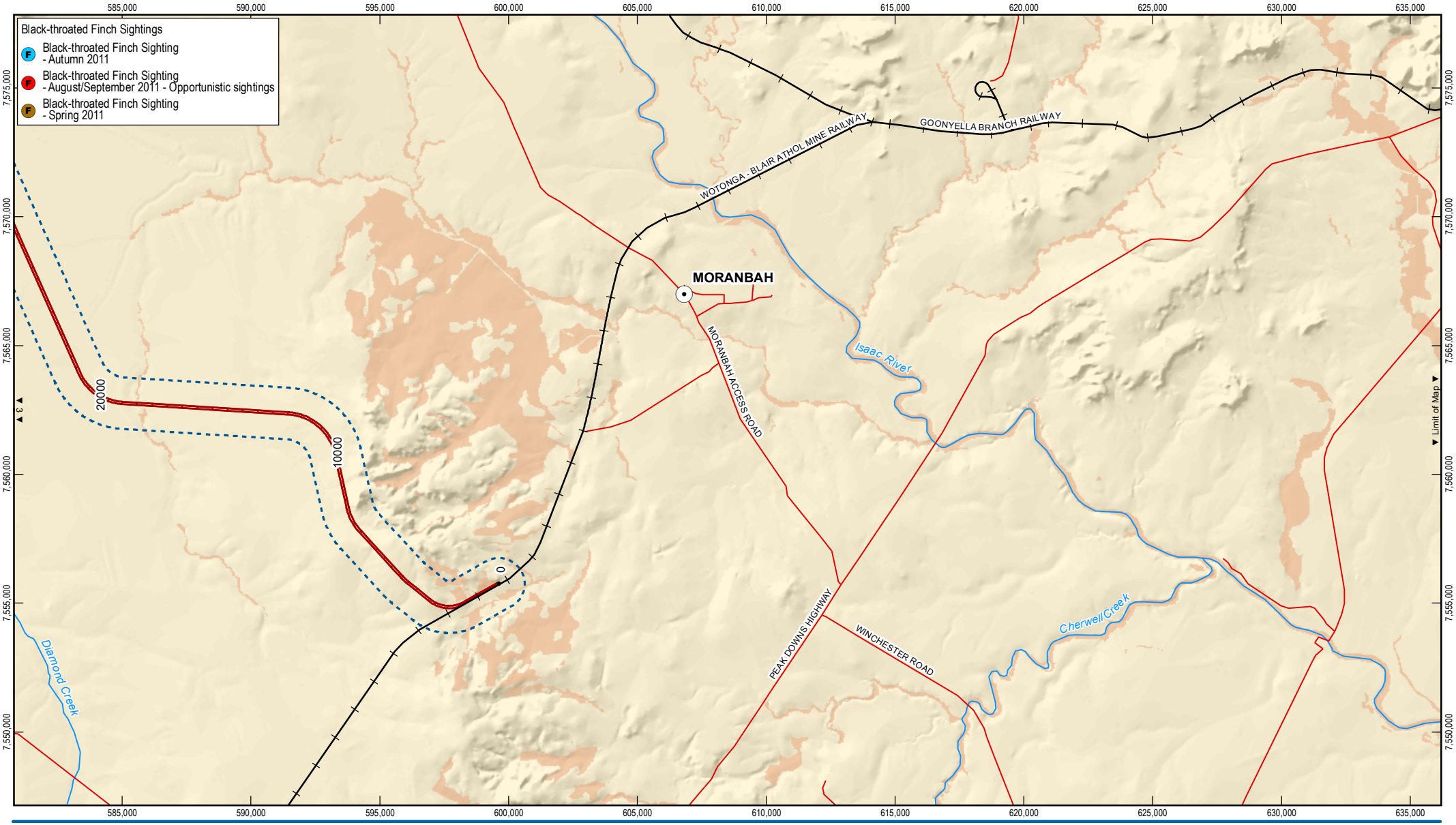

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Black-throated Finch (southern) Habitat at the Rail Study Area and the Surrounding Landscape

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Commonwealth listed threatened fauna – may occur

The likelihood of occurrence assessment indicated that the following EPBC Act listed threatened species may occur at the Study Area, based on distribution and/or presence of potentially suitable habitat:

- Yakka skink (*Egernia rugosa*)
- Dunmall's snake (*Furina dunmalli*)
- Brigalow scaly-foot (*Paradelma orientalis*)
- Greater long-eared bat (*Nyctophilus timoriensis*) (south-eastern form)
- Northern quoll (*Dasyurus hallucatus*)
- Red goshawk (*Erythrotriorchis radiatus*)
- Australian painted snipe (*Rostratula australis*)

These species were not detected during field studies at the Study Area. They may occur based on the presence of suitable habitat (refer to Table 5-8). Potential habitat for these species within the Study Area and broader landscape is presented in Volume 4 Appendix AA.

5.2.4.4 State Listed Threatened Fauna

The desktop assessment indicated that 16 NC Act listed threatened fauna species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Study Area. Of these, two were confirmed present during field surveys in the area:

- Squatter pigeon (southern) (as discussed in Section 5.2.4.3)
- Little pied bat

Little pied bat

The little pied bat is sparsely distributed throughout the southern half of Queensland, It is often associated with dry sclerophyll forest, and woodlands and often forages along watercourses (Menkhorst and Knight, 2004). The little pied bat was recorded via Anabat throughout the May surveys in four separate locations throughout the Study Area, three of which were forest habitats adjacent to watercourses (refer Figure 5-2). A number of habitats within the Study Area could provide habitat for the little pied bat. More specifically, forest and woodland habitats that provide hollows or are adjacent to watercourses are likely to provide suitable roosting and foraging habitat. This corresponds with the following habitat types in the Study Area (as discussed in Table 5-8 and presented on Figure 5-9).

State listed threatened fauna – may occur

In addition to the ornamental snake and black-throated finch (discussed in Section 5.2.2.1), the following NC Act listed threatened fauna species are considered likely to occur at the Study Area, based on distribution, previous records and habitat suitability:

- Black-necked stork (*Ephippiorhynchus asiaticus*)
- Grey falcon (*Falco hypoleucos*)
- Cotton pygmy-goose (*Nettapus coromandelianus*)

The grey falcon has the potential to occur in woodland vegetation in the Study Area. Suitable habitat corresponds with the following habitat types in the Study Area:

- Eucalypt open woodland with native grass understorey
- Eucalypt and acacia mixed woodland or forest often on clay soils
- Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey

Natural and artificial waterbodies have potential to provide suitable habitat for the black-necked stork and cotton pygmy-goose.

5.2.4.5 Fauna Pest Species

Six terrestrial vertebrate pest species were recorded from the Study Area and comprised:

- One amphibian – cane toad
- Five mammals – pig, wild dog, cat, European fox, and European rabbit

All of these species are Class 2 Declared Animals under the LP Act. Class 2 Declared Animals are species that are established in Queensland and currently do, or potentially may, have a notable negative economic, environmental or social impact. Local governments, communities and landowners are required to manage these species under the LP Act. The pig, wild dog, cat and European rabbit are also identified as priority species for management under the Isaac Regional Council (IRC) Draft Pest Management Plan (IRC, 2011).

Other pest species that may occur in the Study Area (based upon desktop assessments, and excluding livestock) include the common myna (*Sturnus tristis*) and the house mouse (*Mus musculus)*. Neither species are declared pests under the LP Act.

5.2.5 Aquatic Ecology

5.2.5.1 Wetlands

The closest wetland of international importance (Ramsar Wetland) is the Shoalwater and Corio Bays Areas, approximately 380 km south-east of the Study Area. No Great Barrier Reef Wetland Protection Areas are mapped within the Study Area, although 107 Wetland Protection Areas exist within 50 km of the Study Area (Figure 5-3). No wetlands of national, state or regional significance occur in the Study Area. Wetlands are not considered to be impacted by the Project.

5.2.5.2 Aquatic Habitats Types

The proposed Project (Rail) intersects DERM mapped major watercourses on 24 occasions, which includes crossing of Eight Mile Creek (3rd order stream), North Creek (2nd order stream), Belyando River (8th order stream), Mistake Creek (6th order stream) Gowrie Creek (4th order stream), Logan Creek (5th order stream), Diamond Creek (3rd order stream) and Grosvenor Creek (3rd order stream). Only some of these crossings and other aquatic habitats within the Study Area (for example farms dams and gilgais) were accessible during field surveys and hence desktop and catchment information has been considered in understanding the potential aquatic habitats available.

Aquatic habitats can generally be categorised into five broad waterbody types that vary in size and geomorphology, these being: lacustrine, palustrine, riverine, drainage lines and gilgais. Figure 5-9 shows the lacustrine, palustrine and riverine habitats across the Study Area and surrounding landscape according to DERM's waterbody mapping layer.

Lacustrine Habitat

Lacustrine habitat describes wetland and deep water habitats located in a topographic depression or a damned river channel (i.e. a lake or pond with free water). They have vegetation (including trees, shrubs, persistent emergents, mosses or lichens) coverage less than 30 per cent (DERM, 2011a). Within the Study Area these habitats are most likely to be permanent farm dams or other isolated pools with limited aquatic vegetation.

Dams represent permanent water sources and can contain suitable micro-habitat in the form of macrophyte beds and occasional woody debris. Farm dams have no natural connectivity to other water sources and there are very limited opportunities for recruitment and dispersal for fish species. Photographic example of this habitat type is shown in Plate 5-7.

Plate 5-7 Permanent Dam (May 2011)

Palustrine Habitat

Palustrine habitat describes waterbodies that are dominated by vegetation (including trees, shrubs, persistent emergents, mosses or lichens) (DERM, 2011b). Similar to lacustrine, palustrine habitat can also represented by dams with the difference being the greater presence of macrophytes or trees and shrubs (greater than 30 per cent cover) in palustrine habitat. DERM mapping (Figure 5-9) identifies this habitat category within the Study Area and wider landscape in areas occurring typically in association with watercourses. No palustrine habitat is mapped within the construction footprint.

Riverine Habitat

Riverine habitats are those with a formed channel that periodically or continuously contain flowing water (DERM, 2011b). The Belyando River and Mistake Creek in the west of the Study Area and Logan Creek and Diamond Creek in the east can be classified as riverine. There are a number of drainage lines that have established stream banks and a formed channel, however, these lines provide limited long term aquatic habitat. The Belyando River (8th order stream) represents the largest watercourse within the Study Area. Within the Study Area, the Belyando River has high ecological value and maintains aquatic habitat for flora and fauna throughout the year, even if in isolated pools. In areas it is fringed on both sides by a riparian zone of mature eucalypt woodland with a grassy ground cover where the riparian zone provides shading of the water body and grassy ground cover stabilises the banks. Habitat features such as submerged woody debris and overhanging and trailing bank vegetation were recorded in some

reaches and provide a variety of habitats for aquatic species. The river experiences strong seasonal variation in flow and is expected to provide an important movement corridor for terrestrial fauna that are restricted to forest remnants. Photographic example of this habitat type is shown in Plate 5-8.

Plate 5-8 Belyando River (May 2011)

Drainage Habitat

Drainage lines are narrow drainage paths (often 1st order streams or not mapped) and occur at the top of stream catchments and meander in other areas of the Study Area. These paths do not have defined banks. Their boundaries are defined by a change in substrate from the adjacent area. These lines provide a pathway for runoff during high volume downpours and are not expected to accommodate long term flows or isolated pools. There is likely to be very little erosion observed in these shallow profile drainage lines.

Gilgais

Gilgais are micro-relief land forms of mounds and depressions formed on shrink-swell and cracking clay soils where water can collect seasonally to form gilgai wetlands (DERM, 2011b). They are depressions in the landscape that can contain water and can attract a variety of reptiles, amphibians, birds, mammals and invertebrates (DERM, 2011b). Gilgais are likely to be distributed across the Study Area particularly in association with brigalow communities, and are likely to be ephemeral. Potential gilgais were detected where natural depressions occurred on clay and clay loam soils. No potential gilgais or depressions identified during the field surveys contained permanent water to support aquatic fauna.

5.2.5.3 Aquatic Flora and Fauna Species

A total of 28 aquatic dependent flora species have been previously recorded in the Study Area, of which 23 species are classified as being of least concern and five species are classified as exotic species.

In the Burdekin and Fitzroy Basins, 51 and 47 freshwater fish species respectively are known to occur (with 40 species similar between the two basins). Of these species, 17 have the potential to occur in waterways intersected by, or of relevance to, the Study Area. This includes five pest species which have the potential to occur in the Study Area.

Threatened fish species recorded in the basins include the Australian lungfish (*Neoceratodus forsteri*), Murray cod (*Maccullochella peelii*) and the freshwater sawfish (*Pristis microdon*). These are not

considered likely to occur in the Study Area (based on habitat range, previous records and known species distributions).

Aquatic reptiles that are known to occur in the Fitzroy and Burdekin basins include eight freshwater turtle species and the estuarine crocodile (*Crocodylus porosus*). The estuarine crocodile and the Fitzroy River turtle are listed as 'vulnerable', and are considered unlikely to occur in the Study Area. The remaining species are least concern and may occur in the Study Area.

The only invertebrate previously recorded in the Study Area is the redclaw crayfish (*Cherax quadricarinatus*). The only aquatic mammal that has the potential to occur in the Study Area is the platypus, which is listed as special least concern. Suitable habitat for the platypus is limited throughout the Study Area, as watercourses are considered to be too ephemeral to support this species.

Aquatic species with the potential to occur in the Study Area inhabit a range of environments and display a range of environmental tolerances.

Pest Species

Desktop investigations recognised a number of pest species that may occur in the Burdekin and Fitzroy basins (DERM 2011h, Carter and Tait 2008). The pest species with potential to occur include:

- Mozambique tilapia (*Oreochromis mossambicus*)
- Spotted tilapia (*Tilapia mariae*)
- Mosquitofish (*Gambusia holbrooki*)
- Guppy (*Poecilia reticulate*)
- Goldfish (*Carassius auratus*)

5.3 Potential Impacts and Mitigation Measures – Construction Phase

Potential impacts to terrestrial and aquatic ecology values associated with the construction phase of the Project have been summarised into four broad categories which include:

- Clearing of vegetation
- Disturbances of watercourses and changes to surface water flows
- Increased anthropogenic activity leading to disturbance
- Introduction of weeds and feral pest species

Each of the potential impacts and proposed mitigation measures are described below.

5.3.1 Vegetation Clearing

5.3.1.1 Overview

The total extent of vegetation clearing, and in particular remnant vegetation, required for the construction phase has been minimised in the concept design phase of the Project (Rail) through avoidance. The Project (Rail) alignment has as far as is practicable (and in consideration of other environmental, social and technical constraints) been located in areas that have been previously cleared or degraded by both past and current land use practices (refer Volume 1 Section 3 Introduction for discussion on Project

alternatives). Residual potential impacts arising from vegetation clearing during the construction phase may include:

- Loss of remnant vegetation in the form of REs, flora habitat and vegetation community extents
- Loss of habitat (roosting, shelter, foraging, breeding) for native fauna including conservation significant fauna
- Degradation of terrestrial and aquatic habitat adjacent to and downstream of cleared areas
- Landscape fragmentation, reduction in connectivity and reduced capacity for fauna dispersal
- Fauna mortality

Detail on each of these potential impacts arising from clearing of vegetation is discussed in below.

5.3.1.2 Loss of Remnant Vegetation

Clearing of vegetation within the construction footprint of the Project (Rail), will potentially result in the loss of approximately 366 ha of remnant vegetation. This encompasses 18 RE types within the Brigalow Belt North bioregion. The total area of potential impact to endangered, of concern and least concern REs within each bioregion is provided in Table 5-11.

Table 5-11 Total Area of Impact to each RE within the Construction Footprint

RE status	Clearing extent			
	Rail corridor	Accommodation camps	Temporary and Permanent Infrastructure	**Total**
Brigalow Belt bioregion				
Endangered	28.4 ha	4.6 ha	4.4 ha	**37.4 ha**
Of concern	190.6 ha	0 ha	9.8 ha	**200.4 ha**
Least concern	123.7 ha	0 ha	4.8 ha	**128.5 ha**
Total	**342.7 ha**	**4.6 ha**	**19.0 ha**	**366.3 ha**

Loss of High Conservation Status REs

Table 5-12 provides a summary of the proposed clearing extent for higher conservation status REs. In addition, the current extent of these REs across the bioregion and subregions traversed by the Project and subsequent total clearing extent (as a percentage of the subregional extent) is also provided. Further, the final column of Table 5-12 provides the current extent of each RE in the protected area estate, which includes National Park, State Forest, Timber Reserves and Conservation Parks. Conservation REs listed as least concern have generally not been included in these tables. Exceptions are made for threshold REs and least concern REs that are also listed as being TECs.

Overall, the REs that will likely be impacted to the greatest extent with respect to clearing are of concern REs 11.4.11 (128.1 ha) and 11.3.3 (46.7 ha) which together equates to approximately 9.4 per cent of the total clearing extent within the construction footprint and 47.7 per cent of the total extent of clearing of

remnant vegetation. Following these extents, all impact to other REs is less than 24 ha, ranging between 1.4 ha and 23.9 ha (refer Table 5-12).

Table 5-12 Impact of Clearing to Higher conservation status REs - Brigalow Belt Bioregion

REs	VM Act/ EPBC Act status	Proposed clearing area	Bioregion current extent[1]	Subregion[2] current extent[1] (% of subregion extent to be cleared[3])	Protected area estate (% of total current extent)[4]
Endangered REs (Total 37.4 ha)					
11.3.1	Endangered **Brigalow TEC**	11.0 ha	80,806 ha	16,679 ha (0.07)	30,702 ha (38.1 %)
11.4.8	Endangered **Brigalow TEC**	2.5 ha	71,909 ha	31,968 ha (0.01)	7,025 ha (9.7 %)
11.4.9	Endangered **Brigalow TEC**	23.9 ha	96,425 ha	40,916 ha (0.06)	25,851 ha (26.8 %)
of concern REs (Total 200.4 ha)					
11.3.3	of concern	46.7 ha	28,1347 ha	66,455 ha (0.07)	33,025 ha (11.7 %)
11.4.5	of concern	3.5 ha	13,257 ha	12,907 ha (0.03)	2,866 ha (21.6 %)
11.4.6	of concern	20.7 ha	34,718 ha	26,097 ha (0.08)	9,399 ha (26.8 %)
11.4.11	of concern	128.1 ha	23,795 ha	23, 191 ha (0.55)	200 ha (0.8%)
11.9.10	of concern	1.4 ha	83,107 ha	15,328 ha (0.01)	6,973 ha (8.4 %)
TEC constituents (Total 37.4 ha)					
11.3.1	endangered	11.0 ha	80,806 ha	16,679 ha (0.07)	30,702 ha (38.1 %)
11.4.8	endangered	2.5 ha	71,909 ha	31,968 ha (0.01)	7,025 ha (9.7 %)
11.4.9	endangered	23.9 ha	96,425 ha	40,916 ha (0.06)	25,851 ha (26.8 %)
Threshold REs (Total 20.4 ha)					
11.3.5	least concern Threshold RE	20.4 ha	55,395 ha	37,214 ha (0.05)	6,036 ha (10.7 %)

[1]Figures calculated from DERM 2010c: 'current extent' is of 2006, where this is <10, 000 ha it is shown in bold.

[2] This is the sum of each REs current extent from all of the subregions/provinces traversed by the alignment.

[3] % = proposed clearing extent as % of subregion current extent – if less than 0.01% then 0.00% is shown.

[4] Protected area estate = national park, state forest, conservation park, timber reserve, figures are from 2005.

Loss of Threatened Ecological Communities

Clearing for the construction footprint will result in the loss of REs that have the potential to also qualify as EPBC Act listed TEC's. The total area of potential TEC's to be cleared from within the construction footprint includes:

- 37.4 ha of REs potentially consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant)

Refer to Volume 1 Section 13 Matters of National Environmental Significance Report for further discussion relating to the impacts on TECs.

Loss of Regulated Regrowth

A total of approximately 19.6 ha of regulated high value regrowth vegetation is currently proposed to be cleared during the construction phase of the Project. Of this, approximately 11.5 ha is categorised as being high value regrowth containing an endangered RE, 6.6 ha is high value regrowth containing an of concern RE, and 1.5 ha is high value regrowth containing a least concern RE.

Loss of Vegetation Communities

Broad vegetation communities have been categorised with fauna habitat types and mapped within the construction footprint (refer Figure 5-9). The extent of each broad vegetation community (as defined in Table 5-6) potentially to be impacted as a result of vegetation clearing for the construction phase of the Project are detailed with the fauna habitat types discussed in Section 5.3.1.3.

Loss of Flora Species and their Habitat

A total of 114 native flora species from 40 families (all listed as least concern under the NC Act) were recorded during the field surveys. Individuals and/or populations of some of these species will be lost from the local environment due to clearing proposed for the construction phase of the Project. As such, this may reduce the genetic diversity within populations of these species and population dynamics and ecosystem functioning may be altered as suitable habitat for dispersal and germination will be lost. In addition, isolation of some populations of flora species (particularly those that require outcrossing for viable seed production) may increase the risk of inbreeding depression.

Furthermore, loss of vegetation may also affect local water and nutrient cycles, affect drainage patterns, remove carbon sinks and lead to increased erosion (refer Volume 4 Appendix Y Soils Assessment and Volume 4 Appendix AB Hydrology Report).

Loss of Cleared Land/Paddocks

In addition to the area of remnant vegetation and regulated regrowth vegetation that will be impacted within the construction footprint, (rail corridor and infrastructure and construction camp footprints), a further 1,502 ha of non-remnant land (predominantly utilised for grazing purposes) will be utilised for construction of the Project (Rail). This equates to a total of 80.4 per cent of the total clearing area of the Project (Rail).

Management and Mitigation Measures

The impact on native vegetation has been reduced by locating the rail corridor and temporary and permanent infrastructure within previously cleared areas. Where native vegetation clearing cannot be avoided, the following management and mitigation measures are proposed:

- Design and layout of the temporary and permanent structures and infrastructure within the construction footprint (including construction areas, such as site offices, construction stockpile locations, machinery/equipment laydown areas and storages, access tracks and workers camps) will further consider avoidance of remnant vegetation (in particular endangered, of concern and threatened REs) and make use of previously cleared, non-remnant land.
- The extent of vegetation clearing will be restricted to the minimum amount necessary for the construction of the Project, particularly in the vegetation types:
  - REs listed as constituents of TECs protected under the EPBC Act
  - Endangered and of concern REs
  - Threshold REs
- The extent of vegetation clearing must be clearly identified on construction plans and in the field. Areas that must not be cleared or damaged are to also be clearly identified on construction plans and in the field. Clearing extents are to be communicated to all necessary construction personnel involved.
- Vegetation clearing operations are to be supervised by a suitably qualified ecologist to monitor compliance of vegetation clearing with the defined clearing extents.
- Where clearing TECs and REs of conservation significance is absolutely unavoidable, offsets will be required (refer Volume 1 Section 11 Draft Offsets Strategy).
- Clearing within areas of high ecological value, such as riparian corridors, must be undertaken with care, and rehabilitated to restore connectivity to the highest realistic extent following clearing (i.e. to a level that considers the requirements of maintaining permanent infrastructure but rehabilitates in all areas no longer required in a way that facilitates the movement of fauna).
- As soon as possible after cleared areas are no longer required (outside of the rail corridor), suitable rehabilitation seeding and/or planting must commence using flora species of local provenance and species specific to the RE cleared at that site. Management of previously disturbed land must occur in accordance with a Project Land Rehabilitation Plan. This plan will provide key performance indicators and detail how the disturbed land will be managed and rehabilitated, including (but not limited to) details regarding seed collection, restoration of soil structure, weed management, flora regeneration, landscape design.

Summary

Vegetation clearing is an unavoidable impact for the Project (Rail) in relation to the construction of the Project (Rail). Where possible, the Project (Rail) footprint has been located in existing cleared areas. The construction footprint is predicted to result in clearing of native vegetation as follows:

- 37.4 ha endangered RE (inclusive of 37.4 ha Brigalow TEC)
- 200.4 ha of concern RE
- 128.5 ha least concern RE

Residual impacts to the current bioregional extents of each RE are one per cent of the total current remnant extent or less.

The clearing of REs for the construction phase of the Project will result in a reduction in the size of RE extents or in some cases, the removal of smaller RE patches within the construction footprint. Following

implementation of management and mitigation measures, the removal of remnant vegetation will still be required. While opportunities exist for management and mitigation with regard to the potential impacts, clearing of vegetation is largely unavoidable. Where the clearing of remnant vegetation is unavoidable and cannot be satisfactorily avoided, managed and mitigated, offsets are likely to be required in accordance with the relevant Commonwealth and State offset policies (refer Volume 1 Section 11).

The flora species and habitats identified within the construction footprint are in general considered to be relatively common in the landscape. Notwithstanding, clearing of vegetation for the construction phase of the Project will result in localised reductions in population extents, diversity and abundance of flora species and general ecosystem resources encompassed within the construction footprint. Where impacts to the loss of flora species and habitat cannot be successfully managed and mitigated, relevant offsets may be required in accordance with Commonwealth and State offset policies (refer Volume 1 Section 11).

5.3.1.3 Loss of Terrestrial Fauna Habitat

The specific loss of terrestrial fauna habitat consequential to the construction of the Project includes the removal of mature vegetation, hollow-bearing trees and hollow logs. Loss of these habitat features in turn creates a loss of perching, foraging and den/nesting resources for native species. A subsequent increase in competition for resources such as food and shelter in remaining remnant habitats may occur. Hollow-bearing trees are recognised as a limited resource in most grazing lands due to previous clearing and, as such, the loss of these habitat features are considered to be a major threat to Australia's biodiversity (Gibbons and Lindenmayer 2002).

The total clearing footprint for the construction phase of the Project (Rail) is approximately 1,868 ha. This encompasses the following vegetation community/fauna habitat types:

- 78 ha of eucalypt open woodland
- 47 ha of acacia woodland or forest
- 35 ha of brigalow shrubland to open forest
- 4 ha of eucalypt and acacia mixed woodland or forest
- 65 ha of open woodland fringing watercourses and on flood plains
- 137 ha of native pastures or grasslands
- 1,502 ha of open cleared land and regrowth

In addition to these vegetation communities (and associated fauna habitat types), two dams (based on DERM's Waterbodies mapping layer, 2010) and 24 mapped watercourses are also likely to be impacted by construction activities. Cattle water toughs also provide a source of water to avian fauna in particular and are common throughout the construction footprint. Consequentially, construction activities will reduce local availability of habitats associated with natural and artificial water bodies.

Loss of terrestrial fauna habitat types (listed above) will reduce local resource availability (for foraging, roosting and breeding) for an array of fauna species including amphibians, ground-dwelling and arboreal reptiles, woodland and grassland birds and terrestrial, arboreal and flying mammals.

Impacts to aquatic fauna and habitat types are detailed in Section 5.3.2.2.

Loss of Habitat – EPBC Act Listed Fauna

The total impact to potential habitat for EPBC Act listed fauna species as a result of the proposed constriction activities for the Project is summarised in Table 5-13.

Vegetation clearing for the construction of the Project may also reduce the local availability of habitat resources for the EPBC Act listed migratory birds confirmed to be present within the Study Area. Impacts to listed threatened and migratory fauna species are discussed further in Volume 1 Section 13 Matters of National Environmental Significance Report.

Table 5-13 Impact to EPBC Act Listed Threatened Fauna Habitat

EPBC Act listed fauna species	EPBC Act/NC Act status	Total clearing extent*
Confirmed present		
Squatter pigeon (southern)	vulnerable/ vulnerable	145.7 ha
Likely to occur		
Ornamental snake	vulnerable/ vulnerable	229.5 ha
Koala	vulnerable/ special least concern	143.2 ha
Black-throated finch (southern)	endangered/ endangered	64.7 ha

*total clearing extent is based on the broad vegetation community/ fauna habitat types as they apply to each species. Exceptions are with black throated finch (which has had its mapped potential habitat refined through mapping only those REs that known records of species have been obtained) and the squatter pigeon (which has had its habitat mapped based on REs characterised by open woodland and forest vegetation).

Loss of Habitat – NC Act Listed Fauna

In addition to those species also listed under the EPBC Act (and therefore captured within Table 5-13), the construction footprint of the Project is considered to encompass potentially suitable habitat for four NC Act listed fauna species. The total impact to potential habitat for these four NC Act listed fauna species comprise:

- Little pied bat (near threatened – NC Act): 147.1 ha of potentially suitable habitat
- Black-neck stork (near threatened – NC Act): 66 ha of potentially suitable habitat
- Grey falcon (near threatened – NC Act): 147.1 ha of potentially suitable habitat
- Cotton pygmy-goose (near threatened – NC Act): 66 ha of potentially suitable habitat

Management and Mitigation Measures

Management and mitigation measures to reduce the impact of habitat loss on the biodiversity features within the construction footprint and surrounding adjacent landscape include:

- Design and layout of the temporary and permanent structures and infrastructure within the construction footprint (including construction areas, such as site offices, construction stockpile locations, machinery/equipment laydown areas and storages, access tracks and accommodation

camps) will further consider avoidance of remnant vegetation (in particular endangered, of concern and threatened REs) and make use of previously cleared, non-remnant land.

- Suitable fauna-friendly culverts that enable the safe passage of fauna (in particular macropods, quolls and small mammals) across the rail corridor will be colocated with culverts, bridges and other crossing structures, particularly in important habitat areas. For example culverts to facilitate movement of fauna (e.g. incorporation of ledges, allow for lighting through use of grids, protect and enhance entries and exits) are advised to be installed where the Project bisects watercourses, drainage lines and remnant vegetation, including the areas mapped as potentially suitable habitat for EPBC Act listed species which are considered likely to occur. The suitability of culvert size will be a consideration during the design of permanent structures. For example, when targeting common fauna such as macropods, larger culverts will encourage use of these structures.
- Prior to vegetation clearing, trees and habitat features (i.e. log piles) that may be used by fauna for nesting or shelter will be marked. During clearing activities, a qualified fauna spotter-catcher will supervise the activity and recommend provisions for the relocation of fauna.
- Habitat features such as hollows and log piles will be salvaged, where possible, and placed in nearby (retained) habitat areas. Where this is not possible, the loss of habitat features will be supplemented in adjacent habitat areas with artificial habitat (i.e. nest boxes, artificial water sources).
- As soon as possible after cleared areas are no longer required (areas outside of the rail corridor), suitable rehabilitation will commence using flora species of local provenance and species appropriate to the cleared REs. Management of previously disturbed land should occur in accordance with a Project Land Rehabilitation Plan. This plan should provide key performance indicators and detail how the disturbed land will be managed and rehabilitated, including (but not limited to) details regarding seed collection, restoration of soil structure, weed management, flora regeneration and landscape design.
- Land clearing activities will, where possible, seek to avoid alteration to waterways such that the impacts to water quality and downstream flows are minimised to the greatest extent possible. Management of erosion and sedimentation in and adjacent to cleared areas must be undertaken in accordance with a Project Construction Environmental Management Plan (Section 13 Environmental Management Plan).

Summary

General Fauna

Clearing of vegetation will result in potential habitat loss for native fauna species. The impact to fauna and fauna habitat has been avoided through locating a large extent (approximately 80 per cent) of the construction footprint, where possible in areas of non-remnant vegetation or cleared land. Standardised monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

Despite the proposed management actions detailed above, unavoidable impacts to fauna habitat will arise as a result of vegetation clearing, particularly localised habitat loss in riparian areas. Where these unavoidable impacts cannot be satisfactorily managed or mitigated, offsets will need to be provided in accordance with Commonwealth and State policies (refer Volume 1 Section 11 Matters of national Environmental Significance).

Conservation Significant Fauna

In general, the construction footprint and surrounding Study Area are not considered to support an 'important population' or 'habitat critical to the survival' of any EPBC Act listed threatened fauna species. Thus, vegetation clearing (and associated impacts) is not considered to constitute a 'significant impact' to any of these species. Similarly, the construction footprint and surrounding Study Area are not considered to support 'important habitat' for EPBC Act listed migratory species, and thus, vegetation clearing (and associated impacts) is not considered to constitute a 'significant impact' to these species.

The impact of clearing of vegetation on potentially suitable habitat for the black-throated finch (southern) is also not considered to constitute a 'significant impact' to this species. Potentially suitable habitat is limited in association with the Project and largely confined to fragmented patches of remnant vegetation associated with rivers and creeks. Suitable habitat for the species is concentrated in the remnant vegetation associated with the Desert Uplands Bioregion to the far north-west of the Study Area (refer Volume 4 Appendix O for discussion on the black-throated finch (southern) in respect of potential impacts associated with the Project (Mine)). As for other fauna, where unavoidable impacts (i.e. habitat loss) cannot be satisfactorily managed/ mitigated and are considered to be a significant impact, offsets will need to be provided in accordance with Commonwealth and State policies (refer Volume 1 Section 11 Matters of national Environmental Significance).

5.3.1.4 Habitat Degradation

Clearing of native vegetation may result in the degradation of vegetation adjacent to areas being cleared as well as downstream habitats. Edge effects may occur where previously intact remnant vegetation (and the habitat it provides) is exposed to a distinct ecotone associated with construction of infrastructure. This may occur where remnant vegetation persists in a continuous tract across the Rail and Infrastructure Corridor, particularly along watercourses (Belyando River, Mistake Creek, Logan Creek, and Diamond Creek).

Clearing of vegetation and construction activities undertaken within the Project (Rail) footprint will cause temporary localised increases in noise, vibration and artificial light disturbance. In addition, further degrading effects to habitat may include increased exposure to dust, wind, weeds and pest animals. Exposure to any of these effects may alter habitat composition (i.e. reduced flora diversity and simplified ecosystem structure) and quality (i.e. reduced availability of forage resources, increased exposure to predators) at the ecotone, thereby potentially changing species diversity in the altered habitat. Where edge effects degrade or simplify habitat at the edge, it is possible the species diversity and habitat utilisation within this edge habitat will be altered and the diversity of native species reduced.

Vegetation clearing also has the potential to facilitate erosion (water and wind) particularly on soil types with a high erosion potential (such as sodic soils, further detail on soils within Study Area is provided in Volume 4 Appendix Y Rail Soils Report) and on high gradient slopes. Where vegetation clearing occurs near drainage lines, erosion may cause sedimentation of waterways, potentially degrading downstream aquatic and riparian habitats.

Management and Mitigation Measures

Impacts to habitats immediately adjacent to and downstream of cleared areas can be avoided or minimised through:

- Locate where possible temporary infrastructure within previously disturbed/degraded and/or cleared areas or within areas of non-remnant vegetation.
- Limiting lighting to work areas and employing directional lighting where lighting is required in areas near remnant vegetation.
- Ensuring all plant and equipment is appropriately serviced and maintained to minimise machinery noise where possible.
- Dust suppression during construction in cleared areas, rehabilitation, and the use of stabilised surfaces where possible.
- Management of weeds in and adjacent to cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and where necessary, eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols (refer Volume 3 Section 13).
- Management of fauna pest species during construction in and adjacent to cleared areas in accordance with a Project Fauna Pest Species Plan. This plan should include details relating to the monitoring and management of pest animals (refer Volume 3 Section 13).
- Management of sewage and other potentially harmful waste should be best-practice and in accordance with applicable guidelines/policies.
- Implementation of a Project Waste and Hazardous Materials Management Plan, which will include waste management and disposal protocols and procedures (refer Volume 3 Section 13).
- Vegetation clearing activities should, where possible, seek to avoid alteration to waterways such that the impacts to water quality and downstream flows are minimised to the greatest extent possible. Management of erosion and sedimentation in and adjacent to cleared areas should be undertaken in accordance with a Project Erosion Management Plan (refer Section 13 Environmental Management Plan).

Summary

Clearing of vegetation has the potential to result in habitat degradation of adjacent and downstream habitats. Actions seeking to manage these potential indirect impacts will be implemented. In consideration of the relatively localised nature and short-term duration of impacts associated with the construction phase of the Project and following implementation of the mitigation measures discussed, it is not expected that adverse or long-term impacts on fauna habitat are likely. Standardised monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

5.3.1.5 Habitat Fragmentation

Vegetation clearing may result in localised fragmentation of habitat in the vicinity of the construction footprint. Much of the landscape surrounding the proposed Rail and Infrastructure Corridor has experienced broadscale vegetation clearing resulting in remnant vegetation remaining as fragmented. As such, fragmentation associated with construction at this location is more likely to reduce the size and connectivity of existing isolated patches, rather than create new fragments. Nonetheless, many of the

patches of remnant vegetation that intersect with the construction footprint are narrow and vegetation clearing at this localised scale may reduce the capacity of some less mobile fauna to move within and between habitats. This is particularly relevant to small, ground-dwelling fauna such as amphibians, reptiles and small ground-dwelling and arboreal mammals.

Fragmentation of regional and state significant bioregional wildlife corridors could occur as a result of vegetation clearing during the construction phase of the Project. Although often somewhat degraded by the current grazing practices within the Study Area, the small riparian corridors or small patches of remnant and advanced regrowth patches act as habitat linkages between larger vegetated patches. Vegetation of a low condition rating can act as important refuges for native fauna, including conservation significant species within the typically degraded.

The clearing of vegetation can sever or severely reduce the extent of these habitat linkages and may impede or reduce the ability of fauna to move across the landscape. Species that are particularly likely to be susceptible to the impacts related to reduction in habitat linkages are those with larger habitat ranges such as macropods and echidnas.

Management and Mitigation Measures

Management and mitigation measures to reduce the impacts of habitat fragmentation to local fauna populations include:

- Landscape permeability will be retained where possible. Where fencing is required around cleared areas, it will be designed such that fauna can move through it (excluding those instances where fenced areas seek to protect fauna from threats such as trains, trenches, human contact). Consideration should be given to not using barbed wire on the top strand of wire fences or suitable fencing to maintain a level of landscape permeability.
- Suitable fauna-friendly culverts that enable the safe passage of fauna (in particular macropods, quolls and small mammals) across the rail corridor will be co-located with culverts, bridges and other crossing structures, particularly in important habitat areas. For example culverts to facilitate movement of fauna (e.g. incorporation of ledges, allow for lighting through use of grids, protect and enhance entries and exits) are advised to be installed where the Project bisects watercourses, drainage lines and remnant vegetation, including the areas mapped as potentially suitable habitat for EPBC Act listed species which are considered likely to occur. The suitability of culvert size will be a consideration during the design of permanent structures. For example, when targeting common fauna such as macropods, larger culverts will encourage use of these structures.
- Design will consider suitable watercourse crossings structures, for example bridge spans, culverts and openings such that fauna passage is facilitated across the Project footprint
- Vegetation clearing will be undertaken in a sequential manner to allow more mobile fauna species the opportunity to disperse away from cleared areas and clearing activities
- Following clearing, Rehabilitation will occur in areas no longer required as track construction progresses to facilitate fauna passage around the construction footprint
- Suitable fauna habitat features (logs, hollows etc) will be relocated to areas of adjacent larger, intact habitat to encourage use. Artificial habitat will be provided (as appropriate and practical) in these relocation areas to encourage use.

- The construction footprint will be reduced in environmentally sensitive areas, particularly at river and creek crossings.

Summary

In consideration of the present fragmented nature of the Study Area due to historic clearing and current land use practices (cattle grazing) and with implementation of the mitigation measures provided, the resulting habitat fragmentation associated with construction of the Project is considered to be localised.

5.3.1.6 Fauna Mortality

Construction activities involved in the clearing of vegetation, including the use of vehicles and machinery have the potential to lead to direct mortality of fauna in the event individuals are struck. Fauna residing in vegetation in particular are at risk of mortality, particularly those that roost or shelter in hollows, or beneath rocks, logs and bark (i.e. arboreal mammals, nocturnal birds, reptiles and frogs) and ground animals that typically tend to hide rather than flee in response to approaching danger (i.e. bandicoots, quails and pigeons) . In addition, nocturnal fauna species that are inactive during daylight hours and therefore unable to disperse away from clearing activities are particularly susceptible to injury or death. This includes conservation significant species such as the yakka skink and ornamental snake.

Management and Mitigation Measures

Management and mitigation measures to reduce the potential for fauna mortality as a result of land clearing activities include:

- All vegetation clearing will be undertaken in the presence of a qualified fauna spotter-catcher. Pre-demarcated habitat features will be thoroughly checked by fauna spotter-catcher prior to clearing. Provisions for the relocation of fauna should be made prior to the commencement of clearing.
- Vegetation clearing will be undertaken in a sequential manner to allow mobile fauna to disperse away from clearing areas
- All vehicles and plant associated with vegetation clearing must adhere to site rules relating to speed limits. Speed limits will be restricted, and clearly signposted so as to minimise the potential for road kill.
- Temporary fencing should be erected to exclude fauna and livestock from construction zones
- A fauna species relocation plan will be developed to facilitate relocation of fauna individuals according to species requirements (particularly if conservation significant fauna species are encountered during clearing activities).
- A fauna mortality register will be maintained to document the location and frequency of mortality and the fauna species most susceptible to injury and death, to enable on-going modifications to fauna conservation management strategies where necessary.
- Site inductions for all staff are to include education sessions regarding the local fauna that may be present on the site and protocols to be undertaken if fauna are encountered
- Sites are to be kept clean and free of waste to prevent the attraction of fauna species to areas of high activity and movement (refer Section 13)
- Work areas are to be inspected daily prior to commencement and fauna present to be relocated or moved

Summary

Direct mortality of fauna during the construction phase of the Project is expected to be reduced should the management and mitigation protocols outlined above be appropriately implemented. Nonetheless it is expected that some fauna mortality will occur during vegetation clearing activities.

5.3.2 Disturbance of Surface Watercourses and Waterbodies

5.3.2.1 Overview

Within the construction footprint for the Project, aquatic habitat (including surface watercourses and waterbodies) will be removed as a result of construction activities. The habitat that will be lost comprises two farm dams and disturbance to habitats of watercourses crossed by the construction footprint. A total of 12 major watercourse crossings and approximately 76 minor watercourse crossings (including unmapped ephemeral drainage lines) have been identified along the proposed rail corridor (Golder Associates, 2011). Of these watercourses, 24 have been mapped by DERM.

Impacts arising from aquatic habitat loss and degradation to aquatic habitat specific to aquatic flora and fauna have been summarised into three categories which comprise:

- Loss of aquatic habitat for aquatic flora and fauna
- Degradation of aquatic habitat and riparian zones
- Aquatic fauna mortality

5.3.2.2 Loss of Aquatic Habitat

Aquatic habitat to be removed within the construction footprint for the Project (Rail) includes at least two farm dams (based on DERM's watercourse mapping) and riparian habitat associated with watercourses. No declared fish habitat is mapped within the Study Area or within the construction footprint.

Within the construction footprint, the aquatic habitat at farm dams are categorised as lacustrine and typically provide limited value for native aquatic flora and fauna. Notwithstanding, there may be a localised impact to any resident native fish, crustacean and turtle species when the dams are drained or filled with material. No palustrine habitat is mapped within the construction footprint.

The majority of the watercourses intersected by the Project footprint are ephemeral streams that have established stream banks and a formed channel, however, these lines provide limited long term aquatic habitat and therefore disturbance impacts are limited at these locations. Belyando River (8th order stream) and Mistake Creek (6th order stream) in the west of the Study Area and Logan Creek (5th order stream) and Diamond Creek (3rd order stream) in the east can be classified as riverine. Belyando River and Mistake Creek in particular, are considered to have high ecological value and maintain aquatic habitat for flora and fauna throughout the year, even if in isolated pools. Localised, short-term impacts as a result of construction disturbance are likely particularly within riverine habitat.

In addition to other creeks intersected by the construction footprint, Diamond Creek and Logan Creek in particular are expected to facilitate periodic flows only, rather than permanent or even short term habitat for aquatic flora and fauna. The potential direct impact to flora and fauna communities will occur only in periods of inundation. However, in the event the location of the crossing of creeks during construction coincides with isolated pools, there will also be an impact to aquatic flora and fauna communities at these locations.

Management and Mitigation Measures

- Avoid and minimise disturbance to rivers and creeks. Construction methodology provides for (as far as is practicable) construction within rivers and creeks to be undertaken in the drier periods and ahead of rail construction. This will reduce disturbance and interference to surface flows and subsequent impacts on aquatic habitats.
- Route selection identified watercourse areas (amongst others) as constraints and sought to minimise impacts to watercourses through avoidance, selection of suitable bridge spans or location in narrower crossing areas, crossing of a tributary rather than the main waterbody, etc.
- Avoid and minimise human and vehicle access to river and creek bed and banks. Construction of river/watercourse crossings ahead of rail construction (as far as is possible) will reduce the need for personnel, equipment, machinery and plant to traverse the river/watercourse and limit disturbance to bed and banks.
- Temporary stream or channel diversion may be required to facilitate activities in wet periods. Stream flow is maintained to provide connectivity between aquatic habitats and facilitate aquatic fauna passage.

Summary

As a result of construction activities, there is likely to be a loss of aquatic habitat with localised, short-term impacts particularly in riverine habitat. With the implementation of the management and mitigation measures provided above, the residual impact to aquatic habitats is expected to be low.

5.3.2.3 Degradation of Aquatic Habitat and Riparian Zones

The riparian zones of watercourses, in particular those with established riparian vegetation (of note – Belyando River, Mistake Creek, Logan Creek and Diamond Creek) play an important role in the composition, function and protection of aquatic ecosystems and are likely to experience localised impacts during construction activities. Impacts are likely in established zones where they assist in stabilising soil, filtering toxicants and nutrients, and providing shade, large woody debris and organic matter for the production of aquatic ecosystems. Construction activities within or adjacent to the creek systems of the watercourses intersected by the construction footprint have the potential to disturb bed and bank substrates and lead to localised erosion and sediment transport to downstream habitats. Sedimentation of water downstream subsequently has the potential to degrade aquatic habitats in the downstream catchment.

Water Quality

Changes in water quality are described in Volume 4 Appendix AB Rail Hydrology Report. The assessment identifies that changes in water quality are most likely to be associated with the potential for increased turbidity and introduction of contaminants from construction machinery and wastes.

The source of most suspended particulates (and in turn increase in turbidity) in waterways is land runoff due to soil erosion (ANZECC 2000), including stream bank erosion. The majority of the watercourses likely to be disturbed during construction are not expected to be regularly inundated due to their ephemeral nature. However, clearing in the catchment at any time creates exposed surfaces with greater potential for erosion during rain periods. Disturbance of the bed and banks when dry will also create volatile areas with a higher potential for erosion when flows resume and catchment runoff occur.

Suspended particulates can influence the aquatic ecosystem when:

- In suspension – when in water column particulates reduce light penetration and thus primary production as well as affecting gill function of fish
- Settling out – when settled sediments can smother organisms and their habitats (ANZECC 2000)

Although riparian ecosystems are likely to be adapted to high turbidity during some periods (i.e. during rain periods and/or periods of flash flooding), an increase in the magnitude of the peaks of turbidity due to construction activities has the potential to have a detrimental effect on aquatic ecosystems.

Oils, fuel, lubricants and other substances containing chemicals will be required to operate construction machinery and commonly contain elements that, at high concentrations, can be toxic to aquatic organisms. Accidental spills or leaks anywhere within the water catchments have the potential to result in contaminants being transported to the aquatic environment with rainfall runoff.

Surface Flows

Changing the direction or volume of runoff flows to the watercourses within the construction footprint has the potential to change the geomorphology of the area as a result of scour and deposition. If water inputs are reduced, changes to the availability of habitats downstream may be realised. Changes to surface flows are discussed in further detail in Volume 4 Appendix AB Rail Hydrology Report.

Management and Mitigation Measures

- Design and layout of the components of the infrastructure will maximise development on existing cleared lands as priority to avoid impacts to the creek bed, banks and riparian areas and the aquatic values that may be provided when inundated (mainly during high water flows).
- Clear, on-ground demarcation of areas to be cleared adjacent to watercourse crossing locations will be undertaken prior to clearing to avoid accidental clearing or stockpiling of cleared vegetation in sensitive areas. Identification of this area for protection where possible will minimise the potential for unnecessary impact to the creek and consequently downstream areas.
- Disturbance to creek banks and control of site runoff from all areas disturbed during construction activities will be managed through the development and implementation of a Project Sediment and Erosion Control Plan. This plan will limit the potential for the degradation of downstream aquatic habitat.
- For those unavoidable impacts (i.e. habitat loss) that cannot be managed, offsets will need to be provided in accordance with Commonwealth and State policies (refer Volume 1 Section 11).

Summary

As a result of construction activities, there is an increased potential for degradation to aquatic habitats downstream of the construction area as a result of changes to water quality and removal of the riparian habitat. With the implementation of the management and mitigation measures provided above, the residual impact to aquatic habitats is expected to be low.

5.3.2.4 Aquatic Fauna Mortality

Mortality or injury to aquatic fauna has the potential to occur when construction activities are undertaken within or adjacent to a waterbody. This is generally due to vehicle/machinery strike or strike from falling vegetation or woody debris. It is unlikely that there will be aquatic fauna communities in many of the minor ephemeral tributaries during the construction period, as these areas typically provide aquatic habitat during flash flows only. The potential for mortality or injury to aquatic fauna species at these locations is unlikely.

Farm dams located within the construction footprint potentially provide suitable habitat for aquatic fauna such as native fish, crustaceans and turtles. Removal of this habitat through filling or draining the dam may result in the mortality of this community, depending on local conditions and timing. If present, fish and crustacean populations in farm dams are not connected to any other aquatic habitats that individuals can independently move to but are isolated populations likely to have been established as a result of stocking or incidental transfer by birds or the like. It is unlikely that these populations contribute to the local biodiversity or genetic diversity of the aquatic communities in the river and creek systems in the wider region. Nevertheless these aquatic fauna communities may not be important in the context of local biodiversity, protection of native species under the NC Act must be considered.

Management and Mitigation Measures

Mitigation measures to address potential impacts arising from aquatic habitat loss and degradation of relevance to terrestrial fauna are outlined in Section 5.3.1.3 and Section 5.3.1.4, respectively. Mitigation measures to address potential impacts to aquatic flora and fauna include:

- Design and layout of the components of the infrastructure will maximise development on existing cleared lands as priority to avoid impacts to the creek bed, banks and riparian areas and the aquatic values that may be provided when inundated (mainly during high water flows).
- Design and layout of watercourse crossings will consider the requirement for fish movement including under flow conditions. This will be done in accordance with Department of Agriculture, Fisheries and Forestry guidelines for the design of stream crossings (Cotterell, 1998) for fish passage.
- To avoid mortality of aquatic fauna within farm dams impacted by construction activities, a Fauna Salvage and Relocation Plan will be required. Relocation would require preliminary sampling of dams to identify the native species present, followed by the development of an appropriate salvage plan for approval by the relevant agencies prior to removal of the habitat. The plan will require consideration of the relocated location in terms of suitability and availability of habitat and resources for the community.
- To avoid mortality of aquatic fauna within higher order watercourses (namely, Belyando River, Mistake Creek, Logan Creek and Diamond Creek) construction activities should preferably be undertaken during dry conditions.
- Disturbance to creek banks and control of site runoff from all areas disturbed during construction activities will be managed through the development and implementation of a Project Sediment and Erosion Control Plan.
- For those unavoidable impacts (i.e. habitat loss) that cannot be managed, offsets will need to be provided in accordance with Commonwealth and State policies.

Summary

There is potential for aquatic fauna mortality to occur through impacts to farm dams and watercourse crossings as a result of construction activities. With the implementation of the management and mitigation measures provided above, the residual impact to aquatic fauna is expected to be low.

5.3.3 Increased Anthropogenic Activity Leading to Disturbance

5.3.3.1 Overview

Habitat degradation, behavioural disruption, injury and mortality may arise as a result of increased vehicular activity and a change in disturbance types within the construction footprint. Habitat degradation and associated behavioural disruption may result from increased dust mobilisation, erosion/sedimentation, and increased exposure to noise, light and vibration, chemical contamination and alteration of waterways. Injury and mortality may occur where animals are struck by vehicles or plant machinery, or where animals become entrapped in active construction areas (pits, trenches, building sites etc.).

Potential ecological impacts arising from disturbances generated from a general increase in activities in the area include:

- Fauna behavioural disruption associated with habitat degradation
- Fauna mortality
- Change in fire regime and risk of fire

5.3.3.2 Fauna Behavioural Disruption

The higher intensity of land use at and near the construction zones associated with rail corridor and associated infrastructure may disrupt local fauna behaviour, largely as a result of increased exposure to light, noise, dust, vehicles and people. Behavioural disruption may be direct (i.e. increased susceptibility to predation due to increased noise reducing prey vigilance, or increased light increasing prey detectability) or indirect (i.e. habitat degradation reducing local resource availability therefore increasing foraging dispersal distances for fauna). In addition, there is expected to be localised and temporary disturbance to wildlife behaviours and dynamics (i.e. foraging, breeding and nesting) adjacent to the construction footprint.

Direct impacts to flora may be incurred through excessive dust settling on plants which can suppress plant growth by limiting the photosynthesis potential of species in close proximity to the construction area (Nanos & Ilias, 2007). The impacts from dust is likely to be a more pronounced where construction activities are located in and adjacent to sensitive habitats (i.e. watercourses and riparian vegetation). In addition, water quality of aquatic environments may be impacted through excessive dust settling on waterbodies that may indirectly affect aquatic flora and fauna. It is important to note that these impacts will be temporary (i.e. only during the construction period), and will be addressed through management relating to dust suppression actions.

Human settlements in the form of construction camps substantially increase the generation of waste materials in the area and consequently may provide additional resources (i.e. food scraps) for feral animals such as pigs, cats and dogs. Feral animals, some of which were confirmed to be present within the Study Area during field surveys, may increase in abundance if easier access to foraging resources is provided.

Further still, increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds in the Study Area. A total of 11 introduced plants were detected within the Study Area, of which, three (these being parthenium, harrisia cactus and prickly pear) are 'declared plants' under the LP Act. Increasing the prevalence of weeds within the construction footprint and the potential for weeds to spread to the surrounding landscape may reduce the quality of habitats for some fauna species.

Management and Mitigation Measures

Management and mitigation measures to reduce disruption to fauna behaviour during construction activities include:

- Directional lighting will be used where lighting is required in areas near remnant vegetation, to avoid disturbance to sensitive habitat (i.e. watercourses and wetlands/ox-bows).
- Dust suppression actions will be undertaken in all cleared areas and on all unsealed roads at suitably regular intervals.
- Frequent maintenance of construction machinery and plant will be undertaken to minimise unnecessary noise.
- Management of sewage and other potentially harmful waste should be best-practice and in accordance with applicable guidelines/policies.
- A Project Waste and Hazardous Materials Management Plan will be implemented, and include waste management and disposal protocols and procedures. This plan must incorporate protocols relating to the:
  - Disposal of green waste (in a manner that minimises potential for spread of weeds)
  - Disposal of food scraps and the like (to minimise potential for pest animals to access food wastes)
- Management of weeds in, and adjacent to, cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and, where necessary, eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.
- Management of fauna pest species in, and adjacent to, cleared areas in accordance with a Project Fauna Pest Species Plan. This plan should include details relating to the monitoring and management of pest animals. Camps and laydown areas to be fenced to prevent encroachment of feral species. Waste material to be appropriately sealed and stored to discourage encroachment by feral species.

Summary

Throughout the construction phase of the Project, habitats adjacent to construction areas will increasingly become more exposed to long-term disturbance. This includes noise and light disturbance in habitats adjacent to the construction footprint, and disturbance from dust and noise in areas adjacent to all roads and access tracks utilised to facilitate vehicle movement within the wider Study Area Given that the majority of the Study Area is already degraded by cattle grazing to a large extent, and following the implementation of the mitigation measures that seek to prevent/reduce exposure to these potentially disruptive activities, the residual impact is likely to be low.

5.3.3.3 Fauna Mortality

The risk of mortality to terrestrial fauna, with respect to clearing of vegetation, is discussed in Section 5.3.1.6 and the risk of mortality to aquatic fauna is discussed in 5.3.2.4. In addition to the information provided, activities other than land clearing, for example general vehicle movement and construction (i.e. civil works) also have the potential to lead to fauna mortality, including livestock if an interaction between machinery and fauna occurs. Animals that are unable to disperse away from areas under active clearing or construction are particularly susceptible to injury or death. This includes amphibians, reptiles, small ground-dwelling mammals and nocturnal species that are inactive during daylight hours. Furthermore, livestock and wildlife that are highly mobile are at risk of being trapped or injured in open pits or trenches within the construction zone. In addition to those measures already mentioned in previous sections, the incidence of direct mortality can be reduced by implementing the mitigation measures outlined below.

Management and Mitigation Measures

Mitigation measures to reduce fauna mortality should include:

- Temporary fencing should be erected around construction zones to exclude mobile animals from civil works areas within the construction zone.
- If any pits/trenches are to remain open after daily site works have been completed, they will be fenced, covered by an impenetrable barrier, or if possible, fauna ramps should be put in place to provide a potential means of escape for trapped fauna.
- Work areas will be checked for fauna that may have become trapped before work commences each day.
- Employees must be made aware of environmental responsibilities during inductions.
- All vehicles and plant will adhere to site rules relating to speed limits. Speed limits should be developed so as to minimise the potential for road kill.
- Reduce the number of construction vehicles mobilising to and from site daily – retain vehicles within the construction zone and transfer personnel by means of bus to and from the work front daily to reduce the exposure for animal strike in areas away from the construction footprint.

Summary

Civil works and increased vehicle movements have the potential to result in fauna mortality. Management actions seeking to avoid or reduce impacts will be implemented. In consideration of the extensive areas of existing disturbance within the construction footprint, the relatively localised nature of impacts associated with civil works, and the management of these impacts through an integrated suite of management actions, avoidable impacts to fauna are considered to be low. Similarly, with the implementation of site rules relating to vehicle movements (including speed limits), negative fauna encounters on roads may be minimised. Standardised monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

5.3.3.4 Change to Fire Regime and Risk of Fire

The construction footprint for the Project traverses land mapped as being low to medium bushfire risk based on the Queensland Fire and Rescue Services Bushfire Risk Analysis mapping for the Isaac Regional Council (DES, 2008). Increased human activity may alter the fire regime of the local landscape. In particular, construction activities that involve tasks such as welding can greatly increase

the risk of bushfire incidents. Bushfires can result in significant mortality of native fauna and flora, and for cattle. Depending on fire intensity, such burns may alter the structural integrity and natural regeneration capacity of affected vegetation, for example, fire in grasslands or grazing pasture during dry seasons can be catastrophic for landowners in periods of drought. Considering the potential impacts of uncontrolled or accidental fires it is therefore essential that effective measures are taken to prevent this occurrence.

Management and Mitigation Measures

A Project Fire Management Plan (refer Section 13) will be implemented to address and minimise fire hazards. As well as documenting protocols and actions for preventing accidentally-lit fires, this plan should outline how fuel loads will be monitored and maintained across the Study Area and include training procedures to instruct staff how to use fire-fighting equipment. Ecological considerations will be incorporated into the development of this plan and response procedures developed.

- Clearing of the construction footprint immediately adjacent to the work front will reduce fire risk associated with hot work activities such as welding. Hot Work activities will be undertaken in open, cleared areas, in areas of lower fire risk and with adequate fire prevention controls in place.
- Nominate designated smoking areas and actively monitor and enforce no smoking outside of these areas.
- Workfronts will be provided with adequate fire fighting equipment (water cart) and training.
- Staff awareness during inductions regarding fire safety risks.

Summary

Implementation of a Project Fire Management Plan may reduce the potential for destructive high intensity fires to disturb habitats within the construction footprint and adjacent surrounding landscape.

5.3.4 Introduction of Pest and Feral Species

5.3.4.1 Overview

Increased access to areas during construction activities and associated construction practices such as vegetation clearing and soil disturbance can facilitate the introduction and spread of pest and feral species. Pest and feral species can have adverse impacts on the flora and fauna diversity of a region and disrupt ecosystems by outcompeting and replacing native species, thereby altering species diversity and potentially disrupting ecosystem function. A total of 11 introduced flora taxa were recorded from the Study Area, three of which are declared as WONs and are declared plants under the LP Act. Six fauna pest species comprising five mammals and one amphibian declared under the LP Act were recorded during field studies.

5.3.4.2 Habitat Degradation and Reduction in Resource Availability

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds at the Study Area. New weed species can be introduced through activities associated with construction, such as the use of contaminated materials (i.e. for fill required for construction) or machinery. Likewise, vegetation clearing through areas of continuous habitats (i.e. at watercourses) and along linear corridors can create the potential for fauna pests and feral predators to penetrate further into bushland areas.

While three introduced plants declared under the LP Act were recorded during field surveys, they were not found to be prevalent across much of the Study Area. Watercourses and associated riparian vegetation in particular are sensitive receptors for weeds and small infestations can be spread over long distances if seeds enter the waterway system. An increase in the prevalence of weeds within the construction footprint and potentially beyond to the surrounding landscape may in turn reduce the quality of habitats for some fauna species.

Human settlement at workers camps (with associated waste production) may provide additional resources for feral animals, for example, pigs and dogs. These feral pest fauna species, confirmed as present within the Study Area (among others), may increase in abundance if easier access to foraging resources is provided. An increase in the prevalence of these animals may adversely impact native fauna as it may lead to:

- Increased competition for resources
- Increased predation (of native species by fauna pest species)
- Habitat degradation (i.e. physical pig damage of riparian areas)

Management and Mitigation Measures

Pest and feral species spread and the potential for introduction will require management during all activities at the site. An integrated suite of actions will be developed to manage pest species, including:

- A Project Waste and Hazardous Materials Management Plan will be implemented, and include waste management and disposal protocols and procedures. This plan should incorporate protocols relating to the:
  - Disposal of vegetation waste (in a manner that minimises potential for spread of weeds)
  - Disposal of food scraps and the like (to minimise potential for pest animals to access food wastes)
- Management of fauna pest species in, and adjacent, to cleared areas in accordance with a Project Fauna Pest Species Plan. This plan should include details relating to the monitoring and management of pest animals. Waste material to be appropriately managed and stored to discourage pests.
- Management of weeds in, and adjacent to, cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and, where necessary, eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.
- A weed audit targeting high risk locations should be conducted at a suitable time of the year when growing conditions and identification of weed species are optimal (i.e. late wet season). High risk locations may include areas such as riparian corridors and areas of black soil. Following the audit, appropriate scale weed mapping can be undertaken to identify weed hotspots and for the preparation of the Project Weed Management Plan.
- All construction machinery and materials brought onto site will be certified as free of weeds and weed seeds. Records are to be kept of compliance with this requirement.
- Signage should be in place in areas along the construction footprint where parthenium occurs advising staff when they are entering or leaving infestation ‘hotspots’.

- Soil stripped and stockpiled from areas containing known weed infestations, particularly of declared weeds, are to be stored separately and are not to be moved to areas free of weeds.
- Staff involved with the construction activities must be educated on weed management procedures and protocols and restrictions placed on bringing domestic animals to the Study Area.

Summary

Rigorous implementation of the proposed mitigation strategies, largely via the development and execution of the plans described above, should assist in minimising the potential for pest plants and animals to increase in abundance within and adjacent to the construction footprint. Regular, standardised monitoring will be a core component of the successful implementation of these plans, with corrective actions (including eradication) to be undertaken at the earliest opportunity after monitoring reveals a new pest plant or animal outbreak.

5.4 Potential Impacts and Mitigation Measures – Operation Phase

Potential impacts to terrestrial and aquatic ecology values associated with the operation phase of the Project have been summarised into four broad categories which include:

- Barrier to movement
- Disturbance of surface watercourses and waterbodies
- Increased anthropogenic activity leading to disturbance
- Introduction of weeds and feral pest species

Each of the potential impacts and proposed mitigation measures are described below.

5.4.1 Barriers to Movement

5.4.1.1 Overview

The Project will create a permanent linear barrier across the landscape for fauna movement. Although the land surrounding the Project has been subject to historical land clearing, important wildlife corridors have been retained throughout the Study Area. Fauna mortality as a result of vehicle strikes and other operational activities is also likely to have an adverse impact on native fauna values within the Project footprint.

5.4.1.2 Habitat Fragmentation

Much of the landscape surrounding the proposed rail and infrastructure corridor has experienced broadscale vegetation clearing, and as a result remnant patches of vegetation are fragmented. As previously stated, construction is more likely to reduce the size and connectivity of existing isolated patches, rather than create new patches. With respect to the operation of the rail corridor, the Project is likely to create a permanent linear barrier for fauna movement, reducing the overall habitat value of remnant vegetation adjacent to the rail corridor, increasing edge effects on habitat and restricting the access to water sources.

At a regional scale it is unlikely that this fragmentation will result in adverse impacts. Locally however, patches of remnant vegetation that intersect the Study Area are narrow, and provide some of the few remaining wildlife corridors in the landscape and are likely to be particularly important for less mobile

fauna to move within and between habitats. This is particularly relevant to small, ground-dwelling fauna such as amphibians, reptiles and small ground-dwelling and arboreal mammals.

Management and Mitigation

Management and mitigation measures to reduce the impact of habitat fragmentation to local fauna populations during the operation phase of the Project include:

- Minimise disturbance to wildlife corridors, particularly within riparian vegetation and at watercourses. Rehabilitate and reduce operational areas in the vicinity of watercourse crossings and where possible reinstate riparian habitat below infrastructure.
- Install fauna underpasses/culverts within suitable habitats and bioregional corridor areas to promote fauna movement. Fauna underpasses will require revegetation, fencing, grids and gaps to allow light in to promote fauna use. Monitor the use of underpasses by fauna.
- Install fencing along the rail corridor. Consideration should be given to reducing the chance of fauna mortality by avoiding the use of barbed wire on the top strand of wire fences.

Summary

Rail operations may reduce the ability for fauna to disperse across the landscape, particularly where the Project intersects remnant vegetation that provides corridors for fauna movement. The mitigation measures outlined above aim to retain and rehabilitate known wildlife corridors and reduce the impact of habitat fragmentation during the operation phase of the Project.

5.4.1.3 Fauna Mortality

With respect to the operation phase of the Project, the risk of fauna mortality relates predominantly to train and maintenance vehicle strikes. The risk to fauna posed by vehicular traffic is significantly less than the risk posed throughout the construction phase of the Project. Vehicular traffic will be lower than that during the construction phase and vehicles will adhere to strict speed limits.

The rail corridor is fenced and fauna passage facilitated at designated points. It is not considered likely that adverse impacts on fauna will result as a consequence of train or vehicle strikes during operations.

Management and Mitigation Measures

Mitigation measures to reduce fauna mortality during operation will include:

- Rail infrastructure will be appropriately fenced to restrict livestock movement within the rail corridor.
- Fauna underpasses within important habitat areas will be incorporated into the design of the rail corridor. Appropriate fencing and revegetation is required to encourage use by fauna species.
- Incidents of fauna strike and mortality are to be monitored during construction and operation.

Summary

Vehicular traffic, from both trains and maintenance vehicles, has the potential to result in fauna mortality. Management actions seeking to avoid or reduce impacts will be implemented. In consideration of the relatively low likelihood of occurrence, localised nature of impacts and the management of these impacts through an integrated suite of management actions, impacts to fauna are considered to be low. Similarly, with the implementation of site rules relating to vehicle movements (including speed limits), negative fauna encounters of roads will be minimised. Standardised monitoring and auditing of the

application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

5.4.2 Disturbance of Surface Watercourses and Waterbodies

5.4.2.1 Overview

The operation phase of the Project has the potential for on-going impacts to surface watercourses and waterbodies located within and downstream of the footprint of the Project. The alteration and/or loss of potential habitat for terrestrial and aquatic species, including those associated with riparian areas and standing water bodies, is discussed in Section 5.3.1.3 (terrestrial fauna habitat loss), Section 5.3.1.4 (terrestrial fauna habitat degradation) and Section 5.3.2.2 (aquatic habitat loss). Potential impacts specific to the operation phase of the Project are discussed below.

5.4.2.2 Change in Aquatic Habitat Availability and/or Suitability for Terrestrial and Aquatic Species

Potential indirect impacts to terrestrial and aquatic flora and fauna species may result as a consequence of minor localised run-off and sedimentation of watercourses and waterbodies (e.g. gilgais and dams) throughout the operational life of the Project. Localised run-off and sedimentation may reduce water quality and the introduce contaminants or pollutants into local water supplies.

Permanent water sources, such as farm dams adjacent to the Project footprint and less ephemeral watercourses, such as the Belyando River are considered more sensitive to indirect impacts from sedimentation and run-off.

Run off and sedimentation is localised and unlikely to result in adverse long-term degradation of downstream and off stream aquatic habitats.

Management and Mitigation Measures

Management and mitigation measures to reduce changes in aquatic habitat availability and/or suitability for terrestrial and aquatic species during operation activities include:

- Ensure all permanent erosion and sediment control devices are functional prior to commencement of railway operation and maintain and repair all devices throughout the life of the Project.
- Current best practice for erosion and sediment control measures will be taken in accordance with the 2008 International Erosion Control Association's Best Practice Erosion and Sediment Control Guidelines (2008) to minimise the potential for sedimentation of receiving waters.
- Trains should remain clean and be maintained to minimise the introduction of contaminants such as oil and fuel.
- A Waste and Hazardous Materials Management Plan will be developed and will include fuel and chemical storage protocols and spill responses (refer Volume 3 Section 13).
- Rehabilitate and maintain aquatic habitats and riparian areas in accordance with rehabilitation plans for a period of 1 year post construction.
- Weed and pest management within operation footprint in accordance with Environmental Management Plan.
- For unavoidable impacts (i.e. habitat loss) that cannot be managed, offsets will need to be provided in accordance with Commonwealth and State policies.

5.4.2.3 Summary

Potential impacts on aquatic habitat during operations as a result of runoff and sedimentation are unlikely to lead to long-term degradation of downstream areas. Implementation of mitigation strategies during operation will further reduce the potential for impact to aquatic habitat availability or suitability for terrestrial and aquatic species. Regular, standardised monitoring will be a core component of the successful implementation of these actions, with corrective actions to be undertaken at the earliest opportunity if monitoring reveals a detrimental change in water quality.

5.4.2.4 Changes to Floodplain Hydrology

As with the construction phase of the Project, the Rail and Infrastructure Corridor during operation will cross 12 major watercourses and approximately 76 minor watercourses (refer Volume 4 Appendix AB). As such the operation footprint is typically located in a low gradient catchment with extensive floodplains. Extensive flooding has been identified in at least three of the major watercourses (Belyando River, Mistake Creek and Diamond Creek) with Belyando River in particular extending approximately 15 km wide at the proposed point of crossing for the Rail and Infrastructure Corridor during a 2008 flood event (Golder Associates, 2011).

The permanent fixture of the rail line will cross floodplains and create a potential barrier to the previous flow of water (refer Volume 4 Appendix AB).

The alteration of floodplain hydrology may impact downstream locations and consequently may impact upon the ecology of aquatic species and terrestrial species dependent on floodplain processes, such as birds. Changes to flood plain hydrology have the potential to impact on the movement of aquatic species between viable water bodies. Movement of aquatic fauna within and between aquatic habitats is a critical life cycle component of many species and is particularly important for dispersal and breeding (Marsden and Power, 2007; Tucker, 1999). If dispersal migrations of species are restricted this may cause a reduction in gene flow leading to genetically isolated populations, cause a decline in species abundance, or may physically isolate populations of aquatic fauna leading to localised extinction (Tucker, 1999). Changes to floodplain hydrology may change floristic compositions over time as a result of changes to soils moisture, invertebrate distribution, woody debris and seed transport and other processes.

Pooling or ponding of water upstream of water crossings as a result of impeded or restricted flow has the potential to adversely impact aquatic and terrestrial habitat.

Aquatic habitats may also be increasingly degraded through the alteration of floodplain hydrology. For example, the channel morphology may change downstream due to increased sediment load following increased erosion as a result of the construction and operation activities. In addition the transport of habitat features such as woody debris may be limited due to sedimentation and drainage structures placed at watercourse crossing points (Wheeler *et al*., 2005).

Management and Mitigation Measures

Mitigation measures proposed to reduce the changes to floodplain hydrology during operation include:

- Minimising the impact to estuarine and lacustrine/palustrine hydrology by avoiding fragmenting these habitats during the design phase.
- Design and layout of watercourse crossings and use of culverts to bridge aquatic habitats will consider the requirement for fish movement including under flow conditions. This will be done in accordance with DEEDI guidelines for the design of stream crossings for fish passage (Cotterell, 1998).
- Culverts will be provided at key areas within floodplain habitats (i.e. lacustrine/palustrine habitats).
- Design will consider suitable watercourse crossings structures, for example bridge spans, culverts and openings such that sufficient flows are maintained across the Project.
- Iterative hydrological modelling will be undertaken through the design phase to better inform flood hydrology and refine the likelihood of potential adverse impacts.

5.4.2.5 Summary

Changes to flood plain hydrology have the potential to impact on the quality of aquatic habitats and the movement of species between viable water bodies. The implementation of the management and mitigation measures provided above should aid in reducing the ecological consequences of this impact so that residual impacts to floodplain hydrology are minimal. Regular, standardised monitoring will be a core component of the successful implementation of these actions, with corrective actions to be undertaken at the earliest opportunity should monitoring reveal a detrimental change in floodplain hydrology.

5.4.3 Increased Anthropogenic Activity Leading to Disturbance

5.4.3.1 Overview

Cattle grazing is the predominant land use in the Study Area and in the surrounding landscape. The Project (Rail) will result in a change to the land use of the Study Area and immediate surrounds. Most notably, habitat fragmentation and faunal disturbance are likely to increase due to the operational characteristics of the Project and to a lesser extent, increased human activity within the Study Area.

5.4.3.2 Fauna Behavioural Disruption

The higher intensity of activity at and near disturbed areas associated with rail operations may disrupt local fauna behaviour, largely as a result of increased exposure to light (maintenance facility), noise, dust, vehicles and people. Behavioural disruption may be direct (i.e. increased susceptibility to predation due to increased noise reducing prey vigilance, or increased light increasing prey detectability) or indirect (i.e. habitat degradation reducing local resource availability therefore increasing foraging dispersal distances for fauna).

It is not proposed that the railway infrastructure will be lit, excepting for the balloon loop (within the mining lease) and maintenance facility. Noise and dust generated through operations is transient and predicted to be within acceptable guideline/criteria limits. Maintenance personnel and vehicle movements will be localised and confined to the operational footprint. Potential impacts are likely to be localised.

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds within the operational area. Eleven introduced plants were detected within the Study Area, of which, three are declared weeds under the LP Act (parthenium, harrisia cactus and prickly pear). Increasing the prevalence of weeds within the operation footprint and the potential for weed spread beyond to the surrounding landscape may reduce the quality of habitats for some fauna species locally.

Management and Mitigation

Management and mitigation measures to reduce disruption to fauna behaviour during operation activities include:

- Dust suppression (watering and or sealing of roads/tracks) within select sensitive environments will be undertaken.
- Frequent maintenance of machinery and plant must be regularly undertaken to minimise unnecessary noise.
- Management of weeds in and adjacent to cleared areas in accordance with a Project Weed Management Plan. This plan will include details relating to the monitoring, management and where necessary eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.
- Management of fauna pest species in and adjacent to cleared areas in accordance with a Project Fauna Pest Species Plan. This plan should include details relating to the monitoring, management and where necessary eradication of pest animals.
- Lighting is not proposed along the railway. Lighting at the maintenance facility will be shielded to avoid lighting non-operational areas unnecessarily.
- Operation staff and maintenance personnel will remain within the operation footprint and make use of designated access and tracks at all times.
- Noise and dust monitoring will be undertaken in response to complaints and/or train operations requirements (refer Volume 3 Section 13).

Summary

Areas adjacent to rail infrastructure corridor will be exposed to disturbance throughout the operation phase of the Project. Implementation of the mitigation measures referenced to and listed above will seek to prevent and reduce exposure to these potentially disruptive activities and processes.

It is considered that management and mitigation opposed will reduce and limit the potential adverse impacts of Project operations on fauna behaviour.

5.4.3.3 Habitat Degradation

Following the extraction, processing and stockpiling, coal is transported to port via the rail infrastructure. Coal dust emissions from coal trains present potential issues in the region with respect to economic loss, public nuisance and environmental impacts. Dust deposition on leaves of plants can reduce the photosynthetic capacity of the plants and impede plant growth. Such an impact could degrade the function and health of the vegetation community; cause plant dieback with prolonged exposure; and reduce food resource availability for fauna species utilising the affected vegetation community. Excessive dust settling on water bodies has the potential to decrease aquatic habitat value within the immediate and downstream areas as a result of reduced water quality. As such, impacts to flora from

coal dust may occur where vegetation is growing immediately adjacent to the rail corridor. Long term exposure to coal dust may result in changes to vegetation communities immediately adjacent to the rail line, which may in turn alter habitat type and quality for fauna.

An environmental evaluation, commissioned by QR National, reviewed the available literature for the impacts of coal dust on flora and fauna, crops and livestock. Connell Hatch (2008) concluded that a dust deposition rate of 500 mg/m²/day can be used as a suitable threshold for negative impacts on crops, livestock and vegetation. With respect to deposition distance adjacent the rail line, records indicate that the highest coal deposition rates, of about 90 mg/m²/day, are likely to occur within the rail corridor with rates dropping rapidly as distance from the tracks increases (i.e. 30 mg/m²/day at 10 metres from the tracks) (Connell Hatch 2008). These measured values are substantially lower than the values noted in literature as being likely to have an impact on crops and livestock. No recent literature has been found that measures such impacts on native vegetation and fauna; however it is likely that the same conclusions will be achieved.

In consideration of the views of the research outlined above, and with the implementation of the management and mitigation measures provided below, it is unlikely that coal dust deposition will have a major impact on the flora and fauna within and adjacent to the operation footprint and surrounding region.

Management and Mitigation

It is recommended that the following dust suppression techniques be implemented during the operation phase of the Project (refer to Volume 4 Appendix AD Rail Air Quality Assessment):

- Train operations are to be conducted in accordance with a Dust Management Plan.
- An Erosion and Sediment Management Control Plan will be developed and should include measures to minimise coal dust run-off into aquatic habitats.
- Trains are to be cleaned regularly and are not to be overloaded.
- Use of veneers where appropriate to minimise the loss of coal particles.
- Regular maintenance and repair of locomotives as it is locomotive emissions that contribute to the overall total suspended particles.

Summary

Predicted dust deposition is considered to be within threshold limits at which adverse impacts on flora and fauna would be experienced. It is unlikely that dust deposition as a result of Project operations will adversely impact native flora and fauna. Some localised impacts may occur.

5.4.3.4 Changes to Fire Regime

Increased human activity may alter the fire regime of the local landscape. For example, the rail and infrastructure corridor may act as a fire break and consequently reduce the natural fire frequency and in turn increase the fuel load which would increase the fire risk for the region. The potential for accidentally-lit fires is potentially increased through the operation phase as a result of sparking during rail operation. The incidence of regulated ‘management burns’ may also change in frequency. Accidental or uncontrolled fires have the potential to negatively impact upon vegetation (and habitat) within, and adjacent to, the rail and infrastructure corridor in particular.

Spontaneous combustion of accumulated or stockpiled coal has the potential to occur within and around the rail corridor, associated rail infrastructure (i.e. rail spurs, loops and unloading stations) and coal waste dumps. Spontaneous combustion typically occurs when oxygen comes into contact with coal and the generated heat cannot dissipate. Ignition of accumulated coal may also occur as a result of any rail maintenance and hot work.

Management and Mitigation Measures

Mitigation measures to reduce changes to fire regimes during operation phase should include:

- A Project Fire Management Plan will be implemented for all phases of the Project. As well as documenting protocols and actions for preventing accidentally-lit fires, this plan should outline how fuel loads will be monitored and maintained across the Study Area. Ecological considerations will be incorporated into the development of this plan and response procedures developed.
- A Spontaneous Combustion Management Strategy will be developed for the Project and should form part of the Fire Management Plan detailed above. The Spontaneous Combustion Management Strategy should identify potential areas prone to spontaneous combustions, detail monitoring strategies, and define responsibilities and any corrective actions following an incident.
- Management of land will be undertaken in accordance with a Project Land Management (Flora and Fauna) Plan. This will complement the Project Fire Management Plan.
- Reducing the risk of spontaneous combustion can be most effectively managed by minimising the residency time of accumulated coal around coal handling facilities through scheduled housekeeping procedures.
- Maintain adequate fire breaks within the rail corridor. A corridor of 95 m is allowed to accommodate the rail line. Adjacent areas will accommodate a maintenance/service road and cleared area that will act as fire break.
- Liaison with Rural Fire Brigade and support services in developing the Fire Management Plan. Assign adequate resources to provision of fire fighting equipment.
- Identify specific areas of risk and times of risk; for example, high fire risk days (refer Section 12 Hazard and Risk).

Summary

Implementation of controls developed as part of a Project Fire Management Plan will reduce the potential for destructive high intensity fires to disturb habitats within the Project area during operations.

5.4.4 Introduction of Pests and Feral Species

Pest and feral species were recorded during field surveys (refer Sections 5.2.4.2 and 5.2.4.5) and may disrupt ecosystems by outcompeting and replacing native species, thus altering ecosystem diversity and potentially disrupting ecosystem function. It has been suggested that one introduced species in particular; buffel grass may disrupt existing fire regimes and create a positive fire-invasion feedback loop (Butler and Fairfax, 2003). Following clearing, buffel grass may build up along the edges of native vegetation thereby increasing fuel loads and leading to hotter fire intensity in these areas. This in turn facilitate further incursion of buffel grass into the remnant vegetation thus disadvantaging the native woody flora in particular (Butler and Fairfax, 2003).

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds. While introduced plants were detected across the Study Area, weeds were not found to be prevalent. Increasing in the prevalence of weeds at the Study Area (and potentially beyond to the surrounding landscape) has the potential to reduce the quality of habitats for some fauna species.

Potential for pest species to use the rail infrastructure corridor as a linear pathway for movement also exists, leading to the introduction of pest species in previously pest-free habitats. An increase in the prevalence of these animals may adversely impact native fauna in that it may lead to:

- Increased competition for resources
- Increased predation (of native species by fauna pest species)
- Habitat degradation (i.e. pig damage of riparian areas)

5.4.4.1 Management and Mitigation Measures

An integrated suite of actions should be developed to manage pest species during the operation phase of the Project, including:

- Management of fauna pest species in and adjacent to cleared areas in accordance with a Project Fauna Pest Species Plan. This plan should include details relating to the monitoring and management of pest species.
- Management of weeds in and adjacent to cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and where necessary eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.
- All plant and equipment brought onto site will be cleaned and weed free. Wash downs between construction areas (as appropriate) will be undertaken during construction and in accordance with landholder agreements.

Summary

Rigorous implementation of the proposed mitigation strategies, largely via the development and execution of the abovementioned plans, should assist in minimising the potential for pest plants and animals to increase in abundance within at and near the Study Area. Regular, standardised monitoring will be a core component of the successful implementation of these plans, with corrective actions (including eradication) to be undertaken at the earliest opportunity after monitoring reveals a new pest plant or animal outbreak.

5.5 Summary of Ecological Impact Assessment

This report presents the findings of ecological assessments conducted within the 95 m wide rail and infrastructure corridor of the Project (Rail), assesses the potential impacts to flora and fauna and identifies possible mitigation measures to manage potential impacts. The assessment considered the Project rail corridor as well as a surrounding 2 km wide Study Area and is based on a combination of desktop studies and field survey events. A summary of the key findings are presented below.

The Project (Rail) construction footprint intersects a predominantly cleared and fragmented landscape, of which 1,502 ha is non-remnant vegetation and 366 ha is remnant vegetation. Within the remnant

vegetation, a range of vegetation communities and habitat types including 18 REs and one EPBC Act listed TECs are present.

One TEC is present within the rail corridor and associated infrastructure and construction camp footprints based on the presence of its constituent REs. The Brigalow TEC comprised a total area of 37.4 ha. The occurrence of the TEC throughout the construction footprint, Study Area and wider landscape is mapped.

No threatened flora species listed under the EPBC Act or the NC Act were recorded within the Study Area from field surveys. Eight terrestrial fauna habitat types are defined across the Study Area, these contain broadly similar habitat values in terms of structure, but provide varying value for wildlife based on their specific forage and shelter resources. Open cleared land was the most common and widespread fauna habitat type within the Study Area, typically providing a low diversity of suitable resources for fauna compared to the higher ecological value of remnant vegetation, which typically occurred in association with watercourses and creek lines.

Squatter pigeon (southern) was the only threatened bird listed under the EPBC Act recorded. The squatter pigeon (southern) is likely to be locally common within the Study Area, and the broader region, where suitable habitat is present. A further three EPBC Act listed threatened fauna are likely to occur at the Study Area, potential habitat for these species within the Study Area was identified and mapped.

Two common EPBC Act listed migratory bird species were recorded at the Study Area. In addition, two EPBC Act listed migratory bird species not recorded during field studies are considered likely to occur. However, habitats at the Study Area are not considered likely to support important assemblages of migratory species.

Aquatic habitats throughout the Study Area are categorised into five broad waterbody types that vary in size and geomorphology. No conservation significant aquatic species were recorded within these habitats, nor are any considered likely to occur.

In relation to EPBC listed fauna species, the Project is not considered to support an important population or habitat critical to the survival, therefore, it is not considered to constitute a ‘significant impact’ to any of these species.

Potential impacts to the identified terrestrial and aquatic ecological values throughout the construction and operation phases of the Project are summarised into the following categories;

- Clearing of vegetation
- Disturbances of watercourses and changes to surface water flows
- Increased anthropogenic activity leading to disturbance
- Introduction of weeds and feral pest species
- Barrier to movement

Clearing for the construction footprint will result in the loss of approximately 366 ha of remnant vegetation. Of this, 37.4 ha of the EPBC Act listed Brigalow TEC will potentially be lost.

To address these impacts mitigation measures are outlined, including avoidance of ecologically sensitive areas, the preparation of Management Plans, the design of fauna-friendly culverts and fish passageways to facilitate fauna and fish passage, on-going monitoring and offsetting to address loss of fauna habitat and vegetation where impacts cannot be adequately avoided or mitigated.

Offsets under a combination of Commonwealth and State legislation will be required. An offset strategy will be provided to identify and manage residual impacts and propose various offset options that meet the relevant legislative requirements

In consideration of the extensive areas of existing disturbance within the proposed rail and infrastructure corridor, the relatively localised nature of impacts associated with civil works, the management of these impacts through an integrated suite of actions, and with the provision of offsets, the overall impacts of the Project can be significantly reduced.