Adani Mining Pty Ltd

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Report for Carmichael Coal Mine and Rail Project

Matters of National Environmental Significance 25215-D-RP-0029

18 November 2012

Revision 1

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Executive Summary

Adani Mining Pty Ltd (Adani) is proposing to develop a 60 million tonne (product) per annum (Mtpa) thermal coal mine in the north Galilee Basin approximately 160 kilometres (km) north-west of the town of Clermont, Central Queensland. All coal will be railed via a privately owned rail line connecting to the existing Goonyella rail system south of Moranbah, and shipped through coal terminal facilities at the Port of Abbot Point and/or the Port of Hay Point (Dudgeon Point expansion). The Carmichael Coal Mine and Rail Project (the Project) will have an operating life of approximately 90 years.

The Project comprises of two major components:

- The Project (Mine): a greenfield coal mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including:
  - A workers accommodation village and associated facilities
  - A permanent airport site
  - Water supply infrastructure
- The Project (Rail): a greenfield rail line connecting the Mine to the existing Goonyella rail system to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and/or the Port of Abbot Point, including:
  - Rail (west): a 120 km dual gauge portion from the Mine site running west to east to Diamond Creek
  - Rail (east): a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah

The Project has been declared a 'significant project' under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and as such, an Environmental Impact Statement (EIS) is required. The Project is also a 'controlled action' and requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project EIS has been developed with the objective of avoiding or mitigating all potential adverse impacts to environmental, social and economic values and enhancing positive impacts. This report specifically addresses Section 9 of the Project Terms of Reference (ToR) addressing matters of NES of relevance to the Project that are protected by the EPBC Act. The controlling provisions for the Project under the EPBC Act were determined to be:

- Sections 12 and 15A (World Heritage properties)
- Sections 15B and 15C (National Heritage places)
- Sections 16 and 17B (Wetlands - Ramsar)
- Sections 18 and 18A (Listed threatened species and communities)
- Sections 20 and 20A (Listed migratory species) and
- Sections 24B and 24C (Great Barrier Reef Marine Park)

Assessment of potential to affect matters of NES of relevance to these controlling provisions has been achieved by integrating knowledge from desktop and field surveys. This has enabled a

description of the existing environment to be developed and confirmation of the presence and prevalence of any matters of NES within the Project Study Area.

Description of the environment and understanding of potential impacts from the Project has been supported by desktop review and conduct of field surveys. Temporally separated field surveys (refer Table 1-2) were conducted across the different geographies of the Project to identify the existing terrestrial and aquatic biodiversity values. This included a rapid site assessment of environmental values of the offsite infrastructure locations in June 2012. Survey effort completed to date has enabled field verification of desktop assessments and habitat predictions. Data from surveys, in conjunction with desktop analysis, is considered adequate to describe potential of the Project to affect matters of NES and inform potential mitigation and management measures.

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
Mine Study Area	Terrestrial and aquatic flora	60 sites, 19 sites 168 sites, 17 sites	Spring: November 2010 and November 2011 Autumn: April/May 2011
Mine Study Area	Terrestrial and aquatic fauna	69 sites, 19 sites 40 sites, 17 sites	Spring: November 2010 and November 2011 Autumn: April/May 2011
Mine Study Area Offsite Infrastructure Location	Rapid assessment only Terrestrial and aquatic habitat	Unstructured opportunistic survey effort	Winter: June 2012

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

Data collected during field surveys and from desktop review of historical records has enabled potential habitat mapping to be completed for species of conservation significance. Recognising the geographical area of the Project, potential habitat mapping has been applied as a conservative measure to predict likelihood of species occurrence for impact understanding. Accordingly, if conservation significant species were not detected during survey, habitat availability is used as a proxy measure to inform likelihood of species occurrence and, therefore, potential to impact upon species.

In consideration of construction and operational activities of the mine and rail components of the Project, potential impacts have been identified and described with respect to flora and fauna species, their confirmed and potential habitat and vegetation communities that occur within (confirmed) or are considered likely to occur within, the Study Area (as per the criteria nominated under Section 1.6.3).

Operation of the mine will be staged across the 90 year life of the site. Operational mine activity will occur approximately three years into the construction of the mine. This will involve both underground and open cut mining works. Construction works for the Project will be progressive and will overlap with operational works from year three onwards.

Potential impacts arising from construction and operational works 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

How these may affect matters of NES of relevance to the Project has been assessed in detail. Potential impacts have been considered with regard to whether an important population of protected species occurs at the site and whether impacts may be significant or not.

The significance of residual impacts, post-mitigation, was evaluated with consideration to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) significance criteria, which are provided in the Significant Impact Guidelines (DEWHA, 2009).

In considering impact to listed taxa and communities, assessment was also made to identify relevant matters for impact assessment in relation to the following:

- An important population – for listed vulnerable threatened species
- Habitat critical to survival – for listed threatened species
- Important habitat – for migratory species

Mitigation measures to avoid/minimise/offset impacts to identified matters of NES resulting from the construction and operational activities associated with the Project have been proposed and offset commitments have been identified. Findings of the assessment are summarised against the controlling provisions for the Project. Management and mitigation commitments for the project have also been summarised in Section 10 of this report.

World Heritage Properties, National Heritage Places and the Great Barrier Reef Marine Park

The DSEWPaC Projected Matters Search Tool did not identify any world heritage properties or National Heritage Places of relevance to the Project. Assessment considered the nearest potential properties or Places which could be affected.

The Wet Tropics World Heritage Area is located over 270 km north of the Study Area with no direct terrestrial, aquatic or biodiversity links to the Study Area. No influences from the Project are predicted to occur on the Wet Tropics World Heritage Area and this area has not been considered further within this assessment.

The Tree of Knowledge and curtilage at Barcaldine is the closest National Heritage Place to the Study Area. It is located approximately 200 km south west of the western extent of the Study Area. No direct or indirect influences on this Place will occur as a consequence of the Project and this Place has, therefore, not been considered further.

The Great Barrier Reef World Heritage Area (GBRWHA) and, hence the Great Barrier Reef Marine Park, are located over 300 km downstream of the Study Area. Although connected aquatically to the Project Study Area via watercourses, substantial watercourse and overland barriers exist between these environs and the Study Area, including the Burdekin River dam. Significant controls will be established to manage onsite and offsite water and sediment quality impacts. These measures will mitigate potential for offsite impacts to aquatic values that could affect the downstream reef environment. The distance from the Great Barrier Reef and the extant barriers would impede Project site conditions from having an influence on the values for which the reef is protected. Accordingly no impacts to the ecological, cultural or social values which the Great Barrier Reef is recognised will occur as a result of the Project.

The Project will not impact upon any World Heritage Areas, National Heritage Places or the Great Barrier Reef Marine Park.

Wetlands – Ramsar

No areas of Ramsar wetland are predicted to be impacted by this Project. The closest Ramsar wetland is 380 km from the site, disconnected from the Study Area by substantial overland barriers. No areas of internationally important wetland will be lost, destroyed or substantially modified as a result of the Project nor will the hydrological regime of those distant wetlands be interfered with. None of the biodiversity for which distant wetlands are recognised will be impacted by Project activities as the Project will not affect the geography of any Ramsar protected wetlands nor will it act to introduce invasive species to any wetland sites. Accordingly, no impacts to Ramsar wetlands are predicted to occur as a result of this Project.

Listed Threatened Species and Communities

Assessment indicates the Project will not realise significant impacts to Brigalow TEC from unavoidable vegetation clearing. In addition, any potential impacts will be restricted to the Project Area only, with management measures ensuring no offsite affects are realised. Large areas of this TEC are protected in the surrounding landscape and losses equate to less than 1 per cent of the subregional extent of the TEC. Losses are not expected to affect the ongoing prevalence or genetic diversity of the TEC within the subregion. Offsets will be proposed to address these losses in accordance with the relevant Commonwealth and State offset policies (refer Volume 1 Section 10 Draft Offsets Strategy).

As a consequence of habitat losses resulting from mining and other Project activities, significant impacts to the black-throated finch (southern) are also expected to occur. Consideration has been given to measures to ameliorate potential for impact to reduce potential to significantly affect the population of this subspecies. These are summarised here.

Habitat loss will be staged. Research will be undertaken prior to mining works to improve knowledge of the habitat dependencies of this species and to identify appropriate areas that can be rehabilitated/engineered to offer alternative habitats into which the species could naturally relocate ahead of mining works. Habitat management, informed by ongoing research and monitoring, will also occur during the Project to minimise the potential to realise a significant ongoing impact upon this species. Research works will contribute to the maintenance of this subspecies within this bioregion and therefore, in general, to the recovery of the subspecies, as per the objectives of the National Recovery Plan for the Black-throated Finch Southern Subspecies (Black-throated Finch Recovery Team, 2007). The onsite and offsite habitat management and research program to be implemented

will be informed by the National Recovery Plan for the Black-throated Finch Southern Subspecies (Black-throated Finch Recovery Team, 2007), and developed in consultation with the Black-throated Finch Recovery Team, and other relevant stakeholders (i.e. Commonwealth and State governments, natural resource management groups, landholders etc.). Examples of recovery actions, documented in the National Recovery Plan for the Black-throated Finch Southern Subspecies (Black-throated Finch Recovery Team, 2007), to be incorporated into the Project Species Specific Management Plan (on and offsite) for the subspecies, will include:

- Investigate breeding requirements and threats to key breeding areas (Action 1.1)
- Investigate feeding and other habitat requirements (Action 1.2)
- Undertake targeted surveys (to identify habitat) (Action 2.4)
- Secure selected sites for conservation (Action 3.1) – analogous to Project offsets
- Address threats on grazing lands (Action 3.2)
- Monitor management effectiveness (Action 3.3)
- Determine suitability of birds in captivity for a reintroduction project (Action 4.1)

Information obtained from such studies will be incorporated into the Project Species Specific Management Plan for the subspecies (under the overarching Project Land Management (Flora and Fauna) Plan). The measures summarised here and detailed throughout this section seek to address the Project's impact to the black-throated finch (southern) to reduce these to the greatest extent possible. Given current knowledge, determining the efficacy of the proposed measures in reducing impacts and protecting the subspecies is difficult to quantify. Preliminary research is required such that a clearer understanding of the subspecies' prevalence and behavioural ecology in the region can be ascertained, thereby allowing for the assessment of Project impacts to the subspecies to be undertaken in the context of a detailed understanding of the subspecies' regional population, abundance and behavioural ecology.

Operational works may realise groundwater draw down impacts to the Doongmabulla Springs, a regionally important Great Artesian Basin discharge spring ecosystem listed as a TEC under the EPBC Act. Predicted drawdowns at all springs in the Doongmabulla system are between 0.05 m and 0.12 m, less than 0.2 m throughout the operational period with the majority of predicted impacts lower than 0.05 m. The predicted drawdown potential at the Doongmabulla springs is 60 per cent of the level considered to be potentially significant (0.2 m) and will occur approximately 60 years into the life of the mine.

Listed Migratory Species

Of the EPBC Act listed migratory species that have the potential to occur within the Mine and Rail Study Areas the~~,~~ eastern great egret (*Ardea modesta*), rainbow bee-eater (*Merops ornatus*) and satin flycatcher (*Myiagra cyanoleuca*) were confirmed present within the Study Area. An additional 11 species are considered likely to occur while four species may occur.

It is recognised that, in spite of the recommended management and mitigation measures, and the active rehabilitation of disturbed areas that will occur through the Project's operational life, unavoidable loss of habitat for migratory species will occur.

Active, targeted management of habitats adjacent to the clearing footprint can improve their quality for migratory species. Establishing alternative habitats for migratory species adjacent to the Project

through active management prior to clearing will encourage individuals to disperse from proposed clearing areas (or attract them to adjacent areas). This may include, but not be limited to, improving forage and nesting resources, increasing access to watering locations, and management of pest and weed species, to enhance the value of adjacent areas. This action will seek to minimise habitat loss (through replacement) and will also act to minimise potential for mortality by providing migratory species with habitat refugia within the operational landscape. The details for such management approaches and actions will consider the staged nature of operations, will be informed by onsite research, and will be detailed within Project Species Specific Management Plans (under the overarching Project Land Management (Flora and Fauna) Plan).

The potential to realise a significant impact upon migratory species within the Study Area has been considered against criteria identified by DSEWPaC. Based on current knowledge the assessment identifies that the Project is not expected to have a significant impact upon any migratory species. This finding is on the basis that:

- The Study Area does not support an important population of any of these species
- The Study Area does not support an ecologically significant proportion of the population of a migratory species
- Measures identified in Sections 5.1.2 to 5.1.5 are expected to manage the potential to directly or indirectly impact these species
- The species are well represented in landscapes that surround the Study Area, where suitable alternative habitat is prevalent and will persist
- The species are not considered to be dependent upon any habitat within the Study Area for any particular lifecycle stages.

As such, while large tracts of habitat suitable for these protected matters will be affected, alternative habitat suitable for these species exists adjacent to the Study Area and within the region. Accordingly the Project is not predicted to adversely impact migratory species.

Cumulative Impacts

A cumulative impact assessment was completed. This assessment reviewed stated impacts from other relevant projects and, utilising a relevance factor, determined the significance of potential cumulative impacts. Assessment has identified that the cumulative impacts having a low risk relate to:

- Aquatic ecology
- Surface water
- Groundwater

The cumulative impact which has a high risk relates to:

- Terrestrial ecology

Under implementation of the proposed Project offsets (as described in Volume 1 Section 9) it is considered that the overall impact of the Project with regard to cumulative impact potential can be managed.

Offsets

The key Commonwealth offsets policy which applies to the Project is the Commonwealth EPBC Act Environmental Offsets Policy (DSEWPaC, 2012) which is applicable to Project (Mine) and Project (Rail).

A number of potential direct and indirect impacts have been identified within the Project footprint under both Commonwealth and State offset policies and include the direct loss of protected vegetation communities, habitat for threatened species and resources as a result of vegetation clearing. The delivery of offsets must meet the specific offset requirements outlined in all relevant environmental offset policies. In general there are two options for delivering offsets, these being either land-based offsets (direct or indirect) and/or offset payments.

There is scope for most of the offset obligations associated with impacts to Commonwealth and State environmental values to be met through the delivery of a combined offset approach that address impacts to environmental values protected under both areas of legislative jurisdiction. Offset options that nominate a complementary approach will need to be agreed with DSEWPaC, Queensland Department of Environment and Heritage Protection (DEHP) and the Queensland Department of Natural Resources and Mines (DNRM) so that these options satisfy the requirements of both Commonwealth and State offset policies.

The options analysis undertaken to date for the Project seeks to achieve compliance with both the Commonwealth and State biodiversity offset requirements primarily in the form of providing direct offsets, at a relevant ratio, in close proximity to the impacted site. A number of options are also available involving indirect offset strategies and/or offset payments to supplement the approach for obtaining direct offsets. These items are linked to the Projects framework for management and mitigation of impacts as well as enhance biodiversity values at both a local and a regional scale.

Where applicable, the identified offsets for the Project have been incorporated into four key stages as part of the offset package deliverable. Those are identified as:

- Stage One – Impact Assessment and Policy Review
- Stage Two – Offset Investigation
- Stage Three – Presentation of Offset Package to Government Bodies
- Stage Four – Implementation of Biodiversity Offset Management Plans

A number of direct and indirect approaches, either currently being undertaken or remaining to be undertaken as part of the offset process for the Project (that may form the final commitments of the offset package) have been identified and include:

- Further refinement of the threatened species habitat modelling that was undertaken as part of the terrestrial ecology reports for the Project (Mine) and Project (Rail) reports, including field validation of models, incorporation of additional field data, to refine actual impact to matters of NES.
- Identification of suitable offset areas over properties within which the Project is impacting, and identification of suitable offset areas over properties on a local scale (within 10 km) and regional scale across the landscape (tens of kilometres from the Study area).
- Identification of large-scale strategic offset sites (properties of several thousand hectares that might be suitable as a strategic offset for the Project)

- Development of rehabilitation strategies to link areas of high ecological value in the landscape (to offset fragmentation effects on regional corridors)
- Wider scale research on matters of NES within the local environment (e.g. black-throated finch surveys within 10 km of the Mine) and within the wider region within Burdekin and Fitzroy Basin Catchments and monitoring plans to assist with mitigating long term threats to matters of NES and biodiversity values
- Field assessment of identified offset areas to determine the suitability of offset extent and condition of vegetation
- Research into vegetation management, rehabilitation, weed management, revegetation, management of threatening processes and other ways to enhance the local and regional biodiversity values. These options may tie into the Projects framework for management of impacts to mitigate Project impacts.
- Preparation of Biodiversity Offset Management Plan(s) to ensure the long-term viability of offset areas. As above, these may also be prepared in accordance with the Project's Management Plans developed as part of the mitigation measures for the Projects operations phase, including but not limited to:
  - pest and weed management
  - fencing for live-stock exclusion
  - fire management
  - rehabilitation and planting
  - monitoring and maintenance activities
  - erosion management
  - ongoing research
- Landholder liaison and negotiation to secure required offsets
- Liaison with regulatory bodies and landowners to finalise contractual arrangements and covenants

Offset payments and financial contributions to research under the Queensland Biodiversity Offset Policy and the EPBC Act Environmental Offsets Policy also should be considered as potential options to form part of the offset package. Ongoing consultation with Commonwealth and State government departments are necessary to determine whether offset payments would be appropriate.

Recommendations

Project activities have been identified as significantly affecting matters of NES. A number of Project commitments have been identified to provide additional baseline data pre-construction to:

- Inform and refine potential for impact upon specific environmental features such as the black throated finch
- Inform offset requirements for specific environmental features
- Establish site specific thresholds for application of effective monitoring of environmental receptors
- Enable applicable management and mitigation measures to be developed and incorporated into Project Environmental Management Plans (Construction and Operation)

- Confirm relevancy of findings from EIS studies immediately prior to construction work commencement to show currency of data at that time
- Confirm agency expectations are met with regard to environmental protection during Project delivery

It is recommended that all pre-construction monitoring and research studies identified are completed to achieve the above and to provide additional information to regulatory agencies.

It is also recommended that consideration be given to establishing technical advisory panels for specific environmental features of concern. Panels could guide additional study requirements, independently verify objectives are achieved by studies and include regulators, proponents and technical specialists to provide a common forum for discussion to enable targeted activity requirements to be identified, agreed and delivered.

While this report addresses matters of NES of relevance to the Project, it is aligned with and has utilised information from all studies completed for the EIS. Readers should be familiar with all works available under Volumes 1, 2, 3 and 4 of this EIS.

1. Introduction

1.1 Project Overview

Adani is proposing to develop a thermal coal mine in the north Galilee Basin approximately 160 km north-west of the town of Clermont, Central Queensland. All coal will be railed via a privately owned rail line connecting to the existing rail system, and shipped through coal terminal facilities at the Port of Abbot Point and/or the Port of Hay Point (Dudgeon Point expansion). The Project will have an operating life of approximately 90 years.

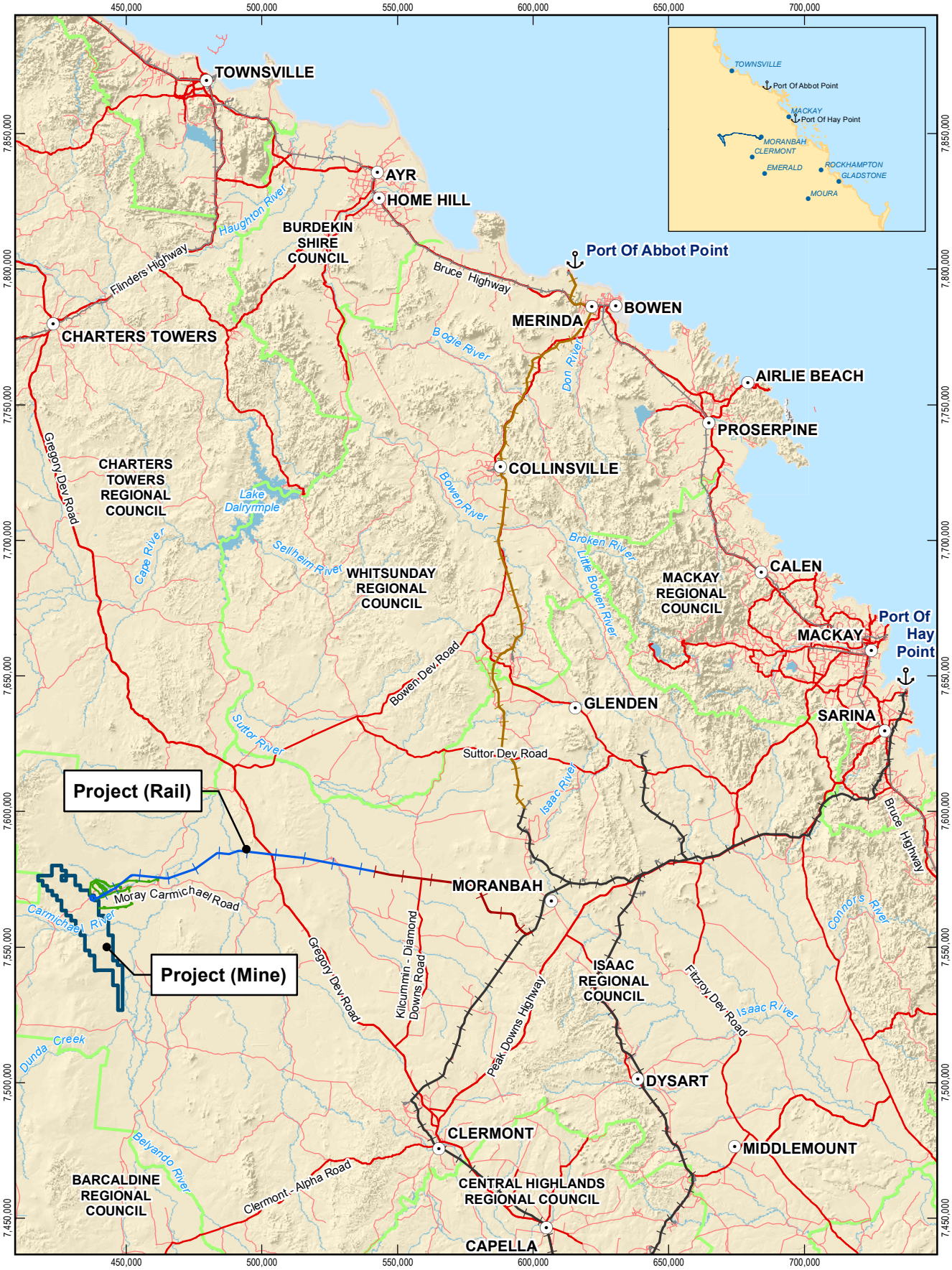
The Project is comprised of two major components:

- The Project (Mine): a greenfield coal mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including:
  - A workers accommodation village and associated facilities
  - A permanent airport site
  - Water supply infrastructure
- The Project (Rail): a greenfield rail line connecting the Mine to the existing Goonyella rail system to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and/or the Port of Abbot Point, including:
  - Rail (west): a 120 km dual gauge portion from the Mine site running west to east to Diamond Creek
  - Rail (east): a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah

The Project has been declared a 'significant project' under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and as such, an Environmental Impact Statement (EIS) is required. The Project is also a 'controlled action' and requires assessment and approval under the EPBC Act.

The Project EIS has been developed with the objective of avoiding or mitigating all potential adverse impacts to environmental, social and economic values and enhancing positive impacts. Detailed descriptions of the Project are provided in Volume 2, Section 2 Project Description (Mine) and Volume 3, Section 2 Project Description (Rail).

Figure 1-1 shows the Project location.



LEGEND

- Town
- Major Port
- Other Rail Network
- Goonyella System
- Newlands System
- State Road
- Local Road
- Watercourse
- Local Government Area
- Project (Rail)
- Rail (West)
- Rail (East)
- Project (Mine)
- Mine (Offsite)

1:2,000,000 (at A4)

0 10 20 30 40 50

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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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Carmichael Coal Mine and Rail Project Location

Job Number 41-25215
Revision L
Date 05-09-2012

Figure: 1-1

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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: © Commonwealth of Australia (Geoscience Australia): Town, Railways, Watercourses (2007); DERM: LGA, (2011), Hillshade (2009); DMR: State Roads (2008); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010), EPC1080 (2011); Adani: Alignment Opt9 Rev3 (2012). Created by: BW, JVC

1.2 Relationship to Other Actions

The Project is located within the Galilee Basin and as such, is closely related to other projects within the area currently under investigation or expected to commence investigations in the next five years. The following projects have been identified as having particular relevance in terms of cumulative impacts associated with project development, offering the opportunity for co-location of infrastructure, and / or providing necessary supporting infrastructure for the export of product coal. Further details are provided in Volume 1 Section 1 Introduction and in Volume 1 Section 11 Cumulative Impacts.

The following projects currently under assessment and have been included in this assessment, as they are relevant in terms of cumulative impacts associated with the Project:

- Alpha Coal Project (EPBC 2008/4648, 2008/4647): Mine element
- Kevin's Corner (EPBC 2009/5033)
- Galilee Coal (Northern Export Facility) (EBPC 2009/4737): Mine element
- South Galilee Coal Project (EBPC 2010/5496)

Adani is also aware of the following proposals within the region; however insufficient information is available at the time of writing (November 2012) to enable inclusion in the cumulative assessment:

- MacMines: development of two open cut and two underground mines with ultimate production and export of 30 Mtpa via a rail spur line linking into the proposed Project (Rail) corridor to export coal through the Port of Abbot Point. Terms of reference for this project are currently under public notification, however no further publicly available information is currently available.

The following projects are relevant as they offer the opportunity for co-location of infrastructure:

- Galilee Coal (Northern Export Facility) (EPBC 2009/4737): Rail element
- Alpha Coal Project (EPBC 2008/4648, 2008/4647): Rail element
- Goonyella to Abbot Point Rail Project (EPBC 2011/6082)
- QR National Central Queensland Integrated Rail Project (EPBC 2012/6321)

The following projects are relevant as they provide necessary supporting infrastructure for the export of product coal:

- Abbot Point Terminal 0 Project (EPBC 2011/6194)
- Port of Hay Point (Dudgeon Point Coal Terminals) (EPBC 2012/6240)

A number of projects are within the region of the Project, however, are not specifically relevant as noted below. These projects have therefore been excluded from the cumulative impact assessment:

- Abbot Point Terminal 2 Project (EPBC 2011/6194): this project is a dedicated coal terminal being developed by BHP Billiton for the purpose of servicing its own coal export requirements. It is unlikely that third party access to the coal terminal would be available. BHP Billiton has publically stated in 2012 that this project is on hold.
- Abbot Point Terminal 3 Project (EPBC 2008/4468): this project is a dedicated coal terminal being developed by Hancock Infrastructure Pty Ltd for the purpose of servicing its own coal export requirements. It is unlikely that third party access to the coal terminal would be available.

1.3 Alternatives to the Project

1.3.1 Overview

Volume 1 Section 1 Introduction provides detailed consideration of feasible alternatives to the Project, including project planning and locality alternatives to the Project, as well as discussion of the consequences of not proceeding with the project. The interdependencies of the Project (Mine) and Project (Rail) components are explained in regard to how each of any infrastructure requirements relate to the viability of the Project. Information is summarised here.

1.3.2 Project Mine

The Project (Mine) is located in the northern extent of the Galilee Basin with access to an estimated 7.8 Bt of indicated plus inferred resource. Initial mine planning has identified a combination of open cut and underground mining methods will be required to access this coal. Adani has access to EPC1690 and part of EPC1080 (and rights to MLAs sought over these areas); it has no other access to coal mining within Australia. Adani has investigated potential sources of coal that meet its specific resource quantum and delivery timeframe requirements and has not identified any viable alternatives.

Planning for above ground infrastructure has been dictated by the location of the coal resource to minimise as far as possible sterilisation of the available resource.

The Macro-conceptual Mine Plan included a detailed assessment of technological alternatives for economic mining methods. This is described in further detail in Section 2 Description of the Project. Specifically the investigation considered open cut versus underground operations and options for best utilisation of the resource.

1.3.3 Project Rail

In October 2010, Adani undertook a high level desk-top assessment to identify possible rail alignments addressing the environmental, hydrological, geotechnical and civil constraints associated with four nominated west-east alignments between EPC 1690 and a connection point to the Goonyella rail system at approximately 14 km south-west of Moranbah.

Environmental considerations included:

- River and waterway crossings
- Wetlands, in particular those triggered under State Planning Policy 4/11 Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments, water bodies, dams, etc.
- Topography and landforms
- Regional ecosystems (REs), in particular endangered and of concern (REs), high value regrowth vegetation and Essential Habitat
- The location and extent of Biodiversity Planning Assessment areas
- Indigenous cultural heritage and Native Title claims
- Environmental features such as restricted area, nature refuges and reserves
- The presence of other infrastructure (including homesteads and settlements), mining and exploration lease and permit boundaries, coal resource areas, roads, power lines and pipelines

- Strategic Cropping Land

The hydrology assessment considered constraints associated with surface water flows, specifically: waterway crossings (Belyando River, Mistake Creek, Middle Creek and Diamond Creek as well as additional major tributaries); flood prone areas; topography; distance to 'sensitive objects'; riparian zones; and the direction of crossings.

The geotechnical assessment considered criteria that had the potential to affect the railway embankment details and soil treatments. This included the extent of black soils or reactive soils; the extent of wet or low strength soils; the extent of basalt; and the extent of hard rock.

Results of the assessment were assessed at an Options Framing Workshop through a multi-criteria analysis (MCA) process. The objectives set for the Options Framing Workshop were:

- To minimise the length of waterway and wetland crossing
- Avoiding significant earthworks features
- To avoid homesteads and sensitive environmental areas
- Avoiding black soil areas as much as possible
- Keeping the total length of corridor to a minimum

A preferred railway alignment was selected having considered all the constraints. The preferred alignment was considered (amongst others) to:

- Minimise wetland crossings
- Improve the Goonyella rail system (Moranbah Junction) approach
- Minimise impact on REs
- Provide a smoother geometry

The preferred alignment was used to initiate discussions with landowners potentially directly impacted by the alignment. A dedicated and independent Land Liaison Officer was appointed to undertake these discussions. Based on feedback received from landowners, further refinement of the alignment was undertaken. Realignment considered the placement of the preferred alignment along cadastral boundaries as far as is practicable, considering all constraints.

A 500 m investigation corridor was established in association with the preferred alignment and presented for use in the EIS. Through the EIS process, development of concept design and on-going liaison with potentially directly impacted landowners (as willing) the 500 m investigation corridor was reduced to a defined 95 m Project (Rail) alignment.

1.3.4 Mine and Rail Interdependencies

The Galilee Basin is not currently serviced by any rail infrastructure which would enable export of coal product from the proposed Mine. As such, the Project comprises both the Mine development and Rail development. However, Adani has identified the opportunity to link to current and proposed rail infrastructure to minimise the potential environment and social impacts of linear infrastructure within the rural environs. However, the two Project elements are inextricably linked and could not proceed as separable developments.

1.3.5 No Action Option

A no action option, that is, that Adani does not develop the Project, would likely lead to their demand for coal being met outside of Australia. While the ash content of the coal is suitable for the Adani's power stations, the feasibility of its use relies on the ability for Adani to gain high efficiencies along the entire supply chain – from extraction, transport and end use in power stations. These efficiencies can only be gained through Adani having ownership and control over the supply chain.

The no action option for the Project (Mine) would see significant capital investment totalling approximately $21.5 billion foregone. The Project (Rail) is expected to require capital expenditure totalling $1.2 billion over a three year period. The benefits of this economic investment will not be realised to the Queensland and national economy if the Project is not developed. Similarly, approximately 3,000 direct jobs associated with operation of the Project (Mine) and approximately 270 associated with the Project (Rail) will be foregone.

1.4 Matters of National Environmental Significance

A copy of the Protected Matters Search is included in Appendix A.

1.5 Legislative Framework

On 6 January 2011, the Commonwealth Government Minister for the Environment determined the Project to be a 'controlled action' under the EPBC Act due to the potential for the Project to impact upon matters of national environmental significance (NES). This decision was based on the referral dated 18 November 2010 (EPBC 2010/5736). It was also determined that the Project require assessment by environmental impact statement (EIS) and would be assessed under the bilateral agreement between the Commonwealth and the State of Queensland relating to environmental assessment (the bilateral agreement), specifically under the provisions for an environmental assessment under the State Development and Public Works Organisation Act 1971.

The controlling provisions for the Project under the EPBC Act were determined to be:

- Sections 12 and 15A (World Heritage properties)
- Sections 15B and 15C (National Heritage places)
- Sections 16 and 17B (Wetlands - Ramsar)
- Sections 18 and 18A (Listed threatened species and communities)
- Sections 20 and 20A (Listed migratory species) and
- Sections 24B and 24C (Great Barrier Reef Marine Park)

A request to vary the referral (EPBC 2010/5736) was submitted to amend the original referral to include EPC 1080.

Under the EPBC Act, environmental offsets (direct or indirect) are a mechanism to compensate for the adverse impacts of developments on matters of NES protected by the EPBC Act.

The Commonwealth Government's EPBC Act Environmental Offsets Policy (Consultation Draft) (DSEWPaC, 2011) outlines the Australian Government's position on the use of environmental offsets under the EPBC Act. While offsets may not necessarily ameliorate 'onsite' impacts to matters of NES, they seek to provide a net environmental gain through targeted actions (on or offsite).

Under the EPBC Act, environmental offsets can be used to maintain or enhance the health, diversity and productivity of the environment as it relates to matters protected by the Act. However, environmental offsets are not applicable to all approvals under the EPBC Act, and they should not be applied where the impacts of a development are considered to be minor in nature or could reasonably be mitigated.

Although the State government offset policies may have the capacity to deliver offsets that will satisfy DSEWPaC's draft policy and the requirements of the EPBC Act, it should not be assumed that that an offset which satisfies State requirements will automatically satisfy the requirements of the EPBC Act. As such, the offset options will need to be agreed with DSEWPaC and the relevant State government agencies on a suitable outcome that satisfies both federal and state offset policies.

1.6 Methodology

Predictions of the extent of threat (risk), impact to protected matters and the benefits of any mitigation measures proposed should be based on sound science and quantified where possible. To this end a description of the existing environmental values of the Study Area 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 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 described under Volume 2, Section 5 Mine Nature Conservation and Volume 3 Section 5 Rail Nature Conservation of this EIS. The areas of investigation referred to and defined in the aforementioned sections include:

- Project (Mine) Study Area: EPC 1690, EPC 1080 and the Mine offsite infrastructure
- Project (Rail) Study Area: a 2 km wide investigation area that encapsulates the Project (Rail) infrastructure corridors over the length of approximately 189 km between the Carmichael Mine and Moranbah Area.

This report includes both components of the Project; therefore the Study Area for this report is defined to include both areas mentioned above, unless otherwise specified.

Note: in addition to the rail corridor and additional infrastructure areas, 30 preliminary locations have been identified for the sourcing of quarry material for ballast and borrow material (fill) for sub-grade formation earthworks. At this stage, these locations are indicative only, and will be refined as the resources are proven through geotechnical investigations and Project design progresses. The actual number of locations that will be disturbed for the sourcing of material will be less than the 30 that are being considered currently. Due to the uncertainty regarding these sites, impacts associated with this facet of the Project (Rail) have not been presented in this assessment. It is acknowledged that when more certainty about the location and extent of these quarry and borrow areas is known, assessment of impacts to ecological values will need to be undertaken.

1.6.1 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. The latter have been used to understand values of relevance to matters protected under state legislation.

Details of the sources of relevance to matters protected under the EPBC Act are provided in Table 1-1.

Table 1-1 Summary of Desktop Sources

Source and name	Description of information source	Desktop Search extent	Limitations of use
Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) **Protected Matters Search Tool** and **Environmental Reporting Tool**	The SEWPAC Protected Matters Search Tool identifies matters of NES and other matters protected by the EPBC Act that may occur within or relate to the Study Area. The tool predicts the potential presence of a species/ecological community in an area based on bioclimatic modelling, known distribution and habitat preferences. The DSEWPaC Environmental Reporting Tool was also queried to provide information on invasive species that have the potential to occur, and nationally important wetlands within or near the Study Area.	For Rail Alignment line searches (approximating with the centrelines of the rail corridors of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with 10 km buffers were undertaken. Point searches using central coordinates of each borrow area, each with a 2 km buffer, were undertaken. For Mine a point search (approximating with the centre of the Mine Study Area: -22.041, 146.364) with a 50 km buffer was searched.	This is a predictive tool only – it does not necessarily indicate that a species/ecological community occurs in a defined area. Presence of a species/ecological community is predicted based on a combination of bioclimatic modelling, known distribution and habitat preferences. In predicting species/community presence, it allows for field survey efforts to be targeted.
DSEWPaC **Directory of Important Wetlands**	The Directory identifies nationally important wetlands. The DSEWPaC Protected Matters Search Tool (see above) lists nationally important wetlands occurring within or related to prescribed search extents.	For Rail Alignment line searches (approximating with the centrelines of the rail corridors of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with 10 km buffers were undertaken. Point searches using central coordinates of each borrow area, each with a 2 km buffer, were undertaken. For Mine a point search (approximating with the centre of the Mine Study Area: -22.041, 146.364) with a 50 km buffer was searched via the DSEWPaC Environmental Reporting Tool (see above)	NA - this mapping identifies the location of wetlands that satisfy at least one criterion agreed upon by the Australian and New Zealand Environment and Conservation Council (ANZECC) Wetlands Network in 1994.

Source and name	Description of information source	Desktop Search extent	Limitations of use
Birds Australia **Bird Atlas Data**	Birds Australia maintains a database of bird records from across Australia.	For Rail Alignment a rectangular area was searched, approximating with the centreline of the Rail Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with a 10 km buffer. For Mine a rectangular area was searched, such that the diagonal extending from the approximate centre of the Mine Study Area (22.041, 146.364) to each corner was 50 kms. The co-ordinates of the search were between latitudes -21.598 and -22.512, and longitudes 145.865 and 146.837.	This database catalogues known records of species in a defined area. The age and lack of spatial precision of species records may limit their value for inclusion in current studies in some instances.
Queensland Department of Natural Resources and Mines (DNRM) **Regional ecosystem (RE) mapping**	The Queensland DNRM maps remnant vegetation using the RE classification system. REs are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil (Sattler and Williams, 1999). REs are classified under the Queensland VM Act as being endangered, of concern or least concern.	Mapping was obtained for the Study Area and the adjacent landscape in an electronic data layer for analysis in a Geographic Information System (GIS) environment.	RE mapping is informed by interpretation of landform, substrate, photo/satellite imagery and where available, field data. The mapping has undergone little or no ground-truthing in many parts of Queensland. Because of this, and the scale at which the mapping is created, RE mapping does not always accurately depict vegetation assemblages on the ground. As such, ground-truthing of REs is a fundamental aspect of field studies for ecological survey.

Source and name	Description of information source	Desktop Search extent	Limitations of use
DNRM **Regrowth vegetation mapping**	Mapped 'high value regrowth vegetation' produced by DNRM.	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	Regrowth mapping is informed by statewide landcover and tree study (SLATS) foliage protective cover (FPC) and pre-clearing RE mapping. The mapping has undergone little or no ground-truthing in many parts of Queensland and like the RE mapping does not always accurately depict on the ground characteristics As such, ground-truthing is required.
DNRM **Essential habitat mapping**	Essential habitat is defined as 'vegetation in which a species that is endangered, vulnerable or near threatened under the NC Act has been known to occur' (DERM, 2011a). DNRM maps Essential Habitat (and Essential Regrowth Habitat) in conjunction with remnant and regrowth vegetation mapping.	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	As Essential Habitat and Essential Regrowth Habitat mapping is underpinned by RE/regrowth mapping, the constraints associated with mapping scale and lack of ground-truthing are applicable to this information source.
Department of Environment and Heritage Protection (DEHP) **Wetland mapping**	Various mapping layers produced by DEHP (including Wetland Protection Areas).	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	Wetlands are identified using the DEHP AquaBAMM Methodology – the on-ground values of individual wetlands identified through this methodology have not necessarily been assessed, as designation is primarily based on existing literature and expert opinion. As such, designation does not reveal the value of these systems for local flora and fauna.

Source and name	Description of information source	Desktop Search extent	Limitations of use
DEHP **Biodiversity Planning Assessment (BPA) mapping – Brigalow Belt bioregion and Desert Uplands bioregion** and **Biodiversity Planning Assessment expert panel reports**	Identifies landscape scale biodiversity features at varying levels of significance (local, regional, state). The mapping methodology is underpinned by DNRM's remnant vegetation (i.e. RE) mapping. Expert panel reports provide information on the landscape-scale values of bioregions, and in some instances identify bioregional priority taxa.	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	As BPA mapping is underpinned by RE mapping, the constraints associated with mapping scale and lack of ground-truthing is applicable to this information source.
DEHP ***Burdekin Natural Resource Management Region Back on Track Actions for Biodiversity* report (DERM 2010c)**	This document identifies priority species in the Burdekin Natural Resource Management (NRM) region, details the regional threatening processes impacting upon these species, and proposes a range of actions to address regional threats. Priority taxa are identified through the DEHP Back on Track species prioritisation framework, in consultation with a range of stakeholders from the region. The document seeks to guide priority species conservation in the region over the next five years.	The document covers the entire Burdekin NRM region (in which a large portion of the Study Area occurs).	Some species/impacts listed in this document are not relevant to the Study Area, as the Burdekin NRM region encompasses a large area of central Queensland.

Source and name	Description of information source	Desktop Search extent	Limitations of use
DEHP **Wildlife Online database**	The DEHP Wildlife Online database maintains a catalogue of animal and plant species records from specific localities across Queensland. As well as common species, records of animals and plants listed as threatened under the NC Act are contained within the database.	A rectangular area was searched, approximating with the centreline of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent with a 10 km buffer was undertaken. Point searches using central coordinates of each borrow area, each with a 2 km buffer, were undertaken.	This database catalogues known records of species in a defined area. DEHP recommend that independent verification of records should be undertaken to inform the accuracy and completeness of information catalogued within this database (i.e. field surveys).
DEHP (Queensland Herbarium) **HERBRECS specimen database**	The HERBRECS database catalogues flora specimen records obtained throughout Queensland.	A rectangular area was searched, approximating with the centreline of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with a 20 km buffer.	This database catalogues known records of species in a defined area. The age and lack of spatial precision of species records may limit their value for inclusion in current studies in some instances.
Queensland Museum **Queensland Museum Data Search**	The Queensland Museum catalogues vertebrate fauna specimen records obtained throughout Queensland.	A rectangular area was searched, approximating with the centreline of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with a 10 km buffer.	This database catalogues known records of species in a defined area. The age and lack of spatial precision of species records may limit their value for inclusion in current studies in some instances.
Burdekin Dry Tropics & Australian Government (Carter *et al.* 2008)	The report documents the diversity and distribution of freshwater fish species within the Burdekin Dry Tropics NRM Region.	The document covers the entire Burdekin Dry Tropics NRM region (in which the Study Area occurs).	Some species listed in this document are not relevant to the Study Area, as the Burdekin Dry Tropics NRM region encompasses a large area of central Queensland. Species distributions are described in terms of sub-catchments and distribution maps are useful to identify species with potential to occur.

Source and name	Description of information source	Desktop Search extent	Limitations of use
DEHP (Natural Resources and Environment Division) Expert Panel Reports: Burdekin Region (DERM 2009b, c, 2011d)	These three reports; aquatic fauna, aquatic flora and aquatic ecosystems, are part of the Aquatic Conservation Assessment for riverine and non-riverine wetlands in the Great Barrier Reef (GBR) catchment. The reports identify rare and threatened, priority and exotic species, species richness, and priority ecosystems and special features of the Burdekin region.	These documents assess the riverine and non-riverine wetlands of the Burdekin region	Some species listed in this document are not relevant to the Study Area, as the Burdekin catchment encompasses a large area of central Queensland.
Publically available Environmental Impact Statement (EIS) documents for projects in the wider region surrounding the Study Area.	EIS documents for projects in the region were sourced from the internet – namely the Alpha Rail EIS (Hancock Prospecting Pty Ltd, 2010) and the Galilee Coal EIS (Waratah Coal Pty Ltd, 2011).	The description of the existing environmental values of landscapes in which other major development projects are proposed to occur were assessed – namely with respect to results of surveys and detection of threatened species.	The project Study Areas of each of the EIS projects (listed at left) do not always correlate with the Study Area of this project. Consequently, this may limit the applicability of the information presented in these EIS documents to the current Study Area.

1.6.2 Field Surveys

Field surveys were conducted to identify the existing terrestrial and aquatic ecological values of the Study Area and to supplement and ground truth the information acquired from the desktop assessment, including verification of the likelihood of occurrence of 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.

Volume 2, Section 5 Mine Nature Conservation and Volume 3, Section 5 Rail Nature Conservation of this EIS describe in detail the approaches completed for all field surveys. Of direct relevance to matters of NES, temporally separated field surveys (refer Table 1-2) were conducted across the different geographies of the Project to identify the existing terrestrial and aquatic biodiversity. This includes a rapid site assessment of environmental values of the offsite infrastructure locations in June 2012. Figure 1-2 depicts the survey effort that was completed across the Project geography.

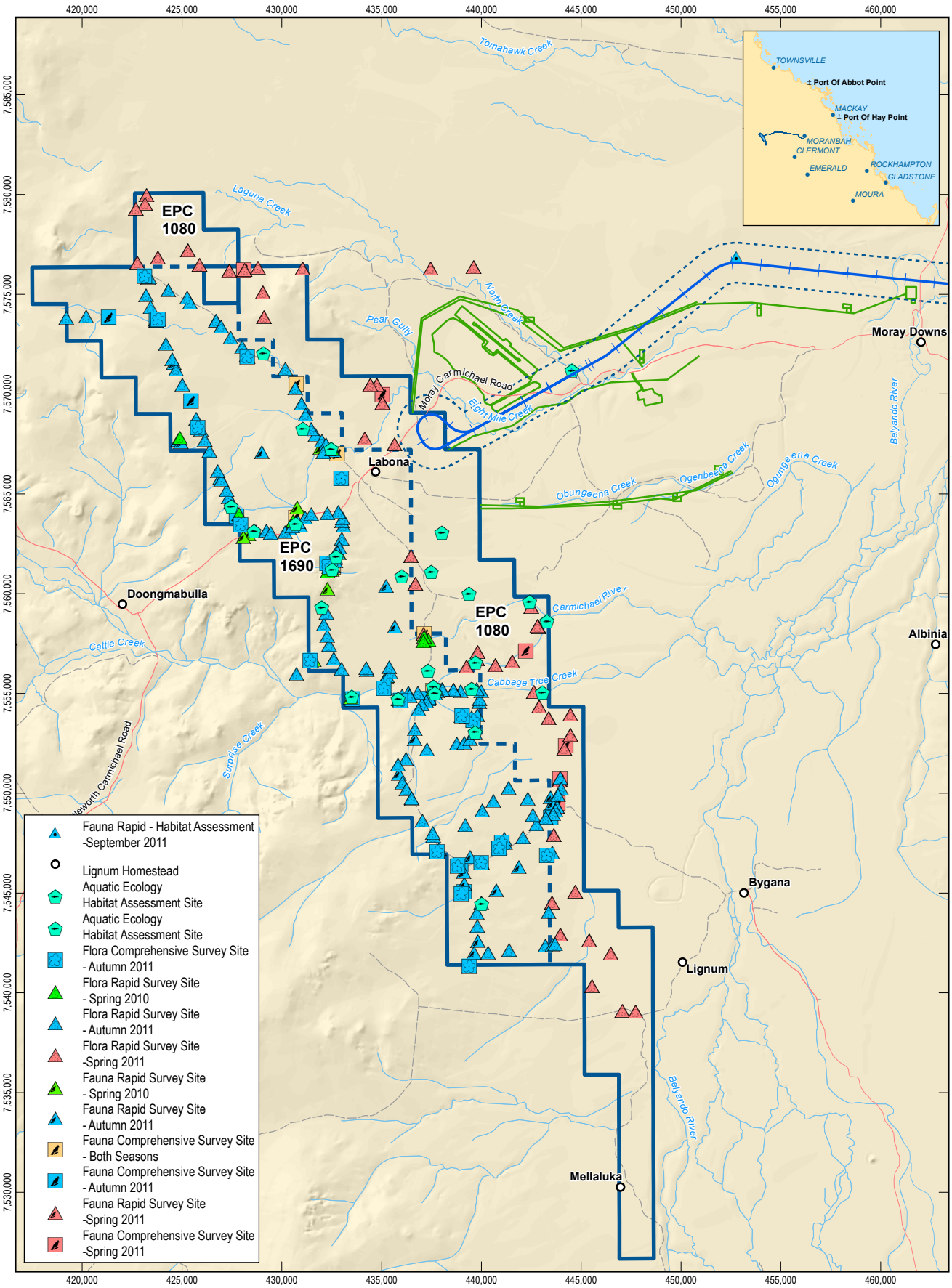
Table 1-2 Temporal Survey Effort

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
Rail Study Area	PMAV Assessments	Various sites along corridor	Winter: June/July 2012
Mine Study Area	Terrestrial and aquatic flora	60 sites, 19 sites 168 sites, 17 sites	Spring: November 2010 and November 2011 Autumn: April/May 2011
Mine Study Area	Terrestrial and aquatic fauna	69 sites, 19 sites 40 sites, 17 sites	Spring: November 2010 and November 2011 Autumn: April/May 2011
Mine Study Area Offsite Infrastructure Area	Rapid assessment only Terrestrial and aquatic habitat	Unstructured opportunistic survey effort	Winter: June 2012
Mine Offset Area	Black throated finch targeted surveys	9 water watch sites, 31 watch sites, 6 remote camera sites	Autumn: May 2012

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

1.6.2.1 Terrestrial Flora Survey Techniques

Flora survey efforts employed standardised approaches recognised by regulatory agencies for describing the existing floristic environment and to inform the presence of any protected species. The assessments conducted identified whether EPBC Act protected taxa were present, and whether mapped threatened ecological communities (TECs) at a Queensland Regional Ecosystem (RE) occurred. A summary of various flora survey methods is provided in Table 1-3.



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Rail (West)

1:275,000 (at A4)
0 1 2 3 4 5
Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision B
Date 07-09-2012

Terrestrial and Aquatic Survey Sites

Figure: 1-2

G:\41\25215\GIS\Maps\MXD\MNES\41-25215_4014_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

Data Source: GHD: Fauna Survey Sites (2010), Study Area, Fauna Survey Sites (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Road, Homestead, Watercourse (2007); DME: EPC 1690 (2010)/EPC 1080 (2011); Adani: Alignment Corridors Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS

Table 1-3 Summary of Terrestrial Flora Survey Methods

Comprehensive survey sites	Rapid survey sites	Targeted and random meander searches
CORVEG secondary site methodology used Quadrat sampling (500 m^2) Complete site lists of woody and non-woody flora species Three measures of abundance collected for woody species, non-woody species relative abundance measured RE verification General site description with notes recorded on landform, geology, soils, past disturbance & weeds All sites photographed extensively	Equates to a quaternary CORVEG site Plotless sampling technique Level of detail collected varies – at all sites, dominant species recorded Extensive species lists generated at a number of sites RE verification Brief notes recorded on landform, geology, soils, weeds	Literature review conducted to determine habitat requirements of rare and threatened species Targeted searches conducted onsite based on habitat requirements Random meander searches were also utilised

Floristic surveys were conducted using CORVEG methodologies defined by the Queensland Herbarium (Neldner et al., 2005), with the objective to investigate the suite of vegetation types occurring within the Study Area. Field surveys were conducted in areas of remnant vegetation including mapped REs. Flora sampling methods included:

- Site species lists
- Random meander and targeted habitat search techniques where suitable habitat was encountered
- Verification of REs using quaternary site assessment methods
- Brief site descriptions

1.6.2.2 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 Scientific Users Registration Certificate (Registration Number 132), Queensland Scientific Purposes Permit (Permit Number WISP06498409) and Queensland Animal Ethics Permits (Permit Number CA2009/11/398 and CA2008/07/280). Survey techniques were approved by the -accredited GHD Animal Ethics Committee and undertaken by appropriately qualified ecologists.

For the purposes of this 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 platypus.

Terrestrial fauna survey methods employed at comprehensive and rapid survey sites are summarised in Table 1-4.

Table 1-4 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)	All rapid assessment sites	Remote camera
Remote cameras set for a series of night monitoring events	Habitat assessment	Waterbody watches
Habitat assessment	Opportunistic search for wildlife traces	Opportunistic wildlife records
Opportunistic search for wildlife traces	Standardised (20 minute) bird surveys	
Standardised (20 minute) bird surveys	Active searches for herpetofauna	
Active searches for herpetofauna	Some rapid assessment sites	
Ultrasonic bat detection (Anabat)	Ultrasonic bat detection (Anabat)	
Standardised spotlighting for nocturnal fauna	Standardised spotlighting for nocturnal fauna	
Call-playback for owls and frogs	Call-playback for owls and frogs	

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.

The following parameters were recorded during habitat assessments:

- Landscape context (size, shape, connectivity or relative isolation of habitat remnants)
- Structural and floristic complexity of vegetation (i.e. tree density, canopy cover, vertical structural complexity of vegetation strata – canopy, shrub and understorey layers, ground cover)
- Structural complexity and relative heterogeneity of ground-level microhabitats (i.e. substrate type, vegetation cover, leaf litter, woody debris, presence of rocks, logs or boulders)
- Habitat features (i.e. hollows, fallen logs, rock outcrops, nests, burrows, water bodies, gilgais)
- Relative abundance of hollows and hollow-bearing (habitat) trees
- Sources of disturbance (i.e. adjacent land-uses, feral animals, predation, weed infestation)

Threatened Species Surveys

In general, targeted surveys for threatened species were incorporated into the sampling methodologies outlined above in Table 1-4 (i.e. ground-trapping and opportunistic searches for

threatened reptiles, Anabat detection for threatened bats). Survey guidelines for threatened species prepared by the Commonwealth Government were reviewed for those threatened species considered likely to occur, or confirmed present in the Study Area. The survey effort applied for the black-throated finch (southern) (*Poephila cincta cincta),* squatter pigeon (southern) (*Geophaps scripta scripta),* ornamental snake (*Denisonia maculate) and* yakka skink (*Egernia rugosa).*

It should be noted that at the time field surveys for the Project were undertaken, the koala was not a listed threatened species (Commonwealth). As such, targeted surveys for this species were not undertaken, although fauna surveys conducted, including habitat assessments, scat searches and spotlighting provided information relating to this species.

A targeted black-throated finch (southern) survey was undertaken in May 2012. A summary of the targeted black-throated finch (southern) survey effort is provided below and full details are presented in Volume 4 Appendix N3 Black-throated Finch Report.

Peophila cincta cincta (black-throated finch (southern))

A combination of three survey methods was employed based on the recommended methods within the Significant Impact Guidelines for the Black-throated Finch (southern) (*Poephila cincta cincta*) (hereafter, the 'Black-throated Finch (southern) Significant Impact Guidelines') (DEWHA 2009). These methods comprised water source watches, two hectare counts and remote fauna cameras.

Water source watches were undertaken within and adjacent to the Study Area following the recommended methods outlined in the 'Background Paper' to the Black-throated Finch (southern) Significant Impact Guidelines (DEWHA, 2009)[1]. Water source watches were conducted at nine different water sources for close to 28 person hours.

Standardised bird surveys were undertaken at each assessment site using the methods recommended for surveys by Birds Australia. This involved a timed 20 minute (minimum) survey of a two hectare search area (2 ha) by one ecologist, recording the number of birds seen or heard calling, and the presence and composition of any mixed flocks. A total of 31 searches with a total of 21 person hours were dedicated to bird surveys within the Study Area.

In addition to water source watches and two hectare counts, remote fauna surveillance camera surveys were undertaken. This involved the use of un-manned motion-sensing cameras that were set up and left in situ to detect fauna over an extended period. Nine cameras were installed at six different water sources where water source watches were also performed.

1.6.2.3 Aquatic Ecosystems and Flora 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 1-2 shows the aquatic survey sites.

An assessment site is defined as a 100 m reach for water bodies and includes bed and banks. The assessment considers all the habitats within this area. Visual habitat assessments of the 100 m reach were used to describe the aquatic ecosystems in terms of habitat diversity and extent,

[1]Note: SEWPAC indicated on 4 July 2011 that black-throated finch (southern) surveys conducted as part of EIS studies satisfied its requirements for presence/absence surveys for the subspecies(meeting between SEWPAC and GHD).

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 (refer Section 6.1.2).

1.6.2.4 Aquatic Fauna Assessment

In field aquatic assessments were used to supplement desktop information on fauna in the region and provide information specific to the Study Area. Given the highly variable flow regime of watercourses in the catchment, desktop information is valuable to providing data that cannot be captured during all seasonal conditions.

Survey for fish and crustaceans was undertaken within water bodies that provided adequate habitat for trapping using box and opera house traps. Given the drier conditions on the earlier survey event trapping generally occurred during the May survey event. The sites selected for fauna assessment are environments representative of the aquatic habitats on the site that were expected to be important for fish and crustaceans. Low trapping success in some areas led to the prioritisation for sampling at the riverine and palustrine habitats rather than dams, which are considered to have lower habitat values. Individual trap placement aimed to sample the variety of microhabitats within the 100 m reach, for example woody debris, root balls and trailing bank vegetation.

Aquatic macroinvertebrate sampling was undertaken in accordance with the Queensland AusRivAs assessment protocols (NRM, 2001). The assessments were undertaken using field sampling and live pick procedures, laboratory analysis and community data analysis. Sampling of macroinvertebrate taxa not considered by AusRivAS (e.g. crabs) was also completed using standard techniques

Threatened Species Surveys

Desktop searches indicate one threatened aquatic species, the freshwater sawfish (*Pristis microdon*) has been historically recorded in the Burdekin Catchment adjacent to the Study Area, however, it is highly unlikely to occur within the Study Area (unsuitable habitat, barriers to movement) and accordingly dedicated searches for this taxa were not required.

1.6.3 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. Determination of likelihood of occurrence considered information relating to:

- Habitat preferences
- Distribution
- Relative abundance
- Previous records from the region

- The occurrence of suitable habitat at the Study Area based on field observations
- The confirmed presence of conservation significant species at the Study Area

A likelihood of occurrence ranking was attributed to each conservation significant species, based on the following framework:

- **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.

1.6.4 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 TEC to which it has been applied. The species and communities that have been mapped according to this methodology comprise:

- Black throated finch (southern)
- Squatter pigeon (southern)
- Reptiles of the brigalow belt, including ornamental snake and yakka skink
- Northern quoll
- Koala
- Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community (TEC)
- The Community of Native Species Dependant on Natural Discharge of Groundwater from the Great Artesian Basin (GAB)

1.6.5 Impact Assessment and Mitigation

In consideration of construction and operational activities of the mine and rail components of the Project, potential impacts have been identified and described with respect to flora and fauna species, their confirmed and potential habitat and vegetation communities that occur within (confirmed) or are considered likely to occur within, the Study Area (as per the criteria nominated under Section 1.6.3). Mitigation measures to avoid/minimise/offset impacts to identified matters of NES resulting from the construction and operational activities associated with the Project have been proposed.

The significance of residual impacts, post-mitigation, was evaluated with consideration to the DSEWPaC significance criteria, which are provided in *Matters of National Environmental Significance Significant impact guidelines 1.1* (hereafter, the 'Significant Impact Guidelines') (DEWHA 2009b).

In considering impact to listed taxa and communities, assessment was also made to identify relevant matters for impact assessment in relation to the following:

- An important population – for listed vulnerable threatened species
- Habitat critical to survival – for listed threatened species
- Important habitat – for migratory species

These are defined as follows.

Important population

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity
- Populations that are near the limit of the species range

Habitat critical to the survival of a species or ecological community

Areas that are necessary for:

- Activities such as foraging, breeding, roosting, or dispersal
- The long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- Maintenance of genetic diversity and long term evolutionary development
- The reintroduction of populations or recovery of the species or ecological community

Such habitat may be, but is not limited to habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/ or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

Important habitat

An 'important habitat' for migratory species is considered to be one or more of the following:

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining
- In addition, any species that are categorised as critically endangered, endangered, vulnerable or extinct in the wild are considered matters of NES and trigger the EPBC Act. Section 179 of the EPBC Act defines these categories as stated below.

- A native species is eligible to be included in the **extinct in the wild** category at a particular time if, at that time:
  - (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range
  - (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
- A native species is eligible to be included in the **critically endangered** category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
- A native species is eligible to be included in the **endangered category** at a particular time if, at that time:
  - (a) it is not critically endangered
  - (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
- A native species is eligible to be included in the **vulnerable category** at a particular time if, at that time:
  - (a) it is not critically endangered or endangered
  - (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.

1.6.6 Project Activities Relevant to Impact Assessment and Mitigation

The Project will require the development of both permanent and temporary infrastructure. To achieve a conservative assessment of impacts temporary impacts are expected to be realised at the site for 10 years and operational impacts are considered to be permanent unless otherwise defined.

The construction phase of the Project (Mine and Rail) will involve the following activities:

- Development of the Mine Infrastructure Area (MIA) – predominantly occurs within non-remnant vegetation (based on field-verified RE mapping)
- Development of offsite infrastructure including a workers accommodation village, an industrial area, a permanent airport and water supply infrastructure – footprint includes clearing of remnant vegetation
- Construction of a 95 m wide rail corridor– footprint includes clearing of remnant vegetation
- Construction of a rollingstock maintenance yard, maintenance roads, and infrastructure at a passing loop for operational requirements (including sub-stations for electrification and signalling and power supply rooms) – footprint includes clearing of remnant vegetation
- Construction of temporary construction camps – footprint includes some remnant vegetation
- Construction of construction plant (comprising flashbutt welding plant, concrete batch plants, ballast stacking and casting yard for bridge structures) – footprint includes some remnant vegetation

Collectively the temporary and permanent infrastructure comprises the Project footprint for the construction phase of the Project. The extent of the Project footprint is presented in Figure 1-3.

The operation phase of the Project (Mine and Rail) will involve the following activities:

- Underground mining staged through development with subsidence of mined areas expected to occur
- Open cut mining staged through development and rehabilitation of pits over the duration of the mine life
- Management of overburden through development and rehabilitation of waste areas over the duration of the mine life
- Development and maintenance of clean water diversion drains to be established along the boundary of the Mine Area, and separating clean inflows from dirty water areas
- Spanning of the Carmichael River at one site to achieve access to the southern part of the Study Area
- Diversion of Eight Mile Creek
- Use of a rail corridor (95 m wide) (fenced and inclusive of maintenance/service road, passing loops and bad order sidings)
- Use and maintenance of rollingstock maintenance yard, maintenance roads, and infrastructure at a passing loop for operational requirements

The mine will be operational for approximately 90 years with staged development of the open cut and underground pits. Site rehabilitation following construction and completion of mining activities at each phase of the project will also be staged over the duration of the mine life.

Site works across all phases of the Project (Mine and Rail) will require the clearing of remnant vegetation, spanning or removal of watercourses and/or standing water bodies, and fragmentation of the landscape, amongst other impacts. These will result in impacts across the site of:

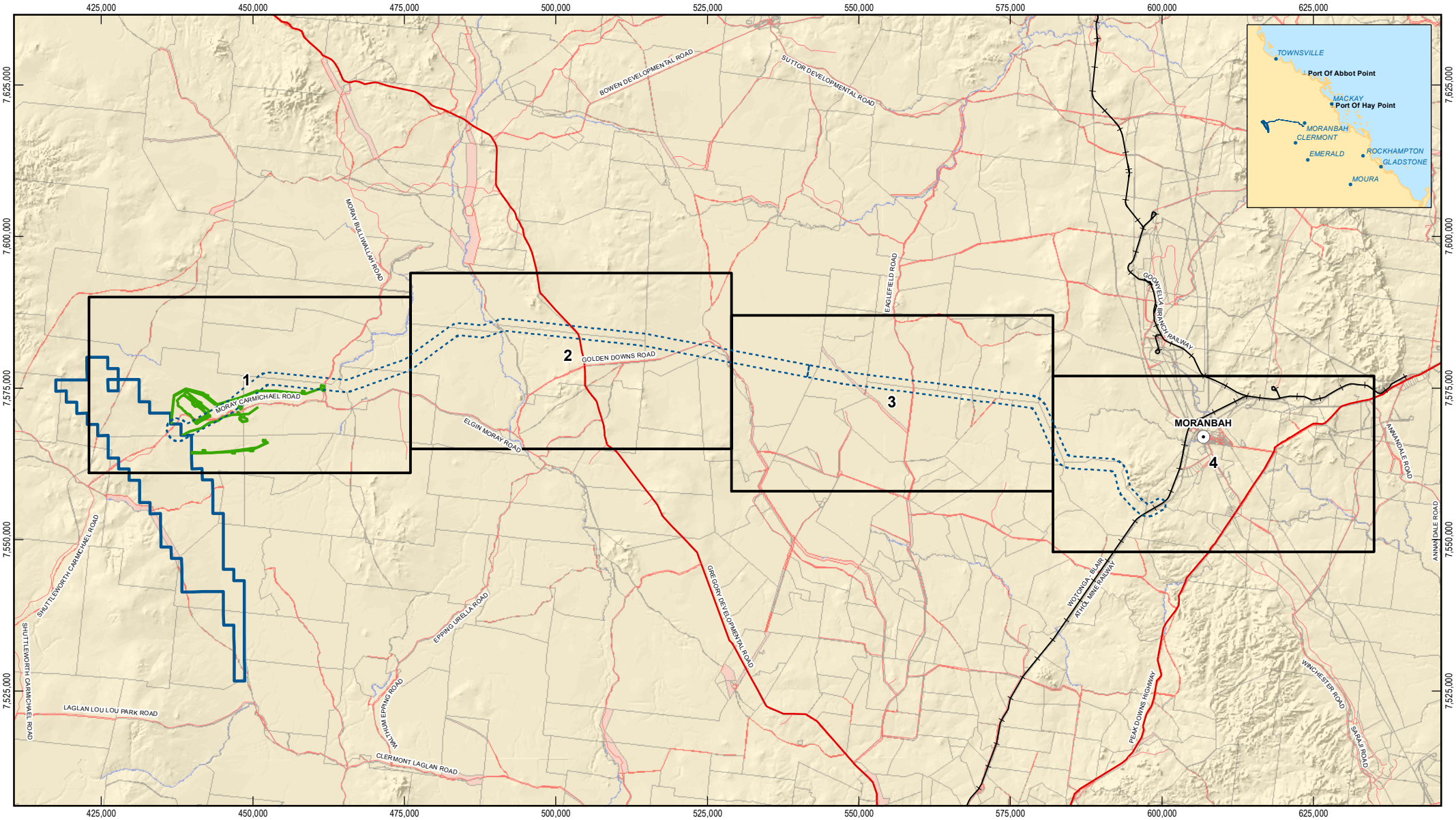
- Clearing and fragmentation of lands
- Removal of water resources and alteration of groundwater from drawdown
- Water required for construction and operational purposes will be sourced from onsite dams or from offsite sources with water course diversions established early in the Project lifecycle and any water leaving site captured within staging dams, treated and recycled
- Alteration of topography associated with subsidence over underground mining pits and mounding of spoil
- Potential introduction of weeds and exotic pests

Each of these impacts will reduce local biodiversity and may potentially affect regional biodiversity and consideration has been given to the significance of these impacts as they relate to matters of NES.

Habitats and species that are likely to be permanently affected as a result of habitat losses or groundwater influences will require offsetting. Volume 1, Section 9 Draft Offsets Strategy provides a considered offset strategy for the Project. Offsets are described in detail Volume 4 Section AH. In addressing offsets for the Project consideration has been given to relevant offset policy requirements.

The offset requirements specific to the Commonwealth and State offset polices are detailed in Volume 4, Section AH Offsets Strategy.

There is scope for most of the offset obligations associated with impacts to Commonwealth and State environmental values to be met through the delivery of a combined offset approach that address impacts to environmental values protected under both areas of legislative jurisdiction. Offset options that nominate a complementary approach will need to be agreed with DSEWPaC and relevant agencies of the Queensland Government so that these options satisfy the requirements of both Commonwealth and State offset policies (and local government requirements if applicable).



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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

Footprint of Construction Phase

Job Number	41-25215
Revision	C
Date	07-09-2012

Figure 1-3
Series Index

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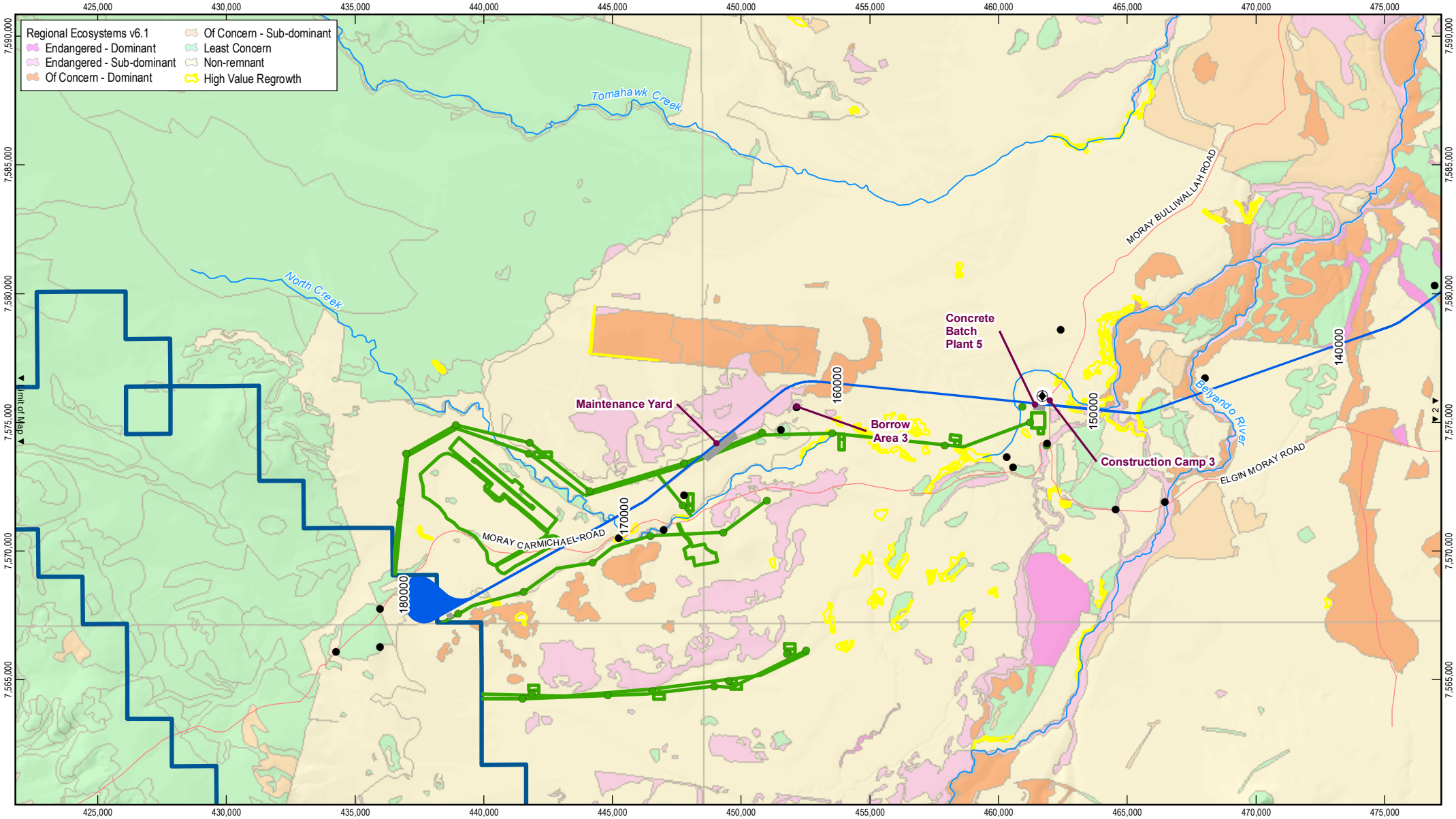
Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Corridors Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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N

LEGEND
- Town
- Construction Camp
- Investigation Areas
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Rail (Infrastructure)

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Footprint of Construction Phase

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

Figure 1-3
Sheet 1 of 4

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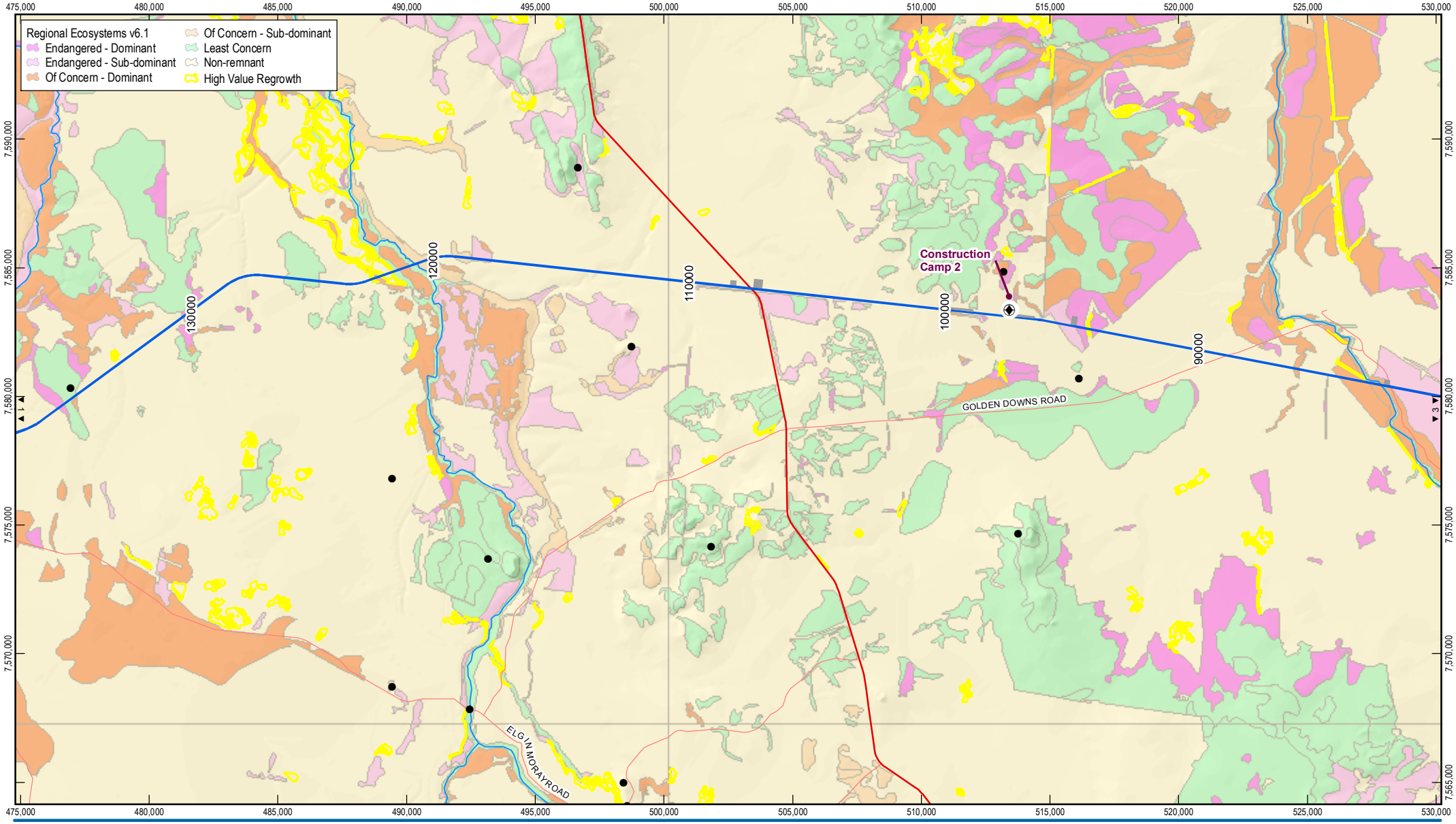

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Footprint of Construction Phase

Figure 1-3
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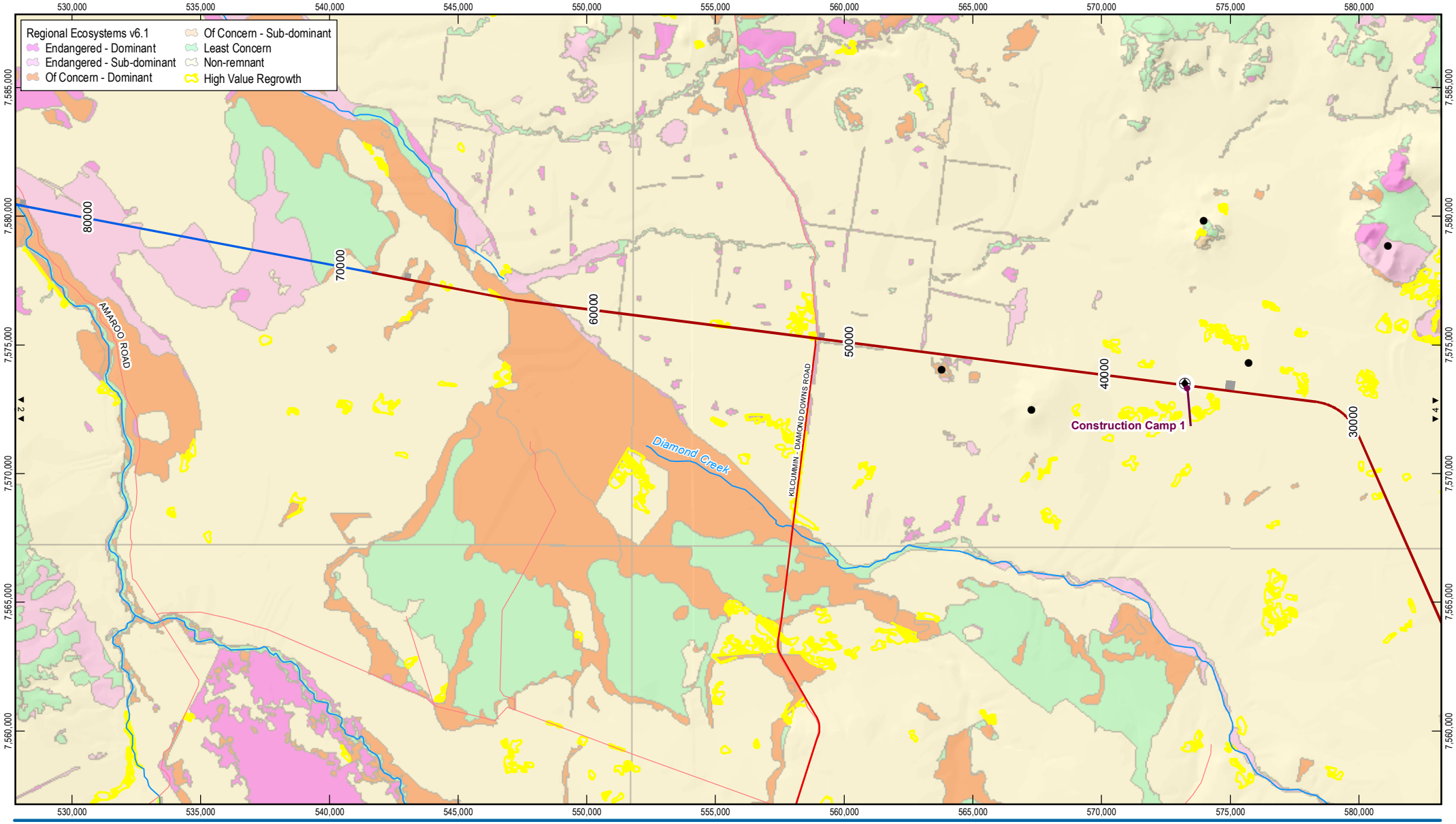

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Footprint of Construction Phase

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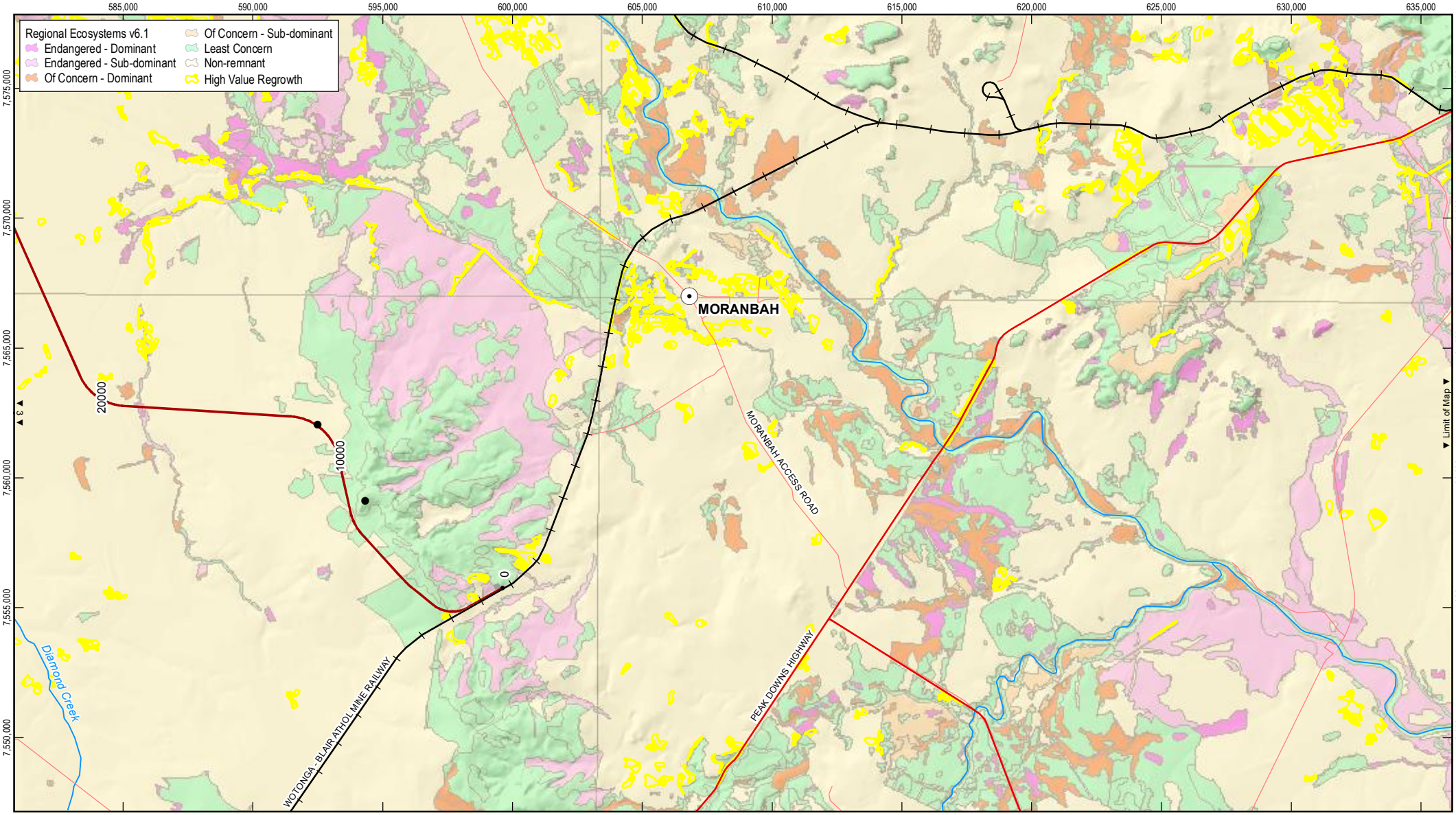

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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Footprint of Construction Phase

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1.7 Limitations and Assumptions

Limitations and assumptions of the study include:

- Given the restricted ability to sample seasonal variability across the Study Area due to site inaccessibility during wet weather and land holder access limitations, addressing the requirements of the Project ToR has been supported by substantial desktop research in combination with the field surveys.
- Dry and cool conditions at the time of field surveys for the Rail Study Area reduced the subsequent data capture of seasonal changes in terrestrial flora and fauna assemblages, habitat condition and utilisation. Habitat assessment where possible and species profiles have been used to provide an understanding of the variation in flora and fauna communities across seasonal variation.
- Where uncertainties exist in determining the likelihood of occurrence of a species within the Study Area, the more conservative of the options under consideration was adopted.
- Planning and development of a Mine plan for the Project (Mine) has evolved as ecological surveys have been conducted. Initial terrestrial ecology surveys focused on the central portion of EPC 1690 (Spring 2010 survey event). This was then expanded to cover the entire area of EPC 1690 (Autumn 2011 survey event) and then for the eastern portion of EPC 1080 (Spring 2011 survey event). As such, latter survey efforts expanded to address new habitat and not all areas have seasonal data. Further, changes have been made to the location and extent of the proposed offsite infrastructure and, as such, not all Project specific locations have been ground-truthed. Survey effort and timing is summarised in Table 1-2 and detailed in Volume 2 Section 5 Nature Conservation (Mine) and Volume 3, Section 5 Nature Conservation (Rail). Additional habitat assessment efforts during the Spring 2011 and Autumn 2011 surveys in conjunction with desktop species information and information from the Spring 2010 survey have been considered suitable to describe the existing environment and seasonal character as it relates to potential for the Project to impact upon matters of NES.
- Since completion of survey events, minor changes have been made to the location and extent of the rail corridor, camps and proposed rail infrastructure. However, these changes remain within the targeted investigation corridor of 500 m and included a survey extent up to 2 km in width. As such, the additional infrastructure areas have been considered by desktop and field assessments. Rail field assessments are considered suitable to describe the existing environment and seasonal character as it relates to potential for the Project to impact upon matters of NES.
- The habitat mapping method was underpinned by a number of assumptions due to the large area over which predictive mapping was undertaken, and in some cases the lack of fine-scaled and species-specific habitat data.

1.8 Report Scope

This report brings together assessments of impacts on matters of NES from other sections of this EIS (e.g. water resources, flora and fauna, cultural heritage and cumulative impacts etc.) to produce a stand-alone assessment in a format suited for assessment under the EPBC Act.

The report is specifically aimed at addressing those matters of NES present within the Study Area, including the mine and the rail line (as defined in Section 1.6).

This report addresses Section 9 of the Project terms of reference (ToR), specifically as shown in Table 1-5. The DSEWPaC provided comment, to the Queensland State Government, on the draft ToR and Section 9 of the Final ToR reflects these comments.

Table 1-5 Cross Reference with Terms of Reference

Terms of Reference Requirement/Section Number	Section of this report
Section 9.1 Provide background to the Project and relationship of Project to other actions	Section 1.1 and 1.2
Section 9.2 Describe matters of NES potentially affected by the Project	Section □
Section 9.3.1 Identify and describe values of the GBR World Heritage Area, Marine Park and National Heritage places of relevance to the Project.	Section 2.1 and 2.2
Section 9.3.2 Describe potential direct, indirect and consequential impacts to values of the GBR World Heritage Area, Marine Park and National Heritage places of relevance to the Project.	Section 2.3 and 2.4
Section 9.4.1 Identify listed threatened and migratory species of relevance to the Project.	Section 4.1, 4.2, 5.1 and 5.2
Section 9.4.2 Describe potential direct, indirect and consequential impacts to values of listed threatened and migratory species of relevance to the Project.	Section 4.3, 4.4, 5.3 and 5.4
Section 9.5.1 Identify and describe the wetlands of international importance of relevance to the Project.	Section 3.1 and 3.2
Section 9.5.2 Describe potential direct, indirect and consequential impacts to wetlands of international importance of relevance to the Project.	Section 3.3 and 3.4
Section 9.6 Assess the relevant impacts of the Project, considering all identified environmental values	Referred to throughout the document but summarised in Section 2.4, 3.4, 4.4, 5.4 and 6.1
Section 9.7 Explore feasible alternatives to the action to reduce impacts and demonstrate reasoning for preference of one alternate to another	Section 1 and 4
Section 9.7.1 Describe avoidance measures to minimise potential impacts	Referred to throughout the document including Section 2.4, 4.3, 5.3, 6.1 and 6.2

Terms of Reference Requirement/Section Number	Section of this report
Section 9.7.2 Describe mitigation measures including: an outline EMP long-term funding of measures evidence of efficacy of measures	Referred to throughout the document including Section 2.3, 3.3, 4.3, 5.3, 6.2
Section 9.8 Provide a detailed description of mitigation measures and offsets, including: Consolidated list of mitigation measures Detail description of proposed offsets	Section 6.1 - 6.4
Section 9.9 Outline impacts to be monitored, baseline monitoring proposals and parameters for monitoring. Provide procedural requirements for reporting and compliance.	Section 7
Section 10 Provide conclusions and recommendations	Section 8
Section 11 References	Section 9
Section 12 Appendices	Section 10

2. World Heritage Areas; National Heritage Places and the Great Barrier Reef Marine Park

2.1 Introduction

A number of geographies within Queensland provide unique environmental, cultural or heritage features. In recognition these areas have been afforded legislative protection. Any project that may interfere with the values for which any protected site has been recognised must ascertain the potential for impact and identify mitigation measures.

To understand whether values of protected sites will be affected by the Project, assessment of impacts of the Project have been completed. These have been supported by desktop and field assessment studies which describe the existing terrestrial and aquatic ecological values of the Study Area. Volume 2 Section 5 Mine Nature Conservation and Volume 3 Section 5 Rail Nature Conservation of this EIS report those findings in detail. In brief, the Study Area occurs in central Queensland within the Burdekin and Fitzroy Basin Catchments, approximately 320 km upstream of the Great Barrier Reef World Heritage Area and the Great Barrier Reef Marine Park. The vast majority of the Study Area is within the Brigalow Belt bioregion except for the extreme western extent of the Study Area which captures the boundary of the Desert Uplands bioregion.

2.2 Description of Environmental Values

2.2.1 Habitats within the Study Area

Aquatic habitats vary in size and geomorphology across the Study Area. They include lacustrine, palustrine and riverine habitats. A number of dams are scattered across the Study Area and streams and seasonal drainage channels direct flows into the more permanent water bodies. Dams have little overhanging or emergent vegetation, however, other water bodies support riparian corridors of varying diversity and width. The dominant riverine environment, the Carmichael River, bisects the proposed mine site and flows east for approximately 20 km to its juncture with the Belyando River. From this point the Belyando River flows in a northerly direction for approximately 90 km where it joins the Suttor River. Beyond its juncture with the Belyando River, the Suttor River flows north (approximately 50 km) to the Burdekin Falls Dam (Lake Dalrymple). The Burdekin River downstream of Burdekin Falls Dam flows for approximately 160 km to its mouth at Upstart Bay near Ayr.

As a result of the high location in the catchment and seasonality in rainfall, flows within the Study Area are restricted to the wetter months, November to March, with many streams and drainage channels drying entirely and larger rivers sustaining only pools or low flows by the winter months (June/July). The Burdekin River Gorge and falls and the Burdekin Falls Dam have influenced the ecology of the catchment by restricting aquatic fauna movement from the eastern coastal area to the upper catchment areas.

Plate 2-1 Terrestrial and Aquatic Habitats found in the Study Area

Open woodland

Cleared land

Eucalypt and Acacia woodland

Woodland with grassy understorey

Belyando River

Permanent Dam

Ephemeral Stream

Gilgai

2.2.2 World Heritage Areas

The two closest world heritage properties to the Study Area are the Great Barrier Reef World Heritage Area and the Wet Tropics World Heritage Area. The Study Area is located approximately 272 km south of the Wet Tropics World Heritage Area with no direct land or aquatic links to the Study Area. The Study Area is also located over 200 km due west and approximately 320 km upstream of the Great Barrier Reef World Heritage Area and the Great Barrier Reef Marine Park. The Carmichael River bisects the proposed mine site and joins a network of river systems which eventually enter the marine coastal waters of Queensland.

The Great Barrier Reef (GBR), a unique reefal mosaic that spans more than 348,000 km^2 of the continental shelf of Queensland. The GBR is recognised globally for its biodiversity, size, prevalence of endemic species, aesthetic and cultural values. In 1981 it was inscribed on the World Heritage List against the following criteria:

- Outstanding example representing a major stage of the earth's evolutionary history given the GBR is the largest single collection of coral reefs in the world
- Outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment given the GBR represents a mature system which has been in existence for millions of years
- Containing unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty
- Providing habitats where populations of rare and endangered species of plants and animals survive

The GBR is also of indigenous cultural importance for Aboriginal and Torres Strait Islanders. Non-indigenous heritage values are also represented and include mapped historic shipwrecks which occur throughout the reef mosaic. These, along with its biological diversity, represent features that are of outstanding national heritage value to Australia which led to the GBR being registered as a place of National Heritage in May 2007.

Prior to inscription upon the World Heritage or National Heritage registers the GBR was recognised as an environment requiring special management to provide sustainable use with appropriate protection. In 1975 the Great Barrier Reef Marine Park was designated and the GBR Marine Park

Authority established as a management agency chartered with the responsibility of management of activities within the Marine Park. The Marine Park covers more than 344,400 km^2 of the GBRWHA and extends 2,300 km along the Queensland coast and encompasses most of the waters from low water mark on the mainland coast (Hutchings et al. 2008). A number of coastal areas, such as operational port environments, are excluded from the Marine Park. This provides opportunity for targeted, intensive management of those environments against the activities which are conducted within those areas. Responsibility for which rests with the various port management agencies operating in Queensland.

The GBR is a multiple use multiple jurisdiction environment managed with an overriding conservation objective to maintain the values of the reef. In this regard the Marine Park Authority works with the Queensland Government, its agencies and port authorities to achieve effective management of the Great Barrier Reef. Given the alignment of the values for which the GBR is designated as a Marine Park, a World Heritage Area and a National Heritage Place, assessment of each these matters is considered within this Section.

2.3 Potential Impacts and Mitigation Measures

The DSEWPaC Projected Matters Search Tool did not identify any world heritage properties or National Heritage Places of relevance to the Project. The Wet Tropics World Heritage Area is located over 270 km north of the Study Area with no direct terrestrial, aquatic or biodiversity links to the Study Area. No influences from the Project are predicted to occur on the Wet Tropics World Heritage Area and this area has not been considered further within this assessment.

The Tree of Knowledge and curtilage at Barcaldine is the closest National Heritage Place to the Study Area. It is located approximately 200 km south west of the western extent of the Study Area. No direct or indirect influences on this Place will occur as a consequence of the Project and this Place has, therefore, not been considered further.

The Great Barrier Reef World Heritage Area is located over 300 km downstream of the Study Area and is connected to the Study Area aquatically via a number of river systems. Waters from the Study Area will flow through a network of river systems and be subject to significant scrubbing prior to reaching the coast. Given the heritage and biodiversity values of the reef, and their interdependency on upstream water quality, consideration to the potential for downstream affects to the reef has been provided herein.

The Project will require the construction of a 189 km long rail corridor (95 m width) in conjunction with open cut and underground mining operation across 46,550 ha. The Project will be staged in delivery over a 90 year period. To facilitate operation permanent mine infrastructure will be established, including a residential village and an air strip (Figure 2-1). These activities will necessitate land clearing, watercourse diversion and stormwater management, construction and mining works and establishment of water treatment facilities. In particular, site development will result in the sequential loss of water courses and water bodies and diversion of catchment runoff around the Project site.

A number of farm dams and lower order water courses (stream orders 1 and 2) will be removed as a result of construction works. The main water body, the Carmichael River, will be-spanned to facilitate mining on the south of the river; riparian vegetation will be left intact except at the crossing point. Water course management will be engineered onsite to divert overland flows around from the mining footprint into the downstream watercourses, using sediment staging ponds to manage turbidity. Land

activity management will control for potential contamination of water courses such that no detrimental downstream effects on water quality and flows are expected as a result of the Project.

The influence of the Project on the groundwater across the Study Area has been investigated in detail and is described in Volume 2 Section 6 Water Resources (Mine) and Volume 3 Section 6 Water Resources (Rail) of this EIS. Impacts to the flow, direction of flow and volumes of groundwater within the Study Area will occur. However, these systems are not directly linked to those associated with the Great Barrier Reef World Heritage waters. Significant catchment area and groundwater recharge systems occur between the Study Area and the coast. No impacts associated with the Project will result in a substantial and measurable change in the hydrological regime of the GBRWHA waters and, therefore, no effects on the Marine Park are predicted either.

The only activity to occur onsite will be those associated with the mining works. Accordingly no impacts to other users of water resources within the Study Area will occur. Direct impacts to downstream water flows which could affect the catchment of the GBRWHA will not occur. Additional assessments of potential effects of the Project on groundwater and the interaction between groundwater and the Carmichael River will clarify potential for indirect impacts to downstream users. Flow on affects to the Marine Park or GBRWHA waters are not predicted to occur.

The Study Area does not bound the coast, it is located 320 km inland of the coast. It does not contribute to the aesthetic values for which the Great Barrier Reef is protected. Accordingly the Project will not have any influence on those values.

The impacts associated with the degradation of aquatic habitats that will be realised onsite will be managed by engineering and construction management solutions, which will be documented within the site Environmental Management Plans (construction and operation) and will include erosion and sediment control requirements to be implemented and monitored throughout the all phases of the Project.

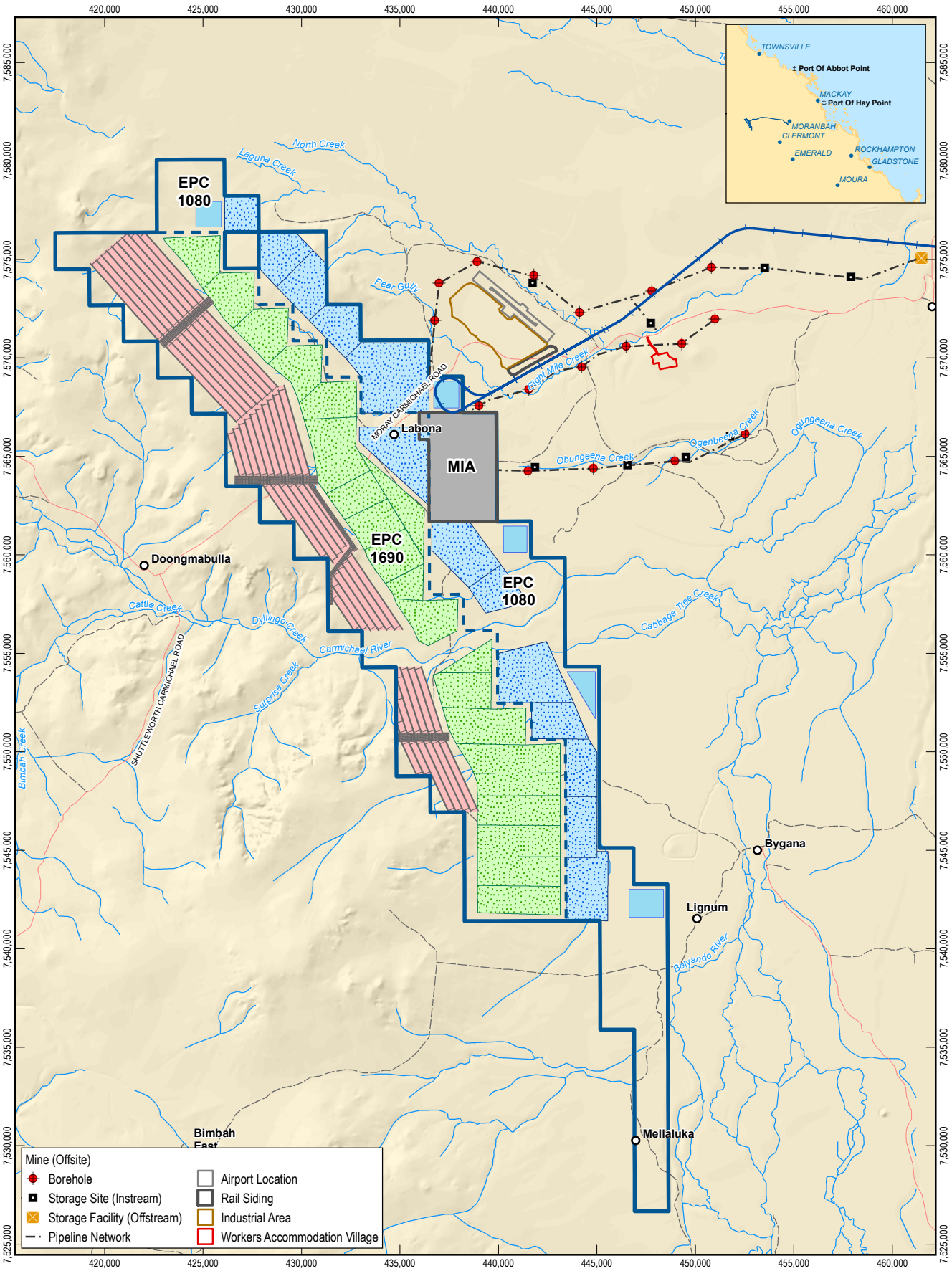
To limit the degradation of downstream aquatic habitat mitigation and management will focus on limiting sediment transport from exposed areas, minimising the risk of increased erosion and managing potential mobilisation or introduction of pollutants. Controlling site runoff from all areas disturbed during construction and minimising bank disturbance will be important in limiting the degradation of habitats downstream of the construction area. Mitigation measures are identified in detail within the Environmental Management Plans (EMP) (Volume 2 Section 13 EMP (Mine), Volume 2 Section 14 EMP (Offsite) and Volume 3 Section 14 EMP (Rail)) for this EIS and include (but are not limited to):

- Clearing of vegetation is not to be undertaken during overland flow events
- Construction activities that affect stormwater flow paths to commence only after suitable stormwater management infrastructure has been established
- Requirement to construct across North Creek during the dry conditions to limit localised erosion at construction areas
- Installation and maintenance standards for sediment fences and other sediment control devices, in particular for areas near earthworks, watercourses and key stormwater flow paths
- Location of all soil or mulch stockpiles away from watercourses and key stormwater flow paths to limit potential for transport of these substances into the watercourses via runoff

- Stabilisation of disturbed areas to be undertaken as soon as practicable after disturbance. If appropriate, clearing of vegetation to be undertaken in a staged manner as construction progresses, minimising the disturbance footprint at all times. Revegetation applicable areas to be undertaken as soon as practicable, using native flora appropriate for local conditions.
- Emergency response protocols and procedures for implementation in the event of a contaminant spill or leak to be clearly articulated in the site Environment Management Plans (construction and operation). Contaminated materials are to be removed from site by a licenced waste collector and transport company, and disposed of at a licenced facility.
- Spill kits to be located at regular intervals across the construction phase footprint to allow for timely response to uncontained spills. All staff to be familiar with their use
- Requirement for the use of vehicles and machinery in good working order to limit potential for hydrocarbon leaks
- All waste management measures, including appropriate storage locations and disposal procedures for domestic and construction waste to be clearly articulated in a Waste and Resource Management Plan
- Regular water quality monitoring of nearby resources to confirm adequacy of management and mitigation measures. Monitoring requirements, water quality targets, corrective actions and reporting requirements to be clearly articulated in a Water Quality Management Plan, embedded within the Environmental Management Plans (construction and operation).

The design of the Mine Infrastructure Area will incorporate stormwater management infrastructure and mechanisms to manage runoff. Stormwater management mechanisms and monitoring requirements will be incorporated in the Water Quality Management Plan.

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 GBRWHA. No onsite habitat impacts are expected to detrimentally affect the values for which the GBR is recognised. No impacts associated with the Project are expected to result in a substantial and measurable change in the hydrological regime of the GBRWHA 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 GBRWHA or Marine Park.



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Construction Phase

Operation Phase

- Underground Mine Area
- Water Management Dams
- Underground Mine Plan
- Open Cut Blocks
- Out of Pit Waste Dumps

1:275,000 (at A4)
0 1 2 3 4 5
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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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision B
Date 07-09-2012

Mine Plan – Areas of Impact

Figure 2-1

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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: DME: EPC 1690 (2010), EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); Adani Pty Ltd: Indicative Mine Plan/Infrastructure (2012). Created by: BW, CA

2.4 Summary

The DSEWPaC Projected Matters Search Tool did not identify any world heritage properties or National Heritage Places of relevance to the Project.

The Wet Tropics World Heritage Area is located over 270 km north of the Study Area with no direct terrestrial, aquatic or biodiversity links to the Study Area. No influences from the Project are predicted to occur on the Wet Tropics World Heritage Area and this area has not been considered further within this assessment.

The Tree of Knowledge and curtilage at Barcaldine is the closest National Heritage Place to the Study Area. It is located approximately 200 km south west of the western extent of the Study Area. No direct or indirect influences on this Place will occur as a consequence of the Project and this Place has, therefore, not been considered further.

The GBRWHA is located over 300 km downstream of the Study Area and although connected aquatically via watercourses, substantial watercourse and overland barriers exist between the ocean and the Study Area, including the Burdekin River dam. Significant controls will be established to manage onsite and offsite water and sediment quality impacts. These measures will mitigate potential for offsite impacts to aquatic values that could affect the downstream reefal environment. The distance from the GBR and the extant barriers would impede site conditions from having an influence on the values for which the reef is protected. No impacts associated with the Project will result in a substantial and measurable change in the hydrological regime of the GBRWHA waters and, therefore, no effects on the Marine Park are predicted either. Accordingly no impacts to the ecological, cultural or social values which the Great Barrier Reef is recognised will occur as a result of the Project.

The Project will not impact upon any World Heritage Areas, National Heritage Places or the Great Barrier Reef Marine Park.

3. Wetlands of International Importance

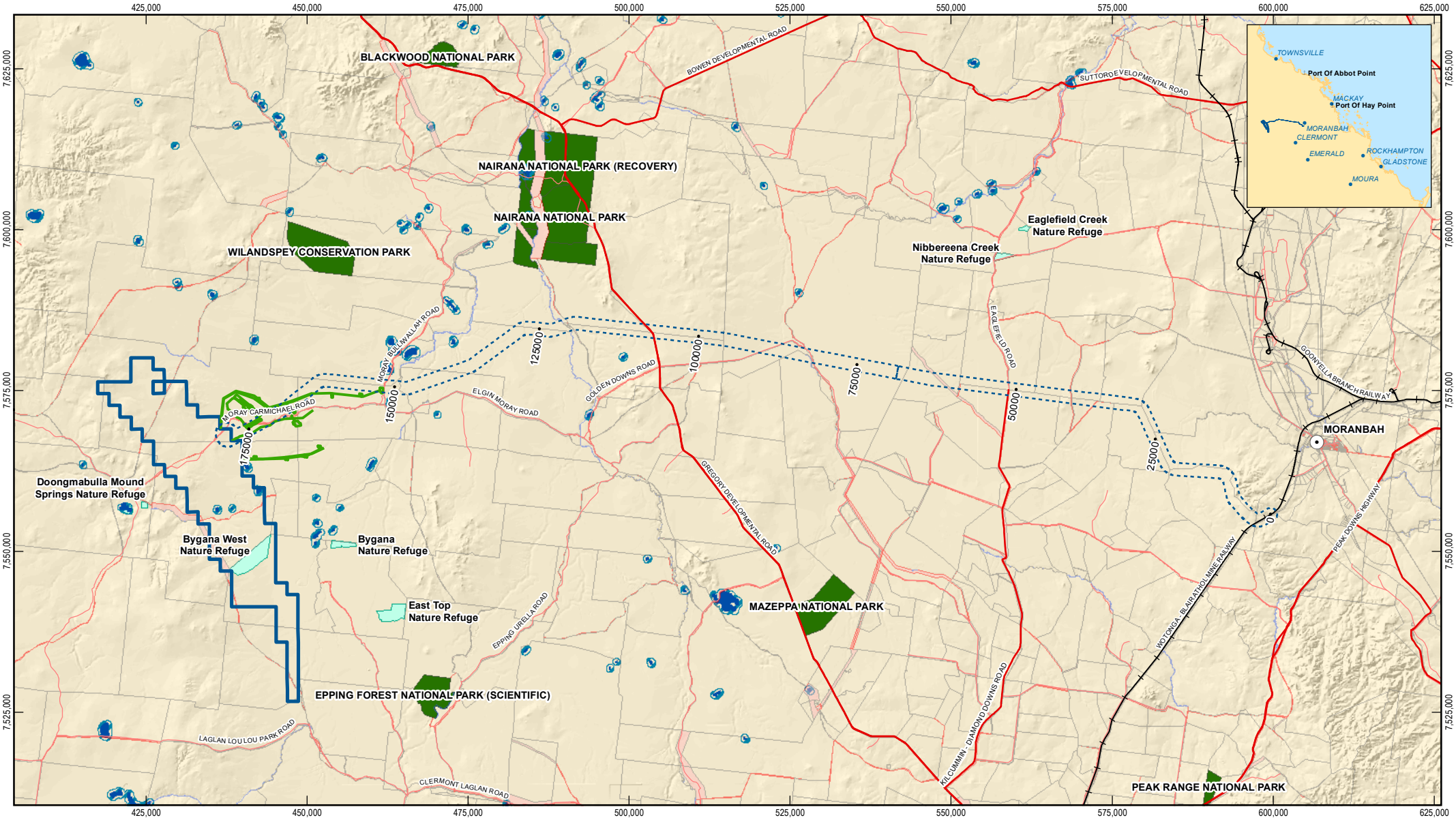
3.1 Introduction

Wetlands that are representative, rare or unique with regard to their biodiversity, size, geomorphology or location for the conservation of biodiversity are recognised under the EPBC Act as a matter of NES. A number of different water body types are recognised as wetlands, including permanent water bodies, seasonal or intermittent lakes, human-made and subterranean hydrological systems. Listed and protected wetlands have met criteria to be afforded Ramsar status and any action that may influence the values for which the wetland has been recognised must be assessed to ascertain the potential for impact and identify mitigation measures.

3.2 Description of Environmental Values

The DSEWPaC Protected Matters Search Tool indicated that the Coongie Lakes Ramsar site in South Australia (located approximately 800 km south west of the Study Area) is of relevance to the Project as the Study Area occurs near the extreme north east of the Cooper Creek Catchment, which drains in a south westerly direction towards north east South Australia (Coongie Lakes and Lake Eyre). The Study Area lies within the Burdekin River and Fitzroy River catchments and no surface waters within the Cooper Creek Catchment are located within the Study Area or surrounds (see Figure 3-1). Accordingly the Coongie Lakes Ramsar site is not connected to the Study Area.

Although not indicated to be of relevance to the Project via the DSEWPaC Protected Matters Search Tool, a wetland of international importance (Ramsar Wetland) that occurs approximately 380 km east of the Study Area (Figure 3-1), outside the Burdekin River catchment, is that associated with the Shoalwater and Corio Bays Areas. Substantial overland barriers exist between the Study Area and the Shoalwater and Corio Bays Areas. Substantial watercourse barriers also exist between the ocean and the Study Area, including the Burdekin River dam. The distance from the protected area and barriers would impede site conditions from having an influence on these coastal wetland protected values.



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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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Carmichael Coal Mine and Rail Project

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Conservation Significant Areas

Figure 3-1

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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

3.3 Potential Impacts and Mitigation Measures

Ramsar wetlands are located to the south and east of the Study Area. Substantial overland and watercourse barriers exist between the Study Area and these protected sites. The Study Area lies within the Burdekin River and Fitzroy River catchments and no surface waters within the Cooper Creek Catchment are located within the Study Area or surrounds. Accordingly the Coongie Lakes Ramsar site is not connected to the Study Area. The substantial distance between the Study Area coupled with onsite environmental management actions and barriers to downstream affects, including the Burdekin River dam, would impede site conditions from having an influence on the Shoalwater and Corio Bays Areas coastal wetland protected values.

3.4 Summary

No areas of Ramsar wetland are predicted to be impacted by this Project. The closest Ramsar wetland is 380 km from the site disconnected from the Study Area by substantial barriers. No areas of internationally important wetland will be lost, destroyed or substantially modified as a result of the Project nor will the hydrological regime of those distant wetlands be interfered with. None of the biodiversity for which distant wetlands are recognised will be impacted by Project activities as the Project will not affect the geography of any Ramsar protected wetlands nor will it act to introduce invasive species to any wetland sites. Accordingly, no impacts to Ramsar wetlands are predicted to occur as a result of this Project.

4. Impact on a Listed Threatened Species and Ecological Communities

4.1 Introduction

Australia supports a high percentage of endemic species and communities. Development, urbanisation, clearing of land for grazing or agricultural purposes and other activities have affected the prevalence and distribution of these species historically. Some are now considered to be threatened or endangered. The EPBC Act offers protection for threatened species and ecological communities to preserve the naturally occurring biodiversity of the Australian landscape. Projects that are at risk of affecting the prevalence or distribution of any listed taxa require assessment under the EPBC Act. Desktop research and field surveys have been applied for this Project to describe the threatened species and communities known or likely to occur within the Study Area that could, therefore, be affected by the Project, the impacts that may be realised, the significance of any impacts and management measures to ameliorate those impacts. Findings are described following.

4.2 Description of Environmental Values

4.2.1 Listed Threatened Flora

Desktop assessment indicated that six EPBC Act-listed threatened flora species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Mine and Rail Study Areas. Of these, none were confirmed present during field surveys.

One flora species listed as threatened under the EPBC Act but not predicted to occur by the Protected Matters Search Tool was confirmed present within the Project Area – waxy cabbage palm *Livistona lanuginosa*.

An additional five EPBC Act listed threatened flora species were identified in the Project ToR for consideration in this assessment. One of these five species, black ironbox (*Eucalyptus raveretiana*), was identified during field surveys for two other projects in the broader region: Galilee Coal Project (Waratah Coal Pty Ltd, 2011) Alpha Coal Project (Hancock Prospecting Pty Ltd, 2010). However, black ironbox is not considered likely to occur within the Study Area of the Project as the eastern extent of Study Area falls approximately 100 km to west of the edge of the species known distribution.

None of these other (additional) species were confirmed present onsite during field investigations, including the black ironbox. A likelihood of occurrence assessment for all species (predicted, previously detected) was undertaken for both the mine and the rail geographies. Details from each of those assessments are provided in detail in Volume 2, Section 5 and Volume 3, Section 5 of this EIS. The likelihood of occurrence assessment indicated that the following EPBC Act-listed threatened flora species may occur at the Study Area, based on distribution and/or presence of potentially suitable habitat:

- *Acacia ramiflora* – vulnerable EPBC Act
- *Dichanthium queenslandicum* – vulnerable EPBC Act

These species were not recorded during field surveys. Both species may occur based on its known geographic distribution and the presence of suitable habitat. Landforms and Regional Ecosystems

known to support these taxa do occur within the Study Area and, accordingly, suitable habitat is considered to be present within the Study Area.

The following EPBC Act listed threatened flora species were predicted to occur at the Study Area by the Protected Matters Search Tool or were identified in the Project terms of reference for consideration in this assessment. These species are, however, considered unlikely to occur based on their current known distribution and/or the lack of suitable habitat at the Study Area:

- *Acacia deuteroneura* – vulnerable EPBC Act
- *Cycas ophiolitica* – endangered EPBC Act
- *Digitaria porrecta* – endangered EPBC Act
- *Eriocaulon carsonii* – endangered EPBC Act
- *Eryngium fontanum* – endangered EPBC Act
- *Eucalyptus raveretiana* – vulnerable EPBC Act
- *Lawrencia buchananensis* – vulnerable EPBC Act
- *Leucopogon cuspidatus* – vulnerable EPBC Act
- *Ozothamnus eriocephalus* – vulnerable EPBC Act

4.2.2 Listed Threatened Fauna

The desktop assessment, summarised in Table 1-1, indicated that a number of EPBC Act listed threatened fauna species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Mine and Rail Study Areas. Of these, three were confirmed present during field surveys:

- Black-throated finch (southern) (*Poephila cincta cincta*)
- Squatter pigeon (southern) (*Geophaps scripta scripta*)
- Koala (*Phascolarctos cinereus*) (combined populations of Queensland, New South Wales and the Australian Capital Territory)

One additional EPBC Act listed threatened fauna species, the greater long-eared bat (*Nyctophilus timoriensis*), was identified in the Project ToR for consideration in this assessment although it did not present in the EPBC search for the area. This species was not identified through the desktop assessment (i.e. predicted to occur or previously recorded in desktop search extent), nor was it confirmed present during field investigations via Anabat detection.

A likelihood of occurrence assessment for EPBC Act listed threatened fauna species was undertaken and details are provided in Volume 2 Section 5 Nature Conservation (Mine) and Volume 3 Section 5 Nature Conservation (Rail) of this EIS and findings are summarised below. Where a difference in likelihood of occurrence outcome exists between the Mine and Rail Study Areas, the higher likelihood outcome has been assumed across the Study Area to provide a conservative understanding of the potential to impact a species as a result of the Project being implemented. For instance, where a species is considered unlikely to occur within the mine footprint but likely to occur within the rail footprint and overall ranking of likely to occur has been applied to the species for assessment.

Table 4-1 Commonwealth Listed Threatened Fauna Species for Mine and Rail Study Areas – Likelihood of Occurrence

Species	EPBC Act / NC Act status	Predicted to occur#		Previously recorded*		Recorded at Study Area		Likelihood of occurrence^	
		Rail	Mine	Rail	Mine	Rail	Mine	Rail	Mine
Reptiles									
ornamental snake *Denisonia maculata*	vulnerable / vulnerable	✓	✓	✓	✓	×	×	Likely	Likely
yakka skink *Egernia rugosa*	vulnerable / vulnerable	✓	×	×	✓	×	×	May occur	Likely
Dunmall's snake *Furina dunmalli*	vulnerable / vulnerable	✓	✓	×	×	×	×	May occur	Unlikely
brigalow scaly-foot *Paradelma orientalis*	vulnerable / vulnerable	✓	×	×	✓	×	×	May occur	Unlikely
northern quoll *Dasyurus hallucatus*	endangered / not listed	✓	×	✓	✓	×	×	May occur	Unlikely
greater bilby *Macrotis lagotis*	vulnerable / endangered	ND	×	ND	✓	ND	×	ND	Unlikely
greater long-eared bat *Nyctophilus timoriensis*	vulnerable / vulnerable	✓	×	×	×	×	×	May occur	Unlikely
retro slider *Lerista allanae*	Endangered / endangered	✓	ND	×	ND	×	ND	Unlikely	Unlikely
Fitzroy River turtle *Rheodytes leukops*	Vulnerable / Vulnerable	✓	ND	×	ND	×	ND	Unlikely	Unlikely

Species	EPBC Act / NC Act status	Predicted to occur#		Previously recorded*		Recorded at Study Area		Likelihood of occurrence^	
		Rail	Mine	Rail	Mine	Rail	Mine	Rail	Mine
Mammals									
koala *Phascolarctos cinereus*	vulnerable/ special least concern	✓	✓	✓	✓	×	✓	Likely to occur at Rail Study Confirmed present at Mine Study Area – a koala was observed in open woodland habitat in the south of the Project Area during Spring 2011	
Birds									
red goshawk *Erythrotriorchis radiatus*	vulnerable / endangered	✓	✓	×	×	×	×	May occur	May occur
squatter pigeon (southern) *Geophaps scripta scripta*	vulnerable / vulnerable	✓	✓	✓	✓	✓	✓	Confirmed present at both Mine and Rail Study Areas– squatter pigeons (southern) were observed on numerous occasions in open woodland habitat across the Study Area during surveys	
star finch (eastern, southern) *Neochmia ruficauda ruficauda*	endangered / endangered	✓	✓	×	×	×	×	Unlikely	Unlikely

Species	EPBC Act / NC Act status	Predicted to occur#		Previously recorded*		Recorded at Study Area		Likelihood of occurrence^	
		Rail	Mine	Rail	Mine	Rail	Mine	Rail	Mine
black-throated finch (southern) *Poephila cincta cincta*	endangered / endangered	✓	✓	✓	✓	×	✓	Likely to occur at Rail Study Area Confirmed present at Mine Study Area – black-throated finches (southern) were observed in the southern and northern parts of the Mine Study Area during the Autumn 2011 survey, opportunistically during site work in August/September 2011, and during the Spring 2011 survey	
paradise parrot *Psephotus pulcherrimus*	extinct / extinct in the Wild	ND	×	ND	✓	ND	×	This species is considered to be extinct and is, therefore, not predicted to occur within the Study Area	
Australian painted snipe *Rostratula australis*	vulnerable/ vulnerable	✓	✓	×	✓	×	×	May occur	May occur

✓ = record supports presence, x = record does not support presence, ND = desktop search did not detect this species

^Likelihood of occurrence assessed against EPBC Act criteria, refer ecological reports for details regarding each assessment and justification of finding

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999*

Predicted to occur within proximity of Study Area based on DSEWPaC Protected Matters Search Tool

* Previously recorded within proximity of Study Area based on desktop searches

4.2.2.1 Listed Threatened Fauna – Confirmed Present

Squatter Pigeon (Southern) (Vulnerable EPBC Act)

The squatter pigeon (southern) is a ground-dwelling pigeon, listed as vulnerable under the EPBC Act. This species' distribution extends from central Queensland as far north as the Burdekin-Lynd divide to the south east of the state (DSEWPaC, 2011c). At present the total population size of the squatter pigeon (southern) is estimated to be around 40,000 breeding birds, with both the extent and the population size considered to be stable (DSEWPaC, 2011c). The squatter pigeon (southern) is locally abundant at some locations in the northern part of its current distribution and is considered to be common in cattle grazed country north of the Tropic of Capricorn (DSEWPaC, 2011c).

Habitat for this subspecies occurs mainly in grassy woodlands and open forests dominated by eucalypts, particularly those near water (DSEWPaC, 2011c). This species has also been recorded less frequently in disturbed habitats such as stockyards, railways, and settlements (DSEWPaC, 2011c). A variety of food items are taken by this ground-dwelling forager, including seeds (grass, legumes, herbs, forbs), insects and ticks (DSEWPaC, 2011c). The breeding season for the squatter pigeon (southern) typically extends from late winter months through to summer, although if conditions are suitable birds are said to be able to breed throughout most of the year (DSEWPaC, 2011c).

Three main threats to the squatter pigeon (southern) exist:

- Loss of habitat due to clearing for agricultural or industrial purposes
- Degradation of habitat by grazing herbivores
- Excessive predation, particularly by foxes and cats (DSEWPaC, 2011c)

Squatter Pigeons (Southern) at the Study Area

Squatter pigeons (southern) were recorded on one occasion during the September survey of the Rail Study Area and on 39 separate occasions across both spring and autumn surveys of the Mine Study Area.

This subspecies was typically encountered on tracks in open woodland habitat featuring a complex grassy understorey. Group size ranged from a single bird to 20 birds. Distribution of the squatter pigeon (southern) is likely to be limited across the Study Area by the availability of drinking water. Full details of squatter pigeon (southern) sightings are presented in Volume 2 Section 5 Nature Conservation (Mine) and Volume 3 Section 5 Nature Conservation (Rail) of this EIS.

Squatter pigeons (southern) observed at the Study Area are shown in Plate 4-1, while examples of habitat from which the subspecies were recorded are presented in Plate 4-2.

Plate 4-1 Squatter Pigeons (Southern) recorded from Central Part of Mine Study Area (May 2011)

Plate 4-2 Habitat from which Squatter Pigeon (Southern) was recorded

open eucalypt woodland along ephemeral creek (April 2011)

open ironbark woodland with native grass understorey (April 2011)

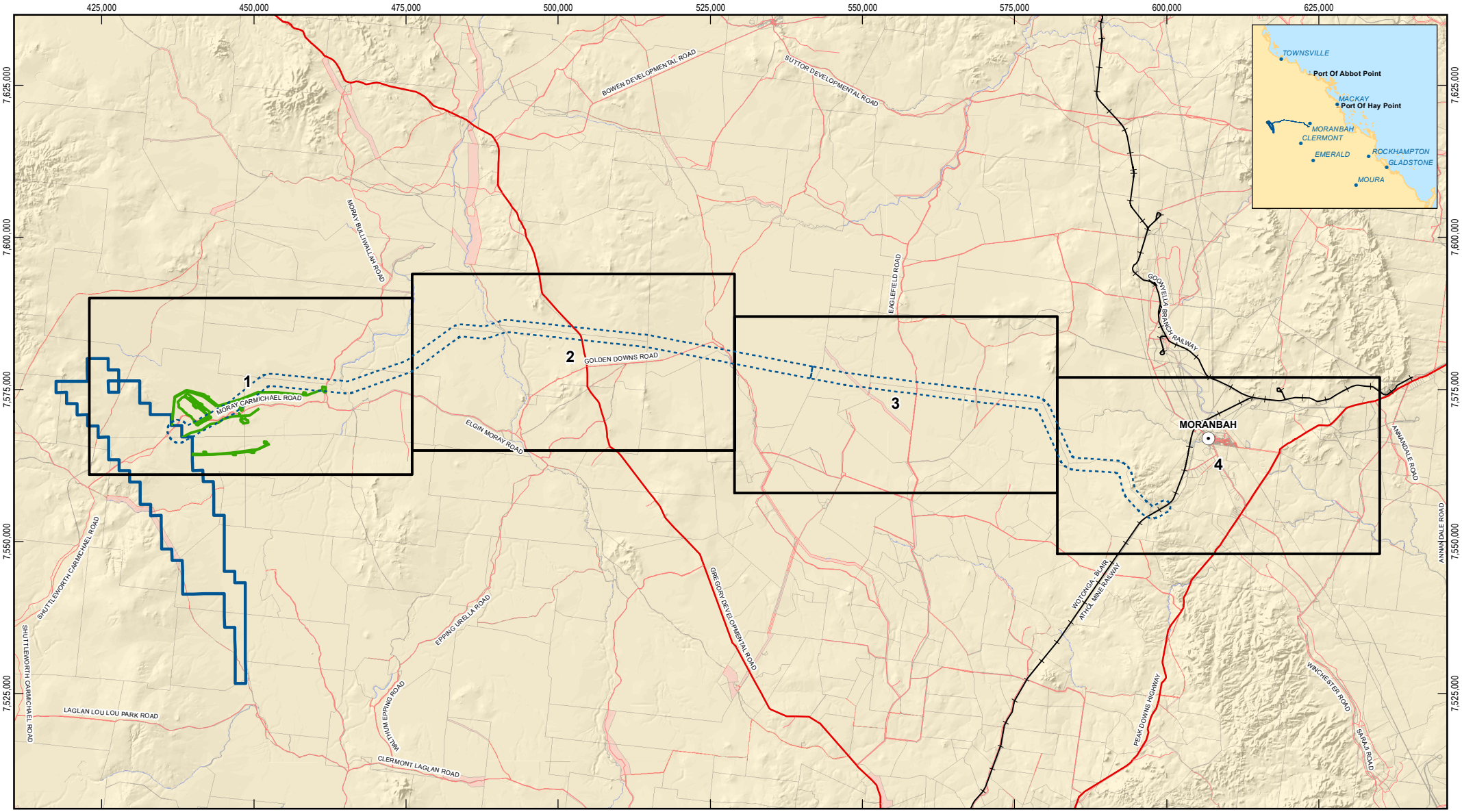
Field and desktop analysis provides an indication of habitat that may be utilised by the squatter pigeon (southern) within the Rail and Mine Study Areas. These habitats have been mapped in Figure 4-1. To map potential habitat for the squatter pigeon (southern) beyond the Study Area, (DERM Version 6.0b) REs characterised by open woodland and forest vegetation were identified and mapped. Potential squatter pigeon (southern) habitat proximal to the Rail and Mine Study Areas are presented Figure 4-2 and Figure 4-3 respectively.

The presence of potentially suitable habitat extends beyond the Project and suggests that the squatter pigeon (southern) is likely to be present in much of the wider landscape, particularly to the west where remnant vegetation dominates the landscape. However, much of the landscape surrounding the Study Area is dominated by non-remnant vegetation with fragmented remnant vegetation often restricted to watercourses. Habitat utilisation and abundance is likely to be influenced by availability of water and prevalence of predators (especially cats and foxes). Predator prevalence may be related to the management regime of individual properties in the landscape surrounding the Study Area.

This species appeared to be common in suitable habitat within the Study Areas, and is likely to be present where suitable habitat occurs in the landscape beyond the Study Areas. Across its range the subspecies is thought to occur as a continuous, inter-breeding population, with no single populations identified as being important for its long-term survival or recovery (DSEWPaC, 2011v).

With respect to the Significant Impact Guidelines (DEWHA, 2009b), it is not considered that squatter pigeons (southern) at the Study Area are part of an 'important population' (of an EPBC Act-listed vulnerable species). That is, squatter pigeons (southern) at the Study Area are not considered to be a part *of a population that is necessary for a species' long-term survival and recovery, including populations identified as such in recovery plans, and/or that are:*

- *Key source populations either for breeding or dispersal*
- *Populations that are necessary for maintaining genetic diversity*
- *Populations that are near the limit of the species range (DEWHA, 2009b)*



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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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Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat Within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
Date 07-09-2012

Figure 4-1 Series Index

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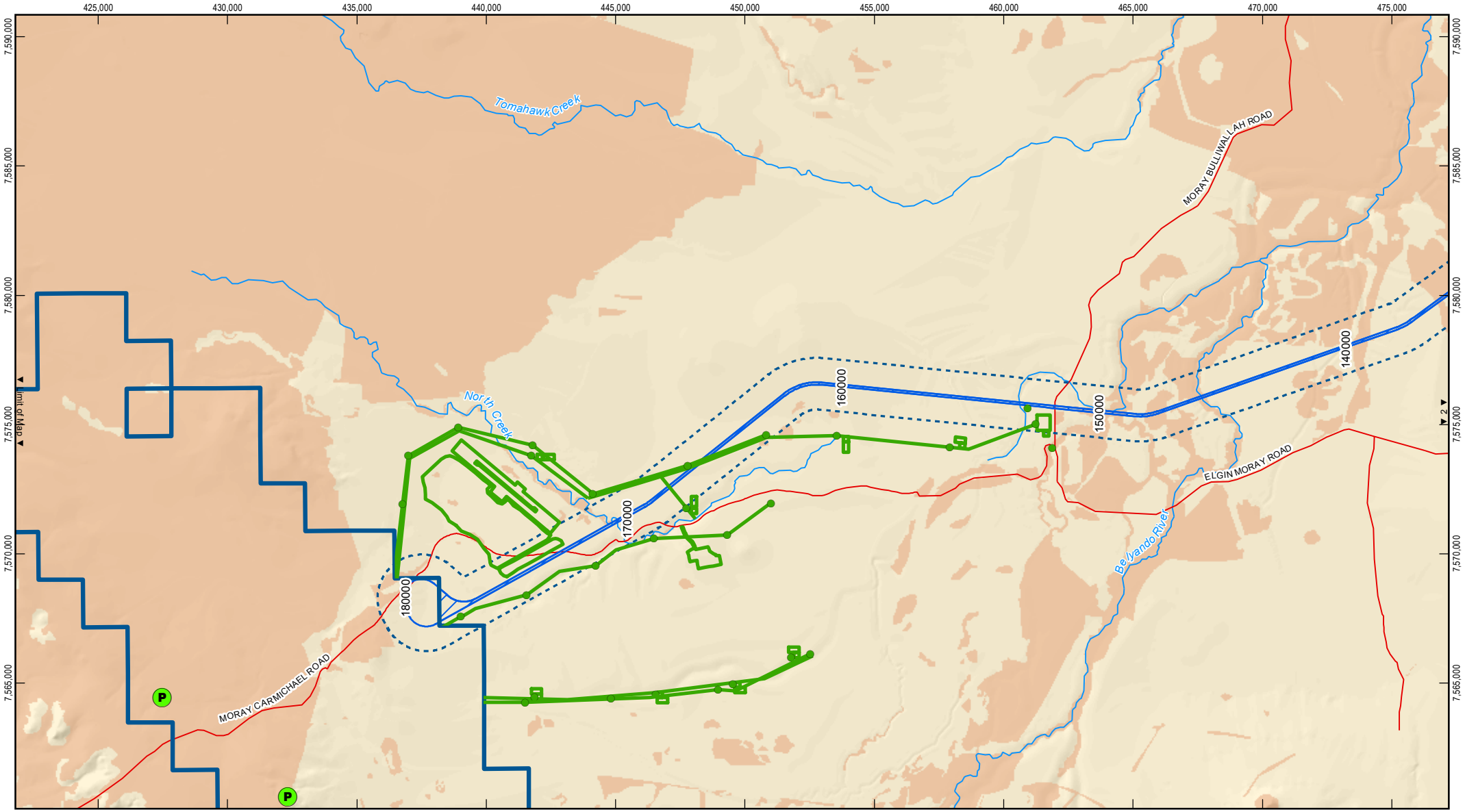
Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Corridors Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW,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



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0 1 2 3 4 5

Kilometres

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

N

LEGEND

- Squatter Pigeon Sighting - Spring 2011
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
Date 07-09-2012

Figure 4-1
Sheet 1 of 4

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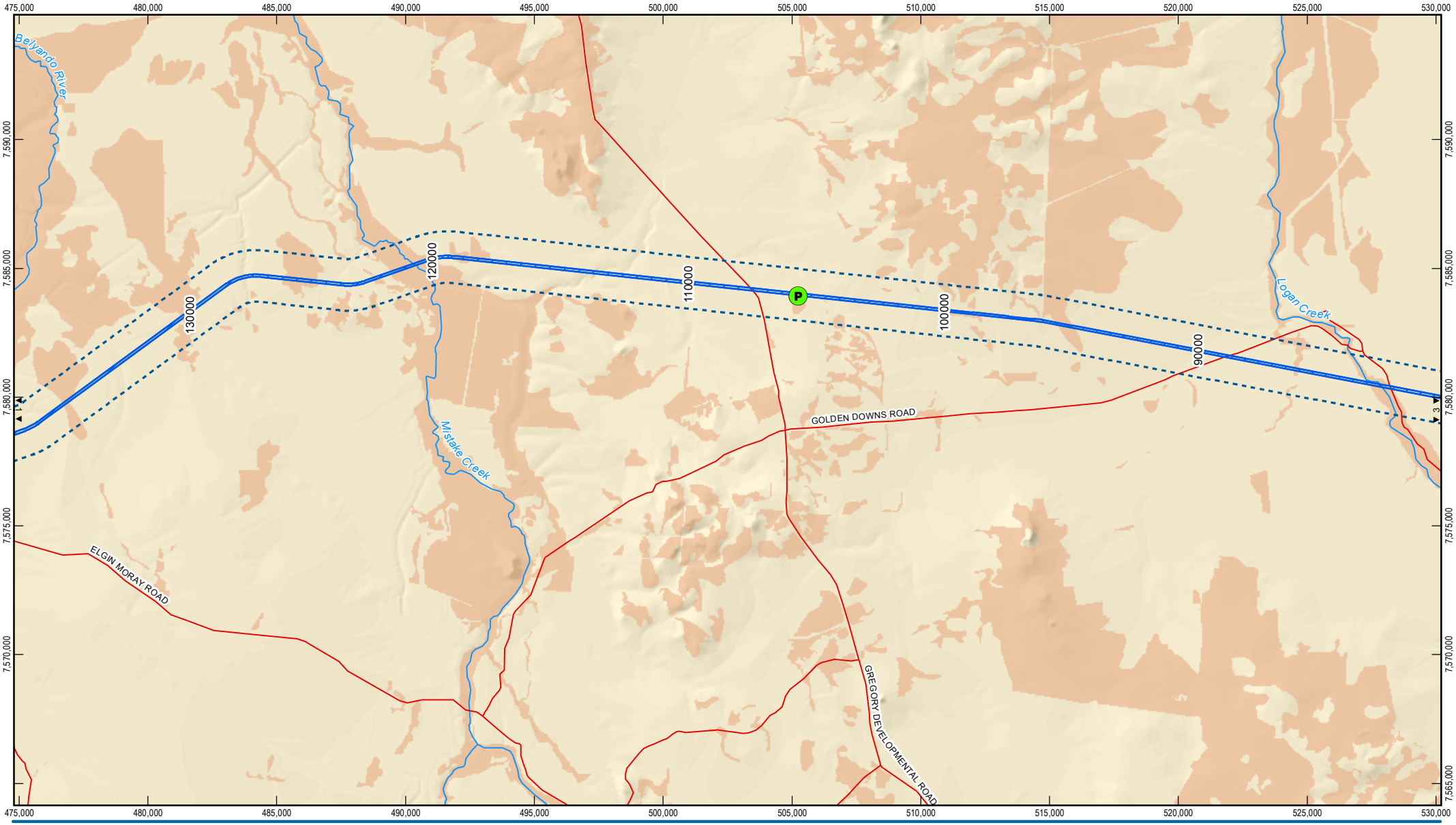
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Potential Squatter Pigeon Habitat, Sightings (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

- Squatter Pigeon Sighting - Spring 2011
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Study Area
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- Mine (Offsite)
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Rail Study Area and Surrounding Landscape

Job Number	41-25215
Revision	B
Date	07-09-2012

Figure 4-1
Sheet 2 of 4

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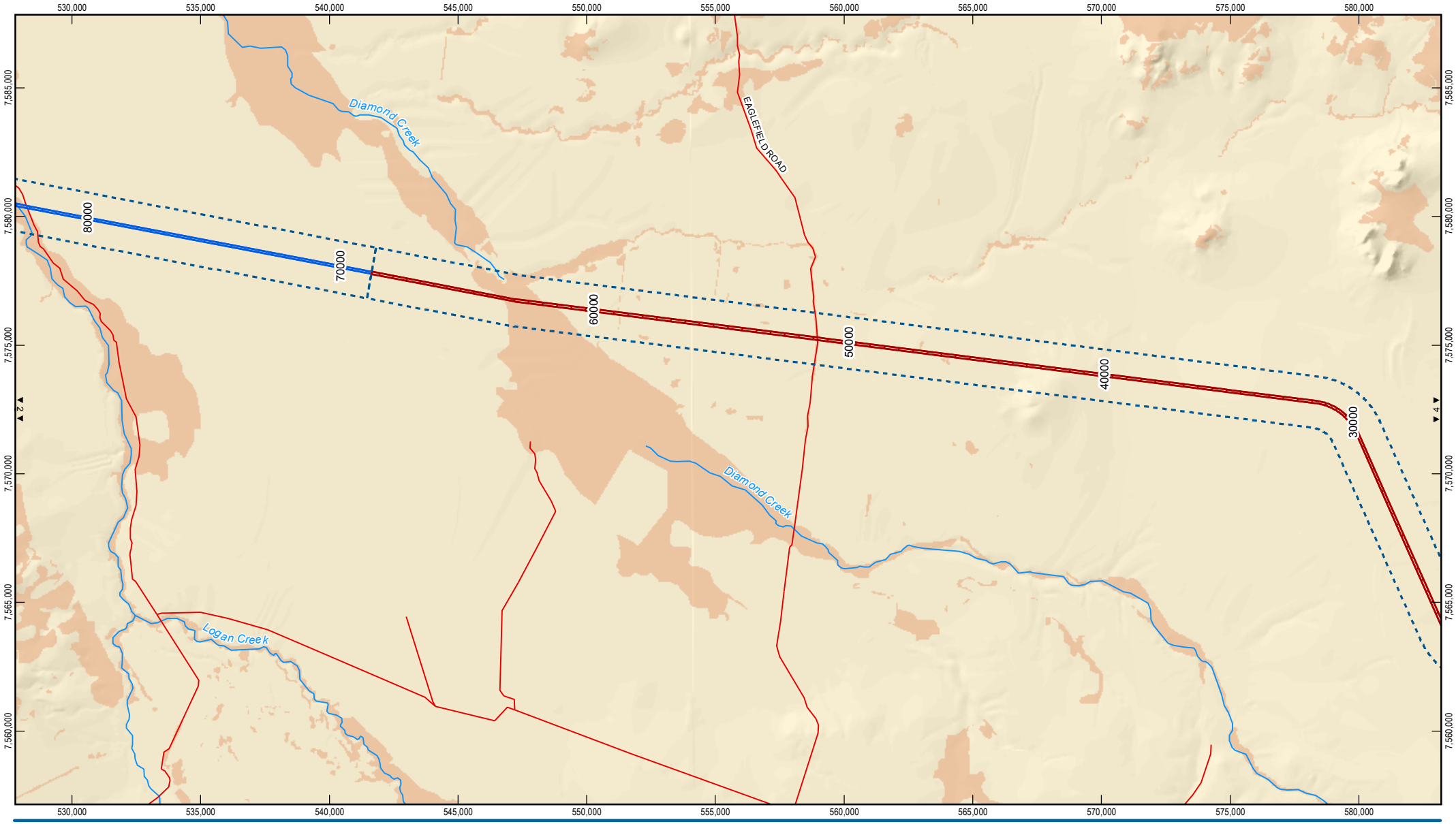
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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



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0 1 2 3 4 5

Kilometres

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

N

LEGEND

- Squatter Pigeon Sighting - Spring 2011
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
Date 07-09-2012

Figure 4-1
Sheet 3 of 4

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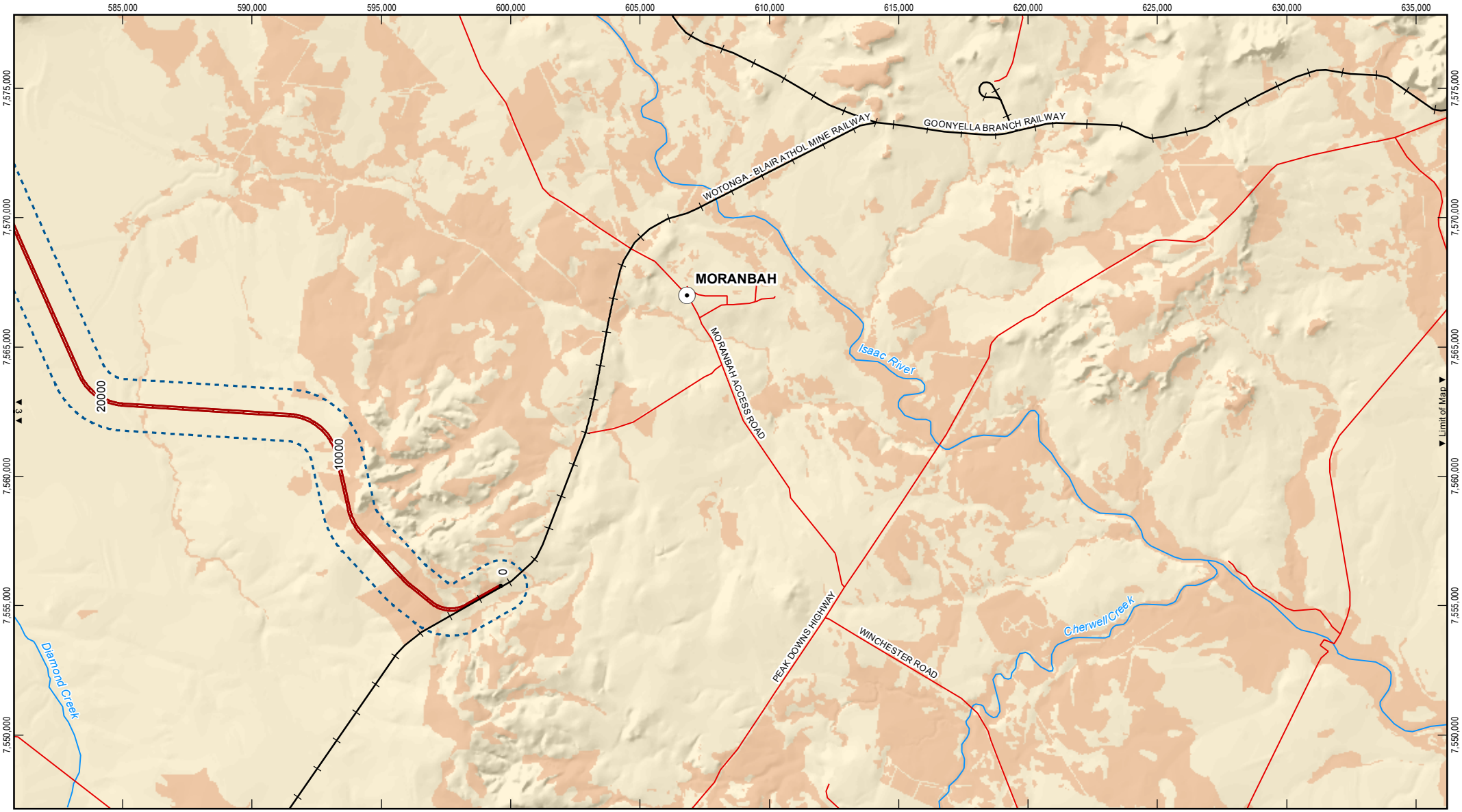
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Potential Squatter Pigeon Habitat, Sightings (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created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

- Squatter Pigeon Sighting - Spring 2011
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Carmichael Coal Mine and Rail Project

Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
Date 07-09-2012

Figure 4-1
Sheet 4 of 4

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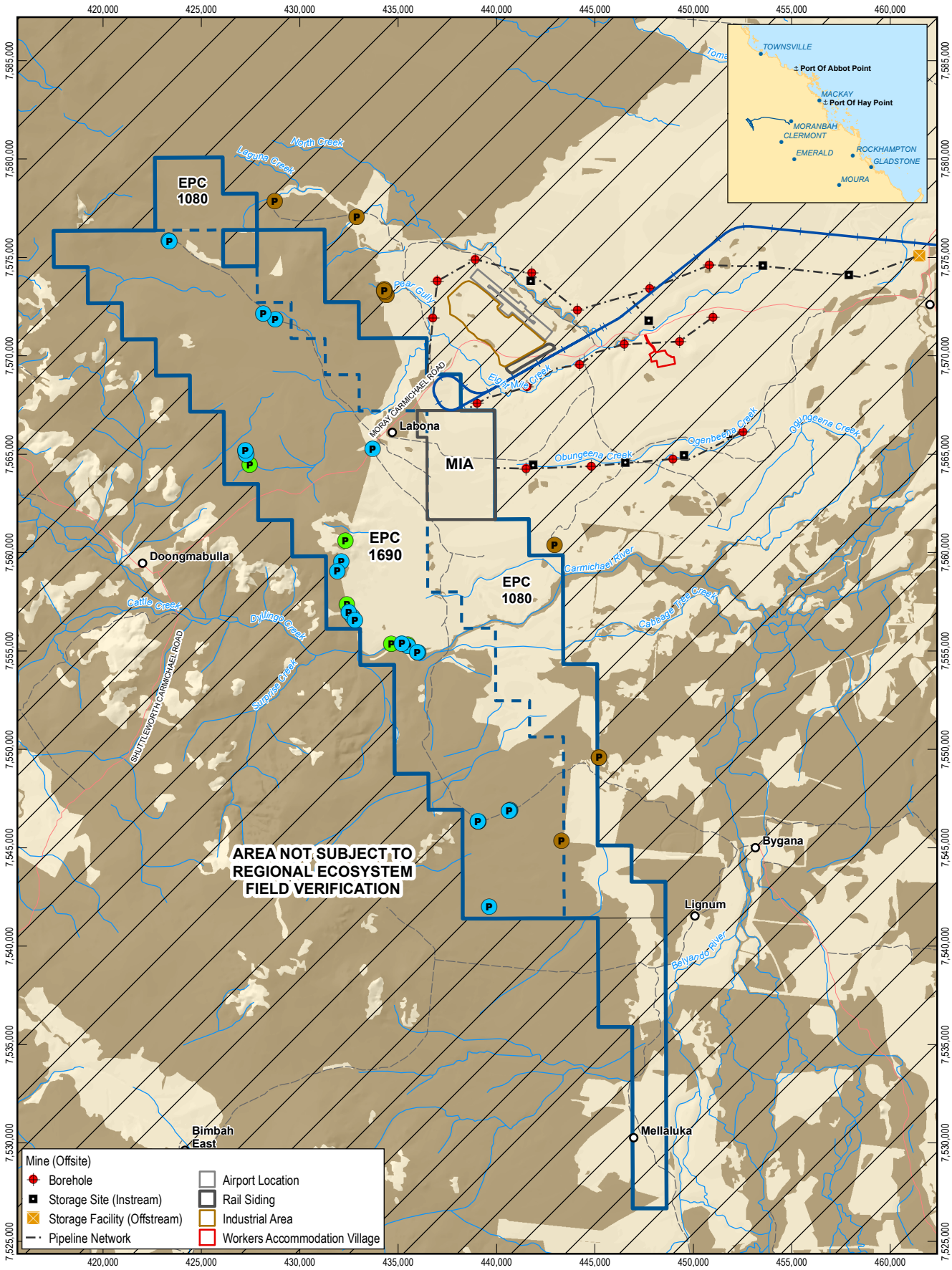
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Potential Squatter Pigeon Habitat, Sightings (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created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



LEGEND

- Squatter pigeon sightings - Spring 2010
- Squatter pigeon sightings - Autumn 2011
- Squatter pigeon sightings - Spring 2011
- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Potential Squatter Pigeon (Southern) Habitat - Based on Field Verified Regional Ecosystems within the Mine Site and DERM Certified Regional Ecosystems Version 6.0b outside the Mine Site

1:275,000 (at A4)
0 1 2 3 4 5
Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

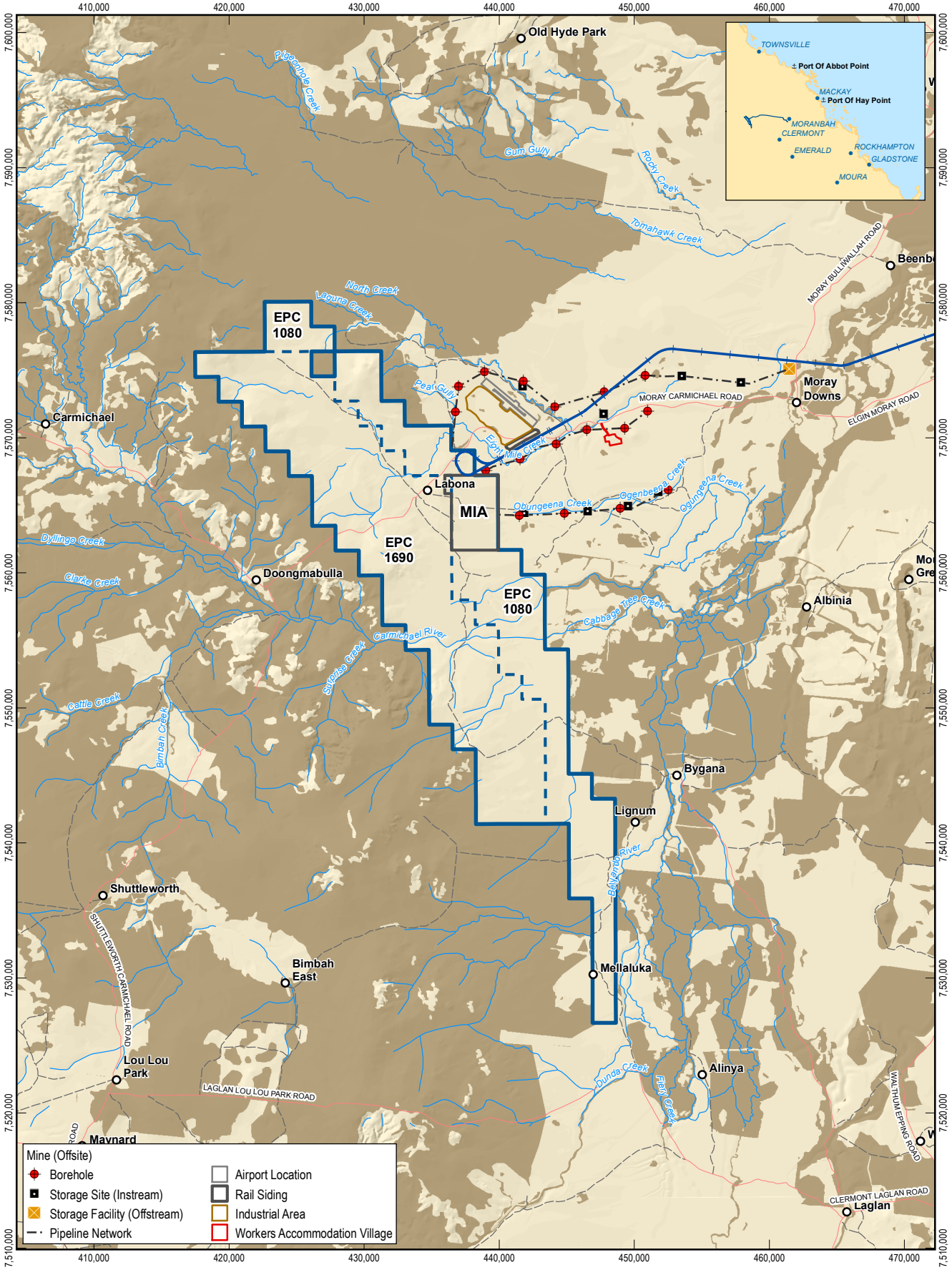
Job Number 41-25215
Revision B
Date 07-09-2012

Potential Squatter Pigeon (southern) Habitat at the Mine Study Area

Figure 4-2

G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_493_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

Data Source: DME: EPC 1690 (2010), EPC 1080 (2011); DERM: Regional Ecosystems v6.0 (2010); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Squatter Pigeon Sightings, Potential Habitat (2011). Created by: BW, CA



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

1:400,000 (at A4)
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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

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision B
Date 07-09-2012

Potential Squatter Pigeon (southern) Habitat beyond the Mine Study Area

Figure 4-3

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: Regional Ecosystems v6.0 (2010); DME: EPC 1690 (2010), EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Potential Habitat (2012). Created by: BW, CA

Black-throated Finch (Southern)

The black-throated finch (southern) is listed as endangered under the EPBC Act (and endangered under the NC Act). This small grass-finch has experienced a large decline in range in recent decades (SEWPAC, 2011k). 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 (SEWPAC, 2011k). 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 (SEWPAC, 2011k).

The black-throated finch (southern) is a predominantly sedentary (Black-throated Finch Recovery Team, 2007; DEWHA, 2009a), gregarious bird that typically forages in groups of up to 30 individuals (DEWHA, 2009a). During the breeding season (in the Townsville region breeding coincides with wet season (February to May)), only small daily movements between forage sites are made (DEWHA, 2009a). Movements of up to 3 km a day may occur during periods where forage resources are scarce (DEWHA, 2009a). Larger movements are thought to be related to periods of drought and/or when water availability is reduced (DEWHA, 2009a). It often forms loose breeding colonies, where a number of nests are made in a single tree, or in neighbouring trees (DEWHA, 2009a). The average clutch size is five, with chicks reaching sexual maturity at six months (DEWHA, 2009a).

The subspecies inhabits grassy open woodland and open forest habitats characterised by trees belonging to the genera Eucalyptus, Corymbia, Acacia and Melaleuca (SEWPAC, 2011k). Generally it occurs in habitats near watercourses or water bodies - almost all recent records of the subspecies south of the tropics have been in riparian areas (SEWPAC, 2011k). 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)
- Trees that provide suitable nesting habitat (DEWHA, 2009a; SEWPAC, 2011k)

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). REs from which the subspecies has been recorded in north Queensland since 1994 (as presented in the National Recovery Plan for the Black-throated Finch Southern Subspecies (Black-throated Finch Recovery Team, 2007)) that are present at the Project Area include:

- RE 10.3.6 *Eucalyptus brownii* open woodland on alluvial plains
- RE 10.3.13 *Melaleuca fluviatilis* and/or *Eucalyptus camaldulensis* woodland along watercourses
- RE 10.3.28 *Eucalyptus melanophloia* or *E. crebra* open woodland on sandy alluvial fans
- RE 10.5.1 *Eucalyptus similis* and/or *Corymbia brachycarpa* and/or *Corymbia setosa* low open woodland to open woodland on sand plains
- RE 10.5.5 *Eucalyptus melanophloia* open woodland on sand plains
- RE 11.3.25 *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines
- RE 11.3.27 Freshwater wetlands

Black-throated Finch (Southern) at the Study Area

- No black-throated finches (southern) were detected during any surveys of the Rail Study Area but are considered likely to occur within that environment given suitable habitat prevalence
- No black-throated finches (southern) were detected during the Spring 2010 survey of the Mine Study Area
- Black-throated finches (southern) were recorded on 34 separate occasions during subsequent Autumn and Spring 2011 surveys of the Mine Study Area
- Black-throated finches (southern) were recorded on nine separate occasions at and near the Project Area during the targeted black-throated finch survey carried out in May 2012

Plate 4-3 shows black-throated finches (southern) observed at the Study Area.

Plate 4-3 Black-throated Finches (southern) during Field Surveys in Study Area

Stock troughs near Bygana West Nature Refuge (April 2011)

Farm infrastructure near southern boundary of Bygana West Nature Refuge (April 2011)

Farm dam at north of Study Area (May 2011)

North-west of Study Area (May 2011)

Figure 4-4 displays the locations of black-throated finch (southern) sightings from the Study Area. Habitat at these locations was typically characterised by open eucalypt (ironbark and/or box) woodland with a native grass understorey and locally-available surface water, although several

sightings of finches drinking from farm dams surrounded by non-remnant vegetation were made during Spring 2011.

Examples of locations from which sightings at the Study Area were made are presented in Plate 4-4, Plate 4-5 and Plate 4-6. These include stock watering troughs and dams at which as well as natural habitats.

Records obtained from the Study Area are towards the south western extent of the subspecies' current known (i.e. post-1998) distribution.

Plate 4-4 Water Sources at Southern part of Study Area (April 2011)

Plate 4-5 Open Eucalypt Woodland with Native Grass understorey at Southern part of Study Area (April 2011)

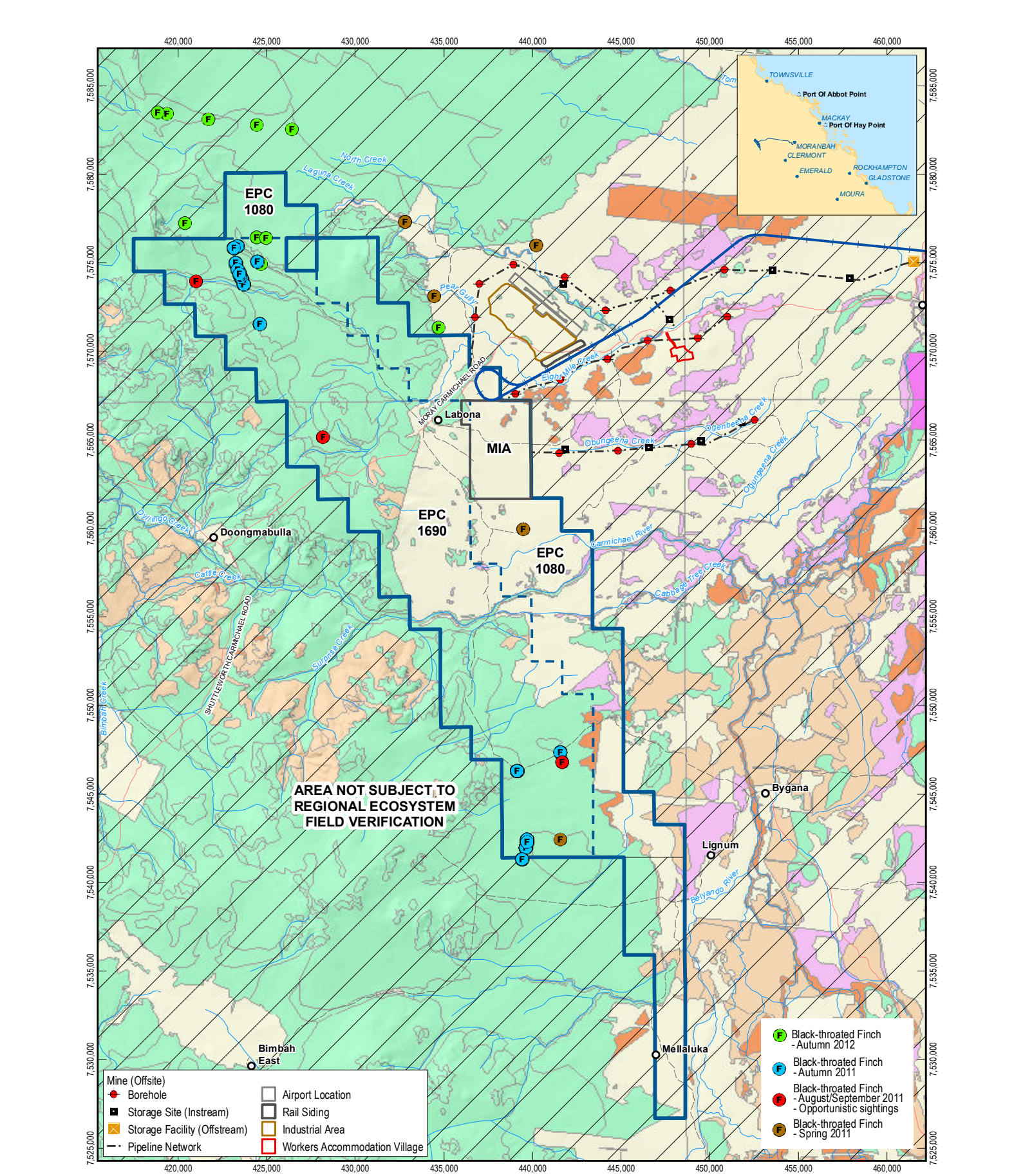
Plate 4-6 Open Eucalypt Woodland with Native Grass understorey and Farm Dam at Northern part of Study Area (May 2011)

Full details of black-throated finch (southern) sightings are presented in Volume 4 Appendix N1 Mine Terrestrial Ecology Report and Appendix N3 Black-throated Finch Report of the EIS. In summary:

- Group size ranged from a single bird to approximately 40 birds
- Sightings were made between (approximately) 8:30 am and 6:30 pm
- Finches were typically observed drinking at dams/stock troughs, or flushed from tracks by slow moving vehicles whilst foraging on the ground
- Weather conditions when sightings were made were typically fine, warm and clear
- Black-throated finches (southern) were occasionally observed in the presence of other finch species – namely double-barred finch (*Taeniopygia bichenovii*) and plum-headed finch (*Neochmia modesta*)

Figure 4-5 and Figure 4-6 provides an indication of habitat that may be utilised by the subspecies at the Study Area. Those REs from which the subspecies has been recorded in north Queensland since 1994 (Black-throated Finch Recovery Team, 2007), and that may represent potentially suitable habitat for the subspecies at the Study Area, were mapped (using the field verified RE mapping – mixed polygons containing a suitable RE were included in the mapping). 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 water bodies (i.e. gilgais, Carmichael River)) it is considered likely that the black-throated finch (southern) will be present.

While black-throated finch (southern) sightings were generally confined to the northern and southern parts of the Study Area, it is considered possible that the subspecies occurs over a larger extent of the Study Area. This is based on the similarity of habitat to that in which the subspecies was recorded being present through much of the Study Area, and the fact that this habitat retains connectivity to that in which the subspecies was recorded.



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area

Regional Ecosystems v6.1

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

1:275,000 (at A4)
0 1 2 3 4 5
Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision C
Date 16-11-2012

Location of Black-throated Finch (southern) Sightings - Project Area

Figure 4-4

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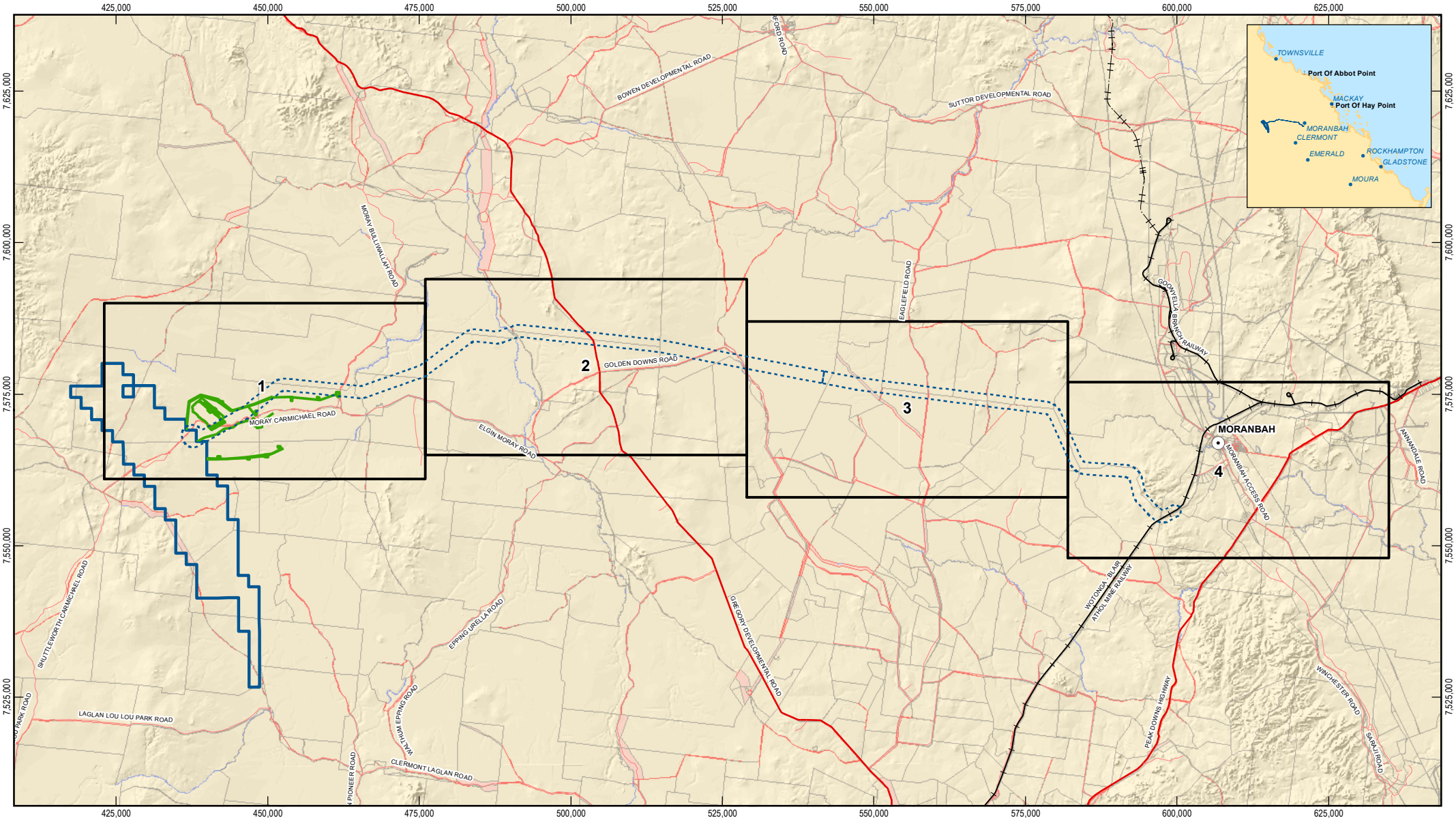
Data Source: DME: EPC 1690 (2010), EPC 1080 (2011); DERM: Regional Ecosystems v6.1 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Black Throated Finch Sightings (2011-2012). Created by: BW, 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
- 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 Black-throated Finch (southern) Habitat at the Rail Study Area and the Surrounding Landscape

Job Number	41-25215
Revision	B
Date	07-09-2012

Figure 4-5
Series Index

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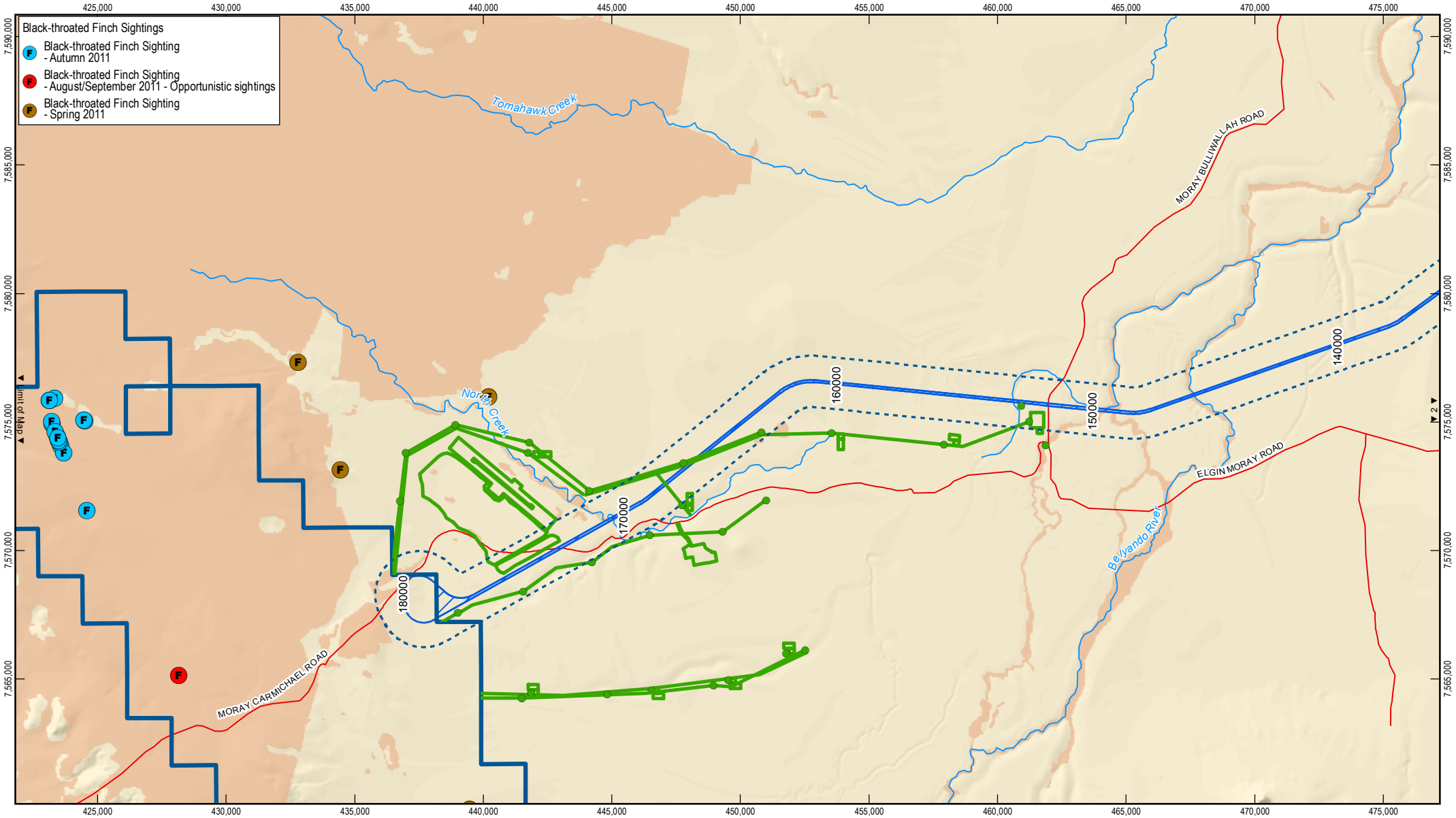
Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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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
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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

Job Number 41-25215
Revision B
Date 07-09-2012

Figure 4-5
Sheet 1 of 4

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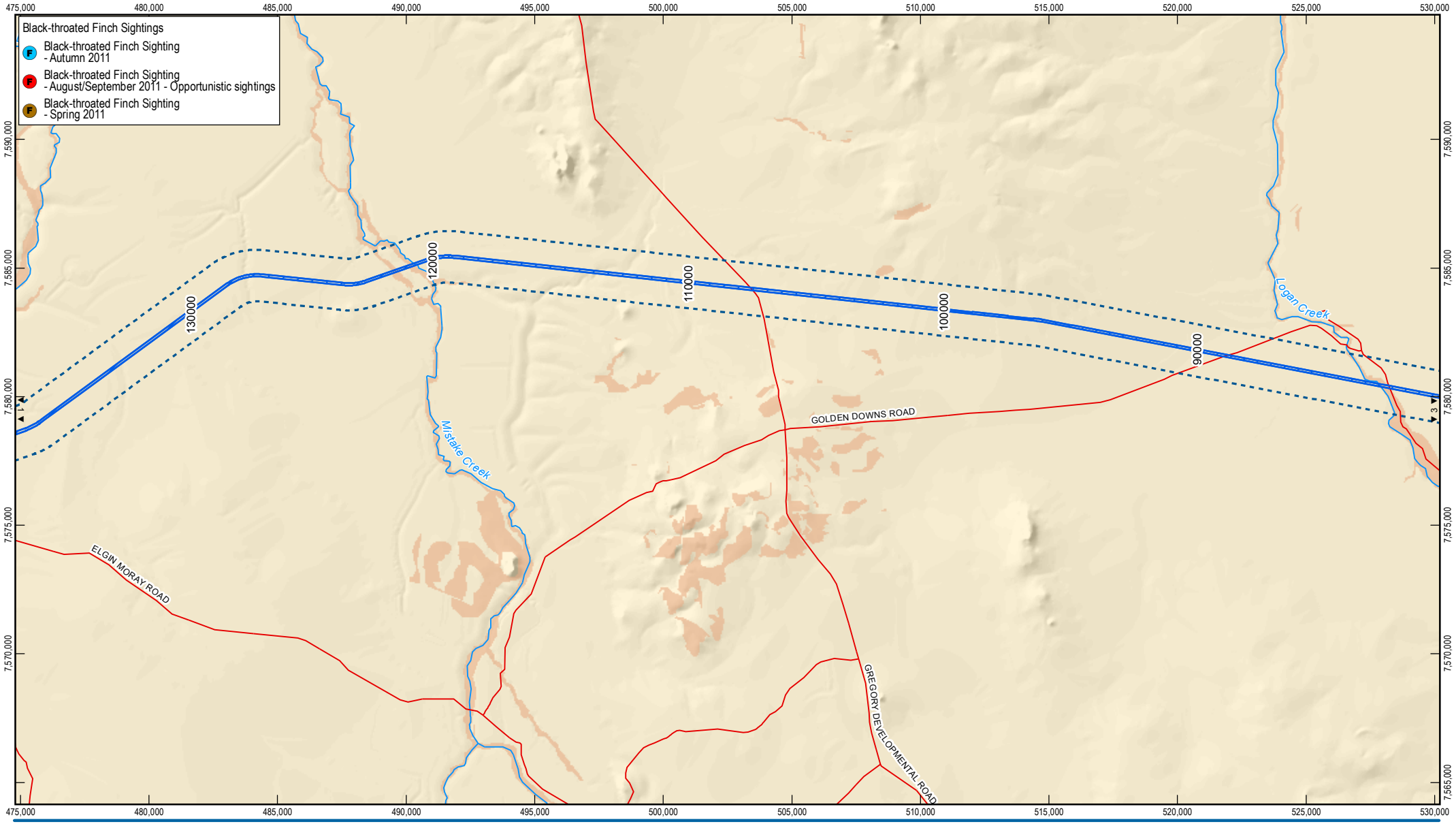

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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND
Town
Road
Other Railway
Watercourse
Mine (Onsite)
Mine (Offsite)
Mine (Offsite)
Rail (West)
Rail (East)
Study Area
Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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

Job Number 41-25215
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Date 07-09-2012

Figure 4-5
Sheet 2 of 4

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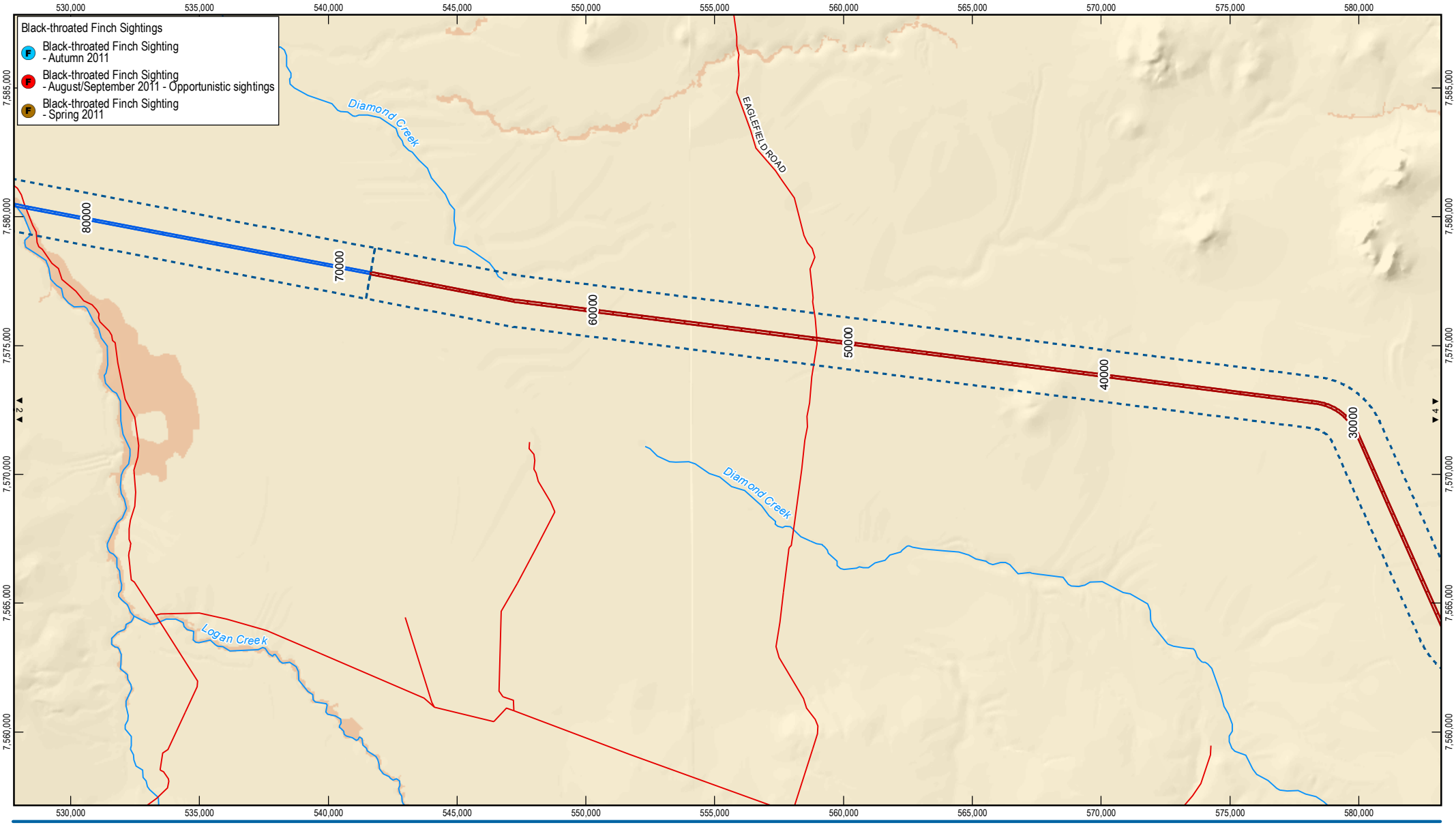
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Black-throated Finch Habitat, Sightings (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). 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
Road
Other Railway
Watercourse
Mine (Onsite)
Mine (Offsite)
Mine (Offsite)
Rail (West)
Rail (East)
Study Area
Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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

Job Number 41-25215
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Figure 4-5
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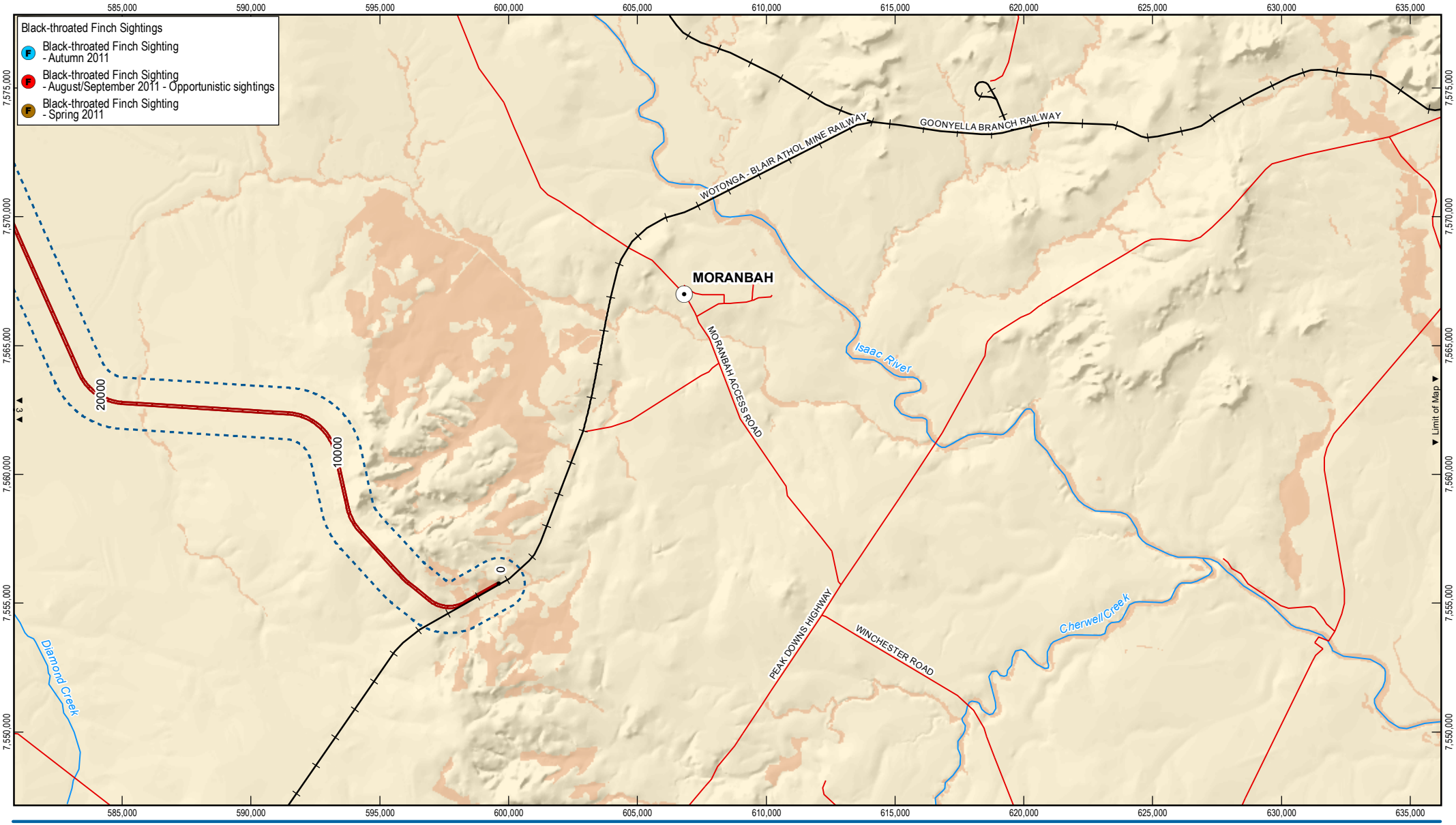

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0 1 2 3 4 5

Kilometres

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

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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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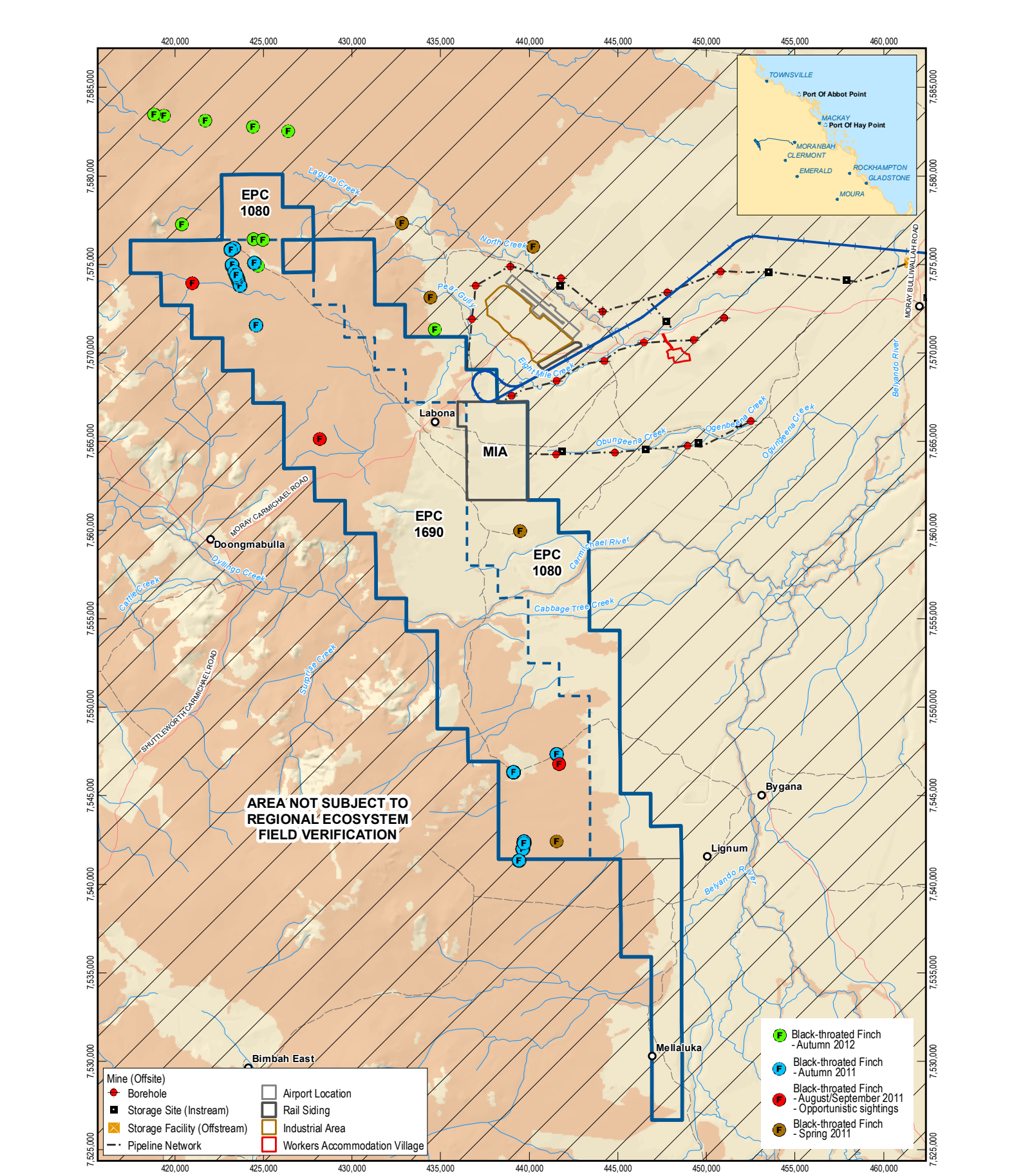

LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Potential Black-Throated Finch (Southern) Habitat - Based on Field Verified Regional Ecosystems within the Mine Site and DERM Certified Regional Ecosystems Version 6.0b outside the Mine Site

1:275,000 (at A4)
0 1 2 3 4 5
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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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Black-throated Finch (southern) Habitat - Project Area

Figure 4-6

Job Number	41-25215
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Date	16-11-2012

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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

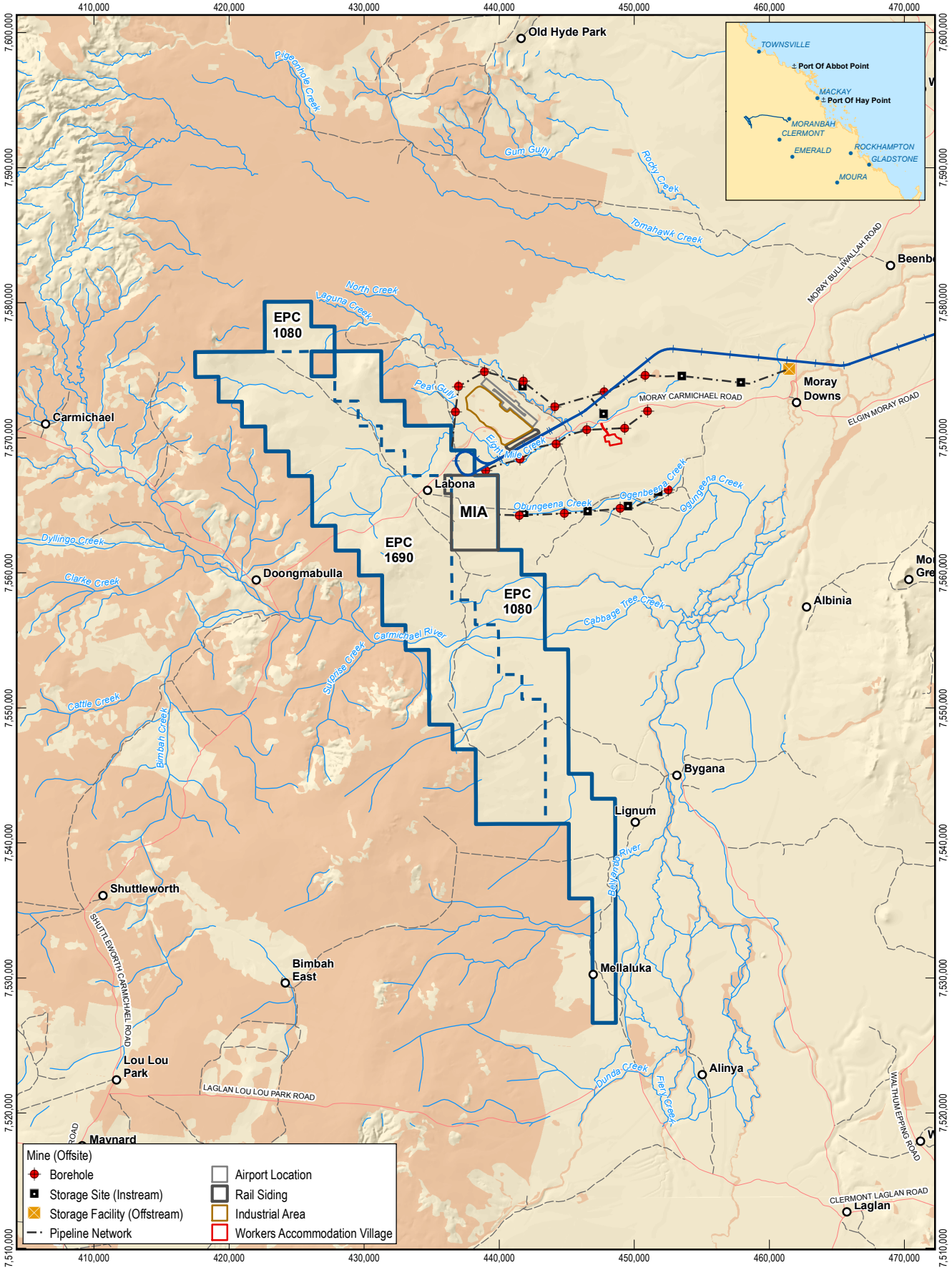
Data Source: DME: EPC 1690 (2010), EPC 1080 (2011); DERM: Regional Ecosystems v6.0 (2010); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Black Throated Finch Sightings (2011 - 2012), Potential Habitat (2011). Created by: BW, CA

No nests or evidence of breeding was detected at the Study Area. However, in consideration of the largely sedentary nature of the subspecies, and the availability of suitable habitat resources, it is considered likely that the black-throated finch (southern) is breeding at the Study Area.

Those REs from which the subspecies has been recorded in north Queensland since 1994 (Black-throated Finch Recovery Team, 2007) that may represent potentially suitable habitat for the subspecies beyond the Study Area, were mapped using DNRM certified REs – mixed polygons containing suitable REs were included in the mapping) – see Figure 4-7 and Figure 4-8. These maps indicate that much of the remnant vegetation to the north, west and south of the Mine Study Area may provide potentially suitable habitat for the black-throated finch (southern), based on the underlying RE mapping. Little potentially suitable habitat occurs to the east of the Mine Study Area.

Habitat utilisation beyond the Study Area will be largely based upon the degree of connectivity/fragmentation of potential habitat patches, and the presence of the three critical habitat resources required by the subspecies (mosaic of native grasses, nesting trees and access to water). The subspecies has been recorded (post-1998) by the Black-throated Finch Recovery Team within approximately 10-20 km of the Study Area (at Doongmabulla Station) (DSEWPaC, 2011d).

It should be noted that a putative record of the subspecies from Bimblebox Nature Refuge was described for the Galilee Coal (Northern Export Facility) Project EIS, located approximately 100 km south of the Study Area, in 2011 (Waratah Coal Pty Ltd, 2011). Although the record has not been confirmed in writing by Birds Australia, DSEWPaC have indicated to the proponent that they have a high degree of confidence in the validity of the record (Waratah Coal Pty Ltd, 2011). The subspecies was not detected during surveys for the rail component of the Galilee Coal (Northern Export Facility) Project, or for the proposed mine site and rail alignment for the Alpha Coal Project (Hancock Prospecting Pty Ltd, 2010)



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

1:400,000 (at A4)
0 2.5 5 7.5 10
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

Job Number 41-25215
Revision B
Date 07-09-2012

Potential Black-throated Finch (southern) Habitat beyond the Mine Study Area

Figure 4-7

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Data Source: DERM: Regional Ecosystems v6.0 (2010); DME: EPC 1690 (2010), EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Potential Habitat (2012). Created by: BW, CA

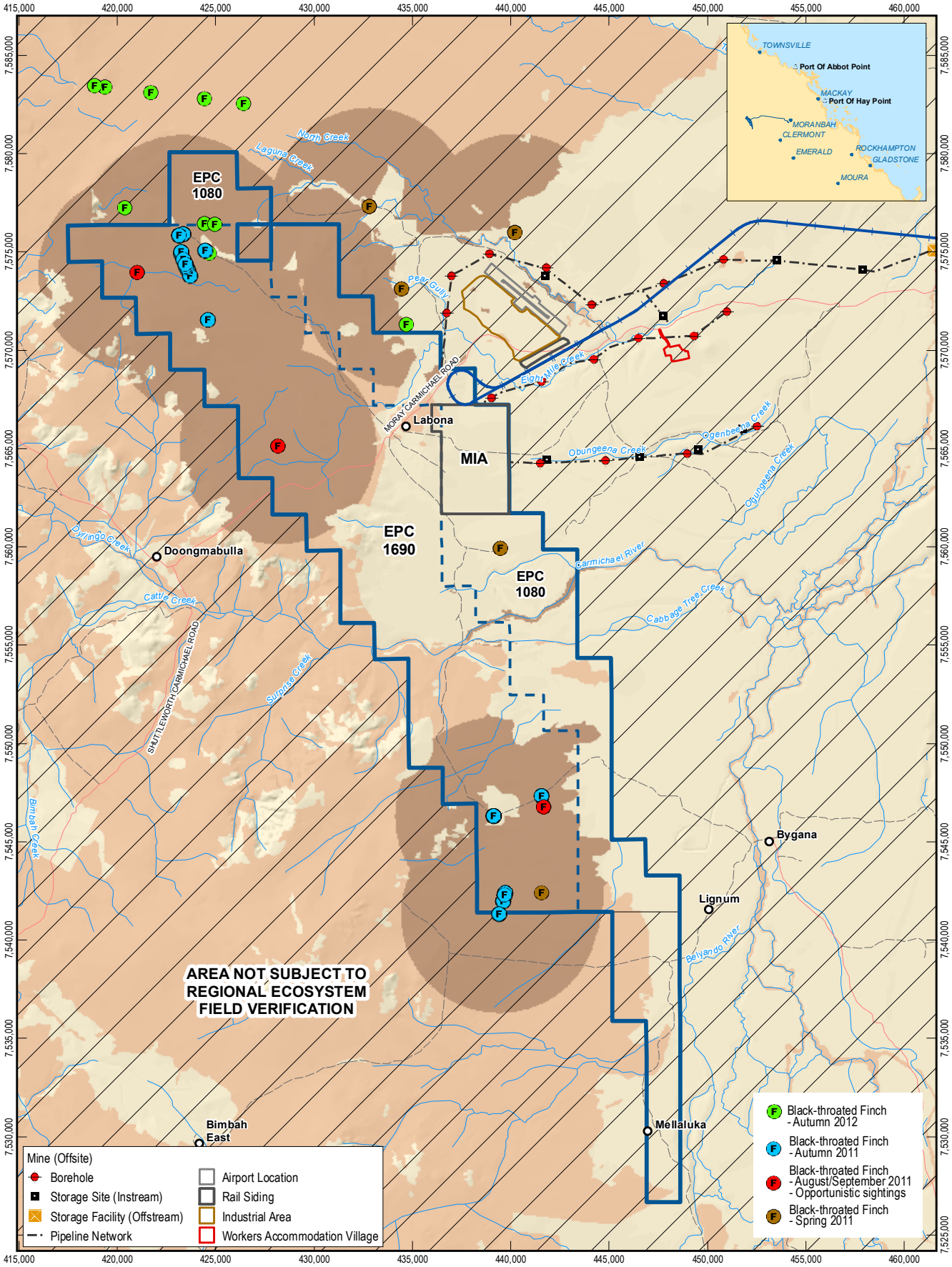
Existing populations of the black-throated finch (southern) are thought to be highly fragmented (DSEWPaC, 2011d). As such DEWHA (2009) define any habitat within 5 km of a post-1995 sighting as an 'important area' for the subspecies. The guidelines also state "that the presence of the black-throated finch (southern) at a site indicates that existing management regime is likely to be compatible with maintaining suitable habitat for the subspecies".

Figure 4-8 shows black-throated finch (southern) important areas at and near the Study Area. These important areas are located within the Mine Study Area, and no sightings were recorded within the Rail Study Area. These important areas were identified by applying a 5 km buffer to sighting records from the Study Area, and selecting potential habitat, based on those (field verified) REs from which the subspecies has been recorded in north Queensland since 1994 (as presented by the Black-throated Finch Recovery Team, 2007) within the 5 km buffer. The approximate extent of important areas for the subspecies in the Study Area is 21,246 ha.

Based on the (currently available) information acquired from desktop and field studies, and in consideration of the Significant Impact Guidelines, (DEWHA, 2009), it is considered that the mine Study Area supports a 'population' of the black-throated finch (southern), noting that a 'population' of an (EPBC Act) endangered species is defined in the Significant Impact Guidelines as 'the occurrence of the species in a particular area', where occurrence relates to:

- *A geographically distinct regional population, or collection of local populations, or*
- *A population, or collection of local populations, that occurs within a particular bioregion* (DEWHA, 2009c).

The Study Area is within approximately 50 km of a cluster of 'important areas' (i.e. habitat within five km of a post-1995 sighting) for the subspecies exhibited in the *Whole of range important areas* map presented in the black-throated finch (southern) (DEWHA, 2009). As such it is possible that the population at the Study Area is part of a collection of local populations.



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Potential Black-Throated Finch (Southern) Habitat - Based on Field Verified Regional Ecosystems within the Mine Site and DERM Certified Regional Ecosystems Version 6.0b outside the Mine Site
- Black-Throated Finch Important Area -Based on SEWPAC Significant Impact Guidelines

1:275,000 (at A4)
0 1 2 3 4 5
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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Black-throated Finch (southern) Important Areas

Job Number 41-25215
Revision C
Date 16-11-2012

Figure 4-8

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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: DME: EPC 1690 (2010), EPC 1080 (2011); DERM: Regional Ecosystems v6.0 (2010); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Black Throated Finch Sightings, Potential Habitat, Important Areas (2011). Created by: BW, CA

Koala (Combined populations of Queensland, New South Wales and Australian Capital Territory)

The koala (combined populations of Queensland, New South Wales and Australian Capital Territory) (vulnerable EPBC Act, special least concern NC Act) is a tree dwelling marsupial that has a widespread distribution in both coastal and inland environments (SEWPAC, 2012). 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 (SEWPAC 2012c). Koalas occupy a range of habitats including temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated eucalypt species (SEWPAC 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 (SEWPAC 2012c). Over a 20 year period from 1990, estimated koala populations within the Brigalow Belt bioregion have suffered a decline of 30 to 40 per cent.

The koala's diet is typically restricted to foliage of *Eucalyptus spp*. or related genera. However, the diet of individual koalas is usually limited to obtaining most of their nutrition from one or a few tree species present at a site. Species-level preferences may also vary between regions or seasons (SEWPAC, 2012). Female koalas can potentially produce up to one offspring a year, giving birth between October and May, however research indicates that breeding averages are more likely to range between 0.3-0.8/year (SEWPAC, 2012).

Generally, the home ranges of individual koalas can extensively overlap, however, these can be quite variable depending on the quality of the habitat and the location. Research undertaken at Blair Athol in central Queensland, approximately 140 km south-east of the Project Area, estimated home ranges at 135 ha for an individual male and 101 ha for females.

The koala (combined populations of Queensland, New South Wales and Australian Capital Territory) is listed as vulnerable under the EPBC Act. Six main threats identified by SEWPAC (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 evidence of the koala was detected during the Spring 2010 and Autumn 2011 surveys. One koala was recorded on the Mine Study Area on one occasion during spotlighting within the south-eastern part of the Project Area (EPC 1080 Study Area) during the Spring 2011 survey. This individual was recorded within an open eucalypt woodland environment representing the '*Ironbark-box grassy woodlands and open woodlands on grey sand plains'* habitat type within the Project Area.

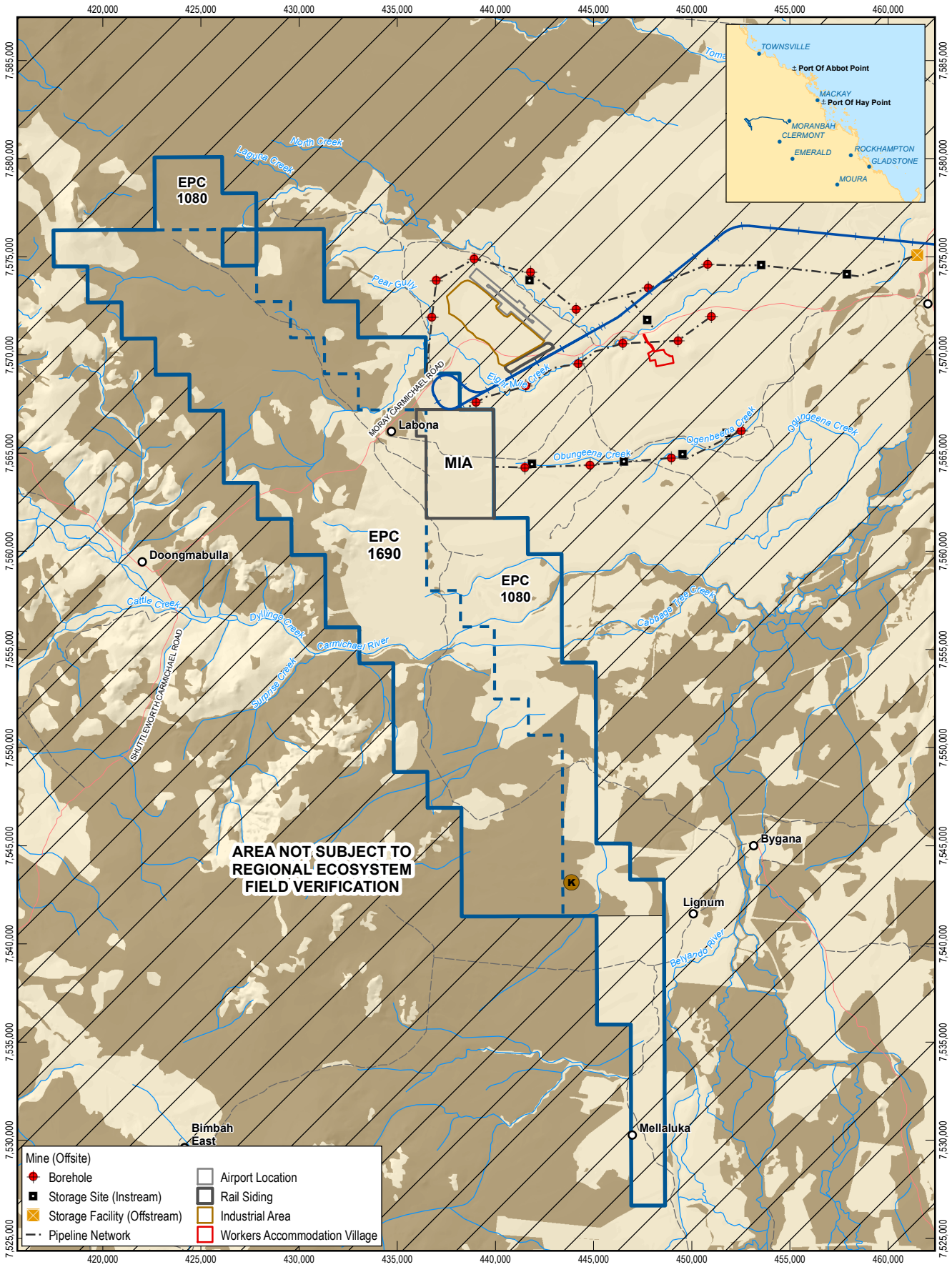
It is likely that the species occurs at low densities in remnant open eucalypt woodland across the Project Area. The Bygana West Nature Refuge in the southern part of the Project Area was proclaimed, amongst other reasons, as it contains suitable koala habitat. Furthermore, mature river

red gum woodland along the Carmichael River within the '*Open forest and woodland fringing watercourses and relict stream channels, and alluvial plains subject to flooding*' represents additional potential koala habitat in the Project Area. The location of the koala observed within the Project Area and an indication of potential habitat that might be utilised by this species within the Project Area is presented in Figure 4-9.

To map potential habitat for the koala beyond the Project Area, (DERM certified) REs characterised by open eucalypt woodland and open eucalypt forest vegetation fringing watercourses were identified and mapped. Potential koala habitat beyond the Project Area is presented in Figure 4-10. The presence of potentially suitable habitat beyond the Project Area suggests that the koala is likely to be present in low densities in the wider landscape (excluding to the east where non-remnant vegetation dominates the landscape). Habitat utilisation and abundance is likely to be influenced by availability of preferred eucalypt species, abundance of predators (especially dogs), climate change and drought (SEWPAC, 2012).

- The koala is considered to have 'scattered populations throughout Queensland' and no defined 'important populations' have been listed by SEWPAC (2012b). With respect to the Significant Impact Guidelines (DEWHA, 2009c), it is not considered that the occurrence of a koala at the Project Area defines it as part of an 'important population' (of an EPBC Act listed vulnerable species). That is, koalas at the Project Area are not considered to be a part of *a population that is necessary for a species' long-term survival and recovery, including populations identified as such in recovery plans, and/or that are:*
- *Key source populations either for breeding or dispersal*
- *Populations that are necessary for maintaining genetic diversity, and/or*
- *Populations that are near the limit of the species range* (DEWHA, 2009c)

Based on the low estimated density of koalas within the Brigalow Belt and the availability of similarly suitable habitat in the landscape surrounding the Project Area, it is not considered that the Project Area represents *habitat critical to the survival of the species.*



LEGEND

- Koala Sighting - Spring 2011
- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Potential Koala Habitat - Based on Field Verified Regional Ecosystems within the Mine Site and DERM Certified Regional Ecosystems Version 6.0b outside the Mine Site

1:275,000 (at A4)
0 1 2 3 4 5
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

Job Number 41-25215
Revision A
Date 07-09-2012

Koala Records and Potential Habitat at the Project Area

Figure 4-9

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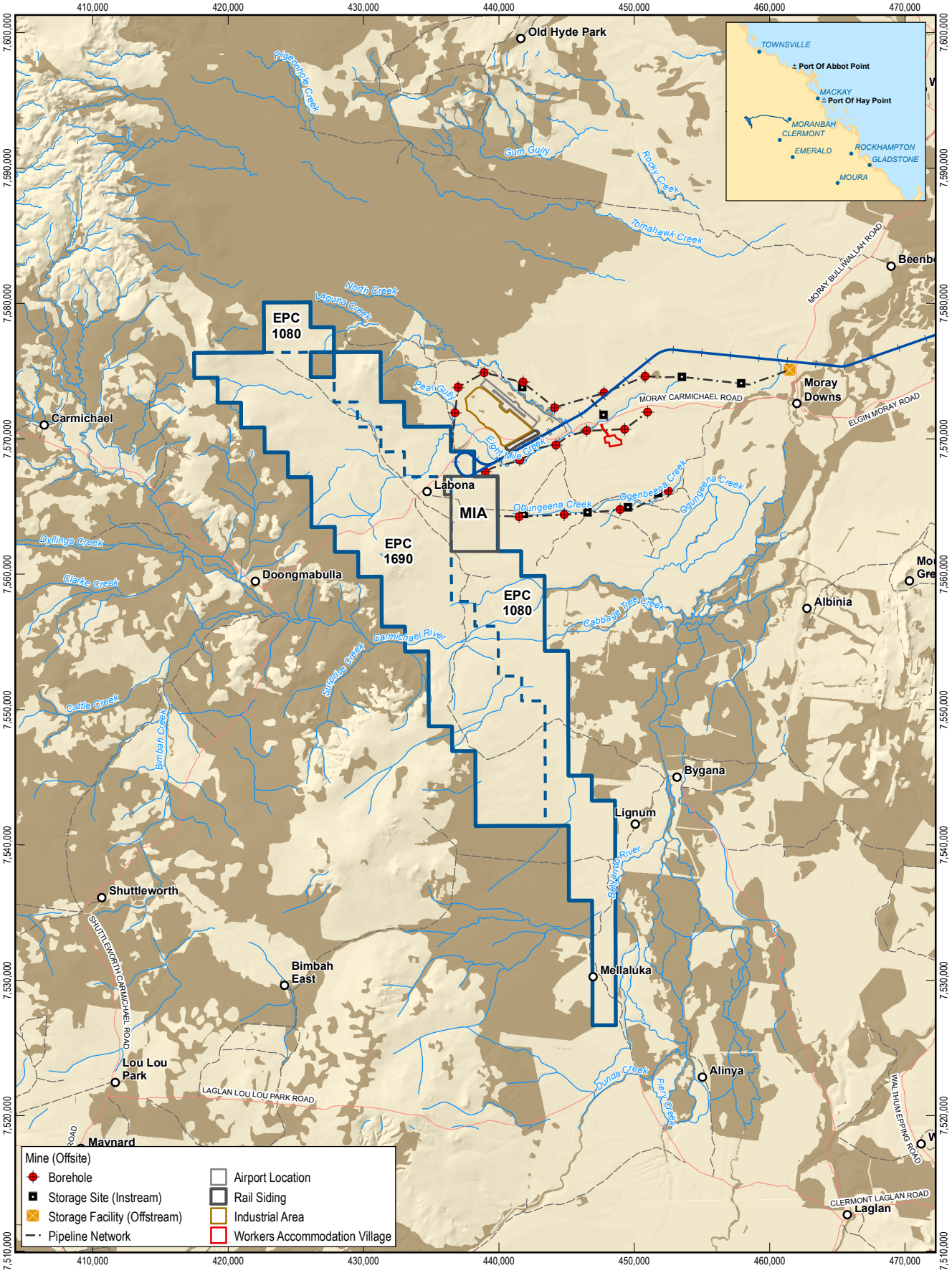
Data Source: DME: EPC 1690 (2010), EPC 1080 (2011); DERM: Regional Ecosystems v6.0 (2010); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Koala Sightings, Potential Habitat (2011). Created by: BW, CA



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Potential Koala Habitat - Based on DERM Certified Regional Ecosystems Version 6.1b

1:400,000 (at A4)

0 2.5 5 7.5 10

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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Potential Koala Habitat
Beyond the Project Area

Job Number	41-25215
Revision	A
Date	07-09-2012

Figure 4-10

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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: Regional Ecosystems v6.1 (2011); DME: EPC 1690 (2010), EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Potential Habitat (2012). Created by: BW, CA

4.2.2.2 Listed Threatened Fauna – Likely to Occur

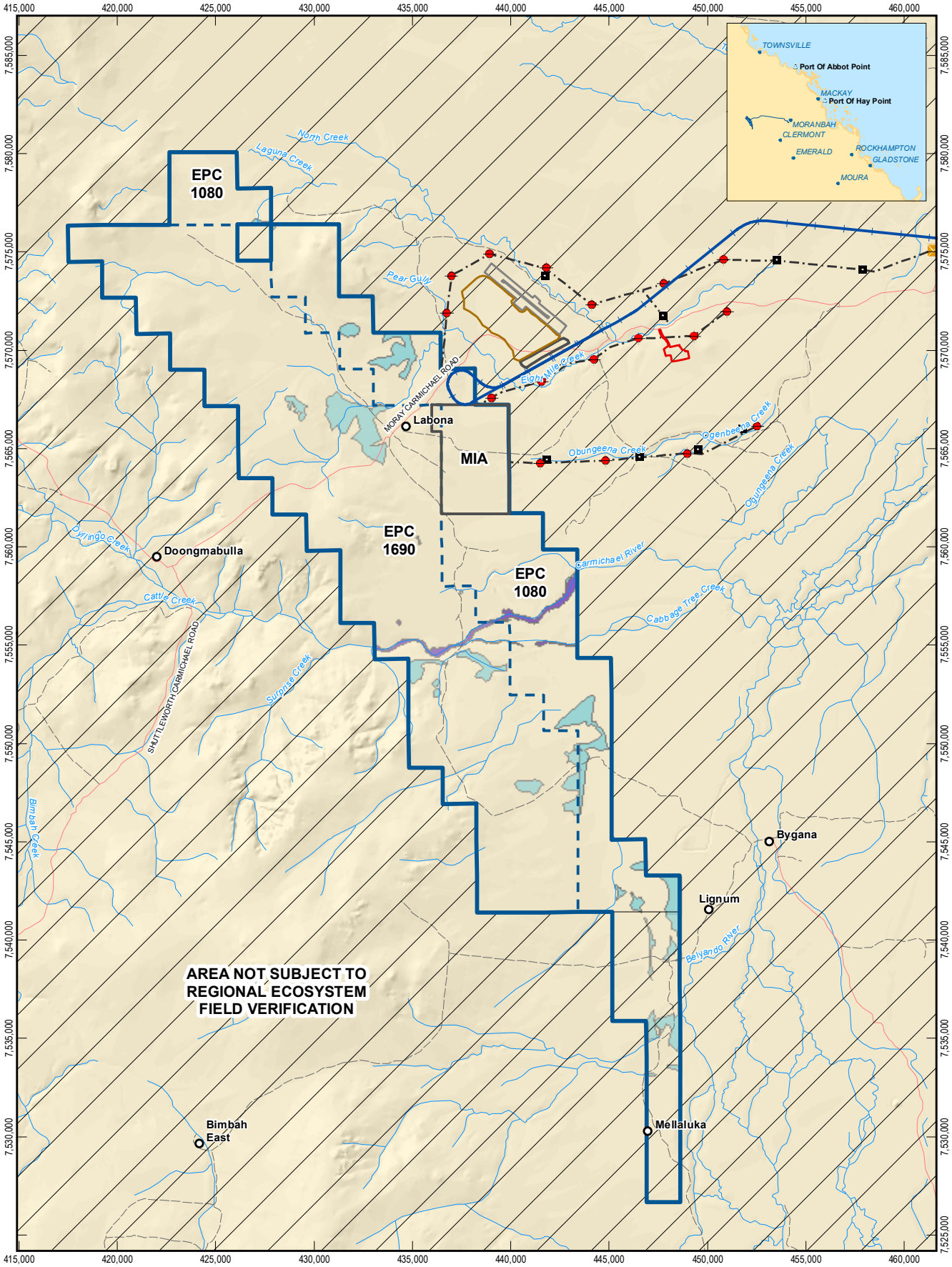
The following EPBC Act listed threatened species are likely to occur at the Study Area, based on distribution, presence of potentially suitable habitat and previous records from the region:

- Ornamental snake (*Denisonia maculata*) – vulnerable EPBC Act; vulnerable NC Act – Likely to occur across both mine and Rail Study Areas
- Yakka skink (*Egernia rugosa*) - vulnerable EPBC Act; vulnerable NC Act – Likely to occur across Mine Study Area

Although these taxa are considered likely to occur within the Study Area, field survey efforts targeted at these taxa did not detect any of these threatened species within the Study Area. These species occur in low densities and are cryptic and failure to detect their presence is not considered an indication of their absence. Rather, it is considered likely that these species occur at the Study Area, based on their known distribution; the presence of suitable habitat and the fact that they have been previously recorded within approximately 50 km of the Study Area (as documented in desktop sources queried, refer Table 1-1). A number of habitat and vegetation types across the Study Area may provide habitat for these listed threatened species. These include, but are not limited to, the following:

- *Ironbark-box grassy woodlands and open woodlands on grey sand plains* – yakka skink
- *Yellow jacket and rough-leaved bloodwood shrubby low open woodland on red sand plains* – yakka skink
- *Eucalypt open woodland with native grass understorey* – ornamental snake, yakka skink
- *Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer* – ornamental snake, yakka skink
- *Brigalow shrubby woodland or open forest typically on clay and clay loam plains* – ornamental snake
- *Eucalypt and acacia mixed woodland or forest often on clay soils* – ornamental snake
- *Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey* – ornamental snake
- *Open forest and woodland fringing watercourses and relict stream channels, and alluvial plains subject to flooding* – yakka skink, ornamental snake
- *Woodland and low open woodland associated with laterised sandstone rises and minor pediments* – yakka skink
- *Natural and artificial water bodies* – ornamental snake

Potential habitat for the ornamental snake is presented in Figure 4-11 and potential habitat for the yakka skink is presented in Figure 4-12 . In the case of the ornamental snake, the limiting factor to utilisation of the potentially suitable habitat 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). The yakka skink does not have highly specific habitat requirements and occurs in a variety of habitat types across its range.



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Gidgee and brigalow woodland on clay plains
- Open forest and woodland fringing streams and on flood plains
- Mine (Offsite)
- Borehole
- Storage Site (Instream)
- Storage Facility (Offstream)
- Pipeline Network
- Airport Location
- Rail Siding
- Industrial Area
- Workers Accommodation Village

1:275,000 (at A4)
0 1 2 3 4 5
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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GHD adani

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Carmichael Coal Mine and Rail Project

Potential Ornamental Snake Habitat within the Study Area

Job Number 41-25215
Revision B
Date 16-11-2012

Figure 4-11

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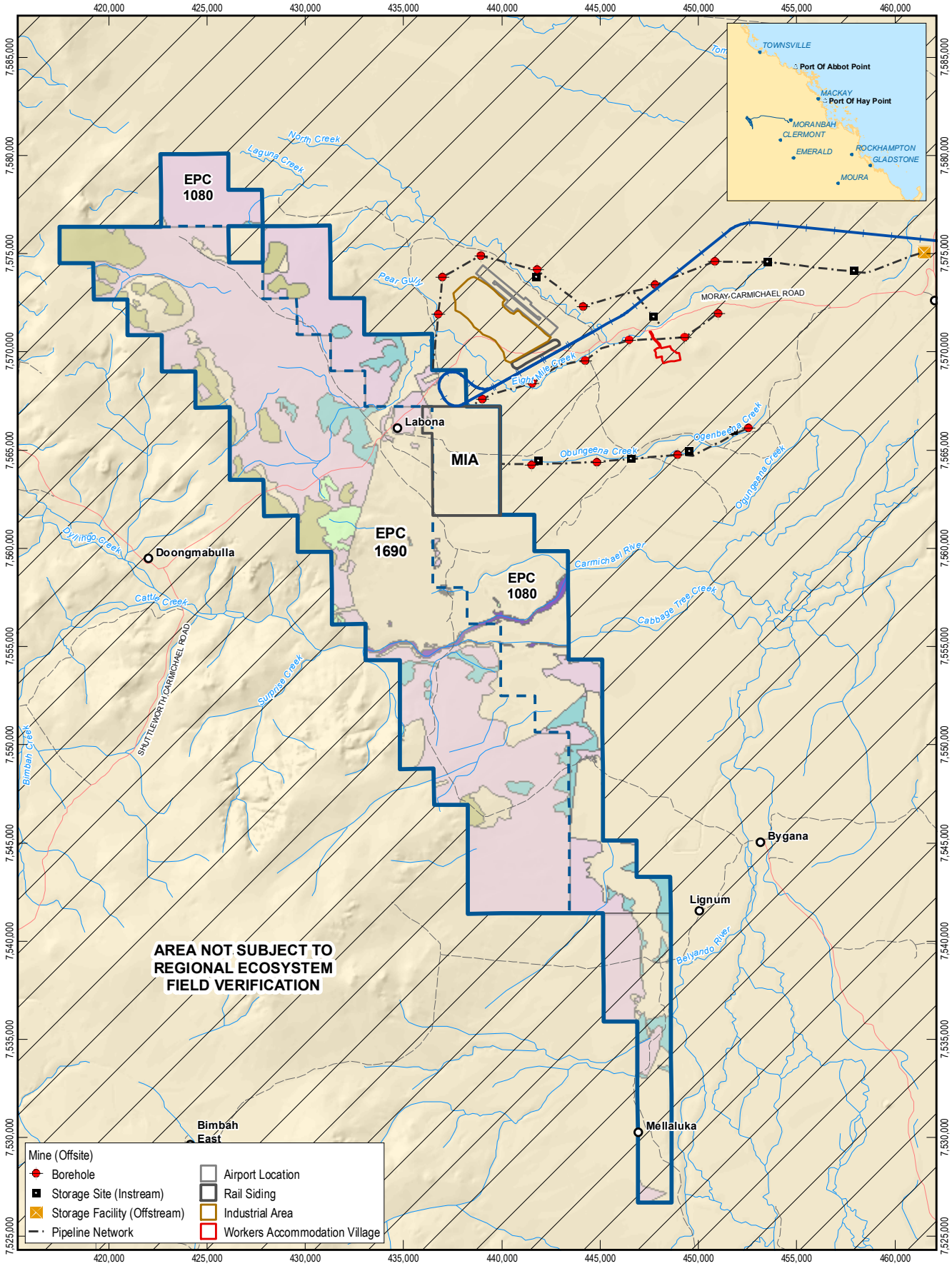
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010), EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Potential Habitat (2011). Created by: BW, CA



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area

Potential Yakka Skink Habitat Type

- Gidgee and brigalow woodland on clay plains
- Ironbark-box grassy woodland on grey sand plains
- Low open woodland on ferricrete/laterised sandstone
- Open forest and woodland fringing streams and on flood plains
- Yellowjacket-rough leaved bloodwood open woodland on red sand plains

1:275,000 (at A4)
0 1 2 3 4 5
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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Potential Yakka Skink Habitat within the Mine Study Area

Job Number 41-25215
Revision B
Date 16-11-2012

Figure 4-12

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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: DME: EPC 1690 (2010), EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Potential Habitat (2011). Created by: BW, CA

With respect to the Significant Impact Guidelines (DEWHA, 2009b), it is not considered that the Study Area supports an 'important population' of the EPBC Act-listed ornamental snake or yakka skink, in so much as:

- Neither of these species were detected at the Study Area during targeted surveys
- The Study Area is not considered to constitute habitat for key source populations (breeding/dispersal), especially given the availability of similarly suitable habitat in the surrounding landscape
- The Study Area does not occur at or near the limit of either the snake or skinks distributional range

Ornamental snakes and yakka skinks, should they occur at the Project Area, are not considered to be a part of a *population that is necessary for a species' long-term survival and recovery, including populations identified as such in recovery plans, and/or that are:*

- *Key source populations either for breeding or dispersal*
- *Populations that are necessary for maintaining genetic diversity, and/or*
- *Populations that are near the limit of the species range* (DEWHA, 2009b)

Based on the fact that neither species was detected at the Project Area despite targeted surveys, and that similarly suitable habitat for both species is present in the landscape surrounding the Project Area, it is not considered that the Project Area represents *habitat critical to the survival of the species* for the yakka skink and ornamental snake (refer Volume 4 Appendix N Mine Terrestrial Ecology Report and Volume 4 Appendix AA Rail Ecology Report of this EIS for further discussion on the ornamental snake and yakka skink at the Mine Study Area and ornamental snake at the Rail Study Area, respectively).

4.2.2.3 Listed Threatened Fauna – May Occur

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

- Dunmall's snake (*Furina dunmalli*) – vulnerable EPBC Act, vulnerable NC Act – may occur at Rail Study Area, unlikely to occur at Mine Study Area
- Greater long-eared bat (*Nyctophilus timoriensis*) (south eastern form) – vulnerable EPBC Act, vulnerable NC Act – may occur at Rail Study Area, unlikely to occur at Mine Study Area
- Brigalow scaly-foot (*Paradelma orientalis*) – vulnerable EPBC Act, vulnerable NC Act – may occur at Rail Study Area, unlikely to occur at Mine Study Area
- Northern quoll (*Dasyurus hallucatus*) – endangered EPBC Act; not listed NC Act –may occur across Rail Study Area
- Red goshawk (*Erythrotriorchis radiatus*) – vulnerable EPBC Act, endangered NC Act – may occur at both Rail and Mine Study Areas
- Australian painted snipe (*Rostratula australis*) – vulnerable EPBC Act, vulnerable NC Act – may occur at both Rail and Mine Study Areas

These species were not detected during field studies at the Study Area. They may occur based on the presence of suitable habitat, being:

- *Eucalypt open woodland with native grass understorey* – brigalow scaly-foot, red goshawk, great long-eared bat, northern quoll (easternmost part of Study Area only)
- *Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer* – brigalow scaly-foot, red goshawk, Dunmall's snake
- *Ironbark-box grassy woodlands and open woodlands on grey sand plains* – red goshawk
- Open forest and woodland fringing watercourses and relict stream channels, and alluvial plains subject to flooding – red goshawk (potential foraging habitat for this wide ranging species)
- *Open eucalypt or acacia mixed woodland* – brigalow scaly-foot, red goshawk, great long-eared bat, Dunmall's snake
- *Brigalow shrubby woodland or open forest typically on clay and clay loam plains* – brigalow scaly-foot, Dunmall's snake
- *Eucalypt and acacia mixed woodland or forest often on clay soils* – brigalow scaly-foot, red goshawk, greater long-eared bat, northern quoll (easternmost part of Study Area only)
- *Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey* – red goshawk, greater long-eared bat, northern quoll (easternmost part of Study Area only)
- *Natural and artificial water bodies* – Australian painted snipe, red goshawk

With respect to the Significant Impact Guidelines (DEWHA, 2009b), it is not considered that the Study Area supports an 'important population' of any of these EPBC Act listed species, in so much as:

- None of the taxa were detected at the Study Area, nor have they been previously recorded within 50 km of Mine Study Area, or within 10 km of rail Study Area
- The Study Area is not considered to constitute habitat for key source populations (breeding/dispersal), especially given the availability of similarly suitable habitat in the surrounding landscape
- The Study Area does not occur at or near the limit of any of the species' range

Should any of these taxa occur at the Study Area, they are not considered to be a part of *a population that is necessary for a species' long-term survival and recovery, including populations identified as such in recovery plans, and/or that are*:

- *Key source populations either for breeding or dispersal*
- *Populations that are necessary for maintaining genetic diversity, and/or*
- *Populations that are near the limit of the species range* (DEWHA, 2009b)

Based on the fact that none of these species were detected at the Study Area (nor have they been recorded from the desktop search extent), and that similarly suitable habitat for these species is present in the landscape surrounding the Study Area (refer Volume 2 Section 5 Nature Conservation (Mine) and Volume 3 Section 5 Nature Conservation (Rail) of this EIS for further discussion on these species, including likelihood of occurrence assessment), it is not considered that the Study Area represents habitat critical to the survival of the species for these species.

4.2.2.4 Listed Threatened Fauna – Unlikely to Occur

The likelihood of occurrence assessment indicated that the following EPBC Act listed threatened fauna species, none of which were recorded during field surveys, are unlikely to occur based on current knowledge of their distribution and/or the lack of suitable habitat within the Study Area:

- Retro slider (*Lerista allanae*) – endangered EPBC Act – unlikely to occur at Rail Study Area, not detected in Mine Study Area search
- Fitzroy River turtle (*Rheodytes leukops*) – vulnerable EPBC Act – unlikely to occur at Rail Study Area, not detected in Mine Study Area search
- Star finch (*Neochmia ruficauda ruficauda*) (eastern and southern) – endangered EPBC Act, – unlikely to occur at either Rail or Mine Study Areas
- Greater bilby (*Macrotis lagotis*) – vulnerable EPBC Act – unlikely to occur at mine Study Area, not detected at Rail Study Area
- Paradise parrot (*Psephotus pulcherrimus*) – extinct EPBC Act –extinct in the wild and, therefore, not likely to occur at either Study Areas

Based on the fact that none of these species were detected at the Study Area (and that suitable habitat for these species is generally lacking from the Study Area none of these taxa are considered likely to occur at the Study Area and impacts are not expected to occur to these species (refer Volume 2 Section 5 Nature Conservation (Mine) and Volume 3 Section 5 Nature Conservation (Rail) of this EIS). These species have, therefore, not been considered further within the impact assessment.

4.2.3 Listed Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages that comprise a particular habitat type. Threatened Ecological Communities (TECs) are ecological communities that have been assessed under the EPBC Act and assigned to one of five categories related to the status of the threat to the community, i.e. conservation dependant, vulnerable, endangered, critically endangered and extinct in the wild.

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

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin (GAB)
- Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

The Brigalow TEC was identified as occurring in the Study Area from field surveys and vegetation mapping. None of the Natural Grasslands TEC, the Semi-evergreen Vine Thicket TEC nor GAB dependent species occur within the Study Area. All TECs are, however, described in more detail below.

One additional EPBC Act listed TEC, Weeping Myall Woodland, was identified in the Project ToR for consideration in this assessment although it did not present in the EPBC search for the area. This

species was not identified through the desktop assessment (i.e. predicted to occur or previously recorded in desktop search extent), nor was it confirmed present during field investigations. This TEC is not present within the Project Area and the SEWPAC mapping for this community locates the far north eastern boundary approximately 200 km to the east and south of the Project Area; no direct or indirect impacts are predicted to occur to this TEC and it is not considered further in this assessment.

4.2.3.1 Brigalow (*Acacia harpophylla* Dominant and Co-dominant)

The Brigalow TEC comprises vegetation communities dominated or co-dominated by brigalow (*Acacia harpophylla*). Within Queensland, 16 REs are described as forming part of this TEC. All of these REs are located in either the Brigalow Belt, South-East Queensland or Mulga Lands bioregions – none are located in the Desert Uplands.

Brigalow communities have undergone a severe decline since the 1940s and now occupy 10 per cent of their former range (DEH, 2001). The main threatening process is broad scale clearing, which historically has been done to create grasslands for grazing. Broad scale clearing of remnant and regrowth vegetation is now managed through legislation in Queensland. Therefore, the main threatening process for this TEC is legislatively controlled. However, it is unlikely that the Brigalow TEC will recover to its former state, given that the vast majority of the cleared areas where this community dominated are now productive grazing lands.

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. Ground truthing has determined that approximately 636 ha of these REs are present within the Rail Study Area and 267 ha of these REs are present within the Mine Study Area. In the Rail Study Area the majority of this brigalow is located west of Gregory Developmental Road, with several small patches occurring close to Diamond Creek, Mistake Creek and approaching the Belyando River. The distribution of Brigalow TEC within the Study Area and in the context of the wider landscape is presented in Figure 4-13.

In the Mine Study Area the majority of this brigalow is located south of the Carmichael River along the eastern boundary of the Study Area at the junction of EPC 1080 and EPC 1690, generally within contiguous remnant vegetation with low levels of fragmentation and high levels of community integrity. The sections north of the Carmichael River are present in small, highly fragmented portions within which the community structure and species composition is generally highly modified from its natural state. The distribution of Brigalow TEC at the Mine Study Area is presented in Figure 4-14.

4.2.3.2 The Community of Native Species Dependant on Natural Discharge of Groundwater from the Great Artesian Basin

The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (abbreviated to 'GAB discharge spring wetlands') TEC comprises a community of species of flora and fauna including fish, invertebrates and aquatic and terrestrial plants clustered around discharge springs emanating from the Great Artesian Basin (GAB) (Fensham *et al*, 2010). For this reason, the TEC is geographically limited to the GAB, and surveys confirmed that this TEC is not present within the Project Area. However, impacts to regional aquifers as a result of groundwater draw down have the potential to impact this TEC.

The nearest GAB discharge spring is the Doongmabulla wetland, a cluster of 11 springs located within a 4 km radius of each other along the Carmichael River, approximately 10 km upstream (west) from the western boundary of the Project Area (Fensham pers. comm., 2012). This wetland has an

area of 5 ha, and contains six flora species of conservation significance, including two species known to be endemic to the Doongmabulla spring (the herb *Eryngium fontanum* and the grass *Sporobolus pamelae*). It has been given a GAB discharge spring wetland conservation ranking of 1a (the highest), based on the presence of endemic species (Fensham *et al*, 2010).

The main threatening processes for this TEC are aquifer draw down (due primarily to uncapped bores, but also to mining activities), excavation of springs, exotic flora and fauna invasion and stock damage, access by tourism, and impoundments (Fensham *et al*, 2010).

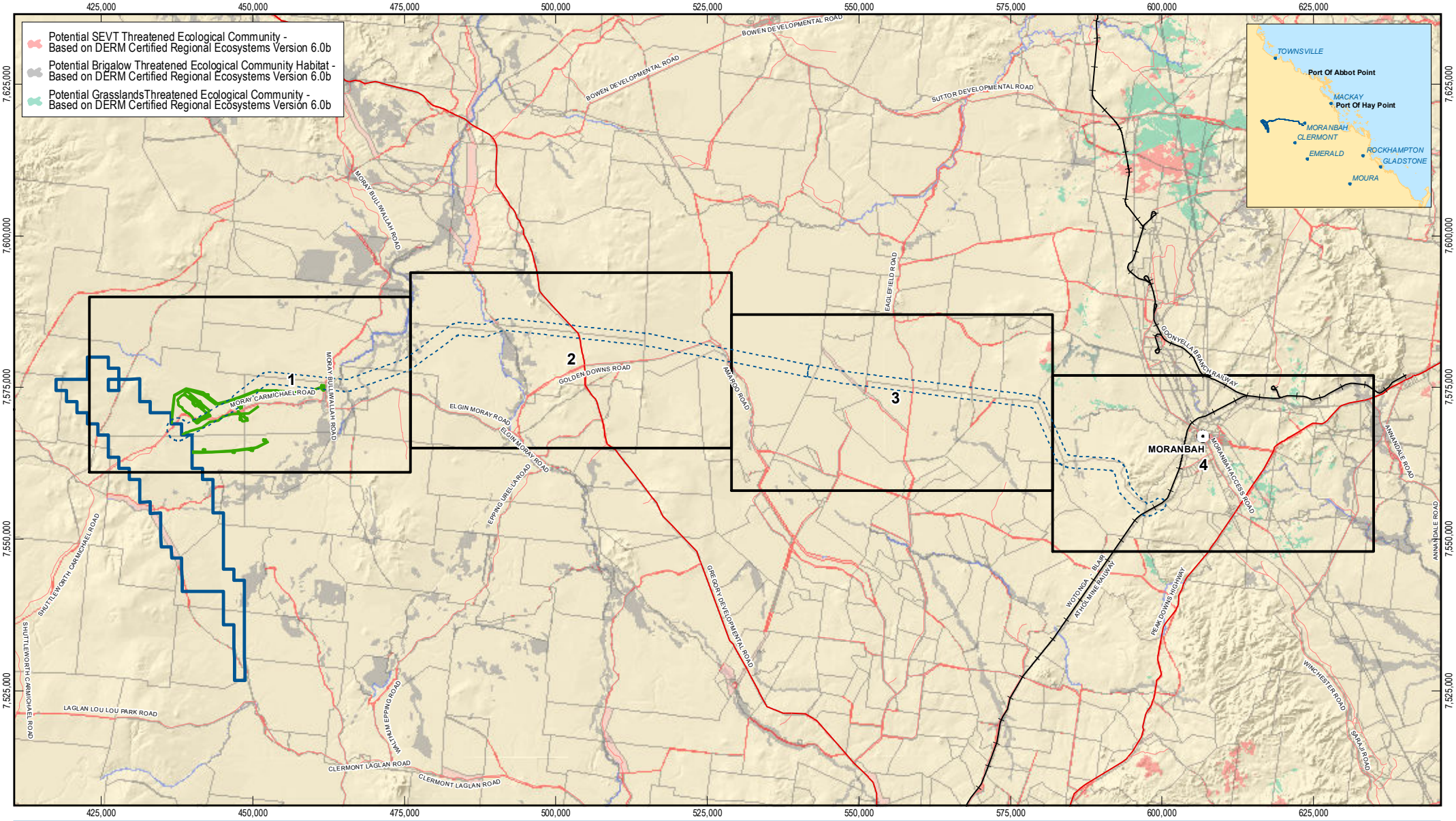
Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

This TEC is comprised typically of native tussock grasslands composed of perennial native grass species. This TEC can occur over a diversity of habitats as influenced by factors such as rainfall, soil, geology and previous land use. This TEC is found on fine textured soils derived from either basalt or fine-grained sedimentary rocks, on flat or gently undulating rises. This ecological community is endemic to Queensland, extending from Collinsville in the north to the Carnarvon National park in the south. It broadly occurs where the Fitzroy River Basin and the Brigalow Belt North coincide. This TEC has been heavily affected by disturbance and degradation and there are very few patches of undisturbed natural grasslands remaining.

The Natural Grassland TEC only occurs within the Northern Bowen Basin subregion of the Brigalow Belt bioregion (TSSC, 2008). No constituent REs, and thus the Natural Grassland TEC, are mapped within the Northern Bowen Basin subregion of the Study Area. However, this TEC may occur adjacent to the eastern extent of the rail Study Area.

4.2.3.3 Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

Semi-evergreen Vine Thicket TEC 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 Semi-evergreen Vine Thicket TEC in Queensland. None of these REs are mapped within the Mine Study Area or Rail Study Area nor were they identified during field surveys. However, this TEC may occur adjacent to rail Study Area. This TEC is not considered likely to be present within the Study Area and is, therefore, not considered further in the impact assessment.



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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 16-11-2012

Figure 4-13
Series Index

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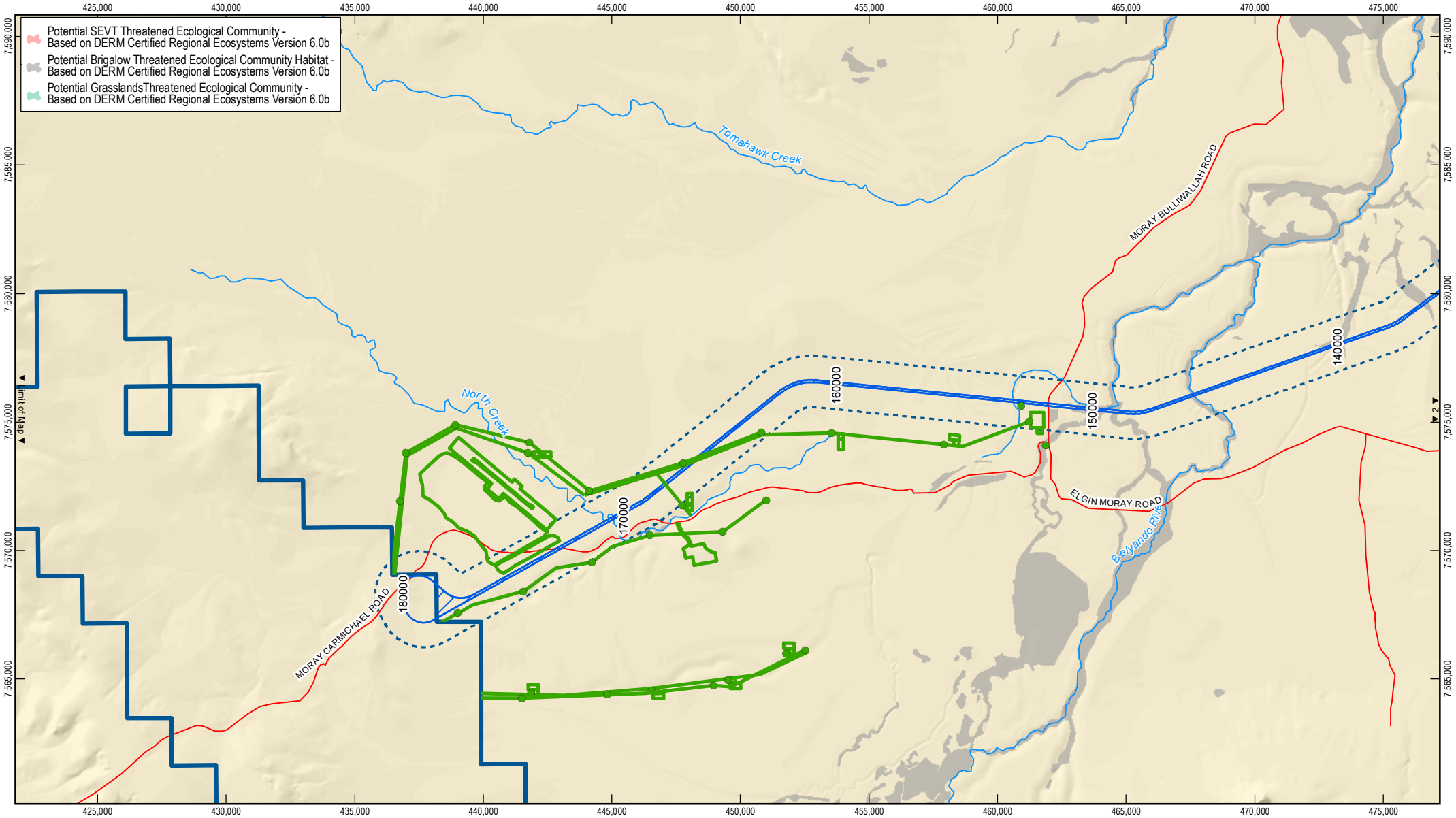
Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Corridors Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW,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



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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

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
Revision C
Date 16-11-2012

Figure 4-13
Sheet 1 of 4

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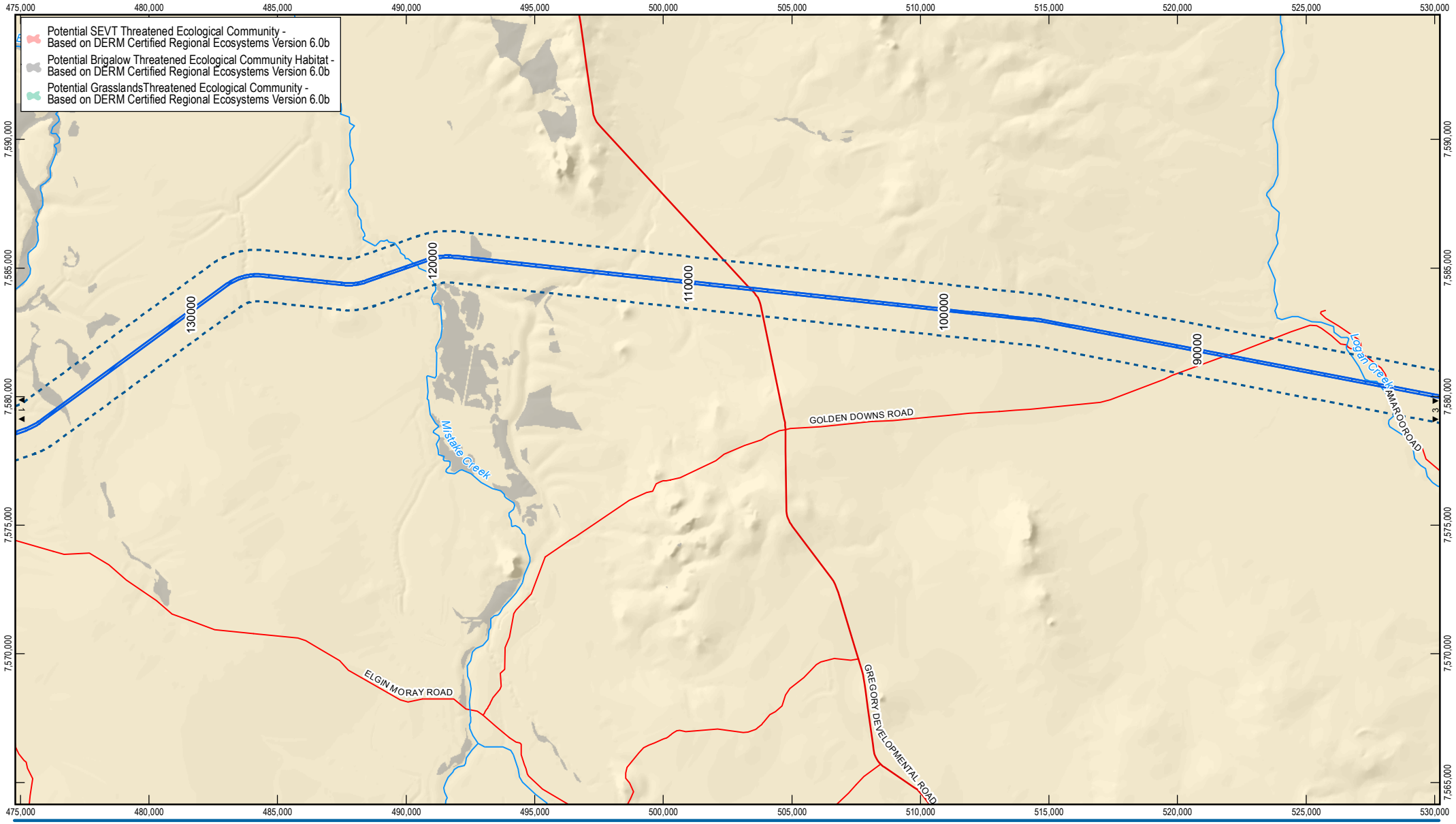
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created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



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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

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

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

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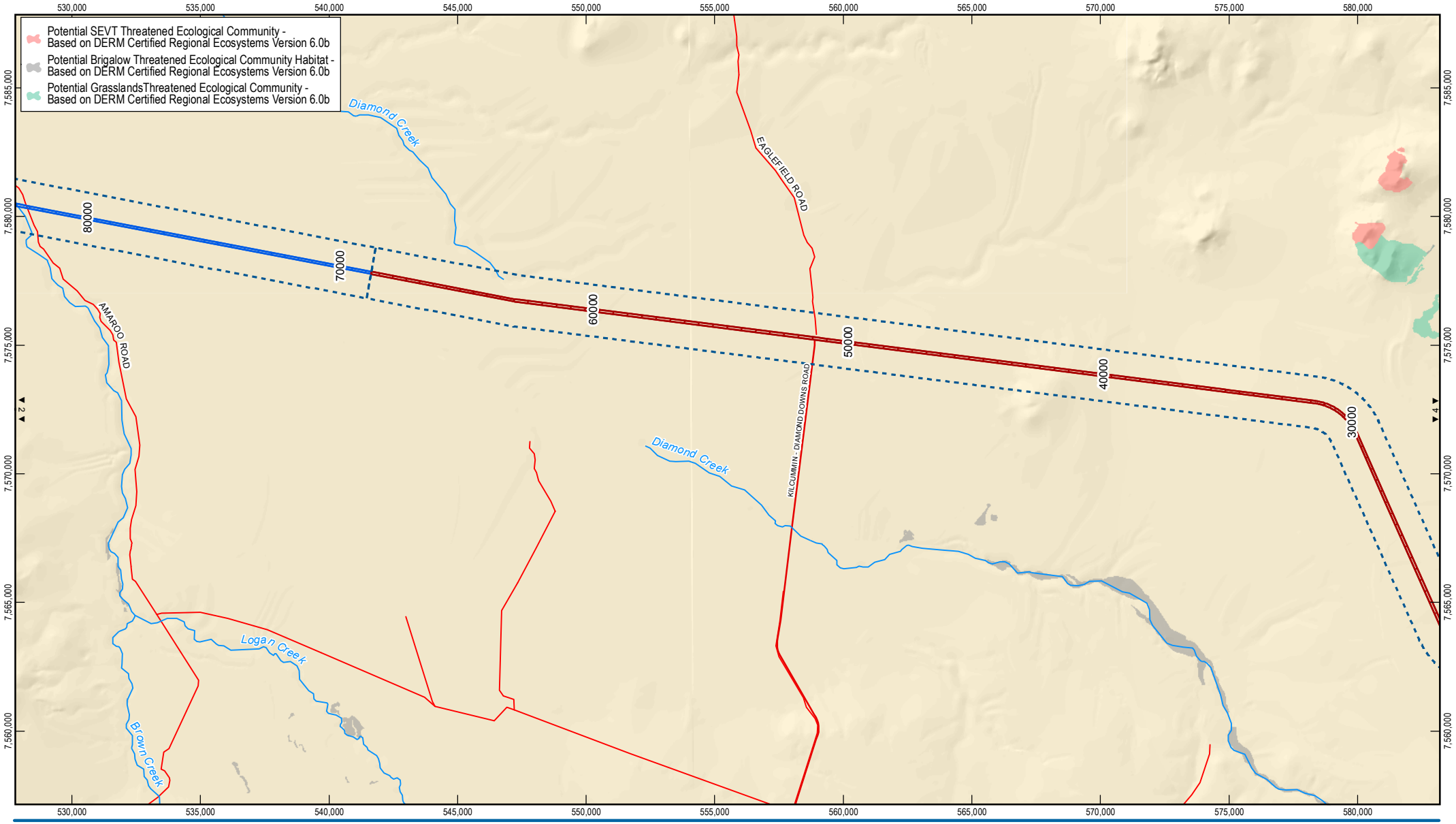
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created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



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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

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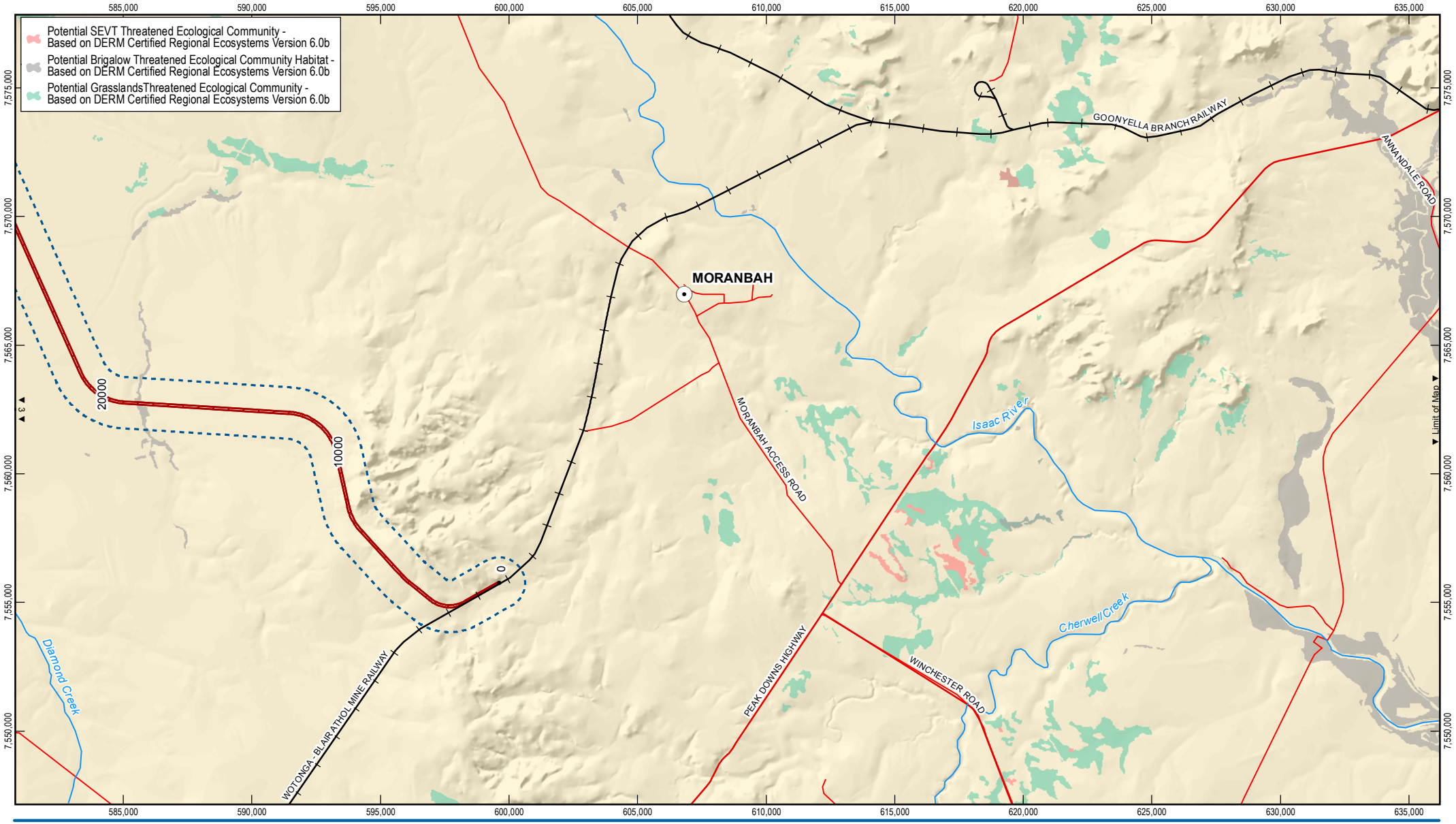
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created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



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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

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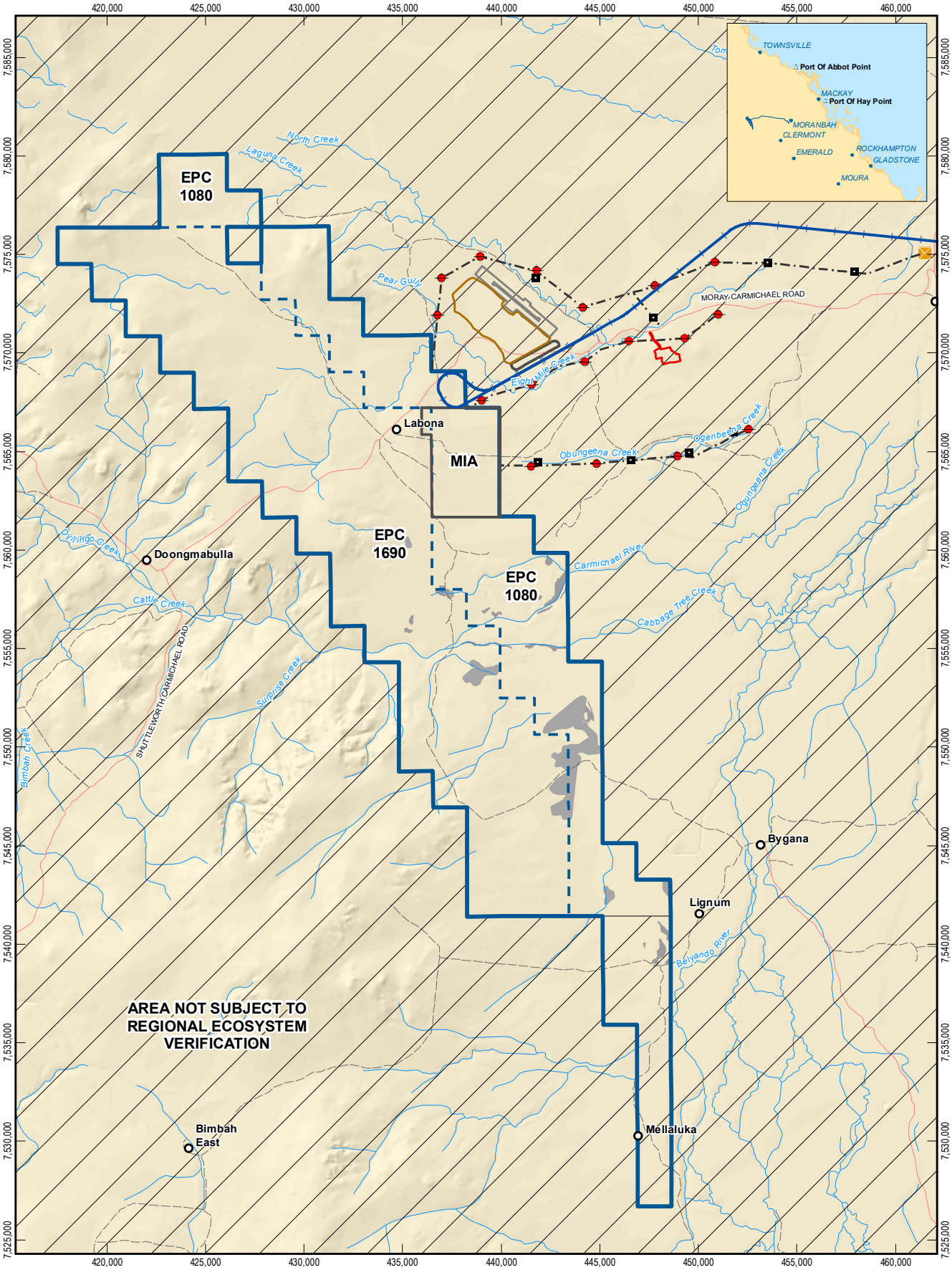
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created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



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Brigalow Threatened Ecological Community
- Mine (Offsite)
- Borehole
- Storage Site (Instream)
- Storage Facility (Offstream)
- Pipeline Network
- Airport Location
- Rail Siding
- Industrial Area
- Workers Accommodation Village

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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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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision B
Date 16-11-2012

Brigalow TEC at Mine Study Area

Figure 4-14

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Data Source: DME: EPC 1690 (2010), EPC 1080 (2011); DERM: Threatened Ecological Communities (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA

5. Potential Impacts and Mitigation Measures

5.1 Summary of Matters of NES for Assessment

Desktop and field survey findings indicate the following protected matters of NES are known or likely to occur within the Study Area:

- Threatened flora:
  - *Acacia ramiflora* – vulnerable EPBC Act; May occur across Study Area
  - King bluegrass (*Dichanthium queenslandicum*) – vulnerable EPBC Act; May occur across Rail Study Area, unlikely to occur across Mine Study Area
- Threatened Species:
  - Black-throated finch (southern) (*Poephila cincta cincta*) – endangered EPBC Act; Known to occur at Mine and likely to occur at Rail Study Area
  - Squatter pigeon (southern) (*Geophaps scripta scripta*) – vulnerable EPBC Act; Known to occur across both Mine and Rail Study Areas
  - Koala (*Phascolarctos cinereus*) (combined populations of Queensland, New South Wales and the Australian Capital Territory) – vulnerable EPBC Act; Known to occur at Mine Study Area and likely to occur at Rail Study Area
  - Ornamental snake (*Denisonia maculata*) – vulnerable EPBC Act; Likely to occur across both Mine and Rail Study Areas
  - Yakka skink (*Egernia rugosa*) - vulnerable EPBC Act; Likely to occur across Mine Study Area
- Threatened Ecological Communities that are known to occur or may occur within or adjacent to the Study Area:
  - Brigalow (*Acacia harpophylla* dominant and co-dominant) – endangered under EPBC Act; Known to occur in Mine and Rail Study Areas
  - The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin (GAB) – endangered under EPBC Act; Known to occur west of Mine Study Area, may be subject to indirect impacts
  - Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin – endangered under EPBC Act; may occur adjacent to Rail Study Area
  - Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions – endangered under EPBC Act; may occur adjacent to Rail Study Area

These protected matters have potential to be impacted by processes described under Section 1.6.6 as a result of the Project progressing.

5.1.1 Conceptual Summary of Potential Impacts

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

- Clearing of vegetation
- Disturbances of watercourses and changes to surface water flows
- Introduction and proliferation of weeds and feral pest species
- Fauna behavioural disruption

These are described in detail in Volume 2 Section 5 Nature Conservation (Mine) and Volume 3, Section 5 Nature Conservation (Rail) of the EIS and considered in reference to matters of NES following. Under Volume 2 Section 5 and Volume 3 Section 5 detailed consideration to approaches to minimise potential impacts were considered, including minimising potential footprint, setback options and construction sequencing. These measures are considered to have been adopted into the assessment here such that impacts identified are those which cannot be avoided. To achieve the impact assessment for matters of NES the rail and mine study components are addressed separately. The impacts from each will be realised across different time frames and will impact matters of NES in different ways. Therefore, to accurately understand impacts the construction and operational phase work impacts on matters of NES are considered for the rail and mine footprint independently. Collective or cumulative impacts as a result of both aspects of the Project progressing are, however, noted where appropriate.

5.1.2 Rail Construction

5.1.2.1 Impacts

Collectively the temporary and permanent infrastructure comprises the Project footprint for the construction phase of the Project. The extent of the Project footprint is presented in Figure 5-1.

Construction of the rail infrastructure will result in clearing of a 95 m wide rail corridor within the Rail Study Area and rail infrastructure will be established. The Project's construction process will be intensive for the first three years with impacts moving progressively along the rail alignment ahead of the laying of track. In total approximately 1,868 ha are predicted to be affected.

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

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).

It should be noted that a conservative approach has been taken in estimating areas. Some of the REs included in this estimation may not have sufficient quality of vegetation composition (in particular the grassland REs) to be classified as a TEC under the EPBC Act.

In addition to these vegetation communities (and associated fauna habitat types), two dams (based on DERM's Waterbodies mapping layer, 2010) and a number of water courses habitats will be disturbed by the construction activities. In total it is predicted that 12 major watercourse crossings and approximately 76 minor water course crossings (including unmapped ephemeral drainage lines) may be affected. The majority of the watercourses intersected by the Project footprint are ephemeral streams that provide limited long term aquatic habitat and therefore disturbance impacts are limited at these locations. Cattle water troughs, however, 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.

Clearing of vegetation and construction activities undertaken within the Project footprint will cause fragmentation of habitat in the vicinity of the construction footprint. Historic land use practices have resulted in a landscape with extant fragmentation. In addition to fragmentation, clearing and construction activities will result in temporary localised increases in noise, vibration and light disturbance. In addition, further degrading effects to habitat may include increased exposure to dust, wind, weeds and introduced animals. Exposure to any of these effects may alter habitat composition and quality 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 in 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 and on high gradient slopes. Where vegetation clearing occurs on floodplains and near drainage lines, erosion may cause sedimentation of waterways, potentially degrading downstream aquatic and riparian habitats.

Individuals and/or populations of some of the species recorded from the terrestrial and aquatic environments across the Study Area will be lost from the local environment due to clearing and watercourse disturbance proposed for the construction phase of the rail Project. Increased anthropogenic disturbance at the Study Area also has potential to alter fauna behaviour, primarily as a result of increased exposure to light, noise, dust, vehicles and people. Generation of wastes, introduction of weeds and pests and indirect impacts to vegetation (e.g. dust settlement) can influence foraging and other fauna behaviours. Anthropogenic influences can, therefore, result in an increased mortality potential, including as a consequence of a change in the fire regime of the site. The total impact to potential habitat for EPBC Act listed fauna and to TEC communities or flora species as a result of the proposed constriction activities for the Rail Project is summarised in Table 5-1.

Table 5-1 Impact to EPBC Act Listed Threatened Matters from Rail Construction

EPBC Act listed fauna species	EPBC Act status	Total clearing extent*
Confirmed present		
squatter pigeon (southern) *Geophaps scripta scripta*	vulnerable	145.7 ha

EPBC Act listed fauna species	EPBC Act status	Total clearing extent*
Brigalow *(Acacia harpophylla* dominant and co-dominant) TEC	endangered	37.4 ha
Likely to occur		
Ornamental snake *Denisonia maculata*	vulnerable	229.5 ha
Black-throated finch (southern) *Poephila cincta cincta*	endangered	64.7 ha
Koala ((QLD, NSW and ACT populations)	vulnerable	143.2 ha
May occur		
Yakka skink *Egernia rugosa*	vulnerable	229.5 ha
Dunmall's snake *Furina dunmalli*	vulnerable	82.4 ha
Brigalow scaly-foot *Paradelma orientalis*	vulnerable	164.8 ha
Greater long-eared bat *Nyctophilus corbeni*	vulnerable	143.2 ha
Northern quoll *Dasyurus hallucatus*	endangered	47.6 ha
Red goshawk *Erythrotriorchis radiatus*	vulnerable	194.6 ha
Australian painted snipe *Rostratula australis*	vulnerable; marine; migratory (CAMBA)	66 ha
Acacia ramiflora	vulnerable	0 ha
King bluegrass *Dichanthium queenslandicum*	vulnerable	0 ha

*total clearing extent is based on the combined effect of construction area footprint and 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).

5.1.2.2 Mitigation and Management Measures

Management and mitigation measures associated with the rail construction are detailed in Volume 3, Section 5 of this EIS and are identified within the Project EMP (Volume 3, Section 13). Key measures to mitigate impacts to matters of NES are summarised here. The total extent of vegetation clearing, and in particular remnant vegetation, required for the rail construction phase has been minimised in the 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 1 Introduction for discussion on Project alternatives).

- Detailed design and layout for construction will further consider opportunities to avoid sensitive habitat, including aquatic habitat, and make use of non-remnant/cleared land. Clearance extent will be restricted to only that necessary for the Project. Rehabilitation of cleared areas is to occur as soon as practically possible after cleared areas are no longer required. Areas to be cleared are to be clearly identified onsite and clearance operations are to be supervised by a suitably experienced ecologist to monitor compliance to clearance extents and for avoidance of impacts to fauna.
- Vegetation clearing will be undertaken in a sequential manner to allow mobile fauna to disperse away from clearing areas. Prior to clearing all demarcated habitat features will be checked for fauna by a fauna spotter-catcher and at risk species will be relocated. A Fauna Species Relocation and Salvage Plan (part of the Species Management 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.
- Fencing, waste management, speed limits, fire controls, light spill controls, dust suppression, pest and weed controls, management of sewage and other potentially harmful wastes and pollutants will be utilised onsite to minimise direct or indirect impacts to fauna or pollution of the environment.
- Design must incorporate stormwater management infrastructure and mechanisms to minimise the change in flow regime of watercourses where appropriate and mitigate potential pollution. This may include holding tanks and/or gross pollutant traps.
- Avoid and minimise human and vehicle access to river and creek bed and banks. Construction of river/watercourse crossings ahead of track 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. A Project Erosion and Sediment Management Control Plan will be implemented to limit degradation of downstream aquatic habitat. Temporary stream or channel diversion may be required to facilitate activities in wet periods. Stream flow should be maintained to provide connectivity between aquatic habitats and facilitate aquatic fauna passage.

5.1.3 Rail Operation

5.1.3.1 Impacts

The operational footprint of the rail infrastructure is wholly contained within the construction footprint. The permanent infrastructure will include:

- Rail corridor (95 m wide) (fenced and inclusive of maintenance/service road, passing loops and bad order sidings)
- Rollingstock maintenance yard

This will enable transport of up to 100 Mtpa to the designated port facility and operate 24 hours, 7 days a week. No clearing of vegetation (outside of the construction phase) is expected to occur within the operation phase of the Project (Rail) other than that required for maintenance of infrastructure and access tracks.

The rail infrastructure will create a permanent linear barrier across the landscape for fauna movement. This will be established within the construction phase and mitigation measures will be applied. However, this fragmentation impact will be realised for the operational life of the rail and will influence the use of the landscape by fauna. This influence is expected to have a localised effect on fauna movements, however, at a regional scale it is unlikely that this fragmentation will result in adverse impacts given that the environment is pre-adapted and currently functions as a fragmented landscape from the existing fragmented nature of the surrounding landscape from historical clearing and grazing practices.

The higher intensity of activity at and near disturbed areas associated with mine operations 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).

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 plants' under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act). 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.

Changes in aquatic habitats used by fauna may occur as a result of rail operation. This may be from runoff carrying contaminants that degraded water or sediment quality, or as a result of an altered catchment landscape from infrastructure creating a barrier to flows and realising a change in the floodplain hydrology. This could reduce availability of water resources through degradation or impeded movement of aquatic fauna within and between habitats during flood periods. Reduction of localised biodiversity may be realised if such potential impacts are not controlled.

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.

5.1.3.2 Management and Mitigation

Landscape fragmentation will be realised during operation of the rail infrastructure. Design will work to minimise impacts as far as practical by avoiding fragmenting habitat, including suitable watercourse crossings and fauna passages. Measures to mitigate and ameliorate potential impacts that may occur during the operation of the rail will, therefore, be implemented during construction. Measures will include:

- Height of the rail corridor above watercourses will be optimised to facilitate the movement of wildlife underneath the infrastructure and reduce potential interference with aquatic fauna movements. Disturbed watercourses will be revegetated to reduce erosion potential. Sufficient spanning of watercourses will be achieved to not interfere with the floodplain hydraulics. Protective vegetative drains and dams will be established to manage stormwater runoff and sediment erosion potential to buffer sensitive flora and fauna and provide alternative water resources.
- Sediment traps will be established at strategic locations to protect waterbodies from sediment and pollutants
- Fauna corridors require revegetation, fencing and grids/gaps to promote fauna use. Consideration will be given to fauna/fish passage requirements and design will adopt criteria which promote fauna use.
- 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.
- Fencing, waste management, speed limits, fire controls, pest and weed controls, vehicle maintenance and pollutant and waste/hazardous substance management, to be coordinated under the Environmental Management Plan (operation), will be utilised onsite to minimise direct or indirect impacts to flora or fauna or pollution of the environment.
- Incidents of fauna strike and mortality are to be monitored during operation. Dead carcases are to be disposed of away from the rail corridor to reduce the occurrence of predators, such as raptors and pest fauna, also being struck by moving trains.
- The rail will be fenced to restrict ability of fauna to move across the rail line
- The railway infrastructure will not be lit, excepting for the balloon loop and maintenance facility. This will mitigate lighting impacts on fauna behaviour for the majority of the length of the corridor. It is expected that fauna will avoid areas such as the loop or maintenance facility, or will habituate to those disturbances.
- 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

Site specific, risk specific, management plans will be developed to control for potential impacts associated with matters including, but not restricted to, fire, pollution, introduction or spread of weeds or pests and release of contaminants. These management actions seek to avoid or reduce impacts

and will be implemented and controlled through an Environmental Management Plan for the rail Project. In consideration of the 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 and localised. Standardised monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required. Losses of vegetation that cannot be ameliorated will be realised during the construction phase and no additional losses that may require offset are expected to occur during the operational phase.

5.1.4 Mine Construction

5.1.4.1 Impacts

The construction phase of the mine Project will involve the following activities:

- Development of MIA – predominantly occurs within non-remnant vegetation (based on field-verified RE mapping)
- Development of the mine offsite infrastructure including a workers accommodation village, an industrial area, a permanent airport and water supply infrastructure

It is understood that:

- Construction will be undertaken during (when possible) dry periods to minimise potential erosion and sediment control impacts as far as practicable
- Construction affected water will be captured and prior to reuse and/or discharge
- Water required for construction will be sourced from onsite dam and offsite sources)
- Sanitation for construction crew will be treated to A standard and recycled onsite or discharged in accordance with relevant approvals

Remnant and non-remnant vegetation is proposed to be cleared during the Mine construction phase. Approximately 24 ha of remnant vegetation and 1,921 ha of non-remnant vegetation is proposed to be cleared for construction of the MIA, and approximately 86 ha of remnant vegetation and 3,227 ha of non-remnant vegetation (including 9 ha of high value regrowth vegetation) is proposed to be cleared for construction of the offsite infrastructure.

Field studies at the Project Area indicated that cleared land had relatively low terrestrial ecological value, and supported a lower diversity of flora and fauna species than more complex habitats featuring remnant vegetation. Cleared areas were generally not found to provide a suite of habitat resources for conservation significant terrestrial ecological values (i.e. threatened species, migratory species, TECs etc.), although black-throated finch (southern) and squatter pigeon (southern) sightings were made at water bodies surrounded by non-remnant vegetation, during the Spring 2011 survey.

To achieve construction of the mine facilities lands will be cleared and infrastructure will be built. Potential impacts arising from vegetation clearing during the construction phase may include:

- Loss of vegetation and fauna habitat (including roosting, foraging and breeding areas)
- 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
- Erosion of surface soils

Land clearing for construction will affect approximately 30 ha of potentially suitable habitat for the black-throated finch (southern) (confirmed present at Study Area) the squatter pigeon (southern) (confirmed present at Study Area) and the koala (confirmed present at Study Area), approximately 57 ha of potentially suitable habitat for the yakka skink (likely to occur at Study Area) and approximately 27 ha of potentially suitable habitat for the ornamental snake (likely to occur at Study Area). In addition to conservation significant species, these vegetation communities provide habitat features for a variety of common woodland bird, reptile and mammal species.

Habitat degradation, behavioural disruption and injury/mortality may arise as a result of increased vehicular activity and a change in disturbance types at the Study Area. Habitat degradation and associated behavioural disruption may result from increased dust mobilisation and increased exposure to noise, light and vibration. Injury and mortality may occur where animals are struck by vehicles or plant, or where animals become entrapped in active construction areas (pits, trenches, building sites etc.). Increased human activity may alter the fire regime of the local landscape, either deliberately through the need to manage bushfire risk, or through the accidental ignition of bushfires.

Introduction and/or spread of weeds and pest species, or introduction of wastes and pollutants, may occur from construction works. In particular, rubbish and wastes associated with the workers accommodation village may attract feral animals such as pigs and dogs, which would adversely affect native biodiversity. Measures will be required to manage pests, wastes and pollutants to maintain the ecological integrity and functioning of non-disturbed lands and waterways.

One small farm dam (approximately 6 ha in size) will be lost as a result of construction of the MIA. This dam is a shallow scrape that has a seasonally fluctuating water level, and does not feature aquatic or riparian vegetation. While the dam is likely to represent a localised water source for fauna, potentially including threatened species such as the black-throated finch (southern) and squatter pigeon (southern), water is readily available from other farm dams throughout the surrounding agricultural landscape. The temporary draining of eight small instream farm dams (on each of North Creek and Obungeena Creek), to allow for expansion of these storages, will represent a temporary loss of what is a locally abundant resource. The water resource will be available post-expansion, when the enlarged dams refill after inflows following rainfall.

There are no mapped water bodies within the workers accommodation village or industrial precinct and airport. Construction of the offsite water supply infrastructure will, however, result in temporary disturbance of aquatic habitats. Existing farm dams on North Creek and Obungeena Creek will be expanded to capture flood flows for the water supply. This process will require these dams to be temporarily drained so that the expansion can be undertaken. The temporary removal of these artificial aquatic habitats will result in localised, short-term impacts to non-conservation significant fish, macrophytes, crustaceans and turtles that are likely to be present; in the medium to longer term, this habitat will be restored when the water is returned.

North Creek and Obungeena Creek are ephemeral second order creek systems that play an important role in providing seasonal connectivity for aquatic fauna upstream and downstream in times of flow. This connectivity is important in maintaining gene flow and genetic diversity between periodically isolated populations. Additionally, these connecting waterways provide for recolonisation and/or population supplementation in the event of a population extinction or bottleneck. The

expansion of the existing water supply dams on these creeks may create habitat fragmentation if flows are reduced due to larger volumes of water captured in the dams.

There is likely to be minimal impact to this aquatic habitat connectivity along watercourses from proposed dam expansions; however if creek diversions are proposed during construction, temporary loss of impacted sections of instream habitat may occur.

If flows occur in either waterway during construction, construction activities will probably preclude fish movement upstream. However, the construction period is short and impedance to movement over a single wet season is not likely to have any long term effects on fish populations. Impacts are also anticipated to be localised, with no aquatic species or habitats of conservation significance affected by the loss of habitat or impedance to movement during construction.

Construction of pump sites and associated pipelines in the riparian zones of North Creek and Belyando River will also impact on aquatic and riparian habitat. Construction of the offsite water supply infrastructure will also result in temporary disturbance of aquatic habitats while pipelines are installed across streams and drainage lines. These include ephemeral drainage lines; North Creek, Obungeena Creek and Eight Mile Creek.

Construction areas for water supply pipeline corridors, including laydown areas and stockpiles will be located within the pipeline corridor, where possible to minimise vegetation clearing related impacts. Additionally, the pipeline right of way within the riparian zone of Belyando River and North Creek will be reduced, where possible to minimise impacts to vegetation communities. The disturbance of the riparian zone may trigger erosion and sedimentation impacts and resulting degradation of adjacent and downstream habitats.

Management measures will, however, be required for all construction operations to mitigate potential impacts to downstream waterbodies that could influence protected matters. These would include changes in water quality as a result of erosion, introduction of contaminants, wastes or other pollutants.

Alteration of the topography of the landscape to achieve development of the MIA will result in changes to surface flows and geomorphology. The existing open grazing land will be compacted and developed and, as such, the resultant land will have a higher potential for runoff. Appropriate stormwater management, including use of water storage dams and gross pollutant traps, will be required to manage potential for erosion and scouring from runoff to manage risk of contaminants entering watercourses.

Individuals and/or populations of some of the species recorded from the terrestrial and aquatic environments across the MIA will be lost from the local environment due to clearing and watercourse disturbance proposed for the construction phase of the mine Project. The total impact to potential habitat for EPBC Act listed fauna species and to TEC communities or flora as a result of the proposed construction activities for the Project is summarised in Table 5-2.

Table 5-2 Impact to EPBC Act Listed Threatened Matters from Mine Construction

EPBC Act listed matters	EPBC Act status	Total clearing extent*
Confirmed present		
Squatter pigeon (southern)	vulnerable	30 ha

Geophaps scripta scripta		
Black-throated finch (southern) *Poephila cincta cincta*	endangered	30 ha
Koala *Phascolarctos cinereus*	vulnerable	30 ha
Likely to occur		
Ornamental snake *Denisonia maculata*	vulnerable	27 ha
Yakka skink *Egernia rugosa*	vulnerable	57 ha
May occur		
Red goshawk *Erythrotriorchis radiatus*	vulnerable	24 ha
Australian painted snipe *Rostratula australis*	vulnerable; marine; migratory (CAMBA)	One artificial waterbody
Acacia ramiflora	vulnerable	0 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).

5.1.4.2 Management and Mitigation

Design will minimise the extent of land to be cleared for the construction of the MIA and offsite infrastructure. Where land clearing is required, the following management and mitigation measures will apply to minimise impacts:

- 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 be identified on construction plans and in the field. Pipeline construction right of way will be reduced where practicable to minimise the removal of riparian vegetation. Clearing extents are to be communicated to all necessary construction personnel involved. Vegetation clearing operations are to be supervised by an ecologist to monitor compliance of vegetation clearing with the defined clearing extents. Each water supply storage area (offsite infrastructure) will include an associated storage area. These will be located, where possible, within existing cleared, non-remnant or disturbed areas.
- Existing dams that are to be extended and/or the dam wall uplifted to increase storage capacity will be partitioned such that works will not interfere with the existing environment and dam area that supports the flow through of water. Works will preferentially occur during dry periods in ephemeral waterhole areas. A Fauna Salvage and Relocation Plan (a component of the Land Management (Flora and Fauna) Plan) will be developed to manage risk of mortality to resident fauna in any watercourse being affected by construction.
- As soon as possible after cleared areas are no longer required, rehabilitation will commence using flora species of local provenance. Management of land disturbed as a result of construction works will occur in accordance with a Project Land Rehabilitation Management Plan. This plan will detail how disturbed land will be managed and rehabilitated, including (but not limited to) details about seed collection, flora regeneration and landscape architecture (i.e. topography). The objective of land rehabilitation will be to provide habitat resources for those localised flora and fauna assemblages identified in this existing terrestrial ecological values report.
- Vegetation clearing will be undertaken in a sequential manner to allow mobile fauna to disperse away from clearing areas. Prior to clearing, all demarcated habitat features will be checked for fauna by a fauna spotter-catcher and at-risk species will be relocated. A Fauna Relocation Plan (a component of the Land Management (Flora and Fauna) 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.
- Waste management, speed limits, fire controls, dust suppression, pest and weed controls, management of sewage and other potentially harmful wastes and pollutants will be utilised onsite to minimise direct or indirect impacts to fauna or pollution of the environment. All environmental controls will be documented within the Environment Management Plan (construction). Efficacy of management measures will be audited regularly and records maintained to demonstrate compliance.
- 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 trenches. Consideration should be given to not using barbed wire on the top strand of wire fences.

- Design must incorporate stormwater management infrastructure and mechanisms to minimise the change in flow regime of watercourses where appropriate and mitigate potential pollution. This may include holding tanks and/or gross pollutant traps.
- Avoid and minimise human and vehicle access to river and creek bed and banks. Existing access tracks will be used where possible and new tracks will align to traverse previously disturbed areas. Watercourse crossings will be minimised during route selection. Where watercourse crossings are required, crossing locations will be selected to avoid or minimise disturbance to aquatic flora, waterholes, watercourse junctions and watercourses with steep banks. Construction of river/watercourse crossings ahead of track 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. A Project Erosion and Sediment Control Plan will be implemented to limit degradation of downstream aquatic habitat. Temporary stream or channel diversion may be required to facilitate activities in wet periods. Stream flow should be maintained to provide connectivity between aquatic habitats and facilitate aquatic fauna passage.

5.1.4.3 Residual

The mine construction impacts will be progressive with a timeframe that achieves peak production within 10 years. There is an initial intense construction phase (first three years) to realise first mine activity. Rehabilitation and progressive development will occur throughout the life of the Project.

5.1.5 Mine Operation

5.1.5.1 Impacts

Full details about the staged operations of the proposed mine are provided in the Description of the Project (refer to Volume 1, Section 2 Description of the Project). Consideration of the intended operational works is provided here to support assessment of impacts to matters of NES that are likely to be associated with operational work activities, and to identify and nominate relevant management and mitigation measures.

The operation phase of the Project is proposed to involve the following activities:

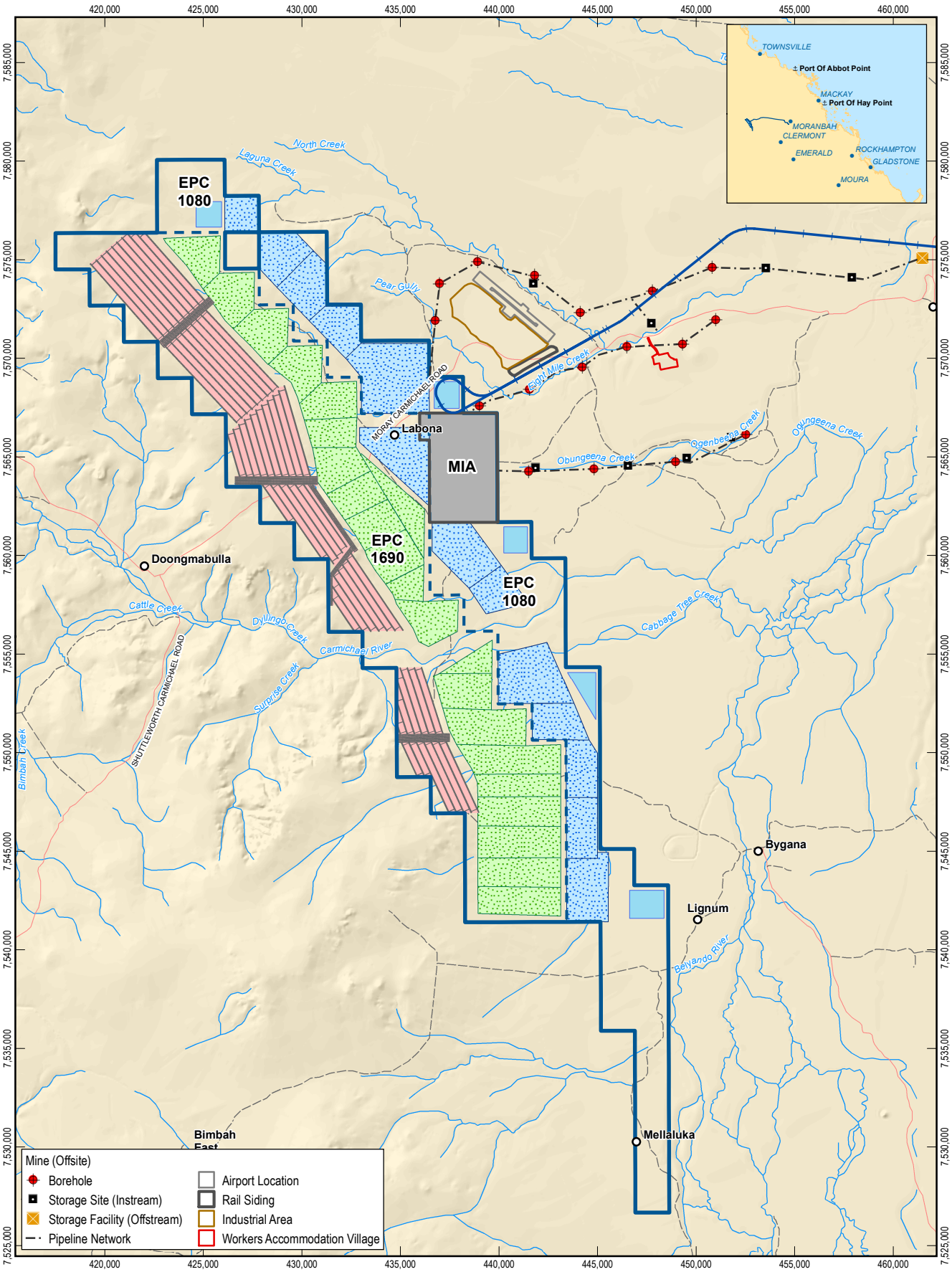
- Underground mining staged through development with subsidence of mined areas expected to occur
- Open cut mining staged through development and rehabilitation of pits over the duration of the mine life
- Management of overburden through disposal (out of pit waste dumping) and development and rehabilitation of waste areas over the duration of the mine life
- Development and maintenance of clean water diversion drains to be established along the boundary of the Study Area, and separating clean inflows from dirty water areas
- Operation of offsite water supply infrastructure
- Establishment of sediment ponds to receive water from mining operations

- Development and maintenance of a 500 m buffer from each bank of the Carmichael River, with establishment of a flood levee bordering the 500 m buffer zone adjacent to the Carmichael River
- Diversion of Eight Mile Creek

The indicative locations of the underground mining area, open cut mining area (blocks), out of pit waste dumps, water management dams, areas potentially exposed to subsidence (i.e. those areas above the underground mine), and areas not to be subjected to operation phase activities, are presented in Figure 5-1. Detailed assessment of subsidence and waste effects of the Project are provided in Volume 2, Section 4 Land. Those assessments and their findings have informed this report.

It is understood that:

- Staged, non-sequential construction of the mine is proposed to occur over 90 years, incorporating
  - Underground mining at the west of the Study Area
  - Open cut mining at the middle of the Study Area
  - Overburden disposal (out of pit waste dumping) and water management dams at the east of the Study Area
- Discharge of water from sediment ponds to nearest drainage line will only occur under licence conditions
- Operation of the offsite water supply infrastructure including:
  - Pumping of water from North Creek and the Belyando River during peak flow periods
  - In-stream river extractions on North and Obungeena Creeks
  - Pumping of local groundwater reserves in the Moray Downs property, outside of the active mining leases
- Management of clean water through sediment basins/traps will be undertaken prior to discharge into the Carmichael River
- Management of water from operations through capture in sediment ponds for reuse will occur
- Access to the southern part of the Study Area will be achieved via one access point, a spanned bridge across the Carmichael River
- No surface water will be extracted from the Carmichael River for operations
- All water leaving the mine footprint will be in keeping with the mine Water Quality Management Plan
- Sanitation for the operation crew will be treated in a packaged plant to an A+ standard
- All effluent will be recycled on site



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Construction Phase
- Operation Phase
- Underground Mine Area
- Water Management Dams
- Underground Mine Plan
- Open Cut Blocks
- Out of Pit Waste Dumps

1:275,000 (at A4)
0 1 2 3 4 5
Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Indicative Mine Plan - Areas of Impact

Job Number 41-25215
Revision B
Date 29-08-2012

Figure 5-1

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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: DME: EPC 1690 (2010), EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); Adani Pty Ltd: Indicative Mine Plan/Infrastructure (2012). Created by: BW, CA

5.1.5.2 Framework for the Management of Operation Phase Impacts

Past land use associated with agricultural activities (most notably broad scale clearing) over several decades has impacted more than 90 per cent of the Brigalow Belt Bioregion and Burdekin catchment (Sattler and Williams, 1999; Dight, 2009). This has significantly altered the landscape in the region, such that the conservation status of remnant vegetation and a number of flora and fauna species has increasingly become a concern to government organisations and local and scientific communities. Notwithstanding the recent efforts by landholders, governments, private industry and research organisations to restore vegetation communities and species habitats through improved contemporary land management practices, there remains concern that future development within the region will hinder the recovery of remnant vegetation, species and habitats.

As is described in the following sections, it is recognised that substantial impacts associated with this Project to the ecological values of the Study Area will occur as a result of mine operations. In recognition of the nature and scale of impacts, and the impact previous land use has had on biodiversity in the region, the following framework is proposed to manage these impacts and assist with biodiversity recovery over the life of Project operations. It is critically important that implementation of the framework becomes a collaboration between the proponent, land managers, research organisations and government so that the package of mitigation measures are able to meet the framework's objective.

In recognition of the variable, staged disturbance that will occur over the life of the mine, the framework will provide detailed adaptive management[2] strategies across a number of key elements that require mitigation. Indeed, the framework will be underpinned by monitoring programs and on-going research such that management actions can be appropriately targeted, implemented, and where required, modified. This approach will need to be linked to the offsets strategy for the Project so that enhancement of biodiversity occurs at both local and regional scales. The local scale is assumed to include the Study Area and the regional scale considers biodiversity values and connectivity across the landscape to tens of kilometres from the Study Area.

Prior to the commencement of Project operations, there will be a requirement to further develop the framework so that detailed plans and strategies contribute to its effective implementation. At this stage of the assessment process, the framework remains a concept, and substantial investment and collaborative efforts between key stakeholders will be required to further develop the framework (this is likely to require negotiation with regulating agencies). From a conceptual viewpoint, the framework will incorporate:

- Management of land and watercourses within the Study Area that will not be subject to direct impacts during parts of, or for the duration of the mine's operation phase (i.e. areas above the proposed underground mining footprint, the riparian corridor about the Carmichael River, areas to be mined in latter stages of the staged development etc.).
- Management (rehabilitation) of land and watercourse/drainage lines post-disturbance (i.e. areas where open cut pits and out of pit waste dumps were located).

[2] Adaptive management:

- Management under uncertainty
- An iterative process, with feedback via monitoring
- Hypothesis driven / information driven
- Revision and updating of management and monitoring over time based on new information and changed goals

- Enhancement of regional biodiversity values through land procurement (including ongoing management) and research as part of the Project's offset strategy.

It is proposed that as part of this framework, a detailed implementation schedule be prepared, outlining the timing and location of the applicable management actions, to reflect the staged development of the mine. Specifically, a series of plans will be developed, that consider individual elements of the framework to meet the overall objective to enhance local and regional biodiversity values. To achieve this, the framework aims to:

- Prevent or minimise, to the greatest extent possible, impacts to ecological values (i.e. vegetation communities, fauna habitats, flora and fauna species, watercourses) at the Study Area. This specifically relates to all those parts of the Study Area that will not be exposed to habitat clearing, either for the duration of the mine's operational life, or at discrete time periods during the Project's operation phase. It includes management of those areas that are currently characterised by remnant vegetation, as well as rehabilitation and management of those parts of the Study Area that are currently cleared. It encompasses management of a range of habitats including riparian, wetland, open woodland and native grasslands communities, and should not be limited to TECs, threatened REs or habitats specific only to threatened species. The prevention/minimisation of impacts will be achieved through the implementation of the mitigation and management measures detailed throughout the following subsections, and will incorporate the actions to be detailed in the:
  - Project Land Management (Flora and Fauna) Plan – the objective of this overarching plan will be to manage unmined land within the Study Area such that adverse impacts to the terrestrial ecological values are minimised, while all opportunities for maintenance and enhancement of these values are identified and realised. It will be underpinned by targeted research that will inform adaptive management, and, at a minimum, will incorporate/make reference to the following - management plans:
  - Project Vegetation Management Plan – monitoring and management of ecological values associated with remnant vegetation located both within unmined areas and areas where vegetation is to remain but may be subject to subsidence.
  - Project Species Specific Management Plan(s) – identification and management of key habitats within the Study Area and in the vicinity of the Study Area for listed species that occur, or are likely to occur, within the Study Area. This will include enhancement strategies for areas that will not be directly impacted by mining activities, revegetation of currently cleared areas to return non-remnant areas to remnant status, and specific measures to manage individual species requirements. Species specific plans will also consider provisions for fauna relocation, where applicable (i.e. for aquatic species prior to draining of aquatic habitats).
  - Project Weed and Pest Management Plan – monitoring and management/eradication of weeds and introduced animals, where they have the potential to reduce the value of vegetation communities and habitats for native species, both in areas that will not be disturbed by mining activities and areas that will be rehabilitated.
  - Project Erosion and Sediment Management Plan – management of operation phase activities where they have the potential to degrade habitats as a result of erosion.

  - Project Waste and Resource Management Plan and Hazardous Substances Management Plan– management of materials associated with the mine's operation phase, where these materials have the potential to degrade habitats.
  - Project Bushfire Management Plan – a documented approach to managing fire onsite, such that the potential for adverse ecological outcomes as a result of fire (frequency and intensity) are minimised.
- Rehabilitate any areas disturbed during the course of staged mining operations (i.e. former open cut blocks, sites of out of pit waste dumps, drainage lines), to the extent that they provide the habitat features and values (including aquatic) that were available prior to disturbance – to be implemented in accordance with the Project Land Rehabilitation Plan.
- Provide offsite biodiversity benefits in the region, through the development and implementation of a Project Offset Strategy. This strategy, to be prepared and implemented in recognition of the staged operations of the mine, will seek to identify measures to protect and enhance the region's biodiversity, through a combination of procurement and management of land within the Study Area and offsite, monitoring and research.

In developing this framework further, to a point where it can be implemented prior to the commencement of mine operations, a number of key tasks will need to be undertaken, including (but not limited to):

- Consultation with relevant stakeholders to inform and develop targeted onsite (Study Area) and offsite management actions. This will include, but not be limited to: landowners adjacent to the Study Area, threatened species recovery teams (e.g. Black-throated Finch Recovery Team), research institutions (e.g. James Cook University, Central Queensland University), and government (DSEWPaC ,DEHP and DNRM). As no detailed discussions have been undertaken at this stage, this will be a priority task so that detailed plans can be prepared that meet the framework objectives.
- Collaboration with organisations that may be able to assist with development and implementation of on-ground management, monitoring and research actions. This may or may not require assistance from the organisations listed above, but will require assistance from a broad range of stakeholders including natural resource management groups, research institutions, conservation organisations, threatened species recovery teams and land managers. On-ground management actions will also need to be linked to offsets for the Project, so that appropriate land procurement (that meets offset policy requirements) and monitoring and research programs are implemented. Given the nature of what is proposed in this framework, the research component will be ongoing, and linked to management measures (adaptive management).
- Following the approvals process, ongoing consultation with regulatory agencies with respect to Government expectations and requirements will be required. Changes in policy, legislation and other conservation drivers will need to be considered throughout the various stages of operation, making government agencies key stakeholders in this framework.
- Complementary aims and objectives between this framework and the Project Offsets Strategy so that identification of offsite areas are appropriate, meet biodiversity conservation and enhancement outcomes and appropriate, targeted management and robust research inform management throughout the operation phase of the Project.

It is important to note that this framework will require frequent revision and updating, over the mine's 90 year operational life, so that it is reflective of the most current political, social and environmental circumstances. The Environmental Management Plan (operation) will allow for revision of management aspects and monitoring requirements at least every 10 years (if not more frequently). This will enable assessment of the response of aquatic and terrestrial ecosystems to both the mining operation (and management actions) and other non-project related factors (for example climate and other impactive activities in the region). Regular review will identify whether additional or alternative management actions are required to be applied to the Project to conserve ecosystem values than are identified by the Project at its outset.

The framework's key attributes, including component management plans, objectives, actions, timeframes and stakeholders, are summarised in Table 5-3.

Table 5-3 Overview of Operation Phase Management Framework

Management Plan	Primary Objective	Key Actions	Timeframes	Stakeholders
Management of land within the Study Area that will not be subject to direct impacts during parts of, or for the duration of the mine's operation phase				
Project Land Management (Flora and Fauna) Plan	To manage unmined land within the Study Area such that adverse impacts to the terrestrial ecological values are minimised, while all opportunities for maintenance and enhancement of these values are identified and realised.	Identify priorities for further field studies and targeted research priorities at the Study Area Undertake mapping on and offsite to identify areas to be managed under this plan (and the sub-plans listed below). This should be done in consideration of staged Project operations Identify parts of the Study Area that should be targeted for ecological management, so as to enhance the value of these areas. This should be done in consideration of staged Project operations. Develop monitoring programs, research projects and natural resource management trials to inform flora and fauna management. Incorporate the findings of onsite research and monitoring into management activities (as detailed in sub-plans listed below).	This overarching management plan (and the component sub-plans) listed below will be prepared prior to the commencement of mine operations. The actions detailed in this overarching management plan (and its component sub-plans) will be implemented throughout the mine's operation phase. Five yearly revision and updating of this plan (and its component sub-plans) will be undertaken to reflect regulatory and environmental circumstances, and will incorporate the most up to date scientific information, including that collected from ongoing research and monitoring programs at and near the Study Area.	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Conservation groups (i.e. Black-throated Finch Recovery Team) Natural resource management groups (Burdekin Dry Tropics NRM group) Land holders in the region Local governments Local communities (Clermont, Alpha, Jericho)

Management Plan	Primary Objective	Key Actions	Timeframes	Stakeholders
Project Vegetation Management Plan	Management of ecological values associated with remnant vegetation located both within unmined areas and areas where vegetation is to remain but may be subject to subsidence.	Map areas of remnant vegetation to be managed, in for each of the staged Project operations. Develop and implement a monitoring protocol, involving demarcated sites in managed areas within the Study Area, and reference sites outside of the Study Area. Collaborate with research institutions to determine research program to identify remnant vegetation changes resulting from subsidence, with the objective of informing management of this process.	Management plan to be prepared prior to commencement of Project operations. Plan's actions to be implemented throughout life of mine operations. Five yearly revision and updating of this plan based on currency of information available. Commence research program at commencement of underground mining operations.	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Natural resource management groups Land holders in the region

Management Plan	Primary Objective	Key Actions	Timeframes	Stakeholders
Project Species Specific Management Plan(s)	Identification and management of key habitats within the Study Area (and in the vicinity of the Study Area) for priority species that occur, or are likely to occur, within the Study Area.	Develop and implement research programs to provide a greater level of detail on the ecology of threatened species at the Study Area – to be undertaken in collaboration with applicable research organisations, conservation groups and government agencies. With respect to the black-throated finch (southern), research initiatives (and habitat management) to be directed by the recovery actions presented in the National Recovery Plan for the Black-throated Finch Southern Subspecies (Black-throated Finch Recovery Team, 2007) Manage habitats at (and in the vicinity of) the Study Area, in accordance with the findings of ongoing research at the site. Implement a monitoring program to review the efficacy of management actions.	Management plan to be prepared prior to commencement of Project operations. Implement ecology and threatened species research at prior to and during mine operations Five yearly revision and updating of this plan based on currency of information available.	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Conservation groups (i.e. Black-throated Finch Recovery Team) Natural resource management groups Land holders in the region

Management Plan	Primary Objective	Key Actions	Timeframes	Stakeholders
Project Weed and Pest Management Plan (weeds)	Monitoring and management/eradication of weeds (namely weeds on national significance and declared plants under the LP Act), where they have the potential to reduce the value of vegetation communities and habitats for native species, both in areas that will not be disturbed by mining activities and areas that will be rehabilitated.	Identification of weed infested areas at the Study Area (Year 1 of Project life) Development and implementation of protocols for eradicating weeds at the Study Area (Year 2 of Project life). Implementation of measures to minimise the introduction and spread of weeds at the Study Area (i.e. provision of weed wash down facilities, requirement for weed-free certification of vehicles entering Study Area) – throughout life of mine. Development and implementation of a weed monitoring program for the Study Area – throughout life of mine.	Management plan to be prepared prior to commencement of Project operations. Five yearly revision and updating of this plan based on currency of information available.	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Conservation groups (i.e. Greening Australia) Natural resource management groups Land holders in the region
Project Weed and Pest Management Plan (introduced animals)	Monitoring and management/eradication of introduced animals, where they have the potential to reduce the value of vegetation communities and habitats for native species, particularly listed species. Focus species will include pigs, rabbits and cats.	Development and implementation of protocols for eradicating/controlling introduced animals at the Study Area (Year 1 and 2 of Project life) Development and implementation of an introduced animals monitoring program for the Study Area – throughout life of mine.	Management plan to be prepared prior to commencement of Project operations. Five yearly revision and updating of this plan based on currency of information available.	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Natural resource management groups Land holders in the region

Management Plan	Primary Objective	Key Actions	Timeframes	Stakeholders
Project Erosion and Sediment Management Plan	Management of operation phase activities where they have the potential to degrade habitats as a result of erosion.	Identify and map erosive soils and potential erosion areas across Study Area – Year 1 of mine life. Implement standard erosion control measures wherever operations have the potential to facilitate erosion – throughout life of mine. Monitor the efficacy of erosion control measures, such that measures can be constantly improved – throughout life of mine.	Management plan to be prepared prior to commencement of Project operations. Plan's actions to be implemented throughout life of mine operations. Five yearly revision and updating of this plan based on currency of information available.	Adani Mining Pty Ltd Research organisations (i.e. universities)
Project Waste and Resource Management Plan and Project Hazardous Substances Management Plan	Management of materials associated with the mine's operation phase, where these materials have the potential to degrade habitats.	Design storage and handling facilities of hazardous and waste materials, such that potential for accidental release (i.e. leaks, spills, explosions) is minimised to the greatest extent possible. Develop a protocol for the management of hazardous material/waste products in instances where spills, leaks or explosions occur.	Management plan to be prepared prior to commencement of Project operations. Plan's actions to be implemented throughout life of mine operations. Five yearly revision and updating of this plan based on currency of information available.	Adani Mining Pty Ltd Research organisations (i.e. universities)

Management Plan	Primary Objective	Key Actions	Timeframes	Stakeholders
Project Bushfire Management Plan	A documented approach to managing fire onsite, such that the potential for adverse ecological outcomes as a result of fire (frequency and intensity) are minimised.	Develop a protocol for fire management at the Study Area. Ecological considerations, informed by onsite studies and input from relevant stakeholders (i.e. university researchers, government agencies), should be incorporated into this protocol, to the extent that mine operations and safety are not compromised.	Management plan to be prepared prior to commencement of Project operations. Plan's actions to be implemented throughout life of mine operations. Five yearly revision and updating of this plan based on currency of information available.	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Natural resource management groups Land holders in the region
Management (rehabilitation) of land post-disturbance				
Project Land Rehabilitation Plan	Rehabilitation of any areas disturbed during the course of staged mining operations, to the extent that they provide the habitat features and values that were available prior to disturbance.	Review existing literature relating to mine rehabilitation, and consult with applicable organisations (universities, government agencies) to determine a detailed procedure for rehabilitation of land post-disturbance. Where required, undertake/contribute to onsite and offsite research (including trials) relating to post-mining rehabilitation, so as to increase the knowledgebase on this subject, and inform the design of the rehabilitation protocol to be implemented at the Study Area. Develop and implement a monitoring protocol to assess rehabilitated areas.	Rehabilitation plan to be prepared prior to conclusion of the first stage of mining operations at the Study Area. Research trials to commence prior to commencement of mining operations. Rehabilitation to commence immediately following conclusion of staged mining operations, and continue to such time that pre-determined rehabilitation targets / benchmarks have been achieved (as revealed through on-going monitoring of rehabilitated areas).	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Natural resource management groups

Management Plan	Primary Objective	Key Actions	Timeframes	Stakeholders
Enhancement of regional biodiversity values				
Project Biodiversity Offsets Package	Identification and implementation of measures to protect and enhance the region's biodiversity, through a combination of procurement and management of land within the Study Area and offsite, monitoring and research.	Prepare a framework for the identification of opportunities to enhance biodiversity values within the Study Area and in the region. Secure offsets as identified through the Project Offset Strategy, and undertake all management and research obligations committed to through the securement of these offsets.	Offset strategy to be prepared as part of Project EIS approvals phase. Identified offsets (in accordance with staging of mine operations) to be secured/committed to prior to commencement of staged mining operations, such that net loss of ecological values is prevented or minimised.	Adani Mining Pty Ltd Commonwealth, State and local government Research organisations (i.e. universities) Natural resource management groups

The individual impacts identified for the Project are described and addressed following. It is proposed that the mitigation measures identified for each of these impacts will form part of the package of mitigation measures described above. Potential operational phase impacts to ecological values have been considered and identified as:

1. Clearing of land (vegetation clearing) and changes to topography:
   - Loss of vegetation and fauna habitat
   - Fauna mortality
   - Habitat fragmentation or changes as a result of change in topography
   - Habitat degradation (i.e. erosion of surface soils, degradation of water quality)
2. Disturbance of surface watercourses and removal of watercourses and waterbodies:
   - Aquatic fauna mortality
   - Loss of habitat for species
   - Alteration/degradation of water quality
3. Alteration in groundwater regime:
   - Changes to terrestrial habitat due to groundwater drawdown
   - Changes to surface water flows and aquatic habitat availability as a result of groundwater drawdown
4. Introduction of pest and weed species:
   - Competition with native species, predation of native specie
   - Habitat degradation (presence and prevalence of pest and weed species) and reduction in resource availability
5. Alteration to air quality and noise environs from altered exposure to disturbance:
   - Disturbance to roosting and foraging areas
   - Habitat degradation from dust settling

These are each addressed following as they relate to matters of NES. Reference should be made to Volume 2, Section 5 and Volume 3, Section 5 of this EIS for assessment of all impacts (i.e. those matters not protected by the EPBC Act) associated with operation of the Project. Reference is made to those wider Project impacts here only if they support assessment of potential impacts to matters protected by the EPBC Act.

Clearing of Land (Vegetation Clearing) and Changes to Topography

Mine operations at the Study Area will require extensive vegetation clearing. Open cut and underground mining is proposed to be staged over the life of the mine. The requirement for clearing follows the progression of the coal extraction. Subsequently, vegetation clearing is proposed to not occur across the entire mining footprint (i.e. areas associated with open cut mining, out of pit waste dumps and water management dams) in a single event, but rather is proposed to be staged to correspond with the sequential development of coal extraction.

Land clearing will result in an increase in exposed earth surfaces and a reduction in vegetated buffer between the location of the activity and the watercourses not yet disturbed. Vegetation clearing also has the potential to facilitate erosion. Where vegetation clearing occurs on floodplains and near

drainage lines, erosion may cause sedimentation of waterways, potentially degrading downstream aquatic and riparian habitats. It is proposed that a levee be constructed on either side of the Carmichael River, both to protect the channel and riparian vegetation, and to provide flood mitigation for the proposed pits to the immediate north and south of the river. The timing of levee construction is proposed to be in accordance with the mine plan.

Altered geomorphology may also affect erosion or sedimentation potential across the landscape. Particularly associated with offsite water supply infrastructure where dams may act as sources of sediment if appropriate bank stabilisation strategies are not properly executed.

Historical land use practises have resulted in a landscape which includes large tracts of cleared land featuring non-remnant vegetation. As such, the potential for long-distance west-to-east fauna dispersal across the landscape through much of the Study Area is currently limited by the presence of large tracts of non-remnant land to the east. A potential north east-to-west movement corridor, associated with connected tracts of remnant vegetation within and to the north east and west of the Study Area may be fragmented by staged mining operations. Similarly, mining in the southern part of the Study Area is expected to fragment a belt of remnant vegetation that extends from west of the Study Area, through the Study Area (at the Bygana West Nature Refuge) to the east towards the Belyando River. Habitat fragmentation will restrict opportunities for localised fauna movement, with impacts more pronounced on small, less mobile animals such as frogs, reptiles and small ground-dwelling and arboreal mammals. Perimeter fencing around the mine site may inhibit fauna movement.

The mining operation requires substantial excavation and movement of earth from and around the Study Area which will contribute to a change in topography across the Study Area. Overburden stockpiles will reach a maximum of 100 m in height. The impacted landscape will be engineered to manage erosion potential. Overland flows will be channelled into staging dams for management of stormwater runoff water quality. Subsidence is expected to occur across the area subject to underground mining, which will influence the topography of the landscape and influence habitat connectivity.

Whilst recognising that vegetation clearing is proposed to be staged, and that at any particular point over the life of the mine, some areas may retain the existing vegetation coverage, where other areas may be under active rehabilitation, this assessment considers the clearing of all vegetation proposed to occur within the indicative mining (operation) footprint over the life of the mine. It should be noted that all calculations presented are approximate, indicative only and based upon digitization of the preliminary mine plan (as at December 2011).

The mining (operation) footprint that is proposed to require vegetation clearing over the life of the mine, encompassing open cut blocks, out of pit waste dumps and water management dams is 19,907 ha (comprising 12,586 ha of remnant vegetation and 7321 ha of non-remnant vegetation). The staged loss of these habitats, over the life of the mine, will reduce the local availability of foraging, breeding and shelter resources for a wide diversity of fauna species. Mobile species may be able to disperse between similar habitats within the Study Area during staged mine operations, or disperse away from the Study Area to similar habitats in the landscape to the north, west and south of the Study Area.

Vegetation clearing may result in the direct mortality of fauna. Those animals that are unable to disperse away from areas under active clearing are particularly susceptible to injury or death. This includes amphibians, reptiles, small ground-dwelling mammals and nocturnal species that are inactive during daylight hours.

It is important to note that large parts of the Study Area will to not be exposed to vegetation clearing during staged operations of the mine. In total, 16,033 ha of land characterised by fauna habitats featuring remnant vegetation will not be cleared. In addition, 6,829 ha of open cleared land (characterised by non-remnant vegetation) will not be cleared of vegetation during the mine's operation phase.

One TEC, Brigalow (*Acacia harpophylla* dominant and co-dominant), was identified in the mine Study Area from field surveys. The presence of this TEC within the Study Area is described in Section 4.2.3. REs comprising this TEC are located within the proposed mining (operation) footprint and are proposed to be impacted by clearing for the operation of the mine. The majority of this TEC occurs south of the Carmichael River. Table 5-4 lists the REs present within the Study Area that form part of this TEC. This table lists the estimated area of direct impact for each TEC RE and the amount of RE within the mining lease that is proposed to not be impacted by vegetation clearing for mining operations.

An approximate area of 267 ha of Brigalow TEC is located within the Mine (operation) footprint. Of that approximately 195 ha (73 per cent) of the TEC is proposed to be directly impacted from vegetation loss associated with clearing activities for mine operations. The remaining 72 ha (27 per cent) is proposed to be retained and not be directly impacted by clearing activities for mining operations but some areas may be subject to subsidence from underground mining activities.

Table 5-4 Approximate Areas of Impact for Threatened Ecological Community REs

RE	VM Act status	Short description[1]	Area of impact[2]	Area of RE remaining[3]
Brigalow (*Acacia harpophylla* dominant and codominant)				
11.3.1	E	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	46 ha	5 ha
11.4.8	E	*Eucalyptus cambageana* open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	< 1 ha	0 ha
11.4.9	E	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains	149 ha	61 ha
Total			**195 ha**	**66 ha**

[1] From REDD (Queensland Herbarium, 2011)

[2] Areas are approximations only as calculated based on ground-truthed RE mapping

[3] Approximate area of RE within the Project Area that will not be cleared for mining operation, however some parts of this area may be subject to subsidence

The footprint for mining operations may contain potentially suitable habitat for one EPBC Act listed flora species, *Acacia ramiflora* (vulnerable EPBC Act), assessment for which identified that it may occur at the Study Area (refer Section 4.2.1). This species was not confirmed present during field surveys of the Study Area. It is likely that potentially suitable habitat for this species will be removed through sequential vegetation clearing for the operation of the mine over the lifespan of the mine. The waxy cabbage palm was detected in field assessments, however it is restricted to the Carmichael River channel. Since the waxy cabbage palm is restricted to the Carmichael River channel, it will not be directly disturbed, nor will it be undermined, and a buffer is to be established. Therefore, there will be no clearing or loss of habitat for this species.

The EPBC Act and Nature Conservation Act 1992 (NC Act) list the endangered black-throated finch (southern) which was recorded at the Study Area (Section 4.2.2). Of the potential habitat for the black-throated finch (southern) identified at the Study Area, Figure 4-8 presents the 'important areas' for the black-throated finch (southern) at the Study Area, as defined in the Black-throated Finch (southern) Significant Impact Guidelines (DEWHA, 2009). These areas are defined as area of identified potential habitat within 5 km of any post-1995 (i.e. Project field survey) sightings of the subspecies.

A total of 9,862 ha of the 21,246 ha of identified black-throated finch (southern) important areas is proposed to be impacted by vegetation clearing over the life of the mine. This comprises:

- 6,808 ha of important areas in areas to be cleared for open cut blocks
- 2,845 ha of important areas in areas to be cleared for out of pit waste dumps
- 209 ha of important areas in areas to be cleared for water management dams

Loss of habitat for the black-throated finch (southern) will be staged, in accordance with the staged development of the operational components of the mine. Previously mined areas will be rehabilitated in parallel with development of previously unmined areas within the Study Area. Nonetheless, an overall reduction in the local availability of habitat for the subspecies will occur as a result of the operation phase of the Project. It is possible that the subspecies may disperse away from the developed parts of the Study Area, either to suitable, unimpacted habitat within other parts of the Study Area, or to potentially suitable habitat in the landscape to the north, west and south of the Study Area.

The provision of surface water in the eastern part of the Study Area (water management dams) may provide additional localised access to drinking water for the subspecies (or at least compensate for the loss of surface water resources in nearby parts of the Study Area).

The EPBC Act (and NC Act) listed vulnerable squatter pigeon (southern) was recorded at the Study Area (Section 4.2.2). The mining (operation) footprint that is proposed to require vegetation clearing over the life of mine operations incorporates 12,391 ha of the 29,716 ha of identified as potential habitat for the squatter pigeon (southern) (based on field verified REs, as identified in Figure 4-2). This comprises:

- 8,115 ha of potential habitat in areas to be cleared for open cut blocks
- 3,861 ha of potential habitat in areas to be cleared for out of pit waste dumps
- 414 ha of potential habitat in areas to be cleared for water management dams

Loss of habitat for the squatter pigeon (southern) is proposed to be staged, in accordance with the staged development of the operational components of the mine. Previously mined areas will be rehabilitated in parallel with development of previously unmined areas within the Study Area. Nonetheless, an overall reduction in the local availability of habitat for the subspecies will occur as a result of the operation phase of the Project. It is possible that the subspecies may disperse away from the developed parts of the Study Area, either to suitable habitat within other parts of the Study Area, or to potentially suitable habitat in the landscape to the north, west and south of the Study Area.

The provision of surface water in the eastern part of the Study Area (water management dams) may provide additional localised access to drinking water for the subspecies (or at least compensate for the loss of surface water resources in nearby parts of the Study Area).

The EPBC Act listed vulnerable koala was recorded at the Project Area (Section 4.2.2.1). The proposed mining (operation) footprint that is proposed to require vegetation clearing over the life of Mine operations incorporates 10,609 ha of the 21,801 ha of identified as potential habitat for the koala (based on field verified REs, as identified in Figure 3-9). This comprises:

- 7,199 ha of potential habitat in areas to be cleared for open cut blocks
- 3,060 ha of potential habitat in areas to be cleared for out of pit waste dumps
- 350 ha of potential habitat in areas to be cleared for water management dams

Habitat loss and fragmentation is a major threat to the koala (SEWPAC, 2012). The loss of habitat considered suitable for the koala is proposed to be staged, in accordance with the staged development of the operational components of the Mine. Previously mined areas will be rehabilitated in parallel with the development of previously unmined areas within the Project Area. Nonetheless, an overall reduction in the local availability of habitat for the species will occur as a result of the operation phase of the Project.

It is possible that the species may disperse away from the developed parts of the Project Area, either to suitable habitat within other parts of the Project Area, or to potentially suitable habitat in the landscape to the west and south, or riparian areas to the east of the Project Area (as presented in Figure 4-10).

The EPBC Act (and NC Act) listed vulnerable ornamental snake was not recorded at the Study Area, however is considered likely to occur based on the suitability of habitat, previous records from the region, and the species' known distribution (Section 4.2.2). The mining (operation) footprint that is proposed to require vegetation clearing over the life of mine operations incorporates 1,368 ha of the 2,540 ha of identified potential habitat for the ornamental snake (based on field verified REs, as identified in Figure 4-11). This comprises:

- 663 ha of potential habitat in areas to be cleared for open cut blocks
- 642 ha of potential habitat in areas to be cleared for out of pit waste dumps
- 64 ha of potential habitat in areas to be cleared for water management dams

While vegetation clearing and associated loss of potential ornamental snake habitat will be staged, an overall reduction in the localised extent of potential habitat for this species is proposed to occur as a result of the Project's operation phase.

The EPBC Act (and NC Act) listed vulnerable yakka skink was not recorded at the Study Area, however is considered likely to occur based on the suitability of habitat, previous records from the

region, and the species' known distribution (Section 4.2.2). The mining (operation) footprint that is proposed to require vegetation clearing over the life of mine operations incorporates 12,282 ha of the 27,027 ha of identified potential habitat for the yakka skink (based on field verified REs, as identified in Figure 4-12). This comprises:

- 7,987 ha of potential habitat in areas to be cleared for open cut blocks
- 3,881 ha of potential habitat in areas to be cleared for out of pit waste dumps
- 414 ha of potential habitat in areas to be cleared for water management dams

While vegetation clearing and associated loss of potential yakka skink habitat is proposed to be staged, an overall reduction in the localised extent of potential habitat for this species will occur as a result of the Project's operation phase.

The regional extent of potentially suitable habitat for two EPBC Act listed vulnerable birds (red goshawk, Australian painted snipe), that may occur at the mine Study Area based on the presence of suitable habitat and known distribution, will be reduced. Potentially suitable habitat for these species will still be present at the Study Area during the mine's operation phase, and occurs in the surrounding landscape.

The loss of vegetation, resulting in a loss of flora species and habitat, is a considerable impact of the Project which will be incurred regardless of management and mitigation measures. Federal and State offset requirements will need to be addressed in relation to proposed vegetation clearing, amongst other impacts, for the Project. Offsetting requirements under the following policies will be addressed:

- DSEWPaC - EPBC Act Environmental Offsets Policy (2012)
- DERM - Queensland Biodiversity Offset Policy (DERM 2011e), a specific-issue offsets policy under the Queensland Government Environmental Offset Policy

Additional information regarding offset requirements for the Project is provided in Section 6.

Disturbance of Surface Watercourses and Removal of Watercourses and Waterbodies

The mine operation area will remove 38,380 ha from the local river catchments, comprising 16,480 ha within the Carmichael River catchment and 21,900 ha from the Eight Mile Creek catchment. Staged clearing of the land within creek catchments and creation of dams associated with offsite water supply infrastructure has the potential to disturb bed and bank substrates and lead to localised erosion and sediment transport to downstream habitats.

The potential impacts to aquatic ecosystems (dependant on stage in life of the mine) are consistent with those discussed in Section 5.1.4 though the extent of clearing and potential for impacts are much greater. Primary impact is related to mobilisation of sediments and other contaminants into the aquatic environment, which will require stringent erosion and sediment control management. The removal of habitat described at the site will reduce the availability of aquatic habitat on a local scale however the loss of these habitats is not expected to have an impact to the aquatic biodiversity of the region as:

- The types of habitat are well represented within the Burdekin Catchment
- Much of the habitat is farm dams or ephemeral waterways that do not contribute to regional re-colonisation or connect permanent aquatic habitats

Within the Project Area the watercourse pathways to be disturbed by pits or piles are generally ephemeral reaches at the top of a catchment rather than reaches that connect permanent aquatic habitat areas. Removal of these watercourse reaches will be temporally distributed throughout the entire mine operation (over 90 years).

It is recognised that acid mine drainage (AMD) can arise in coal seams where there is a high sulphur content. If this is the case, coal seams, when exposed to air and water can produce sulphuric acid (NSW Department of Planning, 2005). Acidic runoff into a watercourse is likely to have adverse impacts to surface water quality and in turn aquatic habitat suitability and faunal use of the environment. Results of testing undertaken as part of the assessment for potential acid mine drainage (see Volume 2 Section 10 and Volume 4 Appendix V Acid Mine Drainage Report) indicate that **the** majority of the overburden and interburden materials (not immediately adjacent to the coal seams) and roof and floor wastes are not likely to be a source of acid immediately after mining. Nor would most of these materials be expected to an immediate source of salinity; however, some portion could be a source of salinity. The clay materials of the overburden and interburden could have a markedly higher potential to release salts and metals to contact water even though the pH may remain alkaline. Typically however, the concentrations of metals in water contacting the waste would be expected to be low while waters remain circum-neutral. Nevertheless, water treatment within the mining operation will consider the potential for AMD and will be designed such that discharge from the footprint of the mine and into any watercourses achieves the required WQO for the Project. WQO will be developed for the Study Area, including for all water to be released into the waterways of the area (refer to Volume 4, Appendix Q Mine Water Quality for further detail on WQO).

In general, it is expected that over staged development of the mine, the local availability of surface water is proposed to be reduced. Operation of offsite water supply infrastructure may also alter habitat availability if water levels within constructed water supply dams and in-stream storages are affected (e.g. during flood harvesting). Areas overlying the underground mining area are proposed to be subject to subsidence. Whilst flow from higher on the catchment is proposed to be diverted away from this area, it is expected that some flow will occur in this area as a result of localised rainfall. There is potential for this water to accumulate in subsidence depressions, creating new surface water resources. These water resources will not be drained, but rather kept to support the ecological values of the system. Design of the underground mine plan should seek to minimise the potential for alteration to surface topography (and overland flows), such that impacts to vegetation communities and fauna habitats in these areas are minimised.

Terrestrial habitats associated with aquatic systems (i.e. riparian vegetation) are proposed to be lost from some ephemeral creek lines within the mining (operation) footprint. Installation of infrastructure may create a barrier to movement for native aquatic fauna species and/or alter hydrological flow. With respect to the operation of the offsite water supply infrastructure, fluctuating or prolonged lowering of water levels within the constructed, water supply dams and in-stream storages on Obungeena Creek and North Creek or during periods of flood harvesting may alter habitat availability for terrestrial species including conservation significant fauna species. Additional aquatic habitat and water resources may be created during times of high water levels; however, these values may also be reduced during extended dry periods.

Pumping of water from Belyando River, North Creek and Obungeena Creek may result in the entrainment of aquatic fauna species resulting in injury or death. This is not expected to affect any matters of NES. Draw down of water levels during periods of flood harvesting to the extent that dams

are drained on Obungeena Creek and North Creek may also result in the mortality of resident aquatic species. Beyond this dams may also naturally dry during periods of drought.

Impacts to surface water quality, including downstream impacts may occur where the geomorphology of waterways is altered, or where sediment and/or contaminants are mobilised during construction activities and enter waterways during and post-rainfall.

Alteration in Groundwater Regime – Mining Activities

The existing groundwater regime of the Project Area will be altered by dewatering of the proposed pits and underground mine tunnels, as detailed in the Mine Hydrogeology Report (Volume 4 Appendix R). Groundwater levels in the vicinity of the Carmichael River are currently within a few metres of the surface level and hence accessible to vegetation, and the key structural species defining the riparian vegetation community of the Carmichael River do have a facultative (i.e. partial or seasonal) dependency on groundwater. The riparian vegetation provides key habitat to the waxy cabbage palm (*Livistona lanuginosa*) which is a groundwater obligate species. This species is listed as vulnerable under the provisions of the Commonwealth EPBC Act and Queensland NCA. The species is not known to be conserved within any conservation tenure. Owing to the facultative and obligate nature of the species defining the riparian vegetation, the vegetation along the Carmichael River is considered to be a groundwater dependent ecosystem (GDE).

The degree of groundwater alteration has been identified in the Mine Hydrogeology Report (Volume 4 Appendix R) to be reliant on a number of factors, including underlying geology, soil type, proximity of proposed works to the Carmichael River and the proposed staging of the mining operations. The greatest impacts on groundwater have been identified in the groundwater model as not occurring until approximately 60 years into the operational life of the mine. As also identified in the modelling report, the impacts are cumulative, but not necessarily in a linear progression, with relative little change in groundwater regimes in the initial phases of the project but changes increasing more significantly in the latter stages of operation.

The groundwater model indicates that drawdown of the groundwater table over the length of the Carmichael River will be highly variable. At its greatest extent of operations and development, after approximately 60 years (of a ninety year mine life), drawdowns of up to between 30 to 60 m have been predicted for the groundwater table in the vicinity of the Carmichael River. This results in a decrease (on average) in river baseflow of 7 per cent (approximately 1,000 m3/day). Alterations of watercourse base flows above 5 per cent are generally considered to be ecologically significant and could be expected to have an adverse impact on aquatic and riparian ecosystem health.

In addition, the cone of groundwater draw down expected to result from the Project development includes the Doongmabulla Springs, a regionally important Great Artesian Basin discharge spring ecosystem listed as a TEC under the EPBC Act. Doongmabulla Springs is located approximately ten km to the south-west of the Study Area. This is a permanent artesian spring provides baseflow to the adjacent Carmichael River. This wetland has an area of 5 ha, and contains six flora species of conservation significance, including two species known to be endemic to the Doongmabulla spring (the herb *Eryngium fontanum* and the grass *Sporobolus pamelae*).

Predicted drawdowns at all springs in the Doongmabulla system are between 0.05 m and 0.12 m, less than 0.2 m throughout the operational period with the majority of predicted impacts lower than 0.05 m. The predicted drawdown potential at the Doongmabulla springs is 60 per cent of the level considered to be potentially significant and will occur approximately 60 years into the life of the mine.

In response to Coal Seam Gas (CSG) proposals, recent assessments of the potential for impacts of these operations on GAB springs have been carried out by DNRM and the Queensland Water Commission. These assessments have identified that drawdowns of over 0.2 m are considered to be potentially significant to the ecology and maintenance of the GAB springs. A change in the groundwater supply to the springs has the potential to reduce the suitability of the ecosystems to support the ecological values for which it is listed.

Given the current state of knowledge of the groundwater interactions and ecology of the springs, the level of impact in the short to medium term is deemed to be insignificant. Monitoring of the springs and groundwater interactions in the initial development stages of the mine as a priority ongoing management action will enable better refinement and understanding of the relationship between the groundwater and mound springs ecology. In the longer term, while the predicted drawdowns are less than that currently regarded as having a potential adverse impact on GAB springs, management measures may be derived during the course of the monitoring program to enable any potential threat to ameliorated during the latter operational phases of the mine (i.e. beyond 60 years).

Impacts (without management and mitigation) expected from the progressive drawdown of groundwater in the Carmichael River vicinity are:

- Reductions in channel flow as groundwater contributions diminish
- Reductions in environmental flows to the lower Carmichael River
- Increase the duration of zero flow and/or low flow periods in the Carmichael River, thereby reducing the temporal availability of aquatic habitat
- Progressive die-back of canopy trees and groundlayer vegetation in the area of groundwater drawdown, including in the riparian corridor of the Carmichael River, which may lead to loss of vegetative cover in these locations
- Loss of surface (channel) flows to the lower Carmichael River may also occur except during high rainfall events
- Loss of aquatic and vegetated habitat and resources for fauna currently utilising the Carmichael River and fringing open forest

Possible impacts expected to the Doongmabulla spring from groundwater drawdown may include:

- Loss of a small area of vegetation, including species of conservation significance, along the outer boundary of the wetland as the volume of flow from the spring declines
- Small declines in the output of the spring

Alteration in Groundwater Regime – Offsite Infrastructure Operation

In addition to affects associated with mining operations, alteration of groundwater regimes may also occur in association with water supply from bore fields in the project Study Area related to offsite infrastructure. Details in regards to potential impacts are provided in Volume 4 Appendix R Mine Hydrogeology Report and Volume 4 Appendix O1 Mine Aquatic Ecology Report. It is expected the offsite bores will be drilled into the more productive Triassic to Quaternary aquifers, which are considered to have a more productive groundwater flow (Hyder Consulting, 2012). Based on preliminary modelling output and anticipated aquifer parameters, it is expected that after 10 years of extraction, the radius of influence of each bore would range between 3 and 5 km. Assuming a 10-year extraction period with cone of influence of 2 km radius, drawdown is expected to range between

0.7 and 2.5 m. This analysis is based on anticipated parameters and should be validated by aquifer testing and subsequent modelling.

Valenza (2012) found that the predicted cone of influence of the nearest bore to the spring systems does not extend beneath the GAB Doongmabulla Spring complex or the Mellaluka Springs. Therefore, it is unlikely that the proposed groundwater extraction will incur any impacts to the ecosystems associated with these springs.

The Carmichael River and Belyando River are the largest water courses in the Study Area whereby each contain high value, groundwater dependent riparian vegetation. As outlined in Volume 2, Chapter 5 a reduction in groundwater levels at these locations as a result of operation of the offsite infrastructure has the potential to impact on structural changes to riparian ecosystems. A worst case scenario would involve localised dieback of riparian vegetation communities such as river red gums and paperbarks.

With regard to the potential to impact the Carmichael River, the offsite infrastructure borefield layout has been designed to maintain a distance equivalent to the maximum expected radius of influence of the extraction bores at peak extraction regime. Given that the river is outside of the proposed bored field's cone of influence Valenza (2012) found that it is unlikely that water supply from bores will impact river flows in the Carmichael River.

For the Belyando River some of the bores have been positioned at distances ranging between 2 and 3 km from the river, resulting in some parts of the river being within the bore field's cone of influence Preliminary analysis undertaken by Valenza (2012) found that the impact on groundwater levels is likely to range between 0.5 and 2.5 m. This could potentially result in localised reductions in baseflows to the Belyando River system.

Introduction of Pest and Weed Species

Pest and feral species may disrupt ecosystems by outcompeting and replacing native species, thus altering ecosystem diversity and potentially disrupting ecosystem function. Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds at the Study Area. While 27 introduced plants were detected at the Study Area (five of which are 'declared plants' under the LP Act (parkinsonia, parthenium, rubber vine, velvety tree pear and prickly pear)), weeds were not found to be prevalent across much of the Study Area. Increasing the prevalence of weeds at the Study Area (and potentially beyond to the surrounding landscape), may reduce the quality of habitats for some fauna species.

Eight introduced fauna species comprising six mammals, one bird and one amphibian were recorded during field studies. A large human settlement (with associated waste production) may provide additional resources (i.e. food scraps) for feral animals such as pigs and dogs. These animals, confirmed as present within the Study Area, may increase in abundance should easier access to forage resources be provided. 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 introduced animals
- Habitat degradation (i.e. pig damage of riparian areas)

Alteration to Air Quality and Noise Environs and Altered Exposure to Disturbance

Cattle grazing is the current land use at the Study Area and in the surrounding landscape. The Project is proposed to result in a change to the land use of the Project Area and immediate surrounds. Most notably, exposure to disturbance will be increased due to the greater level of activity at the Project Area, and the higher human population at and near the Project Area. 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).

Following extraction, coal will be processed and stockpiled in preparation for transport to port. Dust from stockpiles and operational works may affect vegetation and aquatic health. Dust deposition may affect the physiology of plants as a result of increasing leaf temperatures and reducing photosynthesis. Chaston and Doley (2006) note that the type of dust is related to impacts to leaf function, with fine dusts having impacts at much lower loads than dusts associated with mining activities, where high dust loads are needed to cause an impact. The authors concluded that dusts associated with mining activities will potentially impact plant physiology in instances where high dust loads may be deposited – typically within the immediate vicinity of the dust source (i.e. coal stockpile, overburden stockpile) (Chaston and Doley, 2006).

Altered land use activities across the Study Area will increase exposure to noise, light, dust, wind, weeds and introduced animals. Exposure to any or some of these effects may alter habitat composition (i.e. reduced flora diversity and simplified flora structure) and quality (i.e. reduced availability of forage resources, increased exposure to predators), thereby potentially changing species diversity in the altered habitat.

5.1.5.3 Management and Mitigation

The operation phase of the mine is proposed to result in the disturbance of approximately 12,586 ha of remnant vegetation. In addition to the area of remnant vegetation required and additional 7,321 ha of non-remnant vegetation (approximate) is proposed to be utilised for the operation of the mine. Due to operational works occurring sequentially throughout the entire Study Area over the life of the mine, the loss of remnant vegetation cannot be greatly minimised, however due to the operational layout of the mine much of the western half of the Study Area is proposed to be retained. Areas to be retained contain both remnant (approximately 14,304 ha, 53 per cent of remnant vegetation within the Study Area) and non-remnant (approximately 4,674 ha) vegetation. However, some of these areas not impacted by clearing may be subject to subsidence as a result of underground mining.

The loss of vegetation within the footprint for mining operations is proposed to impact upon approximately 195 ha of Brigalow TEC, as defined by field-verified RE mapping. Relevant legislative approvals will be required before the removal of this feature and appropriate offsetting obligations will need to be addressed.

Vegetation clearing is proposed to occur sequentially throughout the life of the mine, this will maintain the ecological values within each area of the Study Area until the time where mining is to occur within each area. Generally, the staged yet permanent loss of remnant vegetation for mining operations is proposed to have an acceptable impact on the REs located within the operational footprint of the mine. Less than one per cent of the current (2006) subregional RE extent for all endangered and of concern REs impacted by the Project is proposed to be lost as a result of vegetation clearing.

Where native vegetation clearing is required, the following management and mitigation measures are recommended:

- The extent of vegetation clearing is to be restricted to the minimal amount necessary for mining operations. During initial mining operations only mining areas subject to the first stage of sequential clearing are to be impacted. Vegetation clearing within or the disturbance of areas that are not subject to mining is to be minimised prior to their operational dates.
- The extent of vegetation clearing for each stage of mining operation 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.
- Remnant (including TEC) vegetation not subject to initial clearing is to be demarcated in the field and all staff are to be educated that these areas are environmental protection areas up until the time when they need to be cleared. Vegetation clearing operations are to be supervised by an ecologist to monitor compliance of vegetation clearing within the defined clearing extents.
- Prior to clearing of any remnant vegetation, the non-remnant areas that will remain unmined should be revegetated and managed to reach remnant status (to match pre-clearing extent). This will be detailed in the Project Land Management (Flora and Fauna) Plan.
- Where land clearing occurs near or within ephemeral waterways, this will be undertaken during dry conditions to minimise the likelihood of erosion and sediment mobilisation during and after rainfall events.
- Prior to construction and mining operation, baseline field surveys to identify initial weed populations and ongoing monitoring of these populations and for any new occurrences are to be undertaken. Any weed populations identified are to be actively managed with the goal to reduce the spread of and eradicate weed species from the Study Area. This will be detailed in the Project Weed and Pest Management Plan.
- As soon as possible after disturbed areas (cleared areas, open cut pits, out of pit waste dumps etc.) are no longer required, rehabilitation should commence to strive to achieve a 'no net loss of vegetation and watercourse' approach. This is to include, but not be limited to, measures including the reinstatement of drainage channels, riparian vegetation, soil profiles to the pre-mining extent, using flora species of local provenance and undertaking revegetation activities. Management of previously disturbed land will occur in accordance with a Project Land Rehabilitation Plan. This plan will detail how disturbed land (including watercourses) will be managed and rehabilitated, including (but not limited to) details about seed collection, flora regeneration and landscape architecture (i.e. topography). The objective of land rehabilitation should be to provide habitat resources for localised flora and fauna assemblages, as identified in this existing terrestrial and aquatic ecological values reports.

Vegetation clearing may result in the direct mortality of fauna. Those animals that are unable to disperse away from areas under active clearing are particularly susceptible to injury or death. This includes amphibians, reptiles, small ground-dwelling mammals and nocturnal species that are inactive during daylight hours. Management and mitigation measures to reduce the potential for fauna mortality as a result of land clearing activities during mine operations are largely analogous to those described for the construction phase of the Project (Section 5.1.4), and include:

- Vegetation clearing will be undertaken in a sequential manner to allow more mobile fauna species the opportunity to disperse away from clearing areas. All vegetation clearing will be undertaken in the presence of a qualified fauna spotter-catcher. Pre-demarcated habitat features should 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.
- All vehicles and plant associated with vegetation clearing will adhere to site rules relating to speed limits. Speed limits will be developed, and clearly signposted so as to minimise the potential for road kill.
- Temporary fencing will be erected, where required, around construction zones to exclude mobile animals from vegetation clearing areas.
- Site inductions are to include education regarding the local fauna of the site and identification of protocols to be undertaken if fauna are encountered.

The proposed mitigation measures detailed above seek to reduce the incidence of fauna mortality resultant from staged vegetation clearing during the operation phase of the Project. Nonetheless, it is anticipated that fauna mortality will occur, particularly for those cryptic and/or less mobile animals that may not be detected by the fauna spotter-catcher prior to or during vegetation clearing activities. This may, therefore, affect listed threatened species including the yakka skink and ornamental snake, which are cryptic, but it may also affect the koala, which is less mobile, or the squatter pigeon (southern), which often forages on the ground. Other bird species, such as the black-throated finch (southern), red goshawk and Australian painted snipe are less likely to be directly impacted by operational works, suffering mortalities, but are more likely to be indirectly affected by works reducing habitat availability within the local landscape and would, therefore, suffer displacement.

Mine operations may reduce the ability for fauna to disperse across the landscape by fragmenting the landscape, either as a result of land clearing or facility construction, thereby reducing fauna corridors. This is more likely in the northern and southern parts of the Study Area where potential north east-to-west/east-to-west fauna movement may occur through the Study Area. Habitat fragmentation and operational works may result in direct or indirect mortality for fauna. Management and mitigation measures to reduce the impact of habitat fragmentation (including risk of mortality) to local fauna populations include:

- Landscape permeability will be retained where possible. Staged mine development should seek to maintain east-west connectivity where possible throughout the mine's operational life. The strip of land to be protected on either side of the Carmichael River will be managed so as to maintain and provide biodiversity values.
- Work areas are to be checked regularly for fauna that may have entered the work area or become trapped and fauna are to be relocated. Management of work areas should seek to avoid attracting fauna. All vehicles and plant will adhere to designated tracks/roads to avoid unnecessary habitat impacts and will adhere to site rules relating to speed limits to minimise potential for road kill.
- Vegetation clearing will be undertaken in a sequential manner to allow more mobile fauna species the opportunity to disperse away from clearing areas. Employees will be made aware of environmental management requirements for vegetation clearing and fauna management and all employees will adhere to requirements at all times.

- Management of land that is yet to be mined, or is to remain unmined, will be undertaken in accordance with a Project Land Management (Flora and Fauna) Plan. This plan will detail how land not subject to direct impacts (i.e. vegetation clearing) should be managed (including details relating to land use (cattle grazing) and fire management), such that the terrestrial ecological values, including connectivity, of such areas are maintained, and where possible, enhanced. This plan will be implemented in conjunction with its component sub-plans relating to the maintenance/enhancement of terrestrial ecological values of undeveloped parts of the Study Area (i.e. Project Weed and Pest Management Plan, and Project Species Specific Management Plans).
- Management actions seeking to avoid or reduce impacts will be implemented, under the guidance of key strategies including the Project Land Management (Flora and Fauna) Plan and the Project Land Rehabilitation Plan. Standardised monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

Maintenance of fauna corridors, risks from vehicle movements within the site and vegetation clearing will be particularly important to mitigate potential to impact upon not just the ground dwelling species (yakka skink and ornamental snake) but also the koala and threatened birds known to occur or potentially occurring at the site.

The removal of the aquatic habitats of the farm dams and ephemeral, low stream order, watercourses within the mine operation footprints area is unavoidable. Although the habitats to be affected are not considered to be high value, many provide habitat for native fauna. In recognition of the staged approach to the mining it will be important to maintain the ecological values of watercourses in undisturbed states until scheduled for disturbance in order to limit indirect impacts to downstream habitats. Watercourses will be affected both directly and indirectly from land clearing and operational works and may result in alteration/degradation of water quality in downstream environs. Operation of offsite water supply infrastructure may also alter habitat availability if water levels within constructed water supply dams and in-stream storages are affected (e.g. during flood harvesting). Although new water sources are proposed to be created via water management dams at the eastern part of the Study Area, management actions to mitigate these risks are identified as follows:

- Design and sequencing of site use to incorporate stormwater management infrastructure and mechanisms to manage runoff. Stormwater management mechanisms and monitoring requirements will be developed prior to any operational activities for each operational area of the Study Area (as it is progressively developed) and incorporated in the Water Quality Management Plan.
- Watercourse diversion required will be achieved prior to any clearing to manage impacts to downstream habitats. Activities that affect watercourse path, including stormwater flow paths or creation of dams, are not to commence until suitable diversion and management of flows is achieved to avoid unnecessary interruption of flows, erosion and water quality degradation.
- Vegetation 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. Dust suppression activities to be undertaken where appropriate.
- Management of erosion and sedimentation will be undertaken in accordance with a Project Erosion and Sediment Management Plan. This plan will identify all practices to be implemented prior to, during, and post-construction to minimise the potential for erosion to occur, including (but

not limited to) timing of clearing activities, sediment and erosion control measures to be implemented, performance criteria and corrective actions. Monitoring and reporting protocols will be detailed within this plan, and responsible parties for implementing the plan's actions should be identified.

- Management of potential contaminant or waste release, or emergency response to such, to be documented within the Environmental Management Plan (operation). Regular water quality monitoring to be completed to confirm adequacy of management and mitigation measures. Monitoring requirements, water quality targets, corrective actions and reporting requirements to be clearly articulated in an Operational Water Quality Management Plan, embedded within the Environmental Management Plan (operation).
- Natural attributes of any aquatic habitats created throughout the mining operation will be enhanced. This will be achieved using measures including establishment of riparian zones with suitable native species and establishing aquatic habitat structure in areas that may provide temporary or permanent aquatic habitats, for example in permanent topographical voids remaining at mined open cut pits or other depressions. Rehabilitation of, or enhancement of, previously disturbed habitat at surface water courses and the creation of fringing habitat for terrestrial species adjacent to constructed water storages and dams will requirement for woody debris or other suitable structure that will promote establishment of aquatic flora and fauna. In addition, works will seek to identify and implement enhancement opportunities in newly created aquatic habitats that may arise as a result of subsidence. These measures will be identified within the Land Rehabilitation Management Plan.
- No water will be sourced from the Carmichael River
- Operating rules will govern extraction from offsite water infrastructure, with the intent that no water harvesting can occur below a set critical level. This approach will manage and maintain the water levels to this critical level to prevent dams being pumped dry. However, beyond this dams may naturally dry during periods of drought.
- Potential to entrain fauna at the point of water extraction will be prevented using screens on intake systems
- Sewage/effluent will be treated to A+ standard such that value and quality of aquatic habitats is not adversely impacted
- The suitability of measures will be audited, reviewed and amended as required but not less than every 10 years during the operational life of the mine

Apart from altered access to, or quality of, surface waters, a reduction in access to groundwater has the potential to result in impacts upon the environs of the Study Area. Current modelling, including for the offsite borefield, indicates that progressive draw down has potential to result in die back of species associated with GDEs and/or springs. The following management measures should be implemented regarding these potential impacts:

- Treated surface water flows from the mine site will be directed, wherever possible/feasible, to the Carmichael River to supplement channel flow
- Prior to construction and mining operation, further research is to be undertaken into the groundwater interaction with the Carmichael and Belyando Rivers and the interaction of groundwater with fringing ecosystems of the Carmichael and Belyando Rivers both within and

outside of the Study Area. The location for reintroduction of surface and ground water should be selected as a result of further research based on observations of channel 'porosity' or 'leakiness' i.e. the intention should be that this water be introduced to the channel at a location where it will remain in the channel (and thus contribute to environmental flows downstream, and not be immediately lost to groundwater).

- The health of the Carmichael River fringing open forest community should be monitored on a quarterly basis, with a focus on canopy health and the species composition of the ground layer. Permanent CORVEG primary monitoring plots and transects (the latter over at least 100 m) should be established at regular intervals along the river for this purpose. Where canopy or ground layer dieback is observed, consideration should be given to supplementary introduction of surface flows as outlined above. This will be detailed within the Project Land Management (Flora and Fauna) Plan.
- Flow data should be monitored on an ongoing basis prior to construction, during operation and post operation upstream, downstream and within the Study Area to measure changes to surface flows.
- When mining within a stage has been completed, restoration works must be undertaken in such a way as to restore aquifers to their previous levels, or to minimise ongoing drawdown (as much as this is possible).

The likely impacts from aquifer drawdown on the Carmichael River from mining activities are proposed to increase progressively as mine development moves south, and maximum drawdown is not expected until the mine is some way into its life.

Further investigations into the Doongmabulla Springs are required if groundwater draw down modelling suggests potential to impact this site. Investigations should be completed prior to draw down which would interfere with the springs to determine the likely impact on the spring of projected groundwater drawdown. These investigations should include detailed flora surveys, geological studies and ongoing modelling and should inform management actions to be implemented and reviewed for mine operations.

In addition to mining activities, operation of offsite infrastructure may impact upon groundwater. The design of the offsite groundwater borefield has aimed to reduce potential impacts on GDEs by allowing for a suitable distance between the abstraction bores and ecological values such as riparian vegetation. Once the proposed bores have been developed (exploration permit in application) with the required yield tests carried out, detailed groundwater surveys can be completed to verify the modelled estimates. It is proposed to position 17 bores within the offsite Study Area with the following constraints:

- No bore would be placed inside the Great Artesian Basin (GAB) Water Resource Plan area
- The minimum sustainable distance will be maintained between the bores and the ecosystems at risk (Carmichael River, Doongmabulla springs and Mellaluka springs). The sustainable distance is defined as the maximum expected radius of influence of the extraction bores, at peak extraction. Currently this is estimated as 2 km; however this value will be verified prior to mine operation and confirmed appropriate during the operational life of the mine.
- Detailed monitoring of groundwater levels and surface water flows at the Carmichael and Belyando Rivers will be completed prior to construction, during operation and post operation

upstream, downstream and within the Project Area to measure changes to groundwater and surface flows and enable reactive management if required.

- A continuous baseline monitoring program will be completed during the life of the mine operation. This will encompass surface flow features both upstream and downstream of the borefield, in conjunction with nearby bore extraction yields and associated drawdown records

To manage risk and potential for pest and feral species spread, and the potential for introduction of new feral species, during the operations an integrated suite of actions should be developed to manage pest species, including:

- A Project Waste and Resources Management Plan and Hazardous Substances 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).
- Monitoring for and management of introduced animals in and adjacent to cleared areas to occur in accordance with a Project Weed and Pest Management Plan. This plan should include details relating to the monitoring, management and where necessary eradication of pest animals.
- Management of weeds in and adjacent to cleared areas to occur in accordance with a Project Weed and Pest 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.
- Weed audits of areas to be developed (during staged mining operations) will be conducted at a suitable time of the year when growing conditions and identification of weed species are optimal. These audits should cover the applicable development area with a particular focus on high risk locations, such as areas of black soil so that appropriate scale weed mapping can be undertaken to identify weed hotspots, for incorporation into the Project Weed and Pest 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.
- Soil stripped and stockpiled from areas containing known weed infestations are to be stored separately and are not to be moved to areas free of weeds.
- Construction staff will not bring domestic animals to the Project Area.
- Management of land that is yet to be mined, or is to remain unmined, will be undertaken in accordance with a Project Land Management (Flora and Fauna) Plan. This plan will detail how land not subject to direct impacts (i.e. vegetation clearing) should be managed (including details relating to land use (cattle grazing) and fire management), such that the terrestrial ecological values, including connectivity, of such areas are maintained, and where possible, enhanced. This plan will be implemented in conjunction with its component sub-plans relating to the maintenance/enhancement of terrestrial ecological values of undeveloped parts of the Study Area (i.e. Project Weed and Pest Management Plan, and Project Species Specific Management Plans).

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 at and near the Project 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.

Habitat degradation, behavioural disruption and injury/mortality may arise as a result of increased vehicular activity and a change in disturbance types at the Project Area. Habitat degradation and associated behavioural disruption may result from increased dust mobilisation and increased exposure to noise, light and vibration. Injury and mortality may occur where animals are struck by vehicles or plant, or where animals become entrapped in active construction areas (pits, trenches, building sites etc.). Increased human activity may also alter the fire regime of the landscape which could affect vegetation and fauna. Management and mitigation measures relevant to these potential impacts include:

- Directional lighting will be used where lighting is required in construction areas.
- Dust suppression actions will be undertaken in all cleared areas, at stockpiles and on all unsealed roads at suitably regular intervals.
- Frequent maintenance of machinery and plant will be undertaken to minimise unnecessary noise and risk of sparks or other creating a fire hazard.
- Implement a Project Bushfire Management Plan to document protocols and actions for preventing accidental fires, including how fuel loads are to be stored and maintained across the Study Area.
- Management of land that is yet to be mined, or is to remain unmined, will be undertaken in accordance with a Project Land Management (Flora and Fauna) Plan. This plan will detail how land not subject to direct impacts (i.e. vegetation clearing) should be managed (including details relating to land use (cattle grazing) and fire management), such that the terrestrial ecological values, including connectivity, of such areas are maintained, and where possible, enhanced. This plan will be implemented in conjunction with its component sub-plans relating to the maintenance/enhancement of terrestrial ecological values of undeveloped parts of the Study Area (i.e. Project Weed and Pest Management Plan, and Project Species-Specific Management Plans).
- As noted above, speed restrictions, adherence to roads and use of trained fauna spotters are required to minimise mortality risk to fauna from increased vehicular activity at site.

The general management and mitigation measures outlined above seek to minimise habitat loss, fragmentation and other direct and indirect impact to the environs and biodiversity of the Project Area. Actions also seek to minimise the extent required for development of the various operational components of the mine, and maintain/enhance those parts of the Study Area that are proposed to not be subject to mining works during parts of, or throughout, the Project's operation phase.

5.1.5.4 Residual Impacts

Conservation Significant Fauna

It is recognised that, in spite of the recommended management and mitigation measures, and the active rehabilitation of disturbed areas that will occur through the mine's operational life, unavoidable loss of fauna habitat will occur. This will include loss of habitat for a number of listed threatened species known or expected to occur at the Project Area, including: black-throated finch (southern),

squatter pigeon (southern), koala, ornamental snake, yakka skink, red goshawk and Australian painted snipe.

Active, targeted management of habitats adjacent to the clearing footprint can improve their quality for migratory species. Establishing alternative habitats adjacent to the Project through active management prior to clearing migratory species habitats will encourage individuals to disperse from proposed clearing areas (or attract them to adjacent areas). This may include but not be limited to improving forage and nesting resources, increasing access to watering locations, and management of pest and weed species, to enhance the value of adjacent areas. This action will seek to minimise habitat loss (through replacement) and will also act to minimise potential for mortality by providing threatened species with habitat refugia within the operational mine landscape. The details for such management approaches and actions will consider the staged nature of operations, will be informed by onsite research, and will be detailed within Project Species Specific Management Plans (under the overarching Project Land Management (Flora and Fauna) Plan).

Notwithstanding the black-throated finch (southern) and koala (discussed below), it is proposed that targeted additional field studies be undertaken to determine the presence of individuals, populations/colonies and/or important habitat areas for threatened species not detected during field surveys for the EIS, that are considered likely to occur at the Project Area (i.e. yakka skink, ornamental snake). The findings of such studies will be a component of Species Specific Management Plans for these animals, and the outcomes will be directly linked to the Project Offsets Strategy.

Excepting the black-throated finch (southern) (refer Section 4.2), the Project Area is not considered to support an 'important population' or 'habitat critical to the survival' (as defined in DEWHA, 2009) of any EPBC Act listed threatened fauna species (i.e. squatter pigeon (southern) or koala (recorded at Project Area), ornamental snake (likely to occur at Project Area), yakka skink (likely to occur at Project Area, red goshawk (may occur at Project Area), Australian Painted Snipe (may occur at Project Area – refer to Section 4.2.2). Thus, habitat loss resultant from vegetation clearing or fragmentation of habitat is not considered to constitute a 'significant impact' to these species. .

The Project Offset Strategy (refer Volume 1, Section 9 Offsets Strategy of this EIS) will address the unavoidable loss of habitat for conservation significant fauna resultant from mine operations. Further studies at the Project Area will assist in informing the offsets strategy with respect to threatened species. The strategy will provide a framework for the identification of measures designed to provide regional biodiversity benefits, where onsite impacts cannot be avoided. Such measures may include the identification and procurement of offsite land to be managed for conservation purposes, and investment in ecological research in the landscape in which the Study Area occurs.

5.1.6 Significance of Impacts on Listed Threatened Species or Ecological Communities

The potential to realise a significant impact upon the listed threatened species or ecological communities within the Project Area has been considered against criteria identified by DSEWPaC. As identified under Section 1.6.3, filtering of species has been undertaken for this assessment to consider only those species which are known, likely or which may occur at the Project Area. Criteria which define these likelihood of occurrence categories are identified in Section 1.6.3. The assessment, therefore, includes all taxa that have:

- Been detected within the Study Area by recent or historic studies and

- A distribution which incorporates the Study Area and for which suitable habitat exists within the Project Area

This assessment does not consider those species:

- Which have not been recorded in the region
- Whose distribution does not encompass the Study Area
- For which suitable habitat does not exist within the Project Area

This approach is, therefore, considered to be a conservative one which captures all threatened species or communities that could potentially be affected by the Project. Those threatened species or ecological communities that could be affected by the Project, as determined by site assessments and desktop studies include:

- Threatened Flora:
  - *Acacia ramiflora* – vulnerable EPBC Act; May occur across Study Area
  - King bluegrass (*Dichanthium queenslandicum*) – vulnerable EPBC Act; May occur across Rail Study Area, unlikely to occur across Mine Study Area
- Threatened Fauna:
  - Black-throated finch (southern) (*Poephila cincta cincta*) – endangered EPBC Act; Known to occur at Mine and Likely to occur at Rail Study Area
  - Squatter pigeon (southern) (*Geophaps scripta scripta*) – vulnerable EPBC Act; Known to occur across both Mine and Rail Study Areas
  - Koala (*Phascolarctos cinereus*) (combined populations of Queensland, New South Wales and the Australian Capital Territory) – vulnerable EPBC Act; Known to occur at Mine Study Area and likely to occur at Rail Study Area
  - Ornamental snake (*Denisonia maculata*) – vulnerable EPBC Act; Likely to occur across both Mine and Rail Study Areas
  - Northern quoll (*Dasyurus hallucatus*) – endangered EPBC Act; Likely to occur across Rail Study Area
  - Yakka skink (*Egernia rugosa*) - vulnerable EPBC Act; Likely to occur across Mine Study Area
- Threatened Ecological Communities:
  - Brigalow (*Acacia harpophylla* dominant and co-dominant) – endangered under EPBC Act; Known to occur in Study Area
  - The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin (GAB) – endangered under EPBC Act; Known to occur west of Mine Study Area, may be subject to indirect impacts
  - Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin – endangered under EPBC Act; may occur in Rail Study Area

To identify whether a significant impact will occur to any of the above identified matters of NES an assessment was also made in relation to whether an important population of these listed threatened species occurs at the Project Area or whether the Project would affect threatened ecological communities or habitat critical to the survival of listed threatened species at the Project Area.

An 'important population' is considered to be one which is necessary for a species' long-term survival and recovery. This may include populations that are:

- Identified as important by a recovery plan
- Key source populations either for breeding or dispersal
- Necessary for maintaining genetic diversity or
- Populations that are near the limit of the species range

Habitat critical to the survival of a threatened species or threatened ecological community includes areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal of the protected matter
- For the long-term maintenance of the species or ecological community
- To maintain genetic diversity and long term evolutionary development
- For the reintroduction of populations or recovery of the species or ecological community

Such habitat may be, but is not limited to habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community and/ or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

5.1.6.1 Threatened Flora

Neither of the threatened flora species predicted to occur in the Study Area from the EPBC search (*Acacia ramiflora* and *Dichanthium queenslandicum*) were detected during field investigations. These floristic species may occur within the Project Area, however, field investigations clarify that if present neither species is prevalent. Field investigations did, however, detect the waxy cabbage palm which desktop assessment did not predict to occur in the Project Area. Assessment against EPBC Act criteria, as discussed in Section 1.6.5, (refer to Volume 2, Section 5 Mine Nature Conservation and Volume 3, Section 5 Rail Nature Conservation of this EIS) indicate that there is not an important population of these species across the Study Area. Given no representatives of *Acacia ramiflora* and *Dichanthium queenslandicum* were found on site and the waxy cabbage palm is restricted to Carmichael River channel, the Project is not expected to lead to a long term decrease in the size of either of these vulnerable species populations. As no representatives were detected it is not considered that the Project could fragment any populations, adversely affect habitat critical to the survival of these species, including for reproduction, or reduce their area of occupancy. Since the waxy cabbage palm is restricted to the Carmichael River channel, it will not be directly disturbed, nor will it be undermined, and a buffer is to be established. Therefore, there will be no clearing or loss of habitat for this species. Management actions will be implemented to avoid losses of habitat and vegetation as far as possible and to avoid introduction or spread of any weeds, pests or diseases that could affect these species detrimentally. Although there is potential for these species to occur within the Study Area, it is not considered likely that the Project will significantly affect either of these species either within the immediate Study Area or the regional landscape.

On this basis, this Project is not expected to significantly affect either the *Acacia ramiflora* or King bluegrass (*Dichanthium queenslandicum*) threatened flora species.

5.1.6.2 Threatened Fauna

Detailed assessment of potential to significantly impact upon any threatened fauna species noted above has occurred giving consideration to the DSEWPaC Significant Impact Guidelines. That assessment is provided in Volume 2, Section 5 Mine Nature Conservation and Volume 3, Section 5 Rail Nature Conservation of this EIS. In summary, assessment identifies that the Project is not expected to have a significant impact upon any of the identified threatened flora or fauna except the black-throated finch (southern).

For species which are not considered to be significantly impacted, this finding is on the basis that:

- Measures identified in Sections 5.1.2 to 5.1.5 are expected to manage the potential to directly or indirectly impact these fauna
- The Study Area does not support an important population of any of these species
- The species are well represented in landscapes that surround the Study Area, where suitable alternative habitat is prevalent and will persist
- The species are not considered to be dependent upon any habitat within the Study Area for survival.

As such, while large tracts of habitat suitable for these protected matters will be affected, alternative habitat suitable for these species exists adjacent to the Study Area and within the region. Accordingly the Project is not predicted to adversely affect:

- The survival of the species as it will not
  - Lead to a long term decrease in the size of the population of any of these species
  - Fragment existing populations of these protected species
  - Affect the breeding success of any of these species
  - Introduce disease of invasive species harmful to the protected species
- The persistence of the species in the regional landscape as it will not:
  - Remove or degrade habitat critical to the survival of the species
  - Reduce the occupancy of the species in the regional landscape
  - Interfere with the recovery of the species

Although a significant impact is not expected to occur to koala, there is little research which has been conducted in this area pertaining to populations of this species within this geography, habitats of importance and potential impacts of development (EPA, 2006). To address this, a number of research actions to be completed by the Project will improve understanding for the management of potential impacts to the koala and loss of habitat as a result of Mine operations. Research will seek to enhance species knowledge and conservation initiatives as per the National Koala Conservation and Management Strategy 2009-2014 (NRMMC, 2009) and future recovery plans for the koala. Mitigation strategies will be guided by actions detailed within the National Koala Conservation and Management Strategy 2009-2014 and will focus on developing and implementing an onsite and offsite habitat management and research program in collaboration with relevant stakeholders (i.e. Commonwealth and State governments, natural resource management groups, landholders etc.). Species specific management and research items to be included in the Project Species Specific Management Plan (on and offsite) for the koala (under the overarching Project Land Management (Flora and Fauna) Plan) may include:

- Onsite and offsite research of koala populations, densities and habitats within a relatively unknown area for this species. Data gathered will be incorporated into the Federal and State database of koala population distribution, density and habitat mapping data.
- Development and implementation of ongoing monitoring programs of koala populations and habitats encompassing the Project Area and surrounding region, to research impacts of development on low density populations.
- Onsite and offsite revegetation and rehabilitation of areas of koala habitat within disturbed areas of preferred habitat types including ironbark-box grassy woodlands and fringing riparian vegetation communities. This is aimed to improve the condition of habitats within and surrounding the Project Area, reduce fragmentation, and encourage connectivity and dispersal. Revegetation will include planting of eucalypt species of the area that are preferred by koalas.
- Monitoring of pest dog populations in the Project Area and implementation of an eradication program if necessary.

With regard to the black-throated finch (southern), however, a significant impact to this protected matter is predicted to occur as a consequence of the Project. Based on the (currently available) information (acquired from desktop and field studies) and in consideration of the Significant Impact Guidelines, (DEWHA, 2009), it is considered that the Project Area, in particular the Mine Study Area, does support a 'population' of the black-throated finch (southern), noting that a 'population' of an (EPBC Act) endangered species is defined in the Significant Impact Guidelines as:

- *A geographically distinct regional population, or collection of local populations, or*
- *A population, or collection of local populations, that occurs within a particular bioregion* (DEWHA, 2009c).

Given the presence and prevalence of the black-throated finch (southern) in the Mine Project Area, and given mining activity is expected to remove and extensively degrade large tracts of habitat for this endangered species, the Project has potential to significantly impact upon this subspecies. In particular, works may:

- Lead to a long-term decrease in the size of the population of black-throated finch (southern)
- Reduce the area of occupancy of the black-throated finch (southern) in a local and a regional landscape
- Fragment, into two or more populations, an existing population (or series of populations) of the black-throated finch
- Adversely affect habitat critical to the survival of the black-throated finch and
- Disrupt the breeding cycle of the species

Further, works may interfere with the species recovery by decreasing the availability or quality of habitat to the extent that the species is likely to decline.

The impacts to this species are expected as a consequence of loss of habitat to mining. Habitat losses will be staged. Research will be undertaken prior to mining works to improve knowledge of the habitat dependencies of this subspecies and to identify appropriate areas that can be rehabilitated/engineered to offer alternative habitats into which the species could naturally relocate ahead of mining works. This preliminary research will also seek to inform the distribution and

abundance of the subspecies in the landscape surrounding the Project Area, and provide information on the ecology of the black-throated finch (southern) in the region.

Habitat management, informed by ongoing research and monitoring, will occur during the life of the Project to minimise potential to realise a significant impact upon this species. Research works will contribute to the maintenance of this subspecies within this bioregion and therefore, in general, to the recovery of the subspecies, as per the objectives of the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007). The onsite and offsite habitat management and research program to be implemented will be informed by the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007), and developed in consultation with the Black-throated Finch Recovery Team, and other relevant stakeholders (i.e. Commonwealth and State governments, natural resource management groups, landholders etc.). Examples of recovery actions, documented in the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007), to be incorporated into the Project Species Specific Management Plan (on and offsite) for the subspecies, will include:

- Investigate breeding requirements and threats to key breeding areas (Action 1.1)
- Investigate feeding and other habitat requirements (Action 1.2)
- Undertake targeted surveys (to identify habitat) (Action 2.4)
- Secure selected sites for conservation (Action 3.1)
- Address threats on grazing lands (Action 3.2)
- Monitor management effectiveness (Action 3.3)
- Determine suitability of birds in captivity for a reintroduction project (Action 4.1)

Information obtained from such studies will be incorporated into the Project Species Specific Management Plan for the subspecies (under the overarching Project Land Management (Flora and Fauna) Plan).

The measures summarised here and detailed throughout this section seek to address the Project's impact to the black-throated finch (southern) to reduce these to the greatest extent possible. Given current knowledge, determining the efficacy of the proposed measures in reducing impacts and protecting the subspecies is difficult to quantify. Preliminary research is required such that a clearer understanding of the subspecies' prevalence and behavioural ecology in the region can be ascertained, thereby allowing for the assessment of Project impacts to the subspecies to be undertaken in the context of a detailed understanding of the subspecies' regional population, abundance and behavioural ecology.

5.1.6.3 Threatened Ecological Communities

With regard to the threatened ecological communities, only the Brigalow TEC was detected across the Project Area. This TEC was found within both the Rail and Mine Project Area.

The Brigalow TEC within the Rail Project Area occurs in contiguous patches associated primarily with creek lines. As for the grasslands TEC, the Brigalow TEC patches are fragmented by non-remnant and cleared habitat, but offer corridors along the waterways for fauna movements. It is expected that 37.4 ha of this TEC will be cleared to facilitate the rail corridor infrastructure development.

Within the Mine Project Area an extant patch of Brigalow TEC occurs south of the Carmichael River at the eastern boundary of EPC 1690 and into the western edge of EPC 1080. In total, across the Mine Project Area, 195 ha of this TEC will be affected by vegetation clearing to facilitate mining and stockpiling works (refer Section 4.2.3). Clearing of the Brigalow TEC will occur late in the operational schedule sequence, several decades from first operational activity commencement.

The TEC to be affected will be as a direct result of vegetation clearing. Vegetation clearing is an unavoidable consequence of the Project. Where possible, the Project footprint has been located in existing cleared areas. However, where the clearing of remnant vegetation, including that protected under the EPBC Act, is unavoidable and cannot be satisfactorily avoided, managed and mitigated, offsets are likely to be provided in accordance with the relevant Commonwealth and State offset policies (refer Volume 1 Section 9 Draft Offsets Strategy). Likely offset requirements for the Project are discussed further in Section 6 below.

The protected Brigalow TEC REs recorded for the Project are known to occur within the landscape immediately surrounding the Project Area and across the region. Residual impacts from clearing across the Study Area are less than 1 per cent of the subregional extent of the TEC (refer Table 5-5). Within Queensland approximately 65 per cent of extant Brigalow TEC occur within protected area estates. Therefore, in general terms of the permanent removal of area, it is considered that this Project will have a minor impact on prevalence of this TEC across Queensland as a result of clearing from the Project footprint. Notwithstanding, clearing of vegetation for the Project will result in reductions in extent, diversity and abundance of these communities and the species that utilise them.

There is the potential for significant impacts to occur on the local presence of the Brigalow TEC given:

- Clearing of 37.4 ha of this TEC at the rail and 195 ha of this TEC at the mine sites will reduce the extent of this ecological community within the local and regional landscape
- This clearing will remove the majority of identified areas of this TEC at the mine site and has potential to fragment this TEC within the rail site
- The alteration of the landscape to mining activities will adversely affect the habitat critical to the persistence of this TEC
- Draw down of groundwater levels may modify factors necessary for this TECs persistence in the surrounding landscape.

Table 5-5 Threatened Ecological Communities and Expected Clearing Impacts

TEC	Proposed clearing area	TEC extent in Queensland[1] (% impact)	Bioregion current extent[2] (% impact)	Subregions current extent[3] (% impact)	Protected area estate (% of Queensland current extent)[4]
Brigalow	232.4 ha	75,187,246 ha (0.0003%)	15,050,991 ha (0.0015%)	1,373,593 ha (0.017%)	49,428,835 ha (4.70%)

[1] Extent of TEC located within Queensland only, excludes areas located within other states. Figures calculated from DERM 2010a, b, c, 2011a: regional ecosystem 'current extent' as of 2006 based on the regional ecosystems comprising each TEC.

[2] TEC current extent within the Brigalow Belt bioregion as impacted by the Project.

[3] Subregions include the Belyando Downs and Northern Bowen Basin of the Brigalow Belt bioregion which are intersected by the project.

[4] Protected area estate = land tenured as national park, state forest and timber reserves within Queensland (DERM 2010a, b, c, 2011a).

It is not expected that the Project will significantly affect the prevalence of the brigalow TEC regionally (refer Table 5-5) as management measures will be implemented to minimise habitat losses within the Study Area and to ensure that no losses of this TEC will be realised outside the Study Area; no invasive species that could detriment the TEC will be introduced or spread as a consequence of the Project and chemicals that would detriment the TEC will not be spread into the regional remaining patches of this TEC.

Accordingly, while local significant impacts from localised losses are expected for the Brigalow TEC subregional or regional impacts are not expected to be significant. Offsets are likely to be provided to address losses in accordance with the relevant Commonwealth and State offset policies (refer Volume 1 Section 9 Draft Offsets Strategy). Likely offset requirements for the Project are discussed further in Section 6.

Native flora, fauna (including fish) and invertebrate species form a community dependant on natural discharge of groundwater from the Great Artesian Basin (abbreviated to 'GAB discharge spring wetlands') TEC (Fensham et al., 2010). This dependency restricts distribution of the TEC to the GAB. Surveys confirmed that this TEC is not present within the Study Area. However, impacts to regional aquifers as a result of groundwater draw down have the potential to impact this TEC.

The nearest GAB discharge spring is the Doongmabulla Springs, a cluster of 11 springs located within a four kilometre radius of each other along the Carmichael River, approximately 10 km upstream (west) from the western boundary of the Study Area (Fensham pers. comm., 2012). This wetland has an area of five hectares, and contains six flora species of conservation significance, including two species known to be endemic to the Doongmabulla Springs (the herb *Erygynium fontanum* and the grass *Sporobolus pamelae*). It has been given a GAB discharge spring wetland conservation ranking of 1a (the highest), based on the presence of endemic species (Fensham et al., 2010).

The main threatening processes for this TEC are aquifer draw down (due primarily to uncapped bores, but also to mining activities), excavation of springs, exotic flora and fauna invasion and stock damage, access by tourism, and impoundments (Fensham et al., 2010). This Project will realise

groundwater draw down that has potential to impact upon this TEC. Conservative (worst case) modelling indicates the influence of mine dewatering reaches the location of the springs with a maximum drop of the groundwater table of between <0.05 and 0.12 m (operation phase) and <0.05 and 0.12 m (post-closure) predicted for the vicinity of the Doongmabulla Springs. Predicted drawdowns at all springs in the Doongmabulla system are between 0.05 m and 0.12 m, less than 0.2 m throughout the operational period with the majority of predicted impacts lower than 0.05 m. The predicted drawdown potential at the Doongmabulla springs is 60 per cent of the level considered to be potentially significant (0.2 m) and will occur approximately 60 years into the life of the mine. Whilst not considered significant.

5.2 Summary

Operation of the mine will be staged across the 90 year life of the site. First mine activity will occur approximately three years into the construction of the mine. This will involve both underground and open cut mining works and operation of offsite infrastructure. Impacts will include land clearing, removal of water resources, alteration of topography and potential for introduction of pests, weeds or release of wastes and pollutants. Construction works for the Project will be progressive and will overlap with operational works from year three onwards.

Potential impacts arising from construction and operational works 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

How these may affect the threatened species or ecological communities has been assessed in detail. Potential impacts have been considered with regard to whether an important population of protected species occurs at the site and whether impacts may be significant or not.

Based on current knowledge assessment indicates the Project will likely realise impacts to the following EPBC Act protected threatened species or ecological communities:

- Brigalow TEC
- Black-throated finch (southern)

Impacts to the TEC result from unavoidable vegetation clearing and will be restricted to the Study Area only with management measures ensuring no offsite affects are realised. Large areas of this TEC are protected in the surrounding landscape and losses equate to less than 1 per cent of the subregional extent of the TEC (refer Table 5-5). Losses are not expected to affect the ongoing prevalence or genetic diversity of the TEC within the subregion. Offsets are likely to be provided to address these losses in accordance with the relevant Commonwealth and State offset policies (refer Volume 1, Section 9 Offsets Strategy). Likely offset requirements for the Project are discussed further in Section 6.

As a consequence of habitat losses to mining, and direct impacts, significant impacts to the black-throated finch (southern) are expected to occur. Further, works may interfere with the species

recovery by decreasing the availability or quality of habitat to the extent that the species is likely to decline.

Habitat losses will be staged. Research will be undertaken prior to mining works to improve knowledge of the habitat dependencies of this species and to identify appropriate areas that can be rehabilitated/engineered to offer alternative habitats into which the species could naturally relocate ahead of mining works. Habitat management, informed by ongoing research and monitoring, will also occur during the Project to minimise potential to realise a significant impact upon this species. Research works will contribute to the maintenance of this subspecies within this bioregion and therefore, in general, to the recovery of the subspecies, as per the objectives of the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007). The onsite and offsite habitat management and research program to be implemented will be informed by the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007), and developed in consultation with the Black-throated Finch Recovery Team, and other relevant stakeholders (i.e. Commonwealth and State governments, natural resource management groups, landholders etc.). Examples of recovery actions, documented in the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007), to be incorporated into the Project Species Specific Management Plan (on and offsite) for the subspecies, will include:

- Investigate breeding requirements and threats to key breeding areas (Action 1.1)
- Investigate feeding and other habitat requirements (Action 1.2)
- Undertake targeted surveys (to identify habitat) (Action 2.4)
- Secure selected sites for conservation (Action 3.1)
- Address threats on grazing lands (Action 3.2)
- Monitor management effectiveness (Action 3.3)
- Determine suitability of birds in captivity for a reintroduction project (Action 4.1)

Information obtained from such studies will be incorporated into the Project Species Specific Management Plan for the subspecies (under the overarching Project Land Management (Flora and Fauna) Plan). The measures summarised here and detailed throughout this section seek to address the Project's impact to the black-throated finch (southern) to reduce these to the greatest extent possible. Given current knowledge, determining the efficacy of the proposed measures in reducing impacts and protecting the subspecies is difficult to quantify. Preliminary research is required such that a clearer understanding of the subspecies' prevalence and behavioural ecology in the region can be ascertained, thereby allowing for the assessment of Project impacts to the subspecies to be undertaken in the context of a detailed understanding of the subspecies' regional population, abundance and behavioural ecology.

Operational works are expected to realise groundwater draw down impacts to the Doongmabulla Springs, a regionally important Great Artesian Basin discharge spring ecosystem listed as a TEC under the EPBC Act. Current modelling indicates between 0.05 m and 0.12 m, less than 0.2 m throughout the operational period with the majority of predicted impacts lower than 0.05 m. Additional research will be completed prior to work commencement to inform potential to impact upon this TEC and identify relevant management and mitigation actions for any impacts.

6. Impact on a Listed Migratory Species

6.1 Description of Environmental Values

The desktop assessment, summarised in Table 1-1, indicated that a number of EPBC Act listed migratory species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Mine and Rail Study Areas (as defined in Section 1.6). Of these, three were confirmed present during field surveys:

- Eastern great egret (*Ardea modesta*)
- Rainbow bee-eater (*Merops ornatus*)
- Satin flycatcher (*Myiagra cyanoleuca*)

A likelihood of occurrence assessment for EPBC Act migratory species was undertaken and details are provided in Volume 2, Section 5 Mine Nature Conservation and Volume 3, Section 5 Rail Nature Conservation of this EIS and findings are summarised in Table 6-1. As discussed in Section 4 above, where a difference in likelihood of occurrence outcome exists between the Mine and Rail Study Areas, the higher likelihood outcome has been assumed across the Study Area to provide a conservative understanding of the potential to impact a species as a result of the Project being implemented.

Table 6-1 Commonwealth Listed Migratory Species for Mine and Rail Study Areas – Likelihood of Occurrence

Species	EPBC Act status	Predicted to occur#		Previously recorded*		Recorded at Study Area		Likelihood of occurrence^	
		Rail	Mine	Rail	Mine	Rail	Mine	Rail	Mine
common sandpiper *Actitis hypoleucos*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA); marine	x	ND	✓	ND	x	ND	Likely	ND
fork-tailed swift *Apus pacificus*	migratory (CAMBA; JAMBA, ROKAMBA); marine	✓	✓	✓	x	x	x	Likely	May occur
cattle egret *Ardea ibis*	migratory (CAMBA; JAMBA); marine	✓	✓	x	x	x	x	May occur	May occur
eastern great egret *Ardea modesta*	migratory (CAMBA; JAMBA, ROKAMBA); marine	✓	✓	x	x	✓	✓	Confirmed present at both Mine and Rail Study Areas	

Species	EPBC Act status	Predicted to occur#		Previously recorded*		Recorded at Study Area		Likelihood of occurrence^	
		Rail	Mine	Rail	Mine	Rail	Mine	Rail	Mine
sharp-tailed sandpiper *Calidris acuminata*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA); marine	x	ND	✓	ND	x	ND	May occur	ND
curlew sandpiper *Calidris ferruginea*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA); marine	x	ND	✓	ND	x	ND	Likely to occur	ND
Latham's snipe *Gallinago hardwickii*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA); marine	✓	✓	✓	x	x	x	Likely	May occur
white-bellied sea-eagle *Haliaeetus leucogaster*	migratory (CAMBA); marine	✓	✓	✓	x	x	x	Likely	Likely
white-throated needletail *Hirundapus caudacutus*	migratory (CAMBA; JAMBA, ROKAMBA); marine	✓	✓	✓	x	x	x	Likely	May occur
Caspian tern *Hydroprogne caspia*	migratory (CAMBA; JAMBA); marine	x	ND	✓	ND	x	ND	Likely	ND
black-tailed godwit *Limosa limosa*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA); marine	x	ND	✓	ND	x	ND	Likely	ND
rainbow bee-eater *Merops ornatus*	migratory (JAMBA); marine	✓	✓	✓	✓	✓	✓	Confirmed present at both Mine and Rail Study Areas	
spectacled monarch *Monarcha trivirgatus*	migratory (Bonn); marine	x	x	x	x	x	x	May occur	May occur

Species	EPBC Act status	Predicted to occur#		Previously recorded*		Recorded at Study Area		Likelihood of occurrence^	
		Rail	Mine	Rail	Mine	Rail	Mine	Rail	Mine
black-faced monarch *Monarcha melanopsis*	migratory (Bonn); marine	x	✓	x	x	x	x	May occur	May occur
satin flycatcher *Myiagra cyanoleuca*	migratory (Bonn); marine	✓	✓	x	x	✓	x	Confirmed present	Likely
glossy ibis *Plegadis falcinellus*	migratory (Bonn; CAMBA); marine	x	ND	✓	ND	x	ND	Likely	ND
common greenshank *Tringa nebularia*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA); marine	x	ND	✓	ND	x	ND	Likely	ND
marsh sandpiper *Tringa stagnatilis*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA); marine	x	ND	✓	ND	x	ND	Likely	ND

✓ = record supports presence, x = record does not support presence, ND = desktop search did not detect this species

Predicted to occur within approximately 50 km of Study Area: DSEWPaC Protected Matters Search Tool

* Previously recorded within approximately 50 km of Study Area: desktop sources including Wildlife Online / Birds Australia

Bonn: Convention on the Conservation of Migratory Species of Wild Animals

CAMBA: Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment

JAMBA: Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment

ROKAMBA: Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds

6.1.1 6.1.1 Listed Migratory Fauna – Confirmed Present

6.1.1.1 Eastern Great Egret (Migratory, Marine EPBC Act)

The eastern great egret is a moderately large wading bird, listed as migratory (CAMBA; JAMBA, ROKAMBA) and marine under the EPBC Act. This species is widespread throughout southern and eastern Asia and Australasia (DSEPWaC, 2011e). Within Australia, the species occurs in all states and territories with major breeding colonies present along the coast of the Northern Territory, the Channel Country of south-western Queensland, north-eastern South Australia, the Darling Riverine Plains region of New South Wales and the Riverina region of New South Wales and Victoria (DSEWPaC, 2011e). The eastern great egret undertakes regular multi-directional movements, mostly

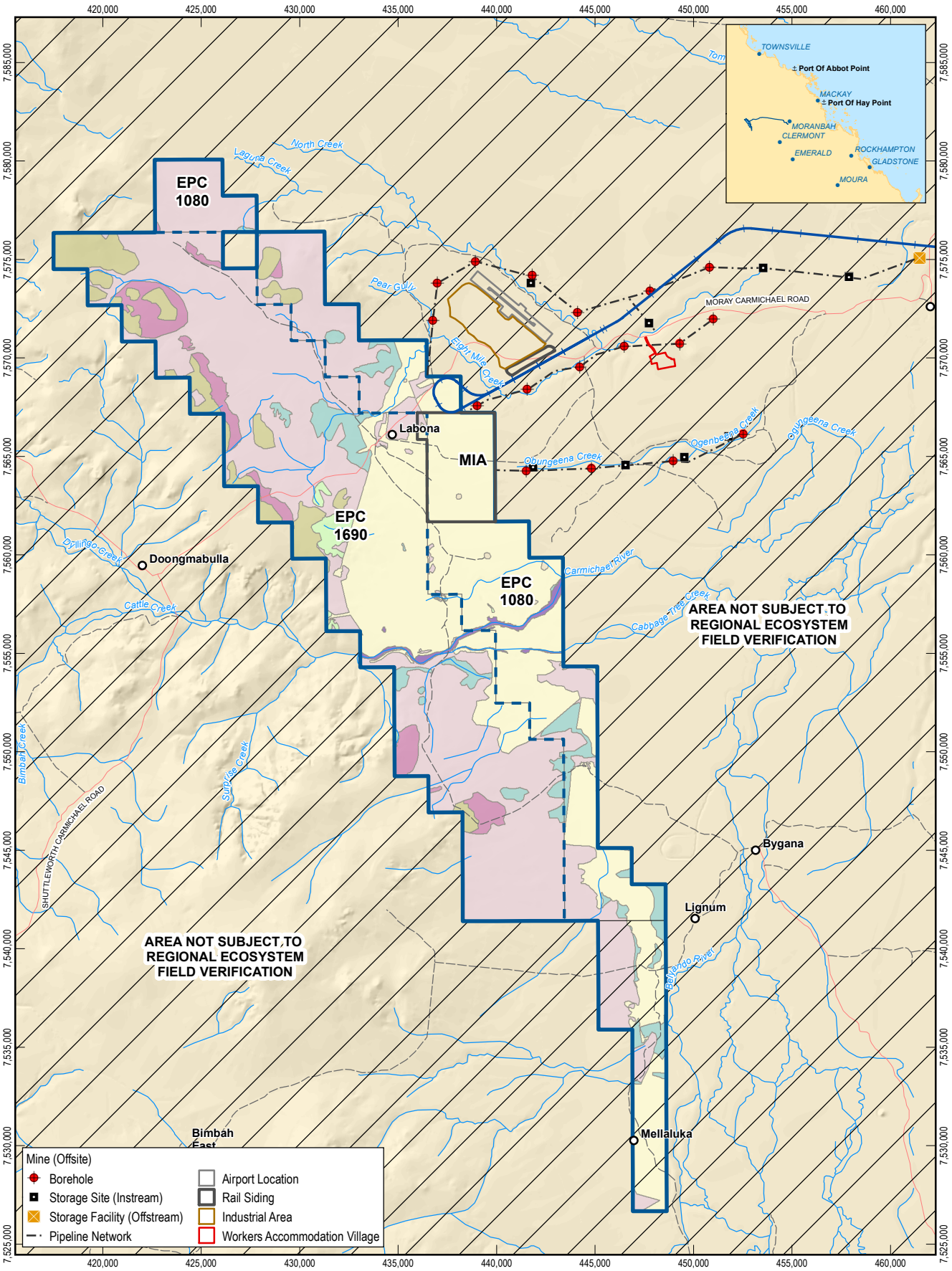
to and from breeding colonies and toward the coast during the dry season (DSEWPaC, 2011e). Long-distance migrations within Australia and to New Zealand and Papua New Guinea are suspected (DSEWPaC, 2011e). The population of eastern great egrets has been estimated at between 25 000 to 100 000 individuals (DSEWPaC, 2011e).

The eastern great egret inhabits a wide range of wetland habitats including shallows of rivers, estuaries, tidal mudflats, freshwater wetlands, sewage ponds, irrigation areas and larger dams (Pizzey and Knight, 2007). Foraging occurs by wading through shallow to moderately deep water where fish, insects, crustaceans, molluscs, frogs, lizards, small birds and mammals are taken from the water and vegetation (DSEWPaC, 2011e). Breeding in this species is influenced by rainfall but generally occurs between November and April. In Australia, breeding colonies generally occur in wooded and shrubby swamps including mangrove forests, Melaleuca swamps, and mixed eucalypt/acacia/lignum swamps (DSEWPaC, 2011e). Threating process include the loss and degradation of habitat as a result of alternation of water flows, draining and clearing of wetlands, burning of wetland vegetation, salinisation and invasion of weeds (DSEWPaC, 2011e).

The eastern great egret was recorded on one occasion during the September survey of the Rail Study Area and on four occasions across the three survey events of the Mine Study Area. The species was typically observed at farm dams. Group size ranged from a single bird to >10 birds. Field and desktop analysis provides an indication of habitat that may be utilised by the eastern great egret within the Rail and Mine Study Areas. These habitats have been mapped as fringing open forest / woodland habitat and natural and artificial water bodies. The distribution of these habitat types within the Study Areas and broader region is presented in Figure 6-1 and Figure 6-2.

Habitat at the Project Area is likely to be used on a temporary to permanent basis by this species. As the eastern great egret is common and widespread, and suitable habitat is likely to occur over much of the surrounding landscape, habitat at the Project Area is not considered to constitute 'important habitat' as defined in the Significant Impact Guidelines (DEWHA, 2009b), that is:

- *Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion (as defined in DEWHA, 2009b) of the population of a species, and/or*
- *Habitat that is of critical importance to the species at particular life-cycle stages, and/or*
- *Habitat utilised by a migratory species which is at the limit of the species' range, and/or*
- *Habitat within an area where the species is declining (DEWHA, 2009b)*



LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area

Broad Vegetation Communities and Fauna Habitat Type

- Gidgee and brigalow woodland on clay plains
- Ironbark-box grassy woodland on grey sand plains
- Low open woodland on ferricrete/laterised sandstone
- Open forest and woodland fringing streams and on flood plains
- Tall mixed shrubland on red sand plains and over ferricrete
- Yellowjacket-rough leaved bloodwood open woodland on red sand plains
- Open cleared land

1:275,000 (at A4)
0 1 2 3 4 5
Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

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Carmichael Coal Mine and Rail Project

Job Number 41-25215
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Date 07-09-2012

Vegetation Communities and Fauna Habitat Types: Project (Mine)

Figure 6-1

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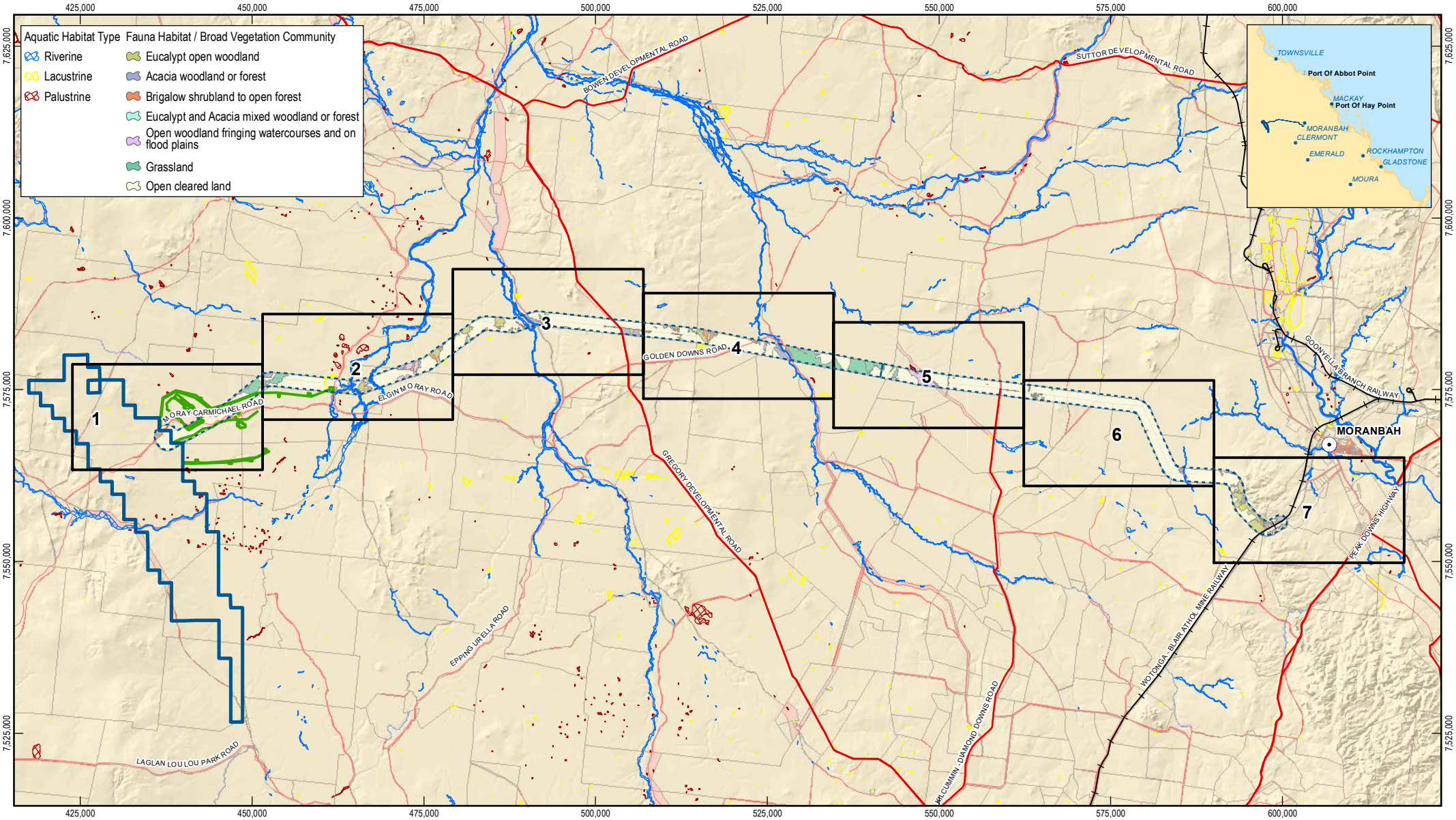
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010), EPC 1080 (2011); DERM: Broad Vegetation Communities, Fauna Habitat Types (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, 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
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Vegetation Communities and Fauna Habitat Types: Project Rail

Job Number 41-25215
Revision B
Date 07-09-2012

Figure 6-2
Series Index

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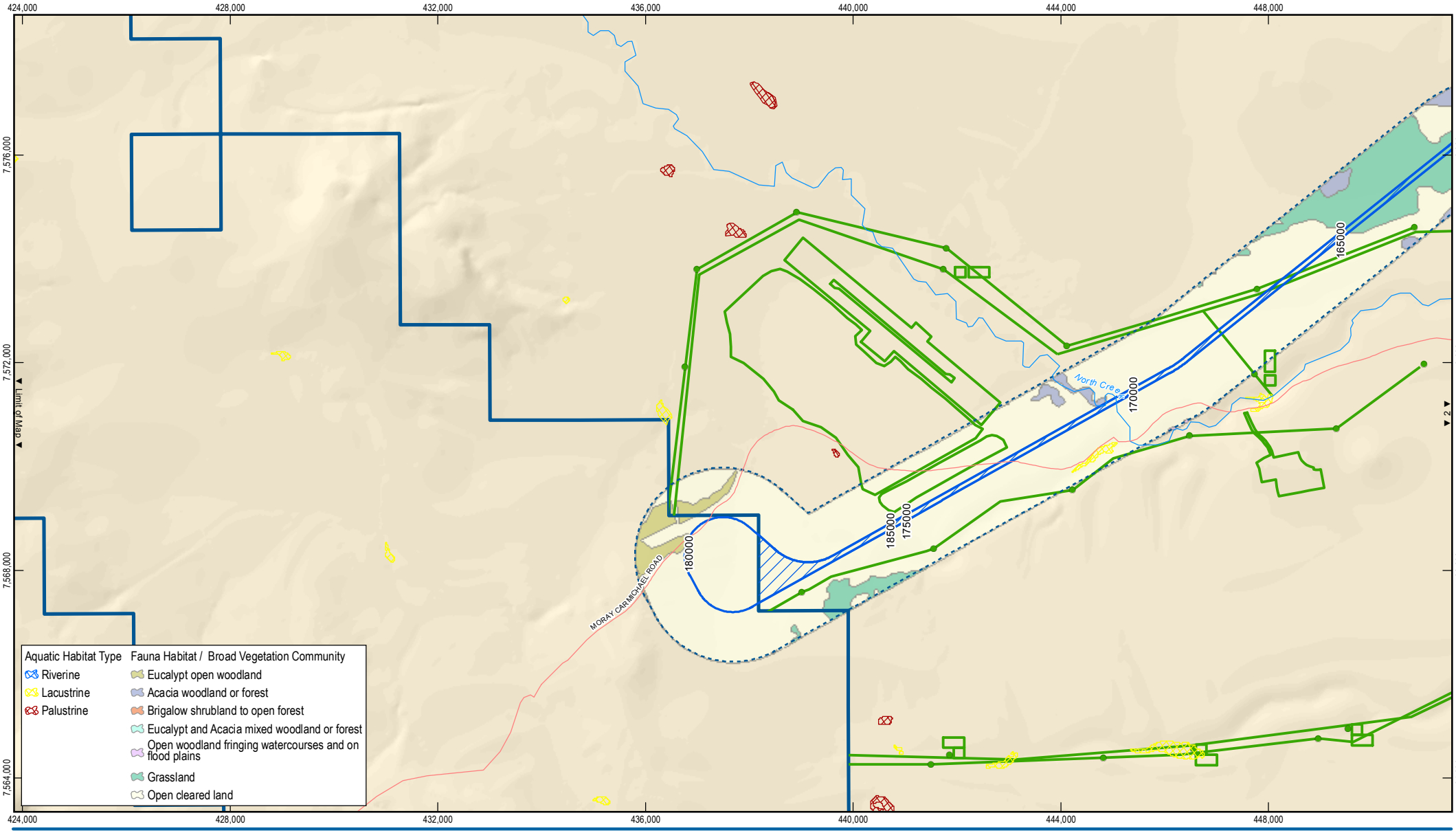
Data source: DERM: DEM (2008), Aquatic Habitat Type / Fauna Habitat / Broad Vegetation Community (2009), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia):Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA



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0 1 2 3 4

Kilometres

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
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Vegetation Communities and Fauna Habitat Types: Project Rail

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Figure 6-2
Sheet 1 of 7

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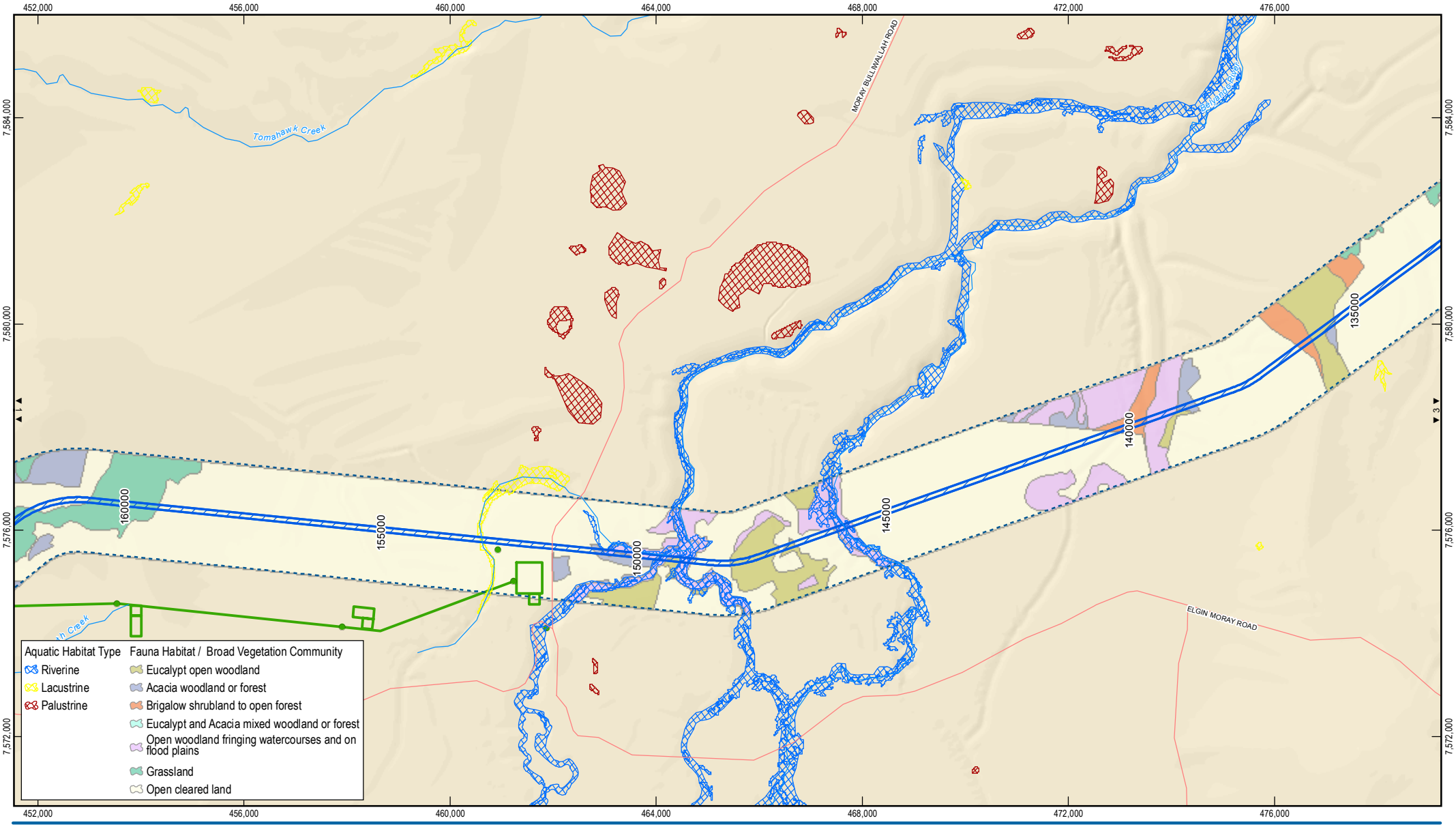
Data source: DERM: DEM (2008), Aquatic Habitat Type, Fauna Habitat / Broad Vegetation Type (2009); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Fauna Habitat Type (2011); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); 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

- 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

Vegetation Communities and Fauna Habitat Types: Project Rail

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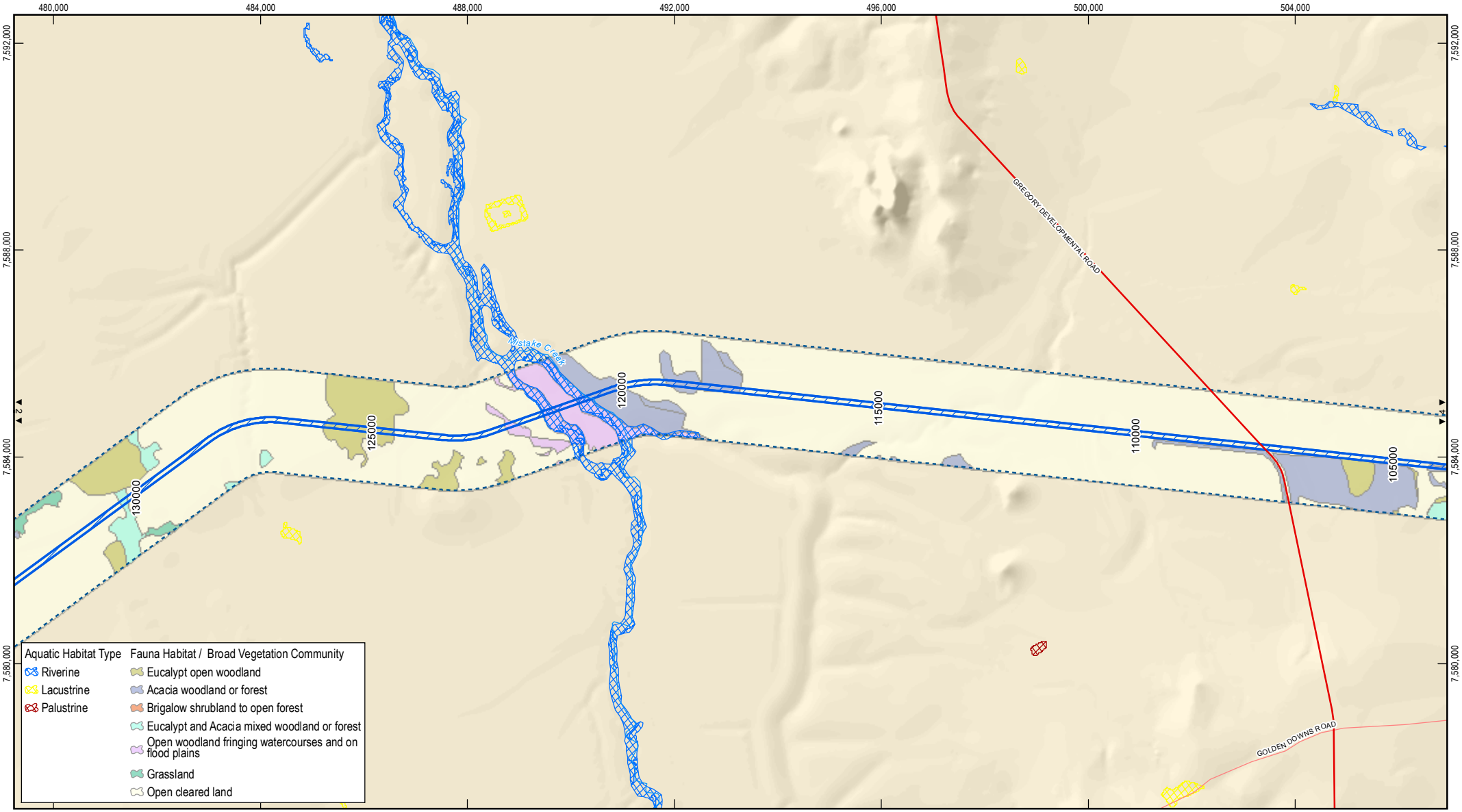
Data source: DERM: DEM (2008), Aquatic Habitat Type, Fauna Habitat / Broad Vegetation Type (2009); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Fauna Habitat Type (2011); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); 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

- 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

Vegetation Communities and Fauna Habitat Types: Project Rail

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Figure 6-2
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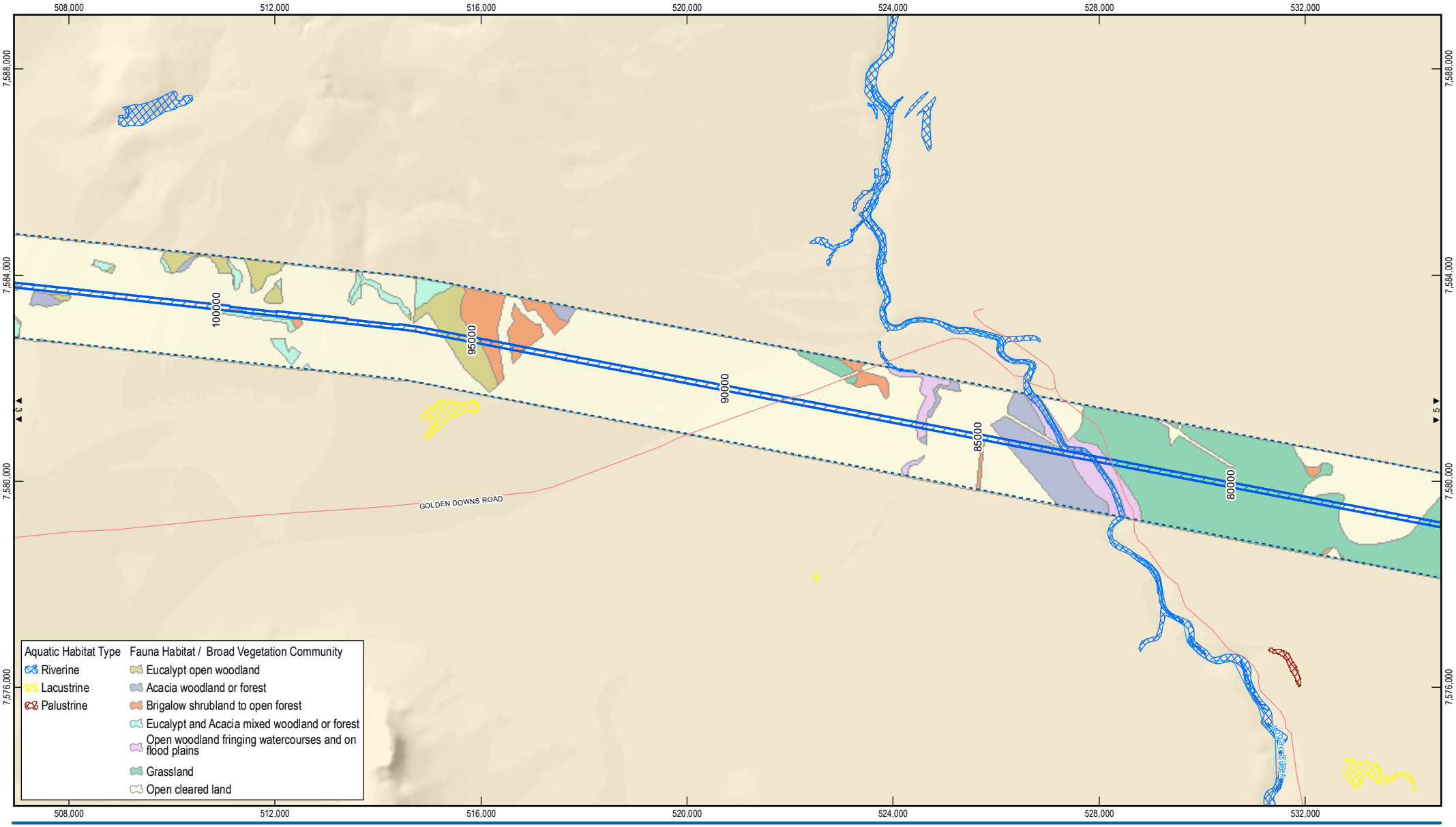
G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_454_rev_c.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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 (2012); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010)/EPC 1080(2011). Created by: BW, MS, CA



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0 1 2 3 4

Kilometres

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
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Vegetation Communities and Fauna Habitat Types: Project Rail

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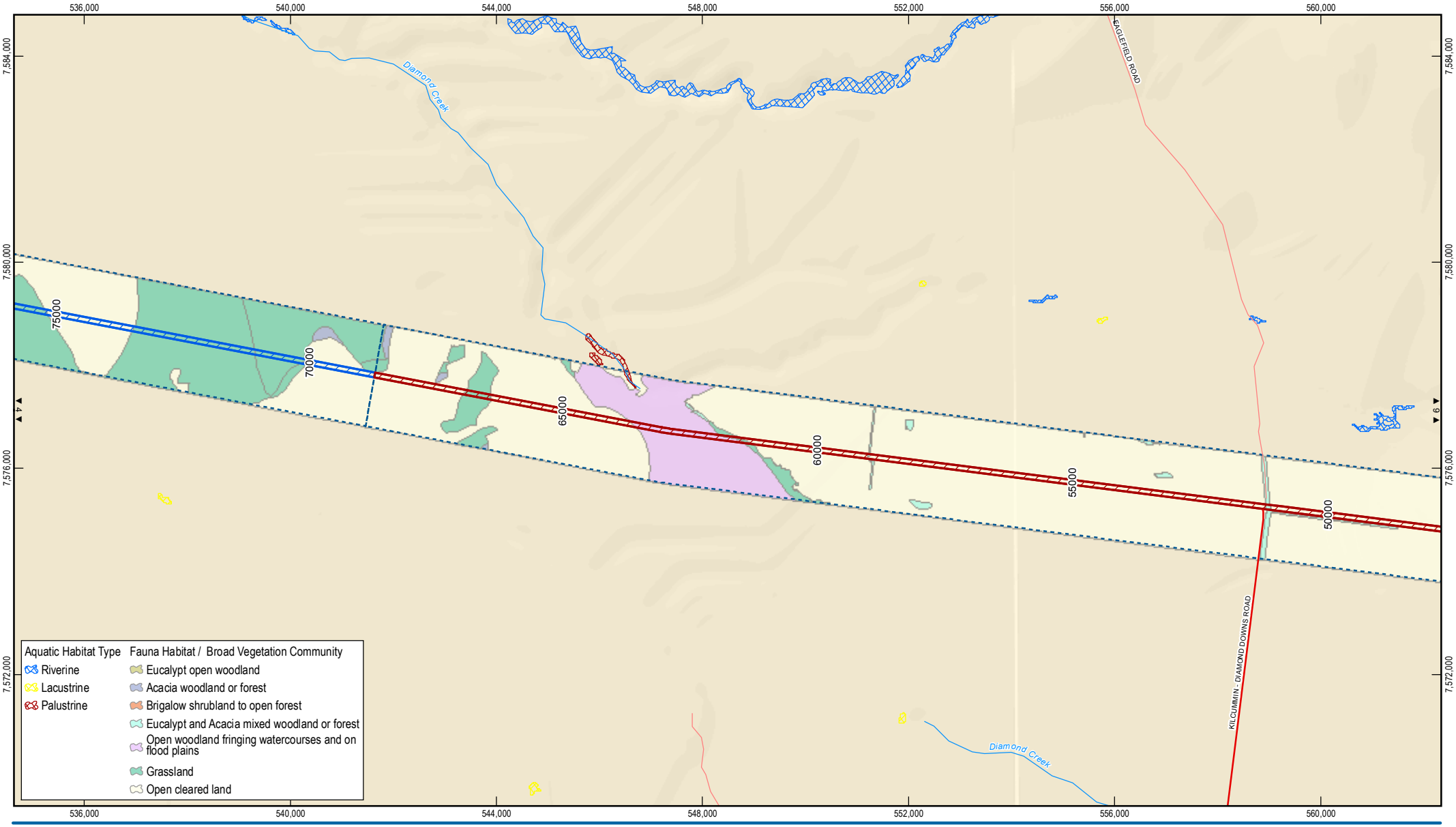
Data source: DERM: DEM (2008), Aquatic Habitat Type, Fauna Habitat / Broad Vegetation Type (2009); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Fauna Habitat Type (2011); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012);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



1:100,000 (at A4)

0 1 2 3 4

Kilometres

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
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

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Carmichael Coal Mine and Rail Project

Vegetation Communities and Fauna Habitat Types: Project Rail

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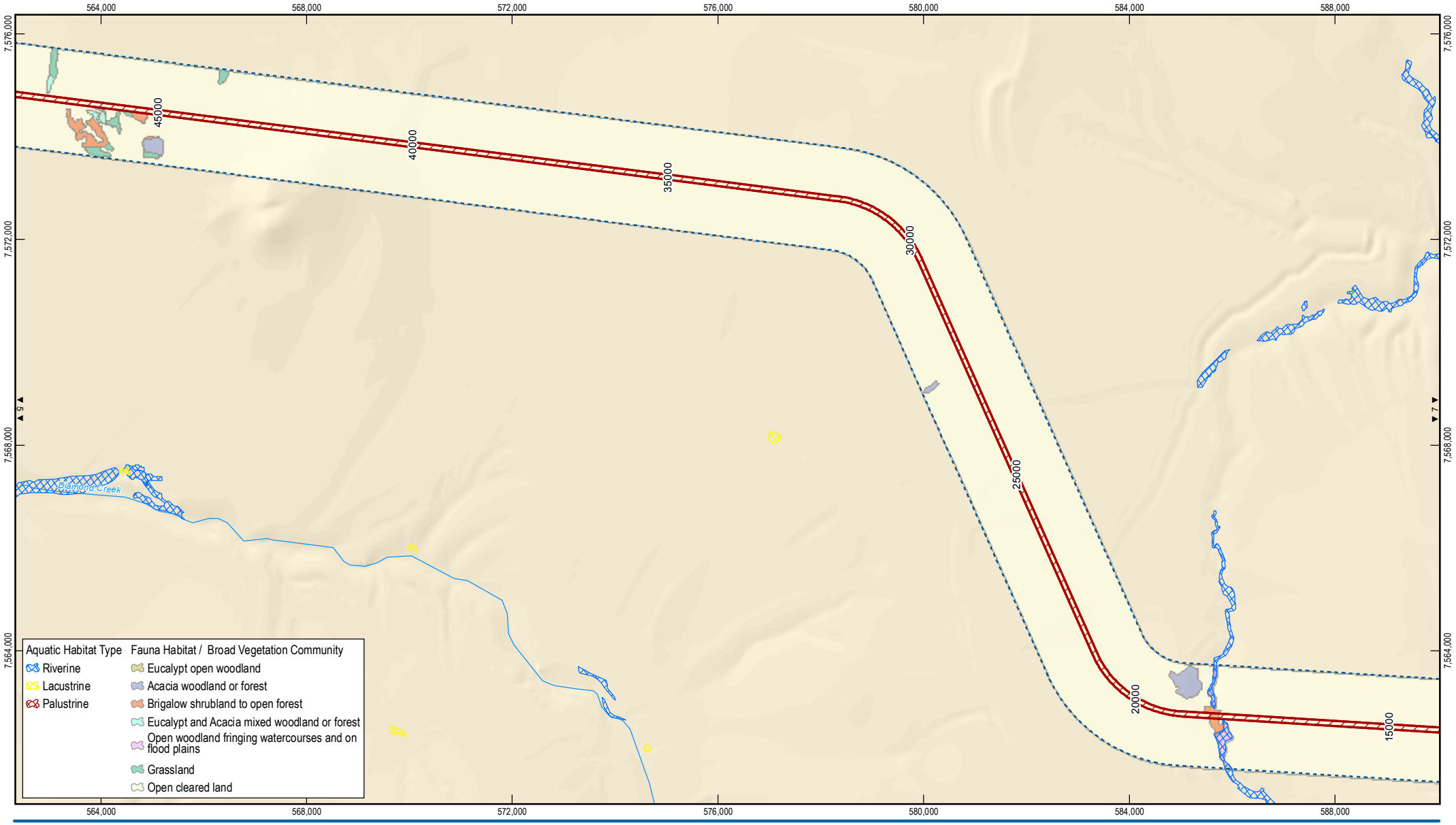
G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_454_rev_c.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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 (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

- 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

Vegetation Communities and Fauna Habitat Types: Project Rail

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G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_454_rev_c.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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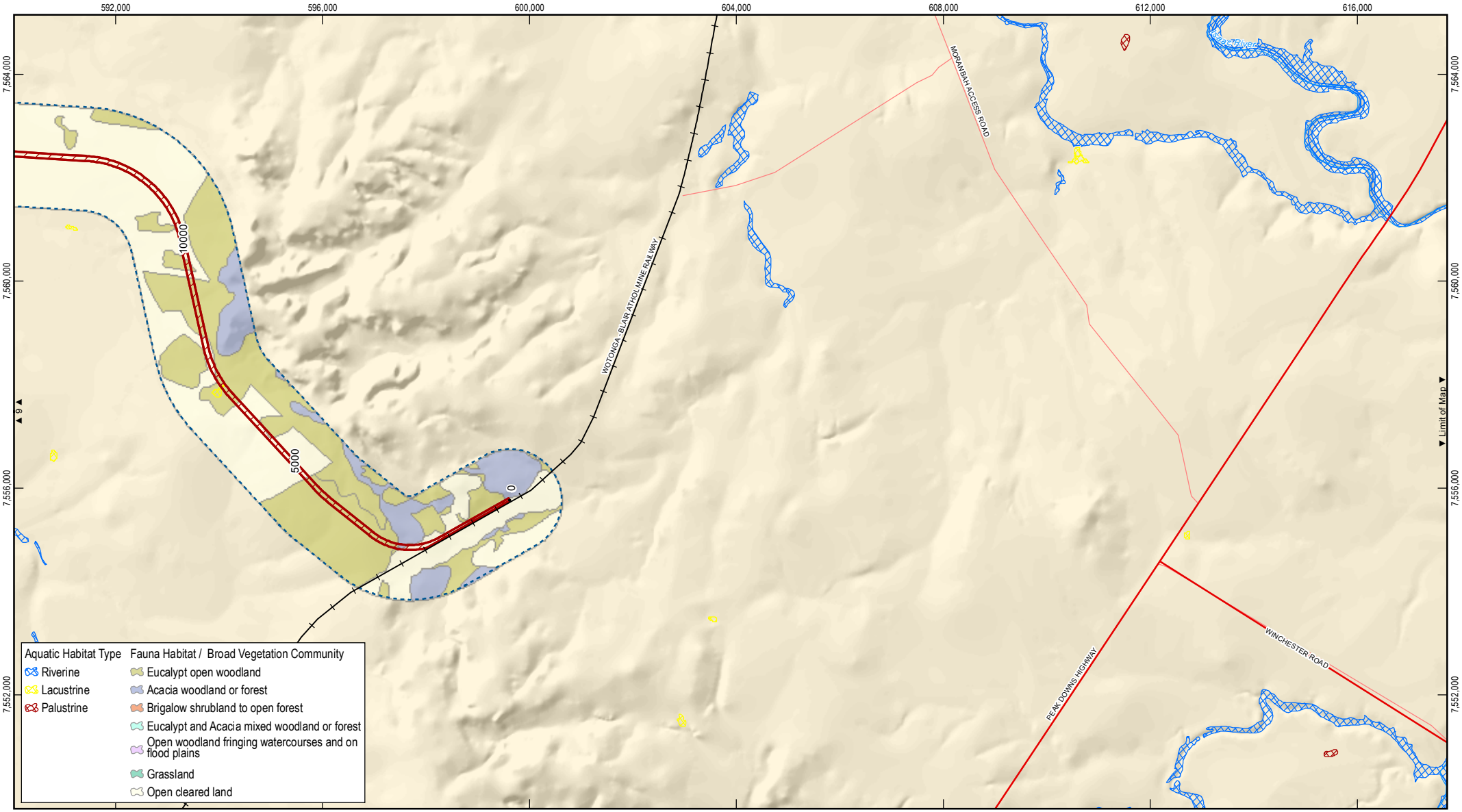

1:100,000 (at A4)

0 1 2 3 4

Kilometres

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
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Vegetation Communities and Fauna Habitat Types: Project Rail

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Figure 6-2
Sheet 7 of 7

G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_454_rev_c.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

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 (2012); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010)/EPC 1080(2011). Created by: BW, MS, CA

6.1.1.2 Rainbow Bee-eater (Migratory, Marine EPBC Act)

The rainbow bee-eater is a medium-sized insectivore, listed as migratory (JAMBA) and marine under the EBPC Act. This species is widespread throughout Australia, eastern Indonesia, eastern Papa New Guinea and the Bismarck Archipelago (DSEWPaC, 2011f). Within Australia, the rainbow bee-eater occurs throughout the country but population numbers are reduced in the severely arid regions of central and western Australia and the species has not been recorded in Tasmania. Migratory patterns in this species are complex and vary between locations. Populations that breed in southern Australia migrate northward to northern Australia, Indonesia and Papua New Guinea in February to April. Populations that breed in northern Australia are considered to be resident with migration restricted to small scale movements between habitats (DSEWPaC, 2011f).

The rainbow bee-eater inhabits open forests and woodlands, shrublands and various cleared habitats including farmland. The species is often recorded near permanent water, particularly in arid or semi-arid areas where riparian, floodplain or wetland vegetation assemblages are utilised. The rainbow bee-eater is commonly observed in disturbed habitats and areas of human habitation including roadside vegetation, quarries and mines (DSEWPaC, 2011f). The rainbow bee-eater primarily feeds on bees and wasps but other insects are also consumed. Foraging usually occurs in flight but prey are also captured from the ground and from foliage (DSEWPaC, 2011f). In Australia, breeding occurs from August to January and nesting occurs in an enlarged chamber at the end of a long burrow or tunnel. The introduced cane toad, which feeds on eggs and nestlings, is the only identified threat to this species (DSEWPaC, 2011f).

The rainbow bee-eater was recorded on one occasion during the September survey of the Rail Study Area and on seven occasions across the three survey events of the Mine Study Area. The species was typically observed within open woodland and riparian habitats. Group size ranged from a single bird to around 60 birds. All habitats at the Project Area were considered to provide potentially suitable habitat for this species. Habitat at the Project Area is likely to be used on a temporary to permanent basis by this species. As the rainbow bee-eater is common and widespread, and suitable habitat is likely to occur over much of the surrounding landscape, habitat at the Project Area is not considered to constitute 'important habitat' as defined in the Significant Impact Guidelines (DEWHA, 2009b), that is:

- *Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion* (as defined in DEWHA, 2009b) *of the population of a species, and/or*
- *Habitat that is of critical importance to the species at particular life-cycle stages, and/or*
- *Habitat utilised by a migratory species which is at the limit of the species' range, and/or*
- *Habitat within an area where the species is declining* (DEWHA, 2009b)

6.1.1.3 Satin Flycatcher (Migratory, Marine EPBC Act)

The satin flycatcher is an insectivorous woodland bird, listed as migratory (Bonn) and marine under the EPBC Act. This species is widespread in eastern Australia and vagrant to New Zealand (DSEWPaC, 2011g). In central Queensland, the satin flycatcher is most common in coastal areas but is also scattered on the Great Divide and occasionally further west. The satin flycatcher overwinters in northern Australia and Papua New Guinea, returning to south-eastern Australia in the summer (DSEWPaC, 2011g).

Habitat for this species includes heavily vegetated gullies in forests, taller woodlands, trees in open country and coastal forests along eastern Australia (Pizzey and Knight, 2007). The majority of individuals are recorded in wet sclerophyll eucalypt forests near wetlands or watercourses (DSEWPaC, 2011g). Satin flycatchers forage in the canopy and sub-canopy of trees where they feed primarily on insects. Breeding in this species occurs during the summer period with nests usually located in a fork on an outer tree branch. Satin flycatchers return to the same locality each year, often nesting in the same tree (DSEWPaC, 2011g). The main threat to the satin flycatcher is the loss of mature forests in south-eastern Australia as a result forest clearing and logging.

Satin flycatchers were opportunistically recorded on two occasions during the spring surveys (2010 and 2011) of the Mine Study Area. The species was observed within the open woodland and farm dam habitats and two individuals were observed on each occasion. Habitat at the Project Area is likely to be used on a temporary to permanent basis by this species. As the satin flycatcher is common and widespread, and suitable habitat is likely to occur over much of the surrounding landscape, habitat at the Project Area is not considered to constitute 'important habitat' as defined in the Significant Impact Guidelines (DEWHA, 2009b), that is:

- *Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion* (as defined in DEWHA, 2009b) *of the population of a species, and/or*
- *Habitat that is of critical importance to the species at particular life-cycle stages, and/or*
- *Habitat utilised by a migratory species which is at the limit of the species' range, and/or*
- *Habitat within an area where the species is declining* (DEWHA, 2009b)

6.1.2 Listed Migratory Species – Likely to Occur

The following EPBC Act listed migratory species are likely to occur at the Project Area, based on distribution, presence of potentially suitable habitat and previous records from the region:

- Common sandpiper (*Actitis hypoleucos*) – migratory (Bonn; CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – inhabits shallow, pebbly, muddy or sandy edges of rivers or streams from coastal to far inland areas including dams and lakes.
- Fort-tailed swift (*Apus pacificus*) – migratory (CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – habitat preferences include open country from semi-deserts to coasts
- Curlew sandpiper (*Calidris ferruginea*) – migratory (Bonn; CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – inhabits tidal mudflats, saltmarsh and saline and freshwater wetlands
- Latham's snipe (*Gallinago hardwickii*) – migratory (Bonn; CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – habitat preferences include soft wet ground or shallow water with tussocks and other green or dead growth, wet parts of paddocks or near dams, scrub or open woodland.
- White-bellied sea eagle (*Haliaeetus leucogaster*) – migratory (CAMBA) and marine EPBC Act – inhabits coasts, estuaries, large rivers and inland lakes
- White-throated needletail (*Hirundapus caudacutus*) – migratory (CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – occupies airspace over forests, woodlands, farmlands, plains, lakes and favoured timbered ranges.

- Caspian tern (*Hydroprogne caspia*) – migratory (CAMBA; JAMBA) and marine EPBC Act – inhabits coastal and offshore waters, beaches, estuaries, larger rivers and lakes some inland
- Black-tailed godwit (*Limosa limosa*) – migratory (Bonn; CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – widespread summer migrant to eastern Australia (Sept-April), mostly on the coasts but makes use of some inland lakes.
- Glossy ibis (*Plegadis falcinellus*) – migratory (Bonn; CAMBA) and marine EPBC Act – inhabits well vegetated wetlands, wet pastures, ricefields, floodwaters, floodplains, brackish or occasionally saline wetlands and occasionally dry grasslands.
- Common greenshank (*Tringa nebularia*) – migratory (Bonn; CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – inhabits mudflats, estuaries, saltmarshes, lake margins, wetlands and claypans.
- Marsh sandpiper (*Tringa stagnatilis*) – migratory (Bonn; CAMBA; JAMBA; ROKAMBA) and marine EPBC Act – inhabits wetlands, bore drains mangroves, tidal mudflats and estuaries

A number of habitat and vegetation types across the Project Area may provide habitat for these listed migratory species. Habitats likely to support the highest diversity of migratory species include:

- Fringing open forest / woodland
- Natural and artificial water bodies
- Eucalypt open woodland

As with the three bird species detected at the Project Area, these 11 migratory species are common and widespread, and thus the Study Area is not considered to support 'important habitat' as defined in the Significant Impact Guidelines (DEWHA, 2009b) for any of these birds.

6.1.3 Listed Migratory Species – May Occur

The likelihood of occurrence assessment identified a further four EPBC Act listed migratory species, including two nominated in the Project terms of reference (spectacled monarch (Monarcha trivirgatus); black-faced monarch (Monarcha melanopsis)) may occur at the Study Area, based on distribution and presence of potentially suitable habitat:

- Cattle egret (*Ardea ibis*) – migratory (CAMBA; JAMBA) and marine EPBC Act – occurs in stock paddocks, croplands, wetlands, tidal mudflats and drains. Not previously recorded in the region.
- Sharp-tailed sandpiper (*Calidris acuminata*) – migratory (Bonn; CAMBA; JAMBA; ROKAMBA) and marine EPBC Act - inhabits tidal mudflats, saltmarshes, mangroves, shallow fresh, brackish and saline inland wetlands, floodwaters and irrigated lands. Not previously recorded in the region.
- Spectacled monarch (*Monarcha trivirgatus*) – migratory (Bonn) and marine EPBC Act - typically inhabits understorey of densely vegetated areas (rainforests, gullies, riparian areas). Predominantly coastal but range extends inland. Not previously recorded in the region.
- Black-faced monarch (*Monarcha melanopsis*) – migratory (Bonn) and marine EPBC Act - rainforest and open forest, gullies and open woodlands (when migrating). Predominantly coastal but range extends inland. Not previously recorded in the region.
- With respect to the Significant Impact Guidelines (DEWHA, 2009b), it is not considered that the Study Area supports an 'important population' of any of these migratory species.

6.2 Potential Impacts and Mitigation Measures

6.2.1 Summary of Matters of NES for Impact Assessment

Desktop and field survey findings indicate the following protected matters of NES are confirmed present, likely to occur or may occur within the Project Area (Mine and Rail):

- Confirmed present:
  - Eastern great egret (*Ardea modesta*)
  - Rainbow bee-eater (*Merops ornatus*)
  - Satin flycatcher (*Myiagra cyanoleuca*)
- Likely to occur:
  - Common sandpiper (*Actitis hypoleucos*)
  - Fort-tailed swift (*Apus pacificus*)
  - Curlew sandpiper (*Calidris ferruginea*)
  - Latham's snipe (*Gallinago hardwickii*)
  - White-bellied sea eagle (*Haliaeetus leucogaster*)
  - White-throated needletail (*Hirundapus caudacutus*)
  - Caspian tern (*Hydroprogne caspia*)
  - Black-tailed godwit (*Limosa limosa*)
  - Glossy ibis (*Plegadis falcinellus*)
  - Common greenshank (*Tringa nebularia*)
  - Marsh sandpiper (*Tringa stagnatilis*)
- May occur:
  - Cattle egret (Ardea ibis)
  - Sharp-tailed sandpiper (*Calidris acuminata*)
  - Spectacled monarch (*Monarcha trivirgatus*)
  - Black-faced monarch (*Monarcha melanopsis*)

6.2.2 Potential Impacts and Mitigation Measures - Rail

Potential impacts to migratory species have been discussed in detail in Volume 3, Section 5 Rail Nature Conservation of this EIS.

Table 6-2 Impact to the EPBC Act Listed Migratory Species - Rail

EPBC Act listed migratory species	Total clearing extent*
Confirmed present	
Eastern great egret (*Ardea modesta*)	131 ha
Rainbow bee-eater (*Merops ornatus*)	1,869 ha Two dams
Satin flycatcher (*Myiagra cyanoleuca*)	147 ha
Likely to occur	
Common sandpiper (*Actitis hypoleucos*)	-
Fort-tailed swift (*Apus pacificus*)	1,869 ha Two dams
Curlew sandpiper (*Calidris ferruginea*)	-
Latham's snipe (*Gallinago hardwickii*)	131 ha Two dams
White-bellied sea eagle (*Haliaeetus leucogaster*)	131 ha Two dams
White-throated needletail (*Hirundapus caudacutus*)	1,869 ha Two dams
Caspian tern (*Hydroprogne caspia*)	-
Black-tailed godwit (*Limosa limosa*)	-
Glossy ibis (*Plegadis falcinellus*)	-
Common greenshank (*Tringa nebularia*)	-
Marsh sandpiper (*Tringa stagnatilis*)	-
May occur	
Cattle egret (*Ardea ibis*)	1,633 ha Two dams
Sharp-tailed sandpiper (*Calidris acuminata*)	-
Spectacled monarch (*Monarcha trivirgatus*)	65 ha
Black-faced monarch (*Monarcha melanopsis*)	182 ha

6.2.2.1 Rail Construction

- 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
- Fauna mortality

6.2.2.2 Rail Operation

- Disturbance as a result of increased exposure to light, noise, dust, vehicles and people
- Spread of introduced weeds
- Degradation of aquatic habitats as a result of runoff or an altered catchment landscape
- Mortality as a result of train and maintenance vehicle strikes.

6.2.3 Potential Impacts and Mitigation Measures - Mine

Potential impacts to migratory species have been discussed in detail in Volume 2, Section 5 Mine Nature Conservation of this EIS.

Table 6-3 Impact to EPBC Act Listed Migratory Species - Mine

EPBC Act listed migratory species	Total clearing extent*
Confirmed present	
Eastern great egret (*Ardea modesta*)	34 ha Permanent dams (at least twelve)
Rainbow bee-eater (*Merops ornatus*)	25,175 ha
Satin flycatcher (*Myiagra cyanoleuca*)	17 ha
Likely to occur	
Common sandpiper (*Actitis hypoleucos*)	17 ha Permanent dams (at least twelve)
Fort-tailed swift (*Apus pacificus*)	25,175 ha
Curlew sandpiper (*Calidris ferruginea*)	17 ha Permanent dams (at least twelve)
Latham's snipe (*Gallinago hardwickii*)	34 ha Permanent dams (at least twelve)
White-bellied sea eagle (*Haliaeetus leucogaster*)	34 ha Permanent dams (at least twelve)
White-throated needletail (*Hirundapus caudacutus*)	25,175 ha

EPBC Act listed migratory species	Total clearing extent*
Caspian tern (*Hydroprogne caspia*)	17 ha Permanent dams (at least twelve)
Black-tailed godwit (*Limosa limosa*)	17 ha Permanent dams (at least twelve)
Glossy ibis (*Plegadis falcinellus*)	17 ha Permanent dams (at least twelve)
Common greenshank (*Tringa nebularia*)	17 ha Permanent dams (at least twelve)
Marsh sandpiper (*Tringa stagnatilis*)	17 ha Permanent dams (at least twelve)
May occur	
Cattle egret (*Ardea ibis*)	21,946 ha Permanent dams (at least twelve)
Sharp-tailed sandpiper (*Calidris acuminata*)	17 ha Permanent dams (at least twelve)
Spectacled monarch (*Monarcha trivirgatus*)	67 ha
Black-faced monarch (*Monarcha melanopsis*)	67 ha

6.2.3.1 Mine Construction

- Loss of fauna habitat (including roosting, foraging and breeding areas) - clearing of land during the construction phase of the Project is proposed to result in a loss of approximately 110 ha of remnant vegetation and approximately 5,149 ha of non-remnant vegetation. One permanent dam (Brigalow Dam) will also be lost as a result of Project construction.
- Degradation of terrestrial and aquatic habitat adjacent to and downstream of cleared areas
- Fauna mortality

6.2.3.2 Mine Operation

- Clearing of land (vegetation clearing) and changes to topography:
  - Loss of fauna habitat
  - Fauna mortality
  - Habitat degradation (i.e. erosion of surface soils, degradation of water quality)
- Disturbance of surface watercourses and removal of watercourses and water bodies:
  - Loss of habitat for species
  - Alteration/degradation of water quality
- Alteration in groundwater regime:

- Changes to terrestrial habitat due to groundwater drawdown
- Changes to surface water flows and aquatic habitat availability as a result of groundwater drawdown

- Introduction of pest and weed species:
  - Competition with native species, predation of native species
  - Habitat degradation (presence and prevalence of pest and weed species) and reduction in resource availability
- Alteration to air quality and noise environs from altered exposure to disturbance:
  - Disturbance to roosting and foraging areas
  - Habitat degradation from dust settling

6.2.3.3 Summary

It is recognised that, in spite of the recommended management and mitigation measures, and the active rehabilitation of disturbed areas that will occur through the Project's operational life, unavoidable loss of habitat for migratory species will occur.

Active, targeted management of habitats adjacent to the clearing footprint can improve their quality for migratory species. Establishing alternative habitats adjacent to the Project through active management prior to clearing migratory species habitats will encourage individuals to disperse from proposed clearing areas (or attract them to adjacent areas). This may include but not be limited to improving forage and nesting resources, increasing access to watering locations, and management of pest and weed species, to enhance the value of adjacent areas. This action will seek to minimise habitat loss (through replacement) and will also act to minimise potential for mortality by providing migratory species with habitat refugia within the operational landscape. The details for such management approaches and actions will consider the staged nature of operations, will be informed by onsite research, and will be detailed within Project Species Specific Management Plans (under the overarching Project Land Management (Flora and Fauna) Plan).

6.2.4 Significance of Impacts on Migratory Species

The potential to realise a significant impact upon migratory species within the Study Area has been considered against criteria identified by DSEWPaC. As identified under Section 1.6.3, filtering of species has been undertaken for this assessment to consider only those species which are known, likely or which may occur at the Project Area. Criteria which define these likelihood of occurrence categories are identified in Section 1.6.3. This approach is, therefore, considered to be a conservative one which captures all migratory species that could potentially be affected by the Project

To identify whether a significant impact will occur to any of the above identified matters of NES an assessment was also made in relation to whether an important population of these listed migratory species occurs at the Study Area. An area of 'important habitat' for a migratory species is:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- Habitat that is of critical importance to the species at particular lifecycle stages; and/or
- Habitat utilised by a migratory species which is at the limits of the species range; and/or

- Habitat within an area where the species is declining.

Detailed assessment of potential to significantly impact upon any migratory species noted above has occurred giving consideration to the DSEWPaC Significant Impact Guidelines. In summary, assessment identifies that the Project is not expected to have a significant impact upon any migratory species. This finding is on the basis that:

- The Project Area does not support an important population of any of these species
- The Project Area does not support an ecologically significant proportion of the population of a migratory species
- Measures identified in Sections 5.1.2 to 5.1.5 are expected to manage the potential to directly or indirectly impact these species
- The species are well represented in landscapes that surround the Project Area, where suitable alternative habitat is prevalent and will persist
- The species are not considered to be dependent upon any habitat within the Project Area for any particular lifecycle stages

As such, while large tracts of habitat suitable for these protected matters will be affected, alternative habitat suitable for these species exists adjacent to the Project Area and within the region. Accordingly the Project is not predicted to adversely impact migratory species by

- Substantially modifying (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroying or isolating an area of important habitat for a migratory species.
- Resulting in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species
- Seriously disrupting the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species

Table 6-4 Significant Impact Criteria Assessment for Migratory Species that May Occur, Likely to Occur or Confirmed Present within the Study Area

Significant Impact Criteria for Migratory Species	Assessment
Confirmed Present	Three migratory bird species, the eastern great egret (*Ardea modesta*), rainbow bee-eater (*Merops ornatus*) and satin flycatcher (*Myiagra cyanoleuca*) were confirmed present within the Study Area during field surveys.
Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a Migratory species	N – No areas of important habitat for migratory species.
Result in an invasive species that is harmful to the Migratory species becoming established in an area of important habitat for the Migratory species	N – No areas of important habitat for migratory species. Weed and Pest Management to manage introduction and spread.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a Migratory species	N- No ecologically significant proportion of the population occurs.
Likely to Occur	Eleven migratory bird species are considered likely to occur within the Project Area. These species include: common sandpiper (*Actitis hypoleucos*), fort-tailed swift (*Apus pacificus*), curlew sandpiper (*Calidris ferruginea*), Latham's snipe (*Gallinago hardwickii*), white-bellied sea eagle (*Haliaeetus leucogaster*), white-throated needletail (*Hirundapus caudacutus*), Caspian tern (*Hydroprogne caspia*), black-tailed godwit (*Limosa limosa*), glossy ibis (*Plegadis falcinellus*), common greenshank (*Tringa nebularia*), and marsh sandpiper (*Tringa stagnatilis*).
Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a Migratory species	N – No areas of important habitat for migratory species.

Significant Impact Criteria for Migratory Species	Assessment
Result in an invasive species that is harmful to the Migratory species becoming established in an area of important habitat for the Migratory species	N – No areas of important habitat for migratory species. Weed and Pest Management to manage introduction and spread.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a Migratory species	N – No ecologically significant proportion of the population occurs.
May Occur	Four migratory bird species may occur within the Project Area. These species include: cattle egret (*Ardea ibis*), sharp-tailed sandpiper (*Calidris acuminata*), spectacled monarch (*Monarcha trivirgatus*), and black-faced monarch (*Monarcha melanopsis*).
Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a Migratory species	N – No areas of important habitat for migratory species.
Result in an invasive species that is harmful to the Migratory species becoming established in an area of important habitat for the Migratory species	N – No areas of important habitat for migratory species. Weed and Pest Management to manage introduction and spread.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a Migratory species	N – No ecologically significant proportion of the population occurs.

6.3 Summary

A desktop and field assessment was undertaken to identify EPBC Act listed migratory species that have the potential to occur within the Mine and Rail Project Areas. Three species, eastern great egret (Ardea modesta), rainbow bee-eater (Merops ornatus) and stain flycatcher (Myiagra cyanoleuca) were confirmed present within the Project Area. An additional 11 species are considered likely to occur while four species may occur.

Potential impacts arising from construction and operational works may include:

- Vegetation clearing and changes to topography
- Loss of habitat including roosting, shelter, foraging and breeding areas
- Degradation and disturbance of habitat as a result of sedimentation, erosion, alteration of water quality and increased exposure to noise, light and dust
- Disturbance of surface watercourses and removal of watercourses and water bodies
- Fauna mortality
- Introduction of pest and weed species
- Alteration in groundwater regime

It is recognised that, in spite of the recommended management and mitigation measures, and the active rehabilitation of disturbed areas that will occur through the Project's operational life, unavoidable loss of habitat for migratory species will occur.

Active, targeted management of habitats adjacent to the clearing footprint can improve their quality for migratory species. Establishing alternative habitats adjacent to the Project through active management prior to clearing migratory species habitats will encourage individuals to disperse from proposed clearing areas (or attract them to adjacent areas). This may include, but not be limited to, improving forage and nesting resources, increasing access to watering locations, and management of pest and weed species, to enhance the value of adjacent areas. This action will seek to minimise habitat loss (through replacement) and will also act to minimise potential for mortality by providing migratory species with habitat refugia within the operational landscape. The details for such management approaches and actions will consider the staged nature of operations, will be informed by onsite research, and will be detailed within Project Species Specific Management Plans (under the overarching Project Land Management (Flora and Fauna) Plan).

The potential to realise a significant impact upon migratory species within the Study Area has been considered against criteria identified by DSEWPaC. Based on current knowledge the assessment identifies that the Project is not expected to have a significant impact upon any migratory species. This finding is on the basis that:

- The Project Area does not support an important population of any of these species
- The Project Area does not support an ecologically significant proportion of the population of a migratory species
- Measures identified in Sections 5.1.2 to 5.1.5 are expected to manage the potential to directly or indirectly impact these species

- The species are well represented in landscapes that surround the Project Area, where suitable alternative habitat is prevalent and will persist
- The species are not considered to be dependent upon any habitat within the Project Area for any particular lifecycle stages.

As such, while large tracts of habitat suitable for these protected matters will be affected, alternative habitat suitable for these species exists adjacent to the Study Area and within the region. Accordingly the Project is not predicted to adversely impact migratory species.

7. Cumulative and Consequential Impacts

7.1 Introduction

An evaluation of the potential cumulative impacts resulting from the Project including an estimation of the overall size, significance and likelihood of these impacts has been undertaken. That assessment is reported in detail in Volume 1, Section 9 Cumulative Impacts. The assessment, as it relates to matters of NES, is summarised here.

7.2 Relevant Projects

The Project is located within the Galilee Basin and as such is closely related to other projects currently under investigation or expected to commence investigations in the next five years. A number of projects have been identified as having particular relevance in terms of cumulative impacts associated with project development or they offer the opportunity for co-location of infrastructure, and / or are a consequential development and provide necessary supporting infrastructure for the export of product coal. Figure 7-1 defines the spatial boundary (Study Area) for the cumulative impact assessment and shows the footprint of each project included in the cumulative impact assessment.

The following projects currently under assessment and have been included in this assessment, as they are relevant in terms of cumulative impacts associated with the Project:

- Alpha Coal Project (EPBC 2008/4648, 2008/4647): Mine element
- Kevin's Corner (EPBC 2009/5033)
- Galilee Coal (Northern Export Facility) (EBPC 2009/4737): Mine element
- South Galilee Coal Project (EBPC 2010/5496)

Adani is also aware of the following proposals within the region; however insufficient information is available at the time of writing (November 2012) to enable inclusion in the cumulative assessment:

- MacMines: development of two open cut and two underground mines with ultimate production and export of 30 Mtpa via a rail spur line linking into the proposed Project (Rail) corridor to export coal through the Port of Abbot Point. Terms of reference for this project are currently under public notification, however no further publicly available information is currently available.

The following projects are relevant as they offer the opportunity for co-location of infrastructure:

- Galilee Coal (Northern Export Facility) (EPBC 2009/4737): Rail element
- Alpha Coal Project (EPBC 2008/4648, 2008/4647): Rail element
- Goonyella to Abbot Point Rail Project (EPBC 2011/6082)
- QR National Central Queensland Integrated Rail Project (EPBC 2012/6321)

The following projects are relevant as they provide necessary supporting infrastructure for the export of product coal:

- Abbot Point Terminal 0 Project (EPBC 2011/6194)
- Port of Hay Point (Dudgeon Point Coal Terminals) (EPBC 2012/6240)

A number of projects are within the region of the Project, however, are not specifically relevant as noted below. These projects have therefore been excluded from the cumulative impact assessment:

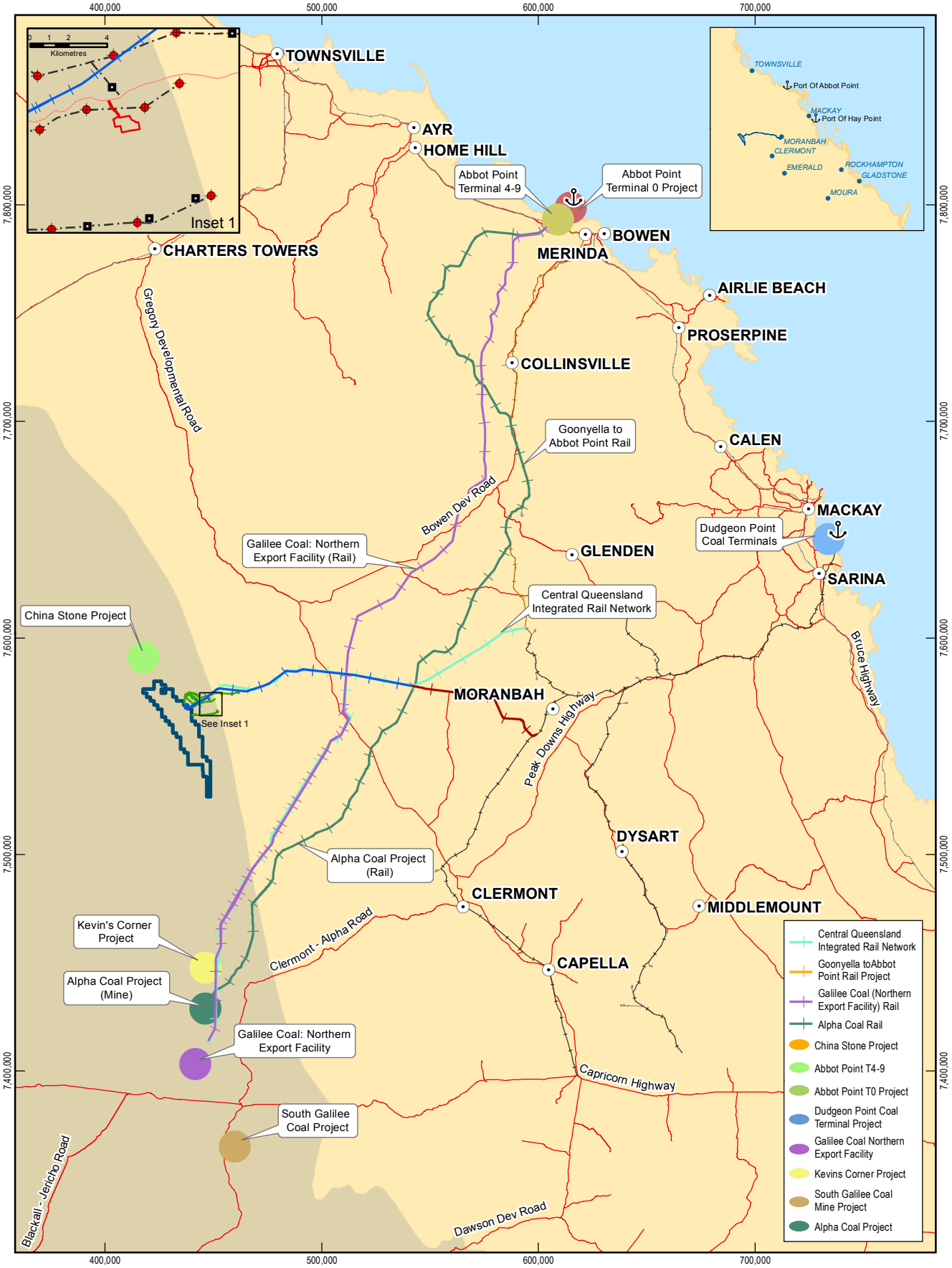
- Abbot Point Terminal 2 Project (EPBC 2011/6194): this project is a dedicated coal terminal being developed by BHP Billiton for the purpose of servicing its own coal export requirements. It is unlikely that third party access to the coal terminal would be available. BHP Billiton has publically stated in 2012 that this project is on hold.
- Abbot Point Terminal 3 Project (EPBC 2008/4468): this project is a dedicated coal terminal being developed by Hancock Infrastructure Pty Ltd for the purpose of servicing its own coal export requirements. It is unlikely that third party access to the coal terminal would be available.

Figure 7-1 defines the spatial boundary (Study Area) for the cumulative impact assessment and shows the footprint of each project included in the cumulative impact assessment.

7.3 Cumulative Impact Assessment

7.3.1 Listed Threatened Ecological Communities

Table 7-1 outlines the listed threatened ecological communities under the EPBC Act predicted to occur in the Project Area and the likely cumulative impacts from projects in the Study Area.



LEGEND

- Town
- Major Port
- State Road
- Other Rail Network
- Goonyella System
- Newlands System
- Project (Mine)
- Mine (Offsite)
- Galilee Basin
- Rail (West)
- Rail (East)
- Mine (Offsite)
- Borehole
- Storage Site (Instream)
- Pipeline Network
- Workers Accommodation Village

1:2,500,000 (at A4)

0 25 50 75 100

Kilometres

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

N

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision C
Date 07-09-2012

Cumulative Impact Assessment Projects Figure: 7-1

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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: LGA (2011); DMR: State Roads (2008); DME: EPC1690 (2010), EPC1080 (2011); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012); Other Projects (2012). Created by: NR,MS

Table 7-1 Threatened Ecological Communities

Species	Conservation Status	Likelihood of Occurrence in Project Area	Likely Project Impact	Likely Cumulative Impact
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered – EPBC Act	Known to Occur	304.4 ha cleared (267 ha – Mine; 37.4 ha – Rail) potential for significant impacts	Clearing of 110 ha for Alpha Coal Rail Project. Also present in Galilee Coal project area.
Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	Endangered – EPBC Act	Known to Occur adjacent to Rail Study Area	May be subject to indirect impacts	Clearing of 108 ha for Alpha Coal Rail Project. Also present in Galilee Coal and Kevin's Corner project areas.
The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin (GAB)	Endangered – EPBC Act	Known to occur west of Mine Study Area	May be subject to indirect impacts	May be subject to indirect impacts

Within Queensland approximately 65 per cent of extant Brigalow TEC and approximately 20 per cent of extant Natural Grasslands TEC occur within protected area estates. Therefore, these areas are protected however there is the potential for the projects in the Study Area to have a cumulative impact on the TECs. Clearing will result in reductions in extent, diversity and abundance of these communities and the species that utilise them. In relation to the Brigalow TEC there is potential for significant cumulative impact given:

- Clearing from multiple projects of this TEC will reduce the extent of this ecological community within the local and regional landscape
- The clearing has the potential to fragment this TEC
- The alteration of the landscape to mining activities will adversely affect the habitat critical to the persistence of this TEC
- Draw down of groundwater levels may modify factors necessary for this TECs persistence in the surrounding landscape

In relation to the Natural Grasslands TEC, significant cumulative impacts could potentially occur on this TEC, given:

- Clearing from multiple projects of this TEC will reduce the extent of this ecological community within the local and regional landscape
- Clearing will remove some of this TEC and will result in fragmentation of patches of this TEC

The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin TEC is found at the Doongmabulla Springs, a cluster of 11 springs located within a four kilometre radius of each other along the Carmichael River, approximately ten kilometres upstream (west) from the western boundary of the study area (defined as EPC 1690, EPC 1080, airstrip and mine village footprints) (Fensham pers. comm., 2012). The main threatening processes for this TEC are aquifer draw down (due primarily to uncapped bores, but also to mining activities), excavation of springs, exotic flora and fauna invasion and stock damage, access by tourism, and impoundments (Fensham et al., 2010). The mine projects included in the Study Area are not located within the same aquifer and therefore will not contribute cumulatively to impacts on the community of native species dependant on natural discharge of groundwater from the Great Artesian Basin TEC.

7.3.2 Flora

Although a number of protected flora species were predicted to occur within the Project Area based on EPBC searches, none were detected during field investigations. Field investigations did, however, detect the waxy cabbage palm which desktop assessment did not predict to occur in the Study Area. The Project is not expected to significantly impact on any flora species of national significance and, therefore, it is not expected to contribute to any significant cumulative impacts on the species.

7.3.3 Listed Threatened Fauna

A significant impact to the black-throated finch (southern) is predicted to occur as a consequence of the Project. The black-throated finch has the potential to be cumulatively impacted by other projects in the Study Area. There is potential habitat within the Alpha Coal Project, Galilee Coal (northern export facility) and Kevin's Corner Project to be removed. This increased pressure on black-throated finch habitat in the Study Area is likely to exacerbate the potential significant impact from the Project. Each proponent will be required to provide offsets in accordance with Commonwealth and State policies for these unavoidable impacts on habitat.

Squatter pigeon and koala are likely to be present in much of the wider landscape than that occupied by the Project. This is based on the presence of potentially suitable habitat, which extends beyond the Project Area, particularly to the west where remnant vegetation dominates the landscape. However, much of the landscape surrounding the study area is dominated by non-remnant vegetation with fragmented remnant vegetation often restricted to watercourses.

The Squatter pigeon has been observed at the Alpha Coal (Hancock Prospecting Pty Ltd, 2010) and Kevin's Corner project areas (Hancock Prospecting Pty Ltd,) indicating the presence of suitable habitat. Therefore an overall reduction in the regional availability of habitat for the subspecies will occur as a result of the projects. Although the koala has been detected during the Mine Study, desktop searches only identified it to occur in adjacent habitats. It is possible that both these species may disperse away from the developed parts of the Project Area, to suitable habitat within other parts of the Study Area. Preservation and enhancement of the corridor along the Carmichael River by the Project may compensate for some of the habitat loss, and facilitate dispersal of the species in the local landscape. Each proponent will be required to provide offsets in accordance with Commonwealth and State policies for unavoidable impacts on habitat.

7.3.4 Listed Migratory Fauna

It is recognised that a cumulative unavoidable loss of habitat for migratory species will occur across the project sites. Alternative habitat suitable for these species exists adjacent to the Project Area and within the region, however whilst the Project is not predicted to have a significant impact on migratory species a potential significant cumulative impact on migratory species cannot be ruled out without further information in regards to each proposed projects impacts.

7.3.5 Aquatic Ecology

Aquatic environment impacts are considered given matters of NES, including the Black-throated finch (Southern) dependency upon these systems. The Project (Mine) Study Area is located within the Carmichael River catchment which is a sub-catchment of the Belyando River within the Burdekin River Basin. The southern Galilee projects are also located within the Burdekin River Basin.

Extractions from the Belyando River, associated with the offsite water supply infrastructure, have the potential to result in a cumulative impact. Modelling undertaken as part of the surface hydrology assessment showed that all required Water Resource Plan Environmental Flow Objectives were met under operational conditions including extractions for the Project (Mine), therefore within the acceptable threshold for impact.

The Supplementary EIS for the Alpha Coal Project indicates a reduction of -0.4 per cent in baseline median flows in the Belyando River at the Gregory Developmental Road (Hancock 2011). The Supplementary EIS for the Alpha Coal Project states that no adverse water quality impacts are expected as a result of the project based on best practice management being implemented for the control of discharges (Hancock 2011). Similar information is not available from other projects.

These changes are within environmental flow objectives and well within the natural fluctuations in flow of this river.

The Project (Rail) has the potential to interact with the Alpha Coal Project (Rail) and the Galilee Coal Northern Export Facility (Rail). The potential cumulative impacts on aquatic environmental values include:

- Loss of aquatic habitat
- Fauna mortality
- Alteration to in-stream and floodplain hydrology
- Increased sedimentation, run-off and dust
- Light, noise and vibration disturbance
- Increase in abundance and diversity of introduced species

Each proponent is expected to implement standard control measures to minimise the above potential impacts and thus no significant cumulative impact on aquatic systems, and therefore dependent species, are predicted.

No areas of Ramsar wetland are predicted to be impacted by this Project. The closest Ramsar wetland is 380 km from the site disconnected from the Project Area by substantial barriers. Therefore the Project will not contribute to any cumulative impacts on Ramsar wetlands.

7.3.6 Groundwater

Groundwater is considered given its potential influence upon dependent ecosystems, including TEC. The Project (Mine) is in a different aquifer from the other mines in the Study Area. Therefore the Project (Mine) will not contribute to cumulative groundwater impacts.

The Project (Rail) has the potential to interact with the Alpha Coal Project (Rail) and the Galilee Coal Northern Export Facility (Rail). It is likely that only one of these rail lines will proceed. Adani is in discussion with these proponents in regards to the design of grade separated crossings and will incorporate design measures to minimise cumulative impacts on groundwater in the area.

The greatest potential for any impact to groundwater is in the vicinity of shallow alluvial aquifers, mostly found near major creeks and rivers, which could be impacted by temporary dewatering for rail construction activities.

Potential operational impacts may result in retention of water (pooling/ponding, water logging) from embankment infrastructure thereby locally increasing groundwater levels.

Extraction of groundwater for supply purposes, either during construction or in operational phase, is likely to be limited and alternative sources of water supply may be available. Work on the rail lines will primarily consist of minor cut and fill activities and sourcing of construction materials (possibly quarrying of rock and borrowing of sand). Deeper disturbances of the ground may occur at creek and river crossing where piles for bridge structures and culverts may be required and hence depending on the construction method temporary dewatering may be necessary.

No significant cumulative impacts on groundwater resources and groundwater quality are expected given:

- No long-term lowering of groundwater levels due to construction dewatering activities is anticipated
- The majority of the Project (Rail) area does not contain well developed or extensive alluvial aquifers. Groundwater in the area is therefore not considered threatened or vulnerable as a resource.
- Outside of the main river corridors groundwater and surface water connectivity is thought to be limited

Similarly, no significant long term cumulative impacts on groundwater resources and groundwater quality are anticipated during operation of the rail lines given that:

- It is expected that only a small number of shallow cuttings will be required for each rail line and hence there will be no significant permanent lowering of groundwater levels due to drainage of cutting areas.
- River crossing points are expected to be designed by each proponent such that compaction of alluvial sediments and upstream ponding of surface water flow is minimised

Hence, no subsequent impacts to matters of NES from groundwater impacts across projects are predicted.

7.4 Consequential Impacts

The development of the Project and other coal mine and rail projects in the Study Area leads to consequential development that provides necessary supporting infrastructure for the export of product coal. The relevant projects included are:

- Abbot Point Terminal 0 Project (EPBC 2011/6194)
- Port of Hay Point (Dudgeon Point Expansion) (EPBC 2012/6240)

Due to existing capacity restrictions on coal exports and the over-subscription to new export capacity currently in the project pipeline, the development of a new coal export terminal is likely to be required for the export of the Project coal. Development approval requirements at Commonwealth, State and Local levels will apply to any such proposals and they will require examination of potential impacts in the application stage and imposition of approval conditions by relevant administering authorities. On this basis, adequate controls are considered to be in place to identify and manage impacts from development that may by consequential to or facilitated by the Project.

7.5 Summary

The cumulative assessment provided in detail in Volume 1, Section 8 Cumulative Impacts defined the spatial and temporal boundary for assessment and reviewed stated impacts from other projects and utilising a relevance factor the significance impacts were determined. Assessment has identified that the cumulative impacts having a low risk relate to:

- Aquatic ecology
- Surface water
- Groundwater

The cumulative impact which has a high risk relates to:

- Terrestrial ecology

Under implementation of the proposed Project offsets (as described in Volume 1 Section 9) it is considered that the overall impact of the Project can be managed.

8. Proposed Offsets

8.1 Introduction

The Offset Strategy outlined within this report is extracted from an overall Project Offset Strategy, which is described in detail in Volume 1, Section 9 Offsets Strategy and Volume 4 Appendix AH. That Strategy provides a proposed approach to compiling an offset package that meets the Project's Commonwealth and State offset obligations. Information from that strategy of relevance to matters of NES is summarised herein.

The Offset Strategy, including components of relevance to matters of NES, will be further developed and finalised following liaison and meetings between the key stakeholders including the client, relevant government agencies (i.e. DSEWPaC, DEHP and DNRM) and an environmental offset broker to discuss final offset requirements and proposed offset options for the Project. An assessment of the offset requirements and an options analysis has been undertaken and will be implemented into a final offsets package (or plan). The following sections provide a summary of that whole of Project assessment.

Throughout the planning and design stages of the Project, steps were taken to minimise the residual impact of the Project by avoiding native vegetation where reasonable and minimising the Project footprint. The Project (Rail) footprint in particular 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).

Notwithstanding, the removal of native vegetation will still occur within the Project (Mine) and Project (Rail) footprints. The impacts that will be realised from construction and operation of the Project are described below as they relate to the various matters of NES of relevance to the Project.

The proposed clearing impacts and offset implications for this Project are discussed in terms of the following environmental offset criteria:

- Commonwealth:
  - Clearing of threatened ecological communities
  - Clearing of habitat for threatened species
- State:
  - Clearing of endangered and of concern REs
  - Clearing of threshold REs
  - Clearing of watercourse vegetation
  - Clearing of wetland vegetation
  - Clearing of corridor vegetation
  - Clearing of high value regrowth vegetation

It is important to note that the Project (Mine) impacts detailed in this report pertain to those proposed in entirety for the 90 year operational life of the mine. Vegetation clearing is not proposed to occur across the entire mining footprint in a single event, but rather is proposed to be staged to correspond with the sequential development of coal extraction. Full details about the staged operations of the

proposed mine are provided in the Description of the Project (refer to Volume 1, Section 2 Description of the Project).

While recognising that vegetation clearing is proposed to be staged, for the purposes of this offset strategy, the assessment below considers the clearing of all vegetation proposed to occur within the indicative mining (operation) footprint over the life of the mine. It should be noted that all calculations presented are approximate and based upon digitization of the preliminary mine plan (as at November 2012).

As described under Section 5-2 and Section 1.1, the Project will require the clearance of REs that are listed as components of TECs and are habitat for threatened species listed under the EPBC. As such, this action carries offset obligations to deliver an overall conservation outcome that improves or maintains the health, diversity and productivity of the environment as it relates to these matters protected by the EPBC Act (DSEWPaC, 2012). The potential impacts to mattes of NES identified for the Project (Mine) and Project (Rail) have been assessed against Commonwealth government offset policies to identify the Project's offset requirements and are outlined below.

Matters of NES recorded from the Project (Mine) footprint that are likely to carry offset obligations under the EPBC Act include:

- One threatened ecological community:
  - Brigalow (*Acacia harpophylla* dominant and co-dominant) – EPBC Act endangered
- Threatened flora:
  - Waxy cabbage palm (*Livistona lanuginosa*) – threatened EPBC Act; not predicted to occur in Study Area, detected in field assessments
- Three threatened species confirmed present:
  - Black throated finch (southern) (*Poephila cincta cincta*) – endangered EPBC Act
  - Squatter pigeon (southern) (*Geophaps scripta scripta*) –vulnerable EPBC Act
  - Koala (*Phascolarctos cinereus*) (combined populations of Queensland, New South Wales and the Australian Capital Territory) – vulnerable EPBC Act
- Two threatened species considered likely to occur:
  - Ornamental snake (*Denisonia maculata*) – vulnerable EPBC Act
  - Yakka skink (*Egernia rugosa*) - vulnerable EPBC Act

Matters of NES recorded from the Project (Rail) footprint that are likely to carry offset obligations under the EPBC Act include:

- Two threatened ecological communities :
  - Brigalow (*Acacia harpophylla* dominant and co-dominant) – EPBC Act endangered
- One threatened species confirmed present:
  - Squatter pigeon (southern) (*Geophaps scripta scripta*) – vulnerable EPBC Act
- Four threatened species considered likely to occur:
  - Ornamental snake (*Denisonia maculata*) – vulnerable EPBC Act
  - Black-throated finch (southern) (*Poephila cincta cincta*) – endangered EPBC Act
  - Koala (*Phascolarctos cinereus*) – vulnerable EPBC act

Direct impacts to these listed matters of NES include loss and alteration of habitat. The extent of potentially suitable habitat for each matter of NES mapped within the Project (Mine) and Project (Rail) footprints has been calculated and are used to determine the likely required offset obligation for each matter of NES as a result of vegetation clearing. It should be noted that there is a large area of overlap in the proposed clearing extents for each species due to shared similar habitat requirements between species. In addition the areas of potential suitable habitat for threatened species is based on mapping of suitable habitat for each species that was based on habitat types considered to be potentially suitable to support the species. This approach was a conservative approach and therefore a larger area has been estimated than is likely present on the ground. There is potential therefore for the combined total disturbance area to be substantially reduced following further refinement.

The proposed clearing extents for matters of NES for the Project (Mine) and Project (Rail) are provided in Table 8-1 and Table 8-2 respectively below.

Table 8-1 Estimate of Impact Areas Relevant to Commonwealth Offset Requirements for Project (Mine)

Environmental Offset	Impact Area (ha)
Threatened Ecological Communities	
Brigalow (*Acacia harpophylla* dominant and co-dominant)	196
Potentially Suitable Habitat for Threatened Fauna – Confirmed Present	
Black throated finch (southern)	18,149
Squatter pigeon (southern)	19,349
Koala	15,362
Potentially Suitable Habitat for Threatened Fauna – Likely to Occur	
Ornamental snake	1,554
Yakka skink	18,465
Waxy cabbage palm	19

Table 8-2 Estimate of Impact Areas Relevant to Commonwealth Offset Requirements for Project (Rail)

Environmental Offset	Impact Area (ha)
Threatened Ecological Communities	
Brigalow (*Acacia harpophylla* dominant and co-dominant)	38
Potentially Suitable Habitat for Threatened Fauna – Confirmed Present	
Squatter pigeon (southern)	146
Potentially Suitable Habitat for Threatened Fauna – Likely to Occur	
Ornamental snake	230

Environmental Offset	Impact Area (ha)
Black throated finch (southern)	65
Koala	143

8.2 Detailed Description of Proposed Offsets

The *EPBC Act Environmental Offsets Policy, 2012* has a list of seven suitable offset requirements that must be considered when determining suitable offsets for Commonwealth environmental values. These comprise:

1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed development.
2. Be efficient, effective, transparent, proportionate, scientifically robust and reasonable
3. Be built around direct offsets but may include indirect offsets
4. Be of a size and scale proportionate to the impacts being offset
5. Be in proportion to the level of statutory protection that applies to the affected species or community
6. Effectively manage the risks of the offset not succeeding
7. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced

It is important that an offset package under this policy seeks to deliver an overall conservation outcome that improves or maintains the protected environmental values being impacted (when compared to the value prior to the action occurring) and will contribute to the ongoing viability of that protected matter. With this in mind, the following values are likely to be assessed by DSEWPaC when reviewing an offset package:

- The maturity and health of the communities or species impacted either directly or indirectly by the Project
- The context of the impacted community or species at a local and landscape scale
- The value that the impacted community or communities may have in providing habitat to assist species in adapting to climate change
- The extent to which the proposed offset targets the specific environmental values being impacted by the Project, with an expectation that an offset will offer at least an equivalent ecological benefit to the area being cleared/impacted.
- The level of certainty that the offset being offered will achieve the conservation gain being touted – where that certainty level is low, a higher quantity or variety of offsets may be required

The use of offsets to meet the watercourse and connectivity performance requirements in particular is complex and there is a substantial overlap in State and Commonwealth policy requirements. Calculation of the offset will be dependent on a number of factors including the quality of the vegetation being cleared and of the vegetation being offered as the offset (referred to as ecological

equivalence). It is generally required under State legislation in particular that areas offered as offsets must be ecologically equivalent to the area being cleared, and that the total offset area required will be proportionate to the ecological value of the offset vegetation.

The Ecological Equivalence Methodology Guideline (DERM, 2011f) has been developed to assist in determining ecological equivalence between the areas proposed for clearing and potential offset areas, under the *Policy for Vegetation Management Offsets* and the QBOP. To determine ecological equivalence in the field, a botanical methodology, known as Biocondition assessment is used (Eyre et al., 2011). Site condition is assessed using a Biocondition score which is based on a comparison between measurements of specific site-based attributes and a benchmark value for each of these attributes, specific to a particular RE. Benchmark values can be obtained by undertaking assessment of 'best-on-offer' vegetation using the methodology for establishing reference sites for Biocondition (Eyre, 2006). By comparing attribute measurements to the benchmark values it is possible to obtain a Biocondition score for a particular site. These scores can then be used to compare the overall condition of offset sites with areas impacted by a project, which is important for assessing ecological equivalence.

As current Offset Policies do not specify ratios, the total offset area that may be required will need to be agreed with regulatory agencies. However, site condition/ habitat quality should be used as a guide rather than area when determining offset areas required in meeting ecological equivalence.

Offset packages typically require the delivery of either direct or indirect offsets, or a combination of the two. Location and size of offsets are also key determinants in an offsets package. Offset policies typically favour offsets that are located in close proximity to the impacted site; however balancing spatial relationships with conservation needs often poses challenges. For example, in selecting the location of offsets it should be taken into account that the location of individuals, populations and communities will significantly affect their interactions and persistence in the wild.

The offset options analysis undertaken to date for the Project and summarised in this report seeks to achieve compliance with both the Commonwealth and State biodiversity offset requirements primarily in the form of providing direct offsets, at a relevant ratio, in close proximity to the impacted site. A number of options are also available involving indirect offset strategies to supplement the approach for obtaining direct offsets. These items are linked to the Projects framework for management of impacts to mitigate Project impacts as well as enhance biodiversity values at both a local and a regional scale (refer to Volume 2 Section 5 of the Carmichael Coal Mine and Rail EIS). In summary, a number of direct and indirect approaches, either currently being undertaken or remaining to be undertaken as part of the offset process for the Project (that may form the final commitments of the offset package) have been identified and include:

- Further refinement of the threatened species habitat modelling that was undertaken as part of the terrestrial ecology reports for the Project (Mine) and Project (Rail) reports, including field validation of models, incorporation of additional field data, to refine actual impact to matters of NES (rather than the broad potential impact assessment undertaken for impact assessment purposes).
- Identification of suitable offset areas over properties within which the Project is impacting, and identification of suitable offset areas over properties on a local scale (within 10 km) and regional scale across the landscape (tens of kilometres from the Study area).

- Identification of large-scale strategic offset sites (properties of several thousand hectares that might be suitable as a strategic offset for the Project)
- Development of rehabilitation strategies to link areas of high ecological value in the landscape (to offset fragmentation effects on regional corridors)
- Wider scale research on matters of NES within the local environment (e.g. black-throated finch surveys within 10 km of the Mine) and within the wider region within Burdekin and Fitzroy Basin Catchments and monitoring plans to assist with mitigating long term threats to matters of MNES and biodiversity values.
- Field assessment of identified offset areas to determine the suitability offset extent and condition of vegetation
- Research into vegetation management, rehabilitation, weed management, revegetation, management of threatening processes and other ways to enhance the local and regional biodiversity values. These options may tie into the Projects framework for management of impacts to mitigate Project impacts.
- Preparation of Biodiversity Offset Management Plan(s) to ensure the long-term viability of offset areas. As above, these may also be prepared in accordance with the Project's Management Plans developed as part of the mitigation measures for the Projects operations phase, including but not limited to:
  - Pest and weed management
  - Fencing for live-stock exclusion
  - Fire management
  - Rehabilitation and planting
  - Monitoring and maintenance activities
  - Erosion management
  - On-going research
- Landholder liaison and negotiation to secure required offsets
- Liaison with regulatory bodies and landowners to finalise contractual arrangements and covenants

Offset payments and financial contributions to research under QBOP and the EPBC Act Environmental Offsets Policy also should be considered as potential options to form part of the offset package. Offset payments are more likely to be considered as part of a package under the QBOP more so than the EPBC Act Environmental Offsets Policy or the Policy for Vegetation Management Offsets (DERM 2011g). Ongoing negotiations with Commonwealth and State government departments are necessary to determine whether offset payments will be permitted by the Project.

8.3 Summary

A number of potential direct and indirect impacts have been identified within the Project footprint. Impacts are primarily the direct loss of protected vegetation communities and habitat for threatened species. Offsets for these impacts must meet the offset requirements outlined in the relevant offset policies, including the EPBC Act EOP, PVMO and QBOP.

The potential for land based offsets on the Adani owned property, Moray Downs, and the Brigalow Belt and Desert Uplands bioregions was assessed and substantial offset potential was identified. The final suitability of offsets depends on an assessment of their ecological equivalence and the application of offset ratios by the Australian Government.

On approval of this strategy, an Environmental Offset Package will be developed to present the proposed solutions to fulfil the offset requirements of the project based on Queensland and Australian Government legislation and offset policies in place at the time that the package is prepared. The package is likely to include a combination of direct and indirect offsets, offset payments and offset transfers.

9. Monitoring and Reporting

Site works across all phases of the Project (Mine and Rail) will require the clearing of remnant vegetation, diversion, spanning or removal of watercourses and/or standing water bodies, and fragmentation of the landscape, amongst other impacts. The various impacts to be realised as a result of the construction and operational phases of the Project as they relate to matters of NES have been described under Sections 1, 3, 4 and 6. These will result in impacts across the site of:

- Clearing and fragmentation of lands
- Removal of water resources and alteration of groundwater from drawdown
- Alteration of topography associated with subsidence over underground mining pits and mounding of spoil
- Potential introduction of weeds and exotic pests

Each of these impacts will reduce local biodiversity and may potentially affect regional biodiversity and consideration has been given to the significance of these impacts as they relate to matters of NES. Through this process a number of environmental monitoring and reporting requirements have been identified. Those targeted at matters of NES are identified under Sections 1, 3, 4 and 6. Those commitments are aligned with actions identified elsewhere within the EIS for protection of environmental values that are not listed under the EPBC Act. Collectively the intent of these commitments is to:

- Provide additional baseline data pre-construction to:
  - Inform and refine the potential for impact upon specific environmental features such as the black throated finch and groundwater draw-down potential
  - Inform offset requirements for specific environmental features
  - Establish site specific thresholds for application of effective monitoring of environmental receptors
  - Enable applicable management and mitigation measures to be developed
  - Confirm relevancy of findings from EIS studies immediately prior to construction work commencement to show currency of data at that time
- Achieve implementation of Project offset commitments
- Demonstrate efficacy of Project offset commitments during the life of the Project
- Achieve monitoring of specific environmental features to demonstrate management actions are effective during construction and operational works
- Enable feedback to improve and amend management and mitigation measures applied to construction and operational works as required to maintain efficacy of those measures in protecting the environment.

All environmental monitoring requirements across the Project have been summarised into a Project Commitments statement, provided under Volume 1, Section 12 Project Commitments. That section of the EIS clarifies pre-construction requirements, offset commitments, environmental monitoring and management requirements during construction and operation and links the various commitments to

the environmental feature of relevance. As such, the monitoring and reporting commitments for matters of NES are also summarised from the preceding sections of this document into Volume 1, Section 10 and are not repeated here.

All relevant environmental management actions for control of potential impacts have been developed into dedicated Environmental Management Plans to be applied to construction and operational phases of both the Mine and Rail. Those plans are provided under Volume 2, Section 13 Environmental Management Plan (Mine), Volume 2 Section 14 Environmental management Plan (Offsite) and Volume 3, Section 13 Environmental Management Plan (Rail). As such, the environmental controlling provisions for protection of matters of NES are also summarised from the preceding sections of this document into those dedicated Environmental Management Plans and are not repeated here.

Reporting commitments and agency liaison requirements from all monitoring and research are similarly identified within the Project Commitments and Project Environmental Management Plans provided under Volume 1 Section 10, Volume 2 Section 13, Volume 2 Section 14 and Volume 3 Section 13. These are not repeated here.

All Project Environmental Management Plans will be informed by monitoring works to be completed pre-construction and during delivery of the Project. They will be adaptable and include provision for revision and update based on monitoring feedback, changes in operational or construction work plans, changes in legislation and to maintain currency against political, social and environmental circumstances.

10. Conclusions and Recommendations

Assessment of the potential to affect matters of NES has been achieved by integrating knowledge from desktop and field surveys. This has enabled a description of the existing environment of the project Study Are to be developed and confirm the presence and prevalence of any matters of NES within the Project Study Area. Where limited data exists potential habitat mapping has informed likelihood of species occurrence within the Mine and Rail Study Areas.

In consideration of construction and operational activities of the mine and rail components of the Project, potential impacts have been identified and described with respect to flora and fauna species, their confirmed and potential habitat and vegetation communities that occur within (confirmed) or are considered likely to occur within, the Study Area (as per the criteria nominated under Section 1.6.3).

Potential impacts arising from construction and operational works 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

How these may affect matters of NES of relevance to the Project has been assessed in detail. Potential impacts have been considered with regard to whether an important population of protected species occurs at the site and whether impacts may be significant or not.

The significance of residual impacts, post-mitigation, was evaluated with consideration to the DSEWPaC significance criteria, which are provided in the Significant Impact Guidelines (DEWHA, 2009).

In considering impact to listed taxa and communities, assessment was also made to identify relevant matters for impact assessment in relation to the following:

- An important population – for listed vulnerable threatened species
- Habitat critical to survival – for listed threatened species
- Important habitat – for migratory species

Mitigation measures to avoid/minimise/offset impacts to identified matters of NES resulting from the construction and operational activities associated with the Project have been proposed and offset commitments have been identified. Findings of the assessment are summarised against the controlling provisions for the Project.

World Heritage Properties, National Heritage Places and the Great Barrier Reef Marine Park

The DSEWPaC Projected Matters Search Tool did not identify any world heritage properties or National Heritage Places of relevance to the Project.

The Wet Tropics World Heritage Area is located over 270 km north of the Study Area with no direct terrestrial, aquatic or biodiversity links to the Study Area. No influences from the Project are predicted to occur on the Wet Tropics World Heritage Area and this area has not been considered further within this assessment.

The Tree of Knowledge and curtilage at Barcaldine is the closest National Heritage Place to the Study Area. It is located approximately 200 km south west of the western extent of the Study Area. No direct or indirect influences on this Place will occur as a consequence of the Project and this Place has, therefore, not been considered further.

The GBRWHA and the Marine Park are located over 300 km downstream of the Study Area and although connected aquatically via watercourses, substantial watercourse and overland barriers exist between the ocean and the Study Area, including the Burdekin River dam. Significant controls will be established to manage onsite and offsite water and sediment quality impacts. These measures will mitigate potential for offsite impacts to aquatic values that could affect the downstream reefal environment. The distance from the GBR and the extant barriers would impede site conditions from having an influence on the values for which the reef is protected. No impacts associated with the Project will result in a substantial and measurable change in the hydrological regime of the GBRWHA waters and, therefore, no effects on the Marine Park are predicted either. Accordingly no impacts to the ecological, cultural or social values which the Great Barrier Reef is recognised will occur as a result of the Project.

The Project will not impact upon any World Heritage Areas, National Heritage Places or the Great Barrier Reef Marine Park.

Wetlands – Ramsar

No areas of Ramsar wetland are predicted to be impacted by this Project. The closest Ramsar wetland is 380 km from the site, disconnected from the Study Area by substantial barriers. No areas of internationally important wetland will be lost, destroyed or substantially modified as a result of the Project nor will the hydrological regime of those distant wetlands be interfered with. None of the biodiversity for which distant wetlands are recognised will be impacted by Project activities as the Project will not affect the geography of any Ramsar protected wetlands nor will it act to introduce invasive species to any wetland sites. Accordingly, no impacts to Ramsar wetlands are predicted to occur as a result of this Project.

Listed Threatened Species and Communities

Based on current knowledge, assessment indicates the Project will likely realise significant impacts to the Black-throated finch (southern).

Impacts to Brigalow TEC will also result from unavoidable vegetation clearing, however, impacts will be restricted to the Project Area only with management measures ensuring no offsite affects are realised. Large areas of this TEC are protected in the surrounding landscape and losses equate to less than 1 per cent of the subregional extent of each TEC. Losses are not expected to affect the ongoing prevalence or genetic diversity of these TEC within the subregion. Offsets will be proposed

to address these losses in accordance with the relevant Commonwealth and State offset policies (refer Volume 1 Section 10 Draft Offsets Strategy).

As a consequence of habitat losses resulting from mining and other Project activities, significant impacts to the black-throated finch (southern) are expected to occur. Further, works may interfere with the species recovery by decreasing the availability or quality of habitat across the footprint of the Project area to the extent that the species is likely to decline. Consideration has been given to measures to ameliorate potential for impact to reduce potential to significantly affect the population of this subspecies.

Habitat losses will be staged. Research will be undertaken prior to mining works to improve knowledge of the habitat dependencies of this species and to identify appropriate areas that can be rehabilitated/engineered to offer alternative habitats into which the species could naturally relocate ahead of mining works. Habitat management, informed by ongoing research and monitoring, will also occur during the Project to minimise potential to realise a significant impact upon this species. Research works will contribute to the maintenance of this subspecies within this bioregion and therefore, in general, to the recovery of the subspecies, as per the objectives of the National *Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007). The onsite and offsite habitat management and research program to be implemented will be informed by the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007), and developed in consultation with the Black-throated Finch Recovery Team, and other relevant stakeholders (i.e. Commonwealth and State governments, natural resource management groups, landholders etc.). Examples of recovery actions, documented in the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (Black-throated Finch Recovery Team, 2007), to be incorporated into the Project Species Specific Management Plan (on and offsite) for the subspecies, will include:

- Investigate breeding requirements and threats to key breeding areas (Action 1.1)
- Investigate feeding and other habitat requirements (Action 1.2)
- Undertake targeted surveys (to identify habitat) (Action 2.4)
- Secure selected sites for conservation (Action 3.1) – analogous to Project Offsets
- Address threats on grazing lands (Action 3.2)
- Monitor management effectiveness (Action 3.3)
- Determine suitability of birds in captivity for a reintroduction project (Action 4.1)

Information obtained from such studies will be incorporated into the Project Species Specific Management Plan for the subspecies (under the overarching Project Land Management (Flora and Fauna) Plan). The measures summarised here and detailed throughout this section seek to address the Project's impact to the black-throated finch (southern) to reduce these to the greatest extent possible. Given current knowledge, determining the efficacy of the proposed measures in reducing impacts and protecting the subspecies is difficult to quantify. Preliminary research is required such that a clearer understanding of the subspecies' prevalence and behavioural ecology in the region can be ascertained, thereby allowing for the assessment of Project impacts to the subspecies to be undertaken in the context of a detailed understanding of the subspecies' regional population, abundance and behavioural ecology.

Operational works may realise groundwater draw down impacts to the Doongmabulla Springs, a regionally important Great Artesian Basin discharge spring ecosystem listed as a TEC under the EPBC Act. Current modelling indicates a 10 cm (maximum) draw down (operation phase); modelling is highly conservative and potential effects to the dependent ecosystem at the Springs from this draw down is currently unquantifiable. Predicted drawdowns at all springs in the Doongmabulla system are between 0.05 m and 0.12 m, less than 0.2 m throughout the operational period with the majority of predicted impacts lower than 0.05 m. The predicted drawdown potential at the Doongmabulla springs is 60 per cent of the level considered to be potentially significant (0.2m) and will occur approximately 60 years into the life of the mine.

Listed Migratory Species

A desktop and field assessment was undertaken to identify EPBC Act listed migratory species that have the potential to occur within the Mine and Rail Study Areas. Three species, eastern great egret (*Ardea modesta*), rainbow bee-eater (*Merops ornatus*) and stain flycatcher (*Myiagra cyanoleuca*) were confirmed present within the Study Area. An additional 11 species are considered likely to occur while four species may occur.

It is recognised that, in spite of the recommended management and mitigation measures, and the active rehabilitation of disturbed areas that will occur through the Project's operational life, unavoidable loss of habitat for migratory species will occur.

Active, targeted management of habitats adjacent to the clearing footprint can improve their quality for migratory species. Establishing alternative habitats adjacent to the Project through active management prior to clearing migratory species habitats will encourage individuals to disperse from proposed clearing areas (or attract them to adjacent areas). This may include, but not be limited to, improving forage and nesting resources, increasing access to watering locations, and management of pest and weed species, to enhance the value of adjacent areas. This action will seek to minimise habitat loss (through replacement) and will also act to minimise potential for mortality by providing migratory species with habitat refugia within the operational landscape. The details for such management approaches and actions will consider the staged nature of operations, will be informed by onsite research, and will be detailed within Project Species Specific Management Plans (under the overarching Project Land Management (Flora and Fauna) Plan).

The potential to realise a significant impact upon migratory species within the Project Area has been considered against criteria identified by DSEWPaC. Based on current knowledge the assessment identifies that the Project is not expected to have a significant impact upon any migratory species. This finding is on the basis that:

- The Project Area does not support an important population of any of these species
- The Project Area does not support an ecologically significant proportion of the population of a migratory species
- Measures identified in Sections 5.1.2 to 5.1.5 are expected to manage the potential to directly or indirectly impact these species
- The species are well represented in landscapes that surround the Project Area, where suitable alternative habitat is prevalent and will persist
- The species are not considered to be dependent upon any habitat within the Project Area for any particular lifecycle stages.

As such, while large tracts of habitat suitable for these protected matters will be affected, alternative habitat suitable for these species exists adjacent to the Project Area and within the region. Accordingly the Project is not predicted to adversely impact migratory species.

Offsets

The key Commonwealth offsets policy which applies to the Project is the Commonwealth *EPBC Act Environmental Offsets Policy* (Consultation Draft) (DSEWPaC, 2011) -applicable to Project (Mine) and Project (Rail).

A number of potential direct and indirect impacts have been identified within the Project footprint under both Commonwealth and State offset policies and include the direct loss of protected vegetation communities, habitat for threatened species and resources as a result of vegetation clearing. The delivery of offsets must meet the specific offset requirements outlined in all relevant environmental offset policies. In general there are two primary options for delivering offsets, these being either land-based offsets (direct or indirect) and/or offset payments.

There is scope for most of the offset obligations associated with impacts to Commonwealth and State environmental values to be met through the delivery of a combined offset approach that address impacts to environmental values protected under both areas of legislative jurisdiction. Offset options that nominate a complementary approach will need to be agreed with DSEWPaC, DEHP and DNRM so that these options satisfy the requirements of both Commonwealth and State offset policies.

Recommendations

Project activities have been identified as having a significant effect on matters of NES. A number of Project commitments have been identified to provide additional baseline data pre-construction to:

- Inform and refine potential for impact upon specific environmental features such as the black throated finch
- Inform offset requirements for specific environmental features
- Establish site specific thresholds for application of effective monitoring of environmental receptors
- Enable applicable management and mitigation measures to be developed and incorporated into Project Environmental Management Plans
- Confirm relevancy of findings from EIS studies immediately prior to construction work commencement to show currency of data at that time
- Confirm agency expectations are met with regard to environmental protection during Project delivery

It is recommended that all pre-construction monitoring and research studies identified are completed to achieve the above and to provide additional information to regulatory agencies. Further, it is also recommended that consideration be given to establishing technical advisory panels for specific environmental features of concern. Panels could guide additional study requirements, independently verify objectives are achieved by studies and include regulators, proponents and technical specialists to provide a common forum for discussion to enable targeted activity requirements to be identified, agreed and delivered.

While this report address matters of NES of relevance to the Project, it is aligned with and has utilised information from all studies completed for the EIS. Readers should be familiar with all works available under Volumes 1, 2, 3 and 4 of this EIS.

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Appendix A

Protected Matters Search

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report: Coordinates

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

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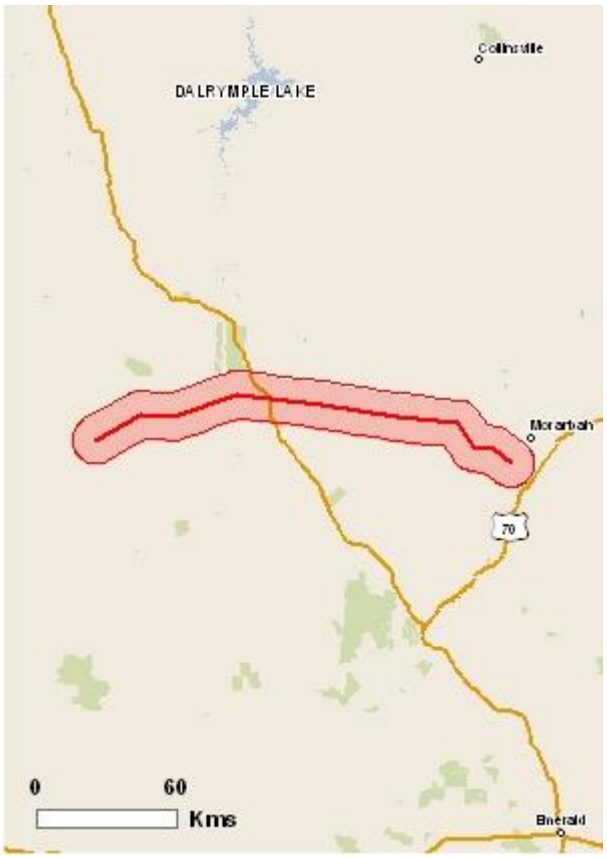

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 10.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communitites:	3
Threatened Species:	17
Migratory Species:	13

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None

Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	None
State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	Endangered	Community likely to occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Poephila cincta cincta Black-throated Finch (southern) [64447]	Endangered	Species or species habitat likely to occur within area
Rostratula australis		

Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Dasyurus hallucatus		
Northern Quoll [331]	Endangered	Species or species habitat may occur within area
Nyctophilus timoriensis (South-eastern form)		
Greater Long-eared Bat, South-eastern Long-eared Bat [66888]	Vulnerable	Species or species habitat may occur within area
OTHER		
Cycas ophiolitica		
[55797]	Endangered	Species or species habitat likely to occur within area
PLANTS		
Acacia ramiflora		
[7242]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium queenslandicum		
King Blue-grass [5481]	Vulnerable	Species or species habitat likely to occur within area
Digitaria porrecta		
Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
REPTILES		
Denisonia maculata		
Ornamental Snake [1193]	Vulnerable	Species or species habitat likely to occur within area
Egernia rugosa		
Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area
Furina dunmalli		
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Lerista allanae		
Allan's Lerista, Retro Slider [1378]	Endangered	Species or species habitat may occur within area
Paradelma orientalis		
Brigalow Scaly-foot [59134]	Vulnerable	Species or species habitat may occur within area
Rheodytes leukops		
Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle [1761]	Vulnerable	Species or species habitat may occur within area

Migratory Species [Resource Information]

Name	Status	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		

White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Nettapus coromandelianus albipennis		
Australian Cotton Pygmy-goose [25979]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species **[Resource Information]**

Name	Status	Type of Presence
Birds		
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Myiagra cyanoleuca		

Satin Flycatcher [612]		Species or species habitat likely to occur within area
Nettapus coromandelianus albipennis		
Australian Cotton Pygmy-goose [25979]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Nairana (Recovery), QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Frogs		
Bufo marinus		
Cane Toad [1772]		Species or species habitat likely to occur within area
Mammals		
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora		
Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis		
Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana,		Species or species habitat likely to occur within area

Red-Flowered Sage, White Sage, Wild Sage [10892]	
Parkinsonia aculeata	
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]	Species or species habitat likely to occur within area
Parthenium hysterophorus	
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]	Species or species habitat likely to occur within area
Prosopis spp.	
Mesquite, Algaroba [68407]	Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-22.01137 146.37083,-21.91215 146.54162,-21.92341 146.66822,-21.83625 146.91074,-21.87472 147.24022,-21.92129 147.52917,-21.94817 147.76182,-22.03703 147.81947,-22.04841 147.90074,-22.10028 147.96578

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This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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