Appendix E
Flora and Aquatic Ecological Assessment

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Glossary of Terms

Biological diversity	The maintenance of a full and diverse range of plant and animal species.
Chainage	The chainage at a location along a rail line is the distance of that point in relation to Sydney (NSW only) based on 0.000 kilometres being located at the end of Central No. 1 Platform.
Concept design	Initial functional layout of a concept, such as for the proposed duplication, to provide a level of understanding to later establish detailed design parameters.
Consent	Approval to undertake a development received from the consent authority.
Construction Environmental Management Plan	A document setting out the management, control and monitoring measures to be implemented during construction of a development, to avoid or minimise the potential environmental impacts identified during an environmental impact assessment process.
Crossover	Railway infrastructure which provides a train the ability to cross between two adjacent tracks.
Culvert	A totally enclosed drain under a road or railway.
Detailed design stage	The stage at which the project design is detailed on the basis of an approved concept design.
Director-General's Requirements	Requirements for an environmental assessment issued by the Director-General of the NSW Department of Planning in accordance with the Environment Planning and Assessment Act 1979.
Down Main	Primary (main) rail line that trains traverse when they are heading away from Sydney (usually positioned on the left when your back is to Sydney).
Emission	The release of material into the surroundings (for example, gas, noise, water).
Erosion	A natural process where wind or water detaches a soil particle and provides energy to move the particle.
Fauna	The animals of a given region or period, taken collectively.
Fill	Earth used to construct an embankment.
Flora	Plants of a particular region that make up the vegetation of a site.
Gradient	The degree of ascent or descent with a uniform slope.
Groundwater	Subsurface water stored in pores of soil or rocks.
Hunter 8 Alliance	Hunter 8 Alliance, which has been formed to deliver a new third track and ancillary infrastructure between Maitland and Minimbah.
Hydrology	The study of rainfall and surface water run-off processes.
Key threatening process	A process specified in Schedule 3 of the Threatened Species Conservation Act 1995 that adversely affects threatened species, populations or ecological communities, or could cause those that are not threatened to become so.

Level crossing	A crossing provided at grade across the railway corridor.
Mitigation	Reduction in severity.
Option	A concept design alternative developed for consideration.
Overbridge	Where a road or pedestrian footway is situated over the railway line.
Plant	Construction machinery, vehicles or equipment needed to carry out mechanical or construction activities.
Precautionary principle	If there are threats of serious or irreversible damage, lack of full scientific uncertainty should not be used as a reason for postponing measures to prevent environmental damage.
Proponent	Australian Rail Track Corporation (ARTC).
Rail corridor	The area of land dedicated to the ARTC between Maitland and Minimbah.
Sediment	Material of varying sizes that has been or is being moved from its site of origin by the action of wind, water or gravity.
Site compound	Area enclosing construction machinery, stockpiles and site offices usually adjacent to construction sites.
Spoil	Excess of rock and/or earth material resulting from construction activities.
Threatened species, populations and ecological communities	Species, populations and ecological communities specified in Schedules 1, 1A and 2 of the Threatened Species Conservation Act 1995.
Turnout	The intersection and mechanisms for the meeting of two tracks.
Underbridge	Where a road or pedestrian underpass is situated under the railway line.

Executive Summary

This Flora and Aquatic Ecological Assessment has been undertaken by the Hunter 8 Alliance on behalf of the Australian Rail Track Corporation (ARTC), as part of the Environmental Assessment, for the Maitland to Minimbah Third Track Project (the Project). This report has been prepared to assess the existing flora and aquatic ecology of the investigation area, impacts of the Project, and to develop mitigation measures to minimise impacts of the Project. An assessment of the potential impacts on fauna habitats has been assessed in a separate report and is included in Appendix F of the Environmental Assessment.

The Hunter 8 Alliance on behalf of the Australian Rail Track Corporation (ARTC) is proposing to upgrade approximately 30 kilometres of the Main Northern Railway between the Maitland Junction and Minimbah Bank (near Belford). The Project would widen the existing rail formation to accommodate a third track. Construction of the third track would include major earthworks, drainage, minor structures, new over and under bridges, modification to existing station platforms, signalling and relocation of existing services.

The flora and aquatic ecology survey and assessment has been prepared with consideration of the *Draft Guidelines for Threatened Species Assessment* under Part 3A of the *Environmental Planning and Assessment Act* 1979 (DEC and DPI, 2005), *Threatened species assessment guidelines: The assessment of significance* (DEC 2007), *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities* (DEC 2004) and the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) *Flora and Fauna Survey Guidelines* (LHCCREMS 2003).

Eight distinct vegetation communities are present in the investigation area, some of which are listed as endangered ecological communities (EECs) under the *Threatened Species Conservation Act* 1995 (TSC Act). These are outlined in the table below:

Vegetation Community	Conservation Significance
Lower Hunter Spotted Gum Ironbark Forest	High. *Lower Hunter Spotted Gum Ironbark Forest EEC* (TSC Act)
Forest Red Gum Open Forest	High. *Hunter Lowland Redgum Forest EEC* (TSC Act)
Swamp Oak Riparian Forest	High. *Swamp Oak Floodplain Forest EEC* (TSC Act)
Grey Box Spotted Gum Ironbark Forest	High. *Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC.* (TSC Act)
Freshwater Wetland	High. *Freshwater Wetland EEC* (TSC Act)
Hakea Scrub	Low

Vegetation Community	Conservation Significance
Cleared with Scattered Trees/ Open Pasture/ Weedy Area	Low
Plantation	Low

One threatened plant, Slaty Red Gum (*Eucalyptus glaucina*), listed as a vulnerable species under the TSC and EPBC Acts was recorded in the investigation area. One Rare or Threatened Australian Plant (RoTAP), Mountain Grevillea (*Grevillea montana*), was also identified within the investigation area. No other threatened terrestrial flora are considered likely to occur within the investigation area. Based on species distribution ranges and habitat requirements, no aquatic species, populations and endangered ecological communities listed under the FM Act are likely to occur in the investigation area.

There are six named creeks in the investigation area including Stony Creek, Lochinvar Creek, Anvil Creek, Sawyers Creek, Black Creek and Jump Up Creek along with numerous permanent and ephemeral unnamed tributaries to these creeks. Most creeks within the investigation area have been rated as poor to average by the Rapid Appraisal of Riparian Condition (RARC) assessment (Jansen *et al*. 2005), due to the width of riparian vegetation, fragmented nature of native vegetation in the local area, high level of weeds in the groundcover, and lack of fauna habitat.

Several small freshwater wetlands also occur within the investigation area, including a large freshwater wetland associated with Stony Creek near Wollombi Road. These wetlands have been rated as poor in the RARC assessment. There are numerous small and large farm dams within the investigation area, which are typically characterised by little or no native riparian vegetation.

Vegetation clearing would be confined to the construction impact zone. The extent of works would remove approximately:

- 23.3 hectares of Hunter Lowland Redgum EEC (inclusive of 2.7 hectares of Slaty Red Gum and 0.8 hectares of Mountain Grevillea which forms part of the EEC).
- 13.2 hectares of Lower Hunter Spotted Gum-Ironbark Forest EEC (inclusive of 0.8 hectares of Mountain Grevillea which forms part of the EEC).
- 14.9 hectares of Swamp Oak Floodplain Forest EEC.
- 0.6 hectares of Freshwater Wetlands EEC.
- 12.7 hectares of Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.
- 2.7 hectares and 50 scattered individual Slaty Red Gum.

An assessment of the impact of the Project was undertaken on threatened species and ecological communities under the provisions of Part 3A of the EP&A Act to determine the significance of impacts for species and communities listed on the TSC Act. The Project is considered unlikely to have a significant impact on threatened species, populations, EECs or their habitat listed under the TSC Act provided adequate areas of offsetting are developed as part of the Compensatory Habitat Strategy. Based on the assessment undertaken in accordance with the *EPBC Act Significant Impact Guidelines* (DEH 2006), the Project is considered unlikely to have a significant impact on Slaty Red Gum provided adequate areas of offsetting are developed as part of the Compensatory Habitat Strategy.

Database searches indicate that no threatened aquatic species listed under the FM Act or EPBC Act have been previously recorded within the investigation area. Additionally, based on species distribution ranges and habitat requirements, no aquatic species, populations and endangered ecological communities are likely to occur in the investigation area. It is therefore considered unlikely for threatened aquatic species, populations or EECs listed under the FM Act or EPBC Act to occur in the investigation area.

With the exception of Sawyers Creek, no trenching, realignment or direct impacts, including instream pylons or excavation of banks for any creeks are anticipated. The Project would involve clearing and/or filling small areas of freshwater wetland and riparian vegetation along the edge of the existing rail line, including small areas of Swamp Oak Riparian Forest, macrophyte beds, native reeds and sedges.

Fish passage would not be impacted as a result of the Project. The existing culverts under the railway would be extended or augmented and would be designed with consideration to Fairfull and Witheridge (2003) for fish friendly crossings. The Project would increase the flow to creeks and drainage lines due to the introduction of more non-porous surfaces through construction of the third track. However, the Project is considered unlikely to significantly alter the timing, duration or velocity of flows to or from wetlands and creeks that intersect the investigation area. Impacts on aquatic processes, species and habitat are considered unlikely as existing culverts along the length of the Project would either be extended or augmented to accommodate the third track.

The Project is not anticipated to impact on availability, depth, quality or flow of groundwater. Construction impacts on groundwater dependent ecosystems are considered unlikely as no dewatering is proposed, apart from at Wollombi Road where localised and temporary lowering of the groundwater would occur during construction. Operational impacts on groundwater dependent ecosystems are considered unlikely.

A number of measures have been recommended to avoid, mitigate and offset impacts of the Project and are discussed in Section 7.

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1. Introduction

This Flora and Aquatic Ecological Assessment has been undertaken by the Hunter 8 Alliance on behalf of the Australian Rail Track Corporation (ARTC) for the Maitland to Minimbah Third Track Project (referred to as 'the Project'). This report has been prepared to assess the existing flora and aquatic ecology of the investigation area, impacts of the Project, and to develop mitigation measures to minimise impacts of the Project.

1.1 Background

ARTC was created by the Commonwealth and State Governments in 1998 to provide a single body responsible for the National Interstate Rail Network. ARTC is a Commonwealth Government corporation and currently has responsibility for the management of over 10,000 route kilometres of standard gauge interstate rail track in South Australia, Victoria, Western Australia and New South Wales (NSW), as well as the Hunter Valley Rail Network and other regional rail links in NSW.

The Hunter Valley Rail Network extends from the Port of Newcastle to Ulan and Narrabri in the west. It is used by passenger services, freight, wheat and coal services. The majority of trains carry coal from mines located across the Hunter Valley to either Carrington (Port Waratah) or Kooragang Island ports at Newcastle for loading onto ships for export.

Due to the forecast increase in coal throughput at the Port of Newcastle to 190 million tonnes per annum (mtpa) by 2012, a number of rail infrastructure improvements to the Hunter Valley Rail Network have been proposed by ARTC. One of the key improvement projects included in the ARTC ten-year strategic plan is a proposed third track adjacent to the existing Main Northern Railway between Maitland and Whittingham, known as the Maitland to Whittingham Third Track Project.

The Maitland to Whittingham Third Track Project is divided into two stages. Stage 1 consists of the construction of the third track between Minimbah and Whittingham. Project Approval for this project was granted by the Minister of Planning on 26 May 2009 and construction commenced in July 2009.

Stage 2 consists of the construction of the third track between Maitland and Minimbah, known as the Maitland to Minimbah Third Track Project. Stage 2 is the subject of this Flora and Aquatic Ecological Assessment and is referred to as 'the Project'.

The purpose of the Project is to increase rail reliability and future capacity between the Hunter Valley and the Port of Newcastle. In addition to providing increased track capacity, the Project aims to improve operational performance along the route. These improved efficiencies would be created through:

- Reduced impacts on coal traffic due to track maintenance activities.
- Reduced loss of freight train paths due to shadow effects from passenger services.
- Reduced loss of available train paths due to train breakdowns.

The Project would also bring benefits to the local and broader community by generating up to 650 full time jobs during construction, creating opportunities for local and regional goods and service providers, and providing greater security for existing coal industry jobs.

1.2 Description of the Project

The Hunter 8 Alliance, on behalf of the ARTC, is proposing to construct a third track adjacent to the existing Main Northern Railway between Maitland and Minimbah. The proposed third track would commence in Farley approximately 2 kilometres west of Maitland Station at approximate chainage 194.500 kilometres and would run adjacent to the Main Northern Railway for approximately 30 kilometres concluding at Minimbah at approximate chainage 224.200 kilometres.

The proposed third track would be predominantly located on the Up side of the Main Northern Railway. Approximately 3 kilometres of track, from chainages 210.170 kilometres to 211.180 kilometres and 214.060 kilometres to 216.000 kilometres, would be located on the Down side.

The Project would involve the construction of approximately 30 kilometres of new rail track as well as construction and/or modification of major infrastructure along the Main Northern Railway. A summary of the major elements of the Project is provided in Table 1-1.

Table 1-1 Major Project Elements

Project Elements	
Earthworks	Major cut and fill earthworks along the route. Other minor earthworks.
Track	Approximately 30 km of new track including turnouts and junctions. Relocation of turnouts from Minimbah and Branxton to Belford. Upgrade of maintenance siding turnouts at Branxton. Track reconditioning of existing Up Main at Greta and Branxton Stations and of the Branxton crossovers.
Drainage	Central and cess track drainage. Amendments to 53 culverts for cross drainage. Re-alignment of Sawyers Creek. Other drainage works around new structures.
Bridges	A new rail underbridge at Stony Creek and Wollombi Road, Farley. Closure of the stock crossing at Farley. Demolition of the existing rail overbridge at Old North Road, Allandale. A new rail underbridge at Allandale Road, Allandale. A new rail underbridge for an unnamed tributary of Anvil Creek (chainage 207.776 km).

Project Elements	
	Demolition and replacement of the existing rail underbridge at an unnamed tributary of Anvil Creek, Greta (chainage 209.989 km). A new rail underbridge at Sawyers Creek, Greta. Modification of the existing rail overbridge at Bridge Street, Branxton. A new rail underbridge at Black Creek, Belford. A new rail underbridge at Jump Up Creek, Belford.
Station Modifications	Modifications to Lochinvar Railway Station. Modifications to Greta Railway Station. Modifications to Branxton Railway Station.

1.3 Investigation Area

The investigation area for this Flora and Aquatic Ecological Assessment is a linear corridor which follows the route of the Main Northern Railway between chainages 194.500 kilometres and 224.200 kilometres and is shown in Figure 1.1.

The investigation area captures the footprint of disturbance for the third track and other associated works, including construction compounds, haul roads and spoil disposal areas.

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0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Watercourse
- Cadastre
- Construction Impact Zone
- Investigation Area
- Watercourse Area
- National Park

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

The Investigation Area

Figure 1.1a

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; Department of Lands: Cadastre - 2004. Created by: fmackay, tmorton

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0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Watercourse
- Cadastre
- Construction Impact Zone
- Investigation Area
- Watercourse Area
- National Park

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

The Investigation Area

Figure 1.1b

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0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Watercourse
- Cadastre
- Construction Impact Zone
- Investigation Area
- Watercourse Area
- National Park

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

The Investigation Area

Figure 1.1c

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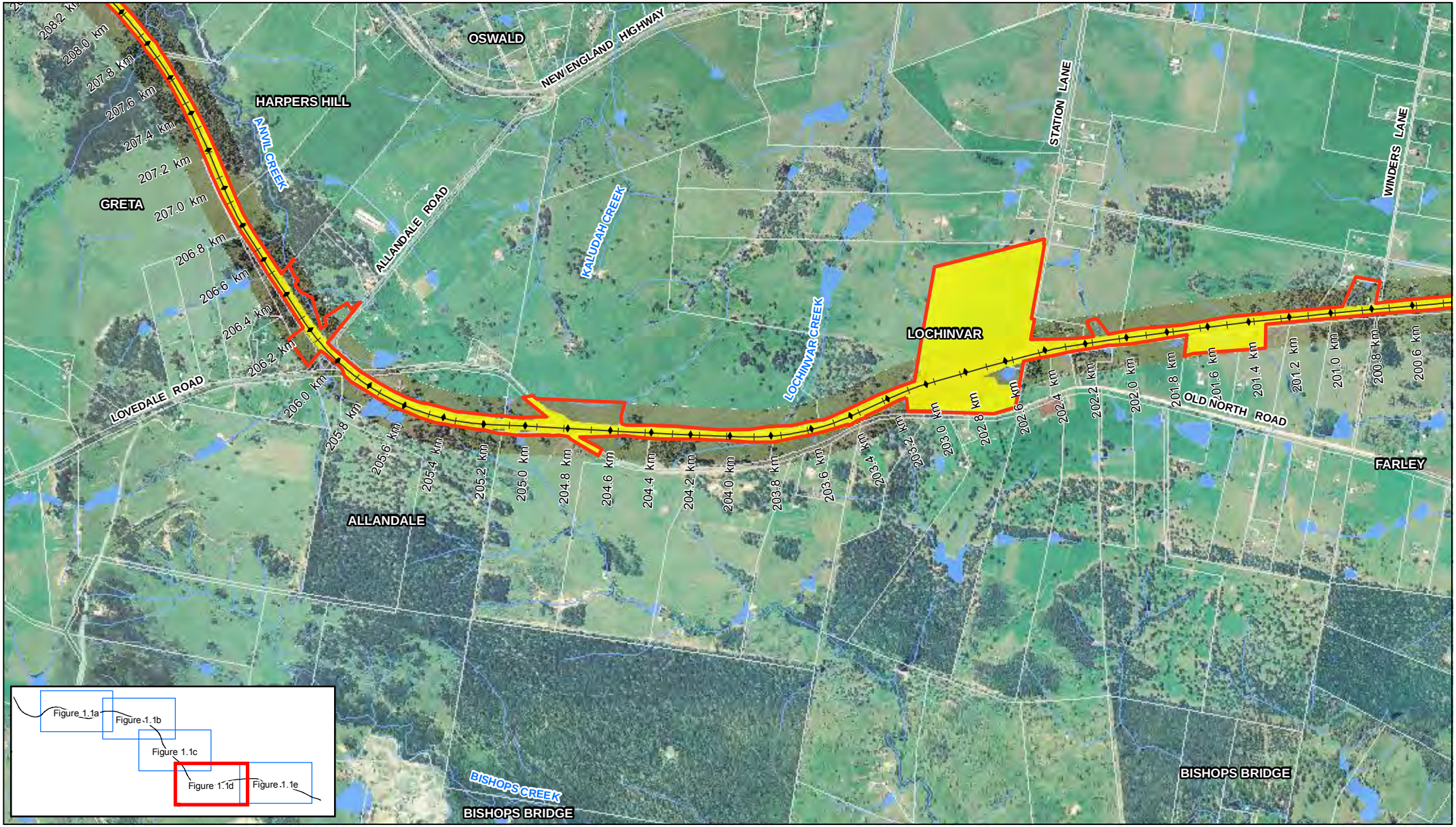
Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; Department of Lands: Cadastre - 2004. Created by: fmackay, tmorton



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Watercourse
- Cadastre
- Construction Impact Zone
- Investigation Area
- Watercourse Area
- National Park

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

The Investigation Area

Figure 1.1d

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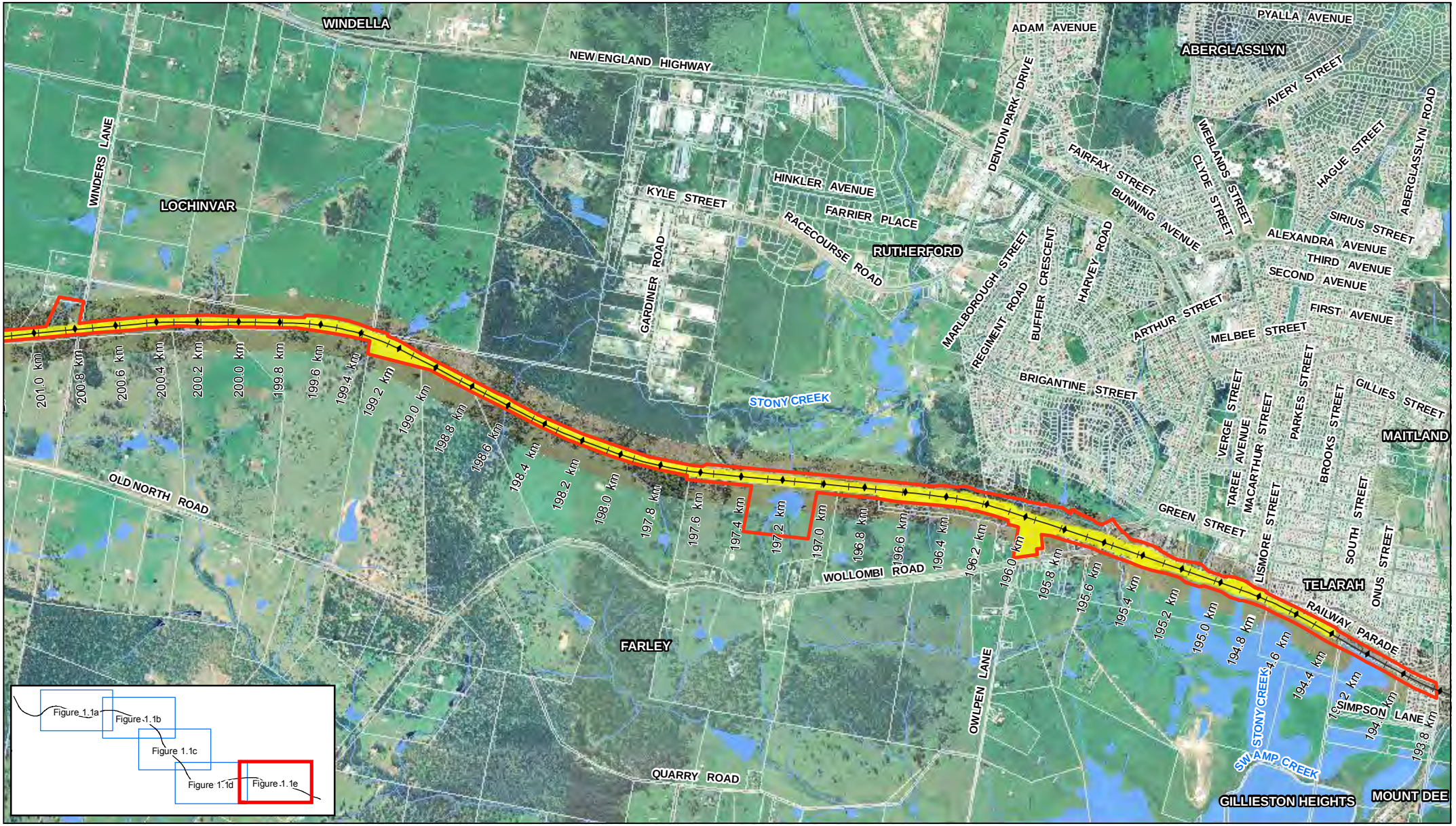

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Watercourse
- Cadastre
- Construction Impact Zone
- Investigation Area
- Watercourse Area
- National Park

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

The Investigation Area

Figure 1.1e

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Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; Department of Lands: Cadastre - 2004. Created by: fmackay, tmorton

1.4 Objectives and Purpose of this Report

The objectives of this Flora and Aquatic Ecological Assessment are to:

- Describe the existing environment of the investigation area in terms of flora and aquatic ecology.
- Assess the significance of impact of the Project on threatened terrestrial flora and threatened aquatic flora and fauna, including whether a significant impact on threatened species / endangered populations / endangered ecological communities listed on the NSW *Threatened Species Conservation* 1995 *(*TSC Act) and *Fisheries Management Act* 1994 (FM Act) is likely to result from the Project.
- Assess the significance of potential impacts of any flora and aquatic ecological Matters of National Environmental Significance (NES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act); and determine whether the Project is likely to constitute a 'controlled action' under the EPBC Act.
- Identify appropriate measures to mitigate the ecological impacts of the Project.

Impacts on threatened terrestrial fauna and their habitats listed under the TSC Act and EPBC Act are outlined in a separate Fauna Impact Assessment report and included in Appendix F of the Environmental Assessment.

Within this report, reference is given to the relevant sections of the EPBC Act, TSC Act, FM Act, *National Parks and Wildlife Act* 1974 (NP&W Act); *Environmental Planning and Assessment Act* 1979 (EP&A Act); and subsequent amendments to these. Specific consideration is given to Part 3A of the EP&A Act and the guidelines provided for threatened species assessment (former NSW of Department of Environment and Climate Change (DECC), now Department of Environment, Climate Change and Water (DECCW)) and Department of Primary Industries (DPI), now Industry and Investment NSW (I&I NSW) (2005), in order to meet the requirements of the Director General's Requirements (DGRs), guidelines and legislation.

The DGRs identify ecology as a key issue for the Environmental Assessment. Table 1-2 outlines the DGRs relating to flora and aquatic ecology and where they have been addressed in this report.

Table 1-2 Director-General's Requirements – Ecology

Director-General's Requirements	Where addressed in this report
Terrestrial and aquatic flora, fauna and habitat, with specific consideration of Endangered Ecological Communities, threatened flora, fauna and populations.	Flora and Aquatic Ecology Impact Assessment is outlined in Section 6.
Vegetation clearing and resultant foraging, roosting and nesting habitat loss, fragmentation, connectivity and edge effects, increase in rail movements, and changes to watercourses and riparian zones.	Flora and Aquatic Ecology Impact Assessment is outlined in Section 6.

Director-General's Requirements	Where addressed in this report
Taking into account of: the *Draft Guidelines for Threatened Species Assessment* (DEC), *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC), *Threatened Species survey and assessment: field survey methods for fauna Amphibians* (DECC), *Principles for use of Biodiversity offsets in NSW* (DECC) and *Fish Passage requirements for Waterway Crossings* (NSW Fisheries).	Flora and Aquatic Ecology Assessment Methods are outlined in Section 4. Flora and Aquatic Ecology Mitigation Measures are outlined in Section 7.

2. Existing Environment

2.1 Definitions

The flora and aquatic ecology field survey was undertaken within the 'investigation area' as shown in Figure 1.1. The investigation area is based on a variable width buffer extending around the existing rail corridor with wider areas for site compound and spoil areas.

The 'construction impact zone' is located within the investigation area, and is narrower than the investigation area. The construction impact zone incorporates the area to be impacted by construction activities with a 10 metre buffer. All areas of vegetation clearing are based on the construction impact zone (as shown in Figure 1.1).

The 'study locality' is the area of land within a 10 kilometre radius of the investigation area.

2.2 Location of Investigation Area

The Project extends from Belford to Maitland within the central and lower Hunter Valley of NSW, within Maitland, Cessnock and Singleton Local Government Areas (LGAs). The Project is located within the Sydney Basin Bioregion and North Coast botanical subdivision.

2.3 Natural and Developed Features Within and Surrounding the Investigation Area

The study locality consists predominantly of agricultural and grazing lands, though some areas of native vegetation remain. It includes the urban centres of Maitland, Lochinvar, Greta, Branxton and Belford, as well as a number of smaller localities. Native vegetation within the study locality occurs in Belford National Park and on private lands. The Hunter River flows through the study locality to the north of the investigation area.

2.3.1 Land Uses

The investigation area includes both remnant native vegetation and agricultural land, which has been largely cleared. The investigation area is influenced by a variety of past and present land uses, including rural residential, remnant native vegetation, rural (grazing land), rail and highway transportation. Existing infrastructure includes the New England Highway and minor roads, rail, high voltage transmission lines, water and sewer mains.

2.3.2 Dominant Hydrological Features

Several named creeks occur in the investigation area. These are Jump Up Creek, Sweetwater Creek, Anvil Creek, Sawyers Creek, Lochinvar Creek and Stony Creek which all form part of the wider Hunter River catchment. There are several small freshwater wetlands within the investigation area, and a large freshwater wetland (Wentworth Swamp) associated with Stony Creek near Wollombi Road. The investigation area also contains numerous unnamed tributaries to the above creeks, ephemeral drainage lines, farm dams and freshwater wetlands. Most of the named creeks have a narrow corridor of native riparian vegetation associated with them.

2.3.3 Soils and Topography

The Project is located within the broad Hunter Valley floodplain. The natural topography along the alignment generally comprises low lying hills, valleys and alluvial plains. The hills are typically undulating, with slopes of generally less than 5° and elevation ranging from 30 to 100 metres above sea level. The topography generally rises along the existing alignment from alluvial plains, associated with the Hunter Valley, near Maitland to the ridge between Allandale and Greta. The Main North Railway is either cut into or filled above the natural topography to provide uniform grades.

The geology along the proposed alignment comprises the Permian Age (250 million years old) Maitland Group, Dalwood Group and Greta Coal Measures. The rocks of the Maitland and Dalwood Groups consist of sandstones, siltstones and conglomerates with minor occurrences of marl and basalt. The alignment crosses the Greta Coal Measures around approximate chainages 195.000 kilometres, 210.000 kilometres and 215.000 kilometres. The Greta Coal Measures comprise sandstones, conglomerate, siltstone and coal.

The Project alignment falls within six soil landscapes (Soil Conservation Service of NSW 2001a, 2001b) including:

- *Bolwarra Heights* - This erosional soil landscape is characterised by rolling low hills with moderately deep, well drained soils.
- *Wallalong* - This residual soil landscape is characterised by undulating hills with convex rounded sideslopes and incised drainage lines.
- *Hunter* – This soil landscape is characterised by alluvial plains and terraces of the Hunter River and its tributaries. The main soils are all formed in alluvium and include clay, silty and sandy clays and sands.
- *Lochinvar* – This soil landscape consists of undulating rises. The main soils are non-calcic brown soils on gentle slopes with brown podzolic soils on the steeper areas. There are yellow solodic soils on the mid to lower slopes of the steeper hills and in some drainage lines.
- *Branxton* - This soil landscape consists of undulating low hill and rises with many small creek flats, extending over a large area between Singleton and Cessnock. The main soils are yellow podsolic soils on midslopes with red podsolic soils on crests.
- *Rothbury* - This soil landscape consists of undulating and rolling hills south and south-east of Singleton. Red podsolic soils occur on upper slopes with yellow podsolic soils on midslopes. Yellow solodic soils and brown soloths occur on lower slopes.

2.4 Climate

The central and lower Hunter Valley has a warm temperate climate with generally warm dry summers and cool wet winters. The average annual rainfall, summer and winter maximum and minimum temperatures are shown in Table 2-1 below.

Table 2-1 BOM Weather Records for Maitland, Cessnock and Singleton (Bureau of Meteorology 2009)

Location	Summer Temperature (°C)		Winter Temperature (°C)		Rainfall (mm)
	Mean Maximum	Mean Minimum	Mean Maximum	Mean Minimum	
Maitland	30	17	17	6	894
Cessnock	29	16	18	4	703
Singleton	30	17	18	6	722

3. Legislation

3.1 Introduction

The Project is subject to a number of State and Commonwealth Acts and planning polices, as outlined below.

3.2 Commonwealth Legislation

3.2.1 Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' undergo an assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Commonwealth Minister for the Environment and Water Resources.

In January 2007, the Commonwealth and NSW governments signed a Bilateral Agreement which allows DEWHA to accredit the assessment regimes under Part 3A, Part 4 and Part 5 of the EP&A Act for assessment purposes under the EPBC Act. The Bilateral Agreement applies only to proposals that the Commonwealth Environment Minister has determined are controlled actions under the EPBC Act, with the exception of nuclear actions (DoP 2007).

The EPBC Act identifies matters of national environmental significance as:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (Ramsar wetlands).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- Nuclear actions (including uranium mining).

The Administrative Guidelines for the EPBC Act (DEH 2006) set out criteria intended to assist in determining whether an action is controlled and hence requires approval. In particular, the Guidelines contain criteria for determining whether a proposed action is likely to have a 'significant impact' on a matter of national environmental significance (MNES). Should the proponent deem the development likely to have a significant impact on a MNES, a referral to the Commonwealth Minister for the Environment would be undertaken to obtain a determination as to whether the development is a 'controlled action' requiring Commonwealth approval.

The EPBC Act has been addressed in the current assessment through:

- Desktop review to determine the threatened species or ecological communities that have been previously recorded within the locality of the site and hence could occur, subject to the habitats present.
- Targeted field surveys for species and ecological communities listed under the Act.
- Development of suitable impact mitigation and environmental management measures for threatened species, where required.
- Assessment of potential impacts on threatened species.

NES matters of potential relevance to this Project include National Heritage Places, Ramsar wetlands of international importance, nationally listed threatened species and ecological communities, and migratory birds. An assessment of the significance of impact of the Project on flora and aquatic ecological Matters of NES is presented in Appendix C and summarised in Section 6.14 in accordance with *EPBC Act Policy Statement 1.1: Significant Impact Guidelines Matters of NES* (DEH 2006).

3.3 State Legislation

3.3.1 Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act)

Within NSW, proposed developments and activities must address the provisions of the EP&A Act. Objective 5(a)(vi) of the EP&A Act encourages the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats.

This assessment has been undertaken in accordance with the *Draft Threatened Species Part 3A Assessment Guidelines* (DEC and DPI 2005) and the *Threatened species assessment guidelines: The assessment of significance* (DEC 2007). DGRs and agency requirements for the Part 3A assessment are outlined in the sections below.

3.3.2 Director General's Requirements for the Environmental Assessment

The Director General's Requirements (DGRs) for the EA were received 29 May 2009. DGRs relevant to flora and aquatic ecology are outlined in Table 1-2.

3.3.3 Department of Environment and Climate Change Submission Regarding Director General's Requirements for the Environmental Assessment

The Department of Environment, Climate Change and Water (DECCW) submission regarding DGRs for the EA was received 29 May 2009. Relevant ecological comments are outlined in Table 3-1.

Table 3-1 DECCW Submission for the Environmental Assessment

DECCW Submission	Where Addressed in Report
Document all the known and likely threatened species, their habitat, population and ecological communities of the site (including any adjacent areas that may be indirectly impacted upon by the project). The accompanying report must provide details of survey methodologies and/or techniques utilised.	Known and likely threatened species and ecological communities occurring in the investigation area are discussed in Section 5 and Table 5-3. Flora and Aquatic Ecology Assessment methods are outlined in Section 4.
Provide a detailed assessment of the impacts on such species, habitats, population and ecological communities.	Flora and Aquatic Ecology Impact Assessment is discussed in Section 6.
Detail the actions that will be taken to avoid or mitigate impacts, or compensate or offset for unavoidable impacts of the project on threatened species, populations, ecological communities and their habitat. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented. Where significant modification of the project to minimise impacts on threatened species, populations of EECs is not possible then compensatory strategies should be considered (if applicable). These may include offsite or local area projects that contribute to long term conservation of affected threatened species, populations and EECs. DECCW would typically consider suitable measures to ensure conservation in perpetuity, such as Section 88B-E of the *Conveyancing Act* 1919, a Voluntary Conservation Agreement under the *National Parks and Wildlife Act 1974*, a biobanking agreement under the *Threatened Species Conservation Act 1995*, and/or a reservation of land under Part 4 of the NP&W Act. This report will need to evaluate and mitigate any adverse impacts on such species, populations and communities on the subject site, within the immediate vicinity and including both direct and indirect (e.g. adverse hydrological changes).	Flora and Aquatic Ecology Mitigation Measures are discussed in Section 7.
A recognised expert from institutions such as the Australian Museum or Royal Botanic Gardens must be used to determine or confirm the identification of species that are unknown or which have only been provisionally identified.	Flora and Aquatic Ecology Assessment Methods (including threatened flora identification by Royal Botanic Gardens) are discussed in Section 4.
Ecological field survey requirements should apply the draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC).*	Flora and Aquatic Ecology Assessment Methods are outlined in Section 4.

DECCW Submission	Where Addressed in Report
Survey effort (including intensity, repetition and coverage) must be at a level that can be reasonably expected to detect the subject species if present in the investigation area. Surveys are required to be undertaken during optimal climatic and seasonal conditions for all potentially occurring flora and fauna species and need to consider issues such as migratory species movements, the availability of shelter, breeding, pollination patterns and prerequisites, and also the relative availability of food resources and habitat.	Flora and Aquatic Ecology Assessment Methods are outlined in Section 4.

3.3.4 Department of Water and Energy Submission Regarding Director General's Requirements for the Environmental Assessment

The Department of Water and Energy (DWE) submission regarding Director-General Requirements for the EA was received 26 May 2009. Relevant ecological comments are outlined in Table 3-2 below.

Table 3-2 DWE Submission for the Environmental Assessment

DWE Submission	Where Addressed in Report
The assessment is required to consider the impact of the project on the watercourses and associated riparian vegetation for the project and provide the following: ◗ Identify sources of surface water. ◗ Details of stream order (using Strahler System). ◗ Details of any proposed surface water extraction, including purpose, location of existing pumps, dams, diversions, cuttings and levees. ◗ Details of any proposed development of diversion works including all construction, clearing, draining, excavation and filling. ◗ Details of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, water quality and hydraulic regime. ◗ Description of the design features and measures to be incorporated into any proposed development to guard against long term actual and potential environmental disturbances. Particularly in respect of maintaining the natural hydrological regime and sediment movement patters and the identification of riparian buffers.	The Aquatic Ecology Assessment Results are outlined in Section 5 with mitigation measures discussed in Section 7. Further details regarding potential impacts to water quality, erosion and sedimentation, and proposed mitigation measures are outlined in the Environmental Assessment.

DWE Submission	Where Addressed in Report
The assessment is required to identify any impacts on Groundwater Dependent Ecosystems (GDE). The NSW Groundwater Dependent Ecosystem Policy provides guidance on the protection and management of GDEs. It sets out management objectives and principles to: ◗ Ensure the most vulnerable and valuable ecosystems are protected. ◗ Management groundwater extraction within defined limits thereby providing flow sufficient to sustain ecological processes and maintain biodiversity. ◗ Ensure sufficient groundwater of suitable quality is available to ecosystems when needed. ◗ Ensure the precautionary principle is applied to protect GDEs, particularly the dynamics of flow and available and the species reliant on these attributes.	Impacts on Groundwater Dependent Ecosystems are outlined in Section 6.7.

3.3.5 Industry and Investment NSW Submission Regarding Director General's Requirements for the Environmental Assessment

The Industry and Investment NSW (I&I NSW) submission regarding DGRs for the EA was received 15 May 2009. Relevant ecological comments are outlined in Table 3-3.

Table 3-3 I&I NSW Submission for the Environmental Assessment

I&I NSW Submission	Where Addressed in Report
The most significant issue is the identification of any waterways that require works and that the works do not reduce the cross sectional area of the waterways and interfere with water flows and fish passage.	The Aquatic Ecology Assessment Results are outlined in Section 5. The Aquatic Ecology Impact Assessment is outlined in Section 6.6 with mitigation measures discussed in Section 7.
Another significant issue is the potential for the need to redirect or divert waterways to allow for construction for the tracks and how stormwater flows will be managed to ensure there are minimal impacts on the receiving waterways.	The Aquatic Ecology Impact Assessment is outlined in Section 6.6. The management of stormwater flows and water quality for receiving waterways is outlined in the Environmental Assessment document.

3.3.6 Threatened Species Conservation Act 1995 (TSC Act)

The TSC Act provides legal status for biota of conservation significance in NSW. The Act aims to, *inter alia*, 'conserve biological diversity and promote ecologically sustainable development'.

The objectives of the Act are to:

- Conserve threatened species, populations, ecological communities and their habitats.
- Promote their recovery.
- Manage the processes that threaten or endanger them.

The Act provides for:

- The listing of 'threatened species, populations and ecological communities', with endangered species, populations and communities listed under Schedule 1, 'critically endangered' species and communities listed under Schedule 1A, vulnerable species and communities listed under Schedule 2.
- The listing of 'Key Threatening Processes' (under Schedule 3).
- The preparation and implementation of Recovery Plans and Threat Abatement Plans.

The TSC Act has been addressed through:

- Desktop review to determine the threatened species, populations or ecological communities that have previously been recorded within the locality of the Project and hence could occur subject to the habitats present.
- Targeted field surveys for threatened species and endangered ecological communities (EEC) listed under the Act.
- Development of suitable impact mitigation and environmental management measures for threatened species and EECs, where required.
- Assessment of potential impacts on threatened species and EECs.

An assessment of the impact of the Project on threatened species and ecological communities listed on the TSC Act under the provisions of Part 3A of the EP&A Act is presented in Appendix B and summarised in Section 6.

3.3.7 Threatened Species Legislation Amendment Act 2004 (TSLA Act)

The TSLA Act seeks to put a greater emphasis on land-use planning at the strategic level focusing on the protection and restoration of native vegetation and threatened species habitat at the landscape scale, consistent with the Government's reforms to natural resource management.

The key areas of threatened species legislation reform include:

- In urban and coastal areas, integration of biodiversity values into better strategic land-use planning, changes to the development assessment process and accreditation of flora and fauna consultants.
- In rural areas, threatened species conservation embedded within native vegetation protection to deliver a simpler and more supportive system of conservation incentives for landholders.

- Listing of threatened species maintained as a scientific process, with enhanced transparency.
- Transparent prioritisation of actions for recovery and threat abatement.
- Upgraded enforcement and compliance provisions.
- Expert advisory councils to advise the Minister for the Environment on social, economic and biodiversity implications.

An assessment of the impact of the Project on threatened species and ecological communities listed on the TSC Act under the provisions of Part 3A of the EP&A Act is presented in Appendix B and summarised in Section 6.

3.3.8 Fisheries Management Act 1994 (FM Act)

The objects of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.

Examination of threatened species, populations and endangered ecological communities distribution ranges and habitat requirements that are listed on the FM Act indicate that none are likely to occur within the vicinity of the Project (Section 6.1). Additionally, no key threatening processes listed on the FM Act apply to the Project. Therefore, the provisions of the FM Act do not apply and no further assessment is required.

Section 6.4 outlines the results of the aquatic ecology impact assessment, which considers potential impacts on aquatic habitat and processes.

3.3.9 Noxious Weeds Act 1993 (NW Act)

The NW Act is a NSW government instrument outlining the definition, declaration, and control of noxious weeds throughout the State. Local government bodies have the responsibility to ensure that the Act is complied with within their boundaries. This Act outlines procedures for the definition, declaration, and control of noxious weeds throughout the State.

Noxious weeds recorded in the investigation area have been identified and appropriate management measures proposed.

3.3.10 Native Vegetation Act 2003 (NV Act)

Pursuant to Section 75U of the EP&A Act, ARTC (as a public authority) is exempt from the requirements of the NV Act to obtain an approval for clearing native vegetation for Part 3A Projects.

3.3.11 Water Management Act 2000 (WM Act)

The WM Act aims to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

Part of the Project is located within a declared floodplain, however it does not constitute a flood work and so consent under Section 256 of the WM Act is not required.

3.3.12 National Parks and Wildlife Act 1974 (NPW Act)

The NPW Act provides for, amongst other things, the conservation of nature, including the conservation of habitat, biological diversity, landforms and landscapes. An assessment of the Project's impacts on conservation areas, habitat, biological diversity, landforms and landscapes has been undertaken as part of this assessment.

4. Methodology

The scope of the flora and aquatic ecology survey and assessment has been prepared in consideration of:

- *Draft Guidelines for Threatened Species* under Part 3A of the *Environmental Planning and Assessment Act* 1979 (DEC and DPI, 2005).
- *Threatened species assessment guidelines: The assessment of significance* (DEC 2007).
- *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities* (DEC 2004).
- Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) *Flora and Fauna Survey Guidelines* (2002).

The investigation area for the flora and aquatic ecology assessment is based on a variable width corridor on both sides of the existing track.

The flora and aquatic ecology survey and assessment included the following:

- Literature review of existing studies for the site and locality, where available.
- Database searches to identify threatened flora and aquatic species recorded in the locality and with potential to occur on-site.
- Flora field survey.
- Compilation of flora species list recorded on-site.
- Mapping of vegetation and descriptions of the vegetation communities occurring on-site.
- Aquatic habitat assessment.
- Assessment of likelihood of occurrence of threatened flora species listed under the TSC Act and / or the EPBC Act.
- Assessment of likelihood of occurrence of threatened aquatic species listed under the FM Act and / or EPBC Act.
- Impact assessment for threatened flora and aquatic species listed on the TSC Act and FM Act in accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005), the *Threatened species assessment guidelines: The assessment of significance* (DEC 2007) and the *EPBC Act Significant Impact Guidelines 1.1* (DEH 2006) for species listed on the EPBC Act.

4.1 Database Searches and Literature Review

Records and potential occurrences of threatened species, populations and endangered ecological communities were extracted from the following databases for a 10 kilometre radius around the investigation area:

- Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife database records.
- Department of Environment, Water Heritage and the Arts (DEWHA) online search for Matters of National Environmental Significance (NES), including threatened and migratory species that may occur in the investigation area.
- NSW Fisheries published information for threatened aquatic species, endangered populations and endangered ecological communities listed under the FM Act which have the potential to occur in the investigation area.
- BioNet database (which comprises threatened species records from the Royal Botanic Gardens, Australian Museum, State Forests, DECC and NSW Fisheries collections).

4.2 Field Surveys

Targeted flora and aquatic surveys were performed by two ecologists from 13 July to 29 September 2009. Survey methodology is described below and survey effort is outlined in Section 4.3.

4.2.1 Flora Survey and Mapping Vegetation Communities

The flora survey included the following:

- Sampling quadrats (20 metres x 20 metres or 40 metres x 10 metres) placed randomly within each vegetation community to collect structural and floristic data.
- Targeted searches for cryptic species (such as orchids) in areas of suitable habitat.
- Walking transects to ascertain vegetation community boundaries and to record species not observed within sampling quadrats.
- An inventory of plant species was compiled and a range of floristic and structural characteristics recorded to facilitate the compilation of vegetation community descriptions. The condition of vegetation communities, including consideration of disturbance (such as weed infestations, fire, rubbish dumping and access tracks) was also recorded.
- GPS recording of vegetation boundaries along walked transects.

4.2.2 Targeted Threatened Flora Survey

Targeted flora random meander surveys were undertaken throughout the investigation area in areas of potentially suitable habitat. The position of threatened plants was recorded using a GPS and mapped in GIS. Threatened species were mapped as dense areas or individuals (refer to Figure 5.2). Where required, samples were sent to Royal Botanic Gardens for verification.

The field surveys were undertaken over two seasons, winter and spring, in an effort to survey for threatened species in optimal detection times (generally associated with flowering period for plants). Table 4-1 summaries the optimal survey periods (DECCW 2009a) for threatened flora which the DECCW and DEWHA database searches indicated have the potential to occur in the investigation area. Note that all EECs listed under the TSC Act, FM Act and EPBC Act with the potential to occur in the investigation area are detectable year-round.

Table 4-1 Optimal Survey Times for Threatened Flora with the Potential to Occur in the Investigation Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Optimal Survey Period	Likely to be Detected in Survey?
Eucalyptus glaucina	Slaty Red Gum	V	V	All year	Winter and Spring
Angophora inopina	Charmhaven Apple	V	V	All year	Winter and Spring
Eucalyptus camaldulensis	River Red Gum population in the Hunter Catchment	E (Population)	-	All year	Winter and Spring
Eucalyptus parramattensis subsp. *decadens*	*Eucalyptus parramattensis* subsp. *decadens*	V	V	All year	Winter and Spring
Eucalyptus pumila	Pokolbin Mallee	V	V	All year	Winter and Spring
Maundia triglochinoides	*Maundia triglochinoides*	V	-	All year	Winter and Spring
Melaleuca biconvexa	Biconvex Paperbark	V	V	All year	Winter and Spring
Melaleuca groveana	Grove's Paperbark	V	-	All year	Winter and Spring
Prostanthera cineolifera	Singleton Mint Bush	V	V	All year	Winter and Spring
Persoonia pauciflora	North Rothbury Persoonia	E	CE	All year	Winter and Spring
Persicaria elatior	Tall Knotweed	V	-	All year	Winter and Spring
Syzygium paniculatum	Magenta Lilly Pilly	V	V	All year	Winter and Spring

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Optimal Survey Period	Likely to be Detected in Survey?
Diuris praecox	Rough Double Tail	V	V	When in flower (July to August depending on prevailing climatic conditions)	Winter
Zannichellia palustris	Horned Pond Weed	E	-	Only September-November (diesback in the summer months)	Spring
Acacia bynoeana	Bynoe's Wattle	E	V	When in flower (September to March)	Possibly in Spring
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	When in flower (July-December)	Winter and Spring
Tetratheca juncea	Black-eyed Susan	V	V	When in flower (July-December, depending on climatic conditions)	Spring
Cynanchum elegans	White-flowered Wax Plant	E	E	When in flower (August to May, with peak in November)	Spring
Diuris pedunculata	Small Snake Orchid	E	E	When in flower (spring)	Spring
Philotheca ericifolia	*Philotheca ericifolia*	V	V	When in flower (spring)	Spring
Rutidosis heterogama	Heath Wrinklewort	V	V	When in flower (Spring and Autumn)	Spring
Callistemon linearifolius	Netted Bottle Brush	V	-	When in flower (September to March)	Winter and Spring
Diuris tricolor	Pine Donkey Orchid	V	V	When in flower (September to November depending on prevailing climatic conditions)	Spring

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Optimal Survey Period	Likely to be Detected in Survey?
Goodenia macbarronii	Narrow Goodenia	V	-	When in flower (September-March, depending on climatic conditions)	Spring
Rulingia prostrata	Dwarf Kerrawang	E	E	When in flower (October-November, depending on climatic conditions)	Spring
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Only in flower (November to February, although may not always flower each year)	Unlikely

Key: V = Vulnerable, E = Endangered, CE = Critically endangered, - = Not listed

Leafless Tongue Orchid (*Cryptostylis hunteriana*) and Bynoe's Wattle (*Acacia bynoeana*) were listed in the DEWHA database search as a species that may have potential habitat within the investigation area. Leafless Tongue Orchid only flowers in mid-summer and would not have been detected in the current survey if present. Bynoe's Wattle is unlikely to occur due to unsuitable soil characteristics within the investigation area. Based on known habitat associations and distribution ranges, these species are considered very unlikely to occur within the investigation area. Additionally, there are no DECCW records for these species within 10 kilometres of the investigation area.

Habitat assessments were undertaken throughout the investigation area to assess if suitable habitat for threatened flora occurred. If suitable habitat occurred within the investigation area, the impact assessment was undertaken based on the assumption that the species had the potential to occur. It is therefore considered that the survey period is adequate to address the DECCW submission requirement ('*survey effort must be at a level that can be reasonably expected to detect the subject species if present in the study area'*) received as a supplement to the Director General's Requirements for the Environmental Assessment.

4.2.3 Aquatic Habitat Assessment

With regards to aquatic ecology, the field surveys incorporated an aquatic habitat assessment, with the following field data recorded:

- General waterway morphology (such as whether permanent or ephemeral; gully / stream / river / wetland; presence of pools; width of waterway; etc).
- Flow regime (intermittent / permanent; tidal / freshwater; slow / rapid).

- Observable indicators of water quality (such as turbidity and presence of aquatic macroinvertebrates).
- Surrounding land use.
- Instream and riparian vegetation.
- Fish habitat (refuge areas, - snags / undercut banks / reedbeds; potential breeding areas – gravel beds, fallen trees).
- Barriers to fish movement – upstream or downstream.
- Classification of waterway with respect to fish habitat (major / moderate / minimal / unlikely).

Aquatic surveys, such as macroinvertebrate and fish sampling, were not be undertaken as part of the ecological assessment, as the results of the database searches (see Section 6) indicate that species distribution ranges for threatened aquatic species listed on the FM Act and EPBC Act do not occur in the investigation area. Furthermore, macroinvertebrate and fish sampling were not requested as part of the DGRs or DECC submission regarding the DGRs (see Table 1-2).

4.2.4 Rapid Appraisal of Riparian Condition

The Rapid Appraisal of Riparian Condition (RARC) procedure, developed specifically for southeastern Australia and for mid to lowland floodplain rivers (Jansen *et al*. 2005), was used to assess the condition of riparian vegetation. The RARC considers those aspects of the riparian zone, including canopy, leaf litter, wood debris and other similar materials, which contribute to providing habitat for terrestrial fauna, organic cycling to the river, vegetation recruitment and control of instream microclimate and water temperatures.

The RARC draws on a number of different sources including the Index of Stream Condition (Ladson *et al*. 1999) to reflect the functional aspects of riparian zones. The site was assigned a total score from a number of contributing variables:

- Habitat – habitat continuity and extent.
- Cover – vegetation structure and structural complexity.
- Natives – dominance of native plant species versus exotics.
- Debris – Stags, logs and leaf litter.
- Features – indicative features.

The allocation of a condition score at the site enables identification of major variables that are absent or lacking at each site. This rapid assessment method has been tested against more detailed measure of biodiversity and riparian zone function (such as soil litter decomposition rates and bird community complexity) with a significant positive relationship between the overall condition score and the more comprehensive habitat/function measure (Jansen *et al*. 2005).

A RARC score less than 25 indicates very poor condition, 25-30 poor, 30-35 average, 35-40 good and more than 40 excellent (Jansen *et al.* 2005).

4.3 Survey Effort

The ecological assessment was undertaken by two ecologists over fifteen days between 13 July and 29 September 2009. The field surveys were staged over two seasons, winter and spring, to maximise the likelihood of detecting threatened species in optimal detection times.

Table 4-2 details the survey effort implemented during the fieldwork.

Table 4-2 Survey Effort

Vegetation Community	Minimum Survey Requirement (DEC 2004)	Survey Effort	Approximate Number of Person Hours
Lower Hunter Spotted Gum Ironbark Forest	3 transects and 3 quadrats[2]	8 transects and 8 quadrats	15
Hunter Lowland Redgum Forest	3 transects and 3 quadrats[2]	13 transects and 13 quadrats	20
Swamp Oak Riparian Forest	3 transects and 3 quadrats[2]	7 transects and 7 quadrats	15
Grey Box Spotted Gum Ironbark Forest	3 transects and 3 quadrats[2]	7 transects and 7 quadrats	15
Freshwater Wetland	2 transects and 2 quadrats[3]	3 transects and 3 quadrats	10
Cleared with Scattered Trees/ Open Pasture/ Weedy Area	5 transects and 5 quadrats[1]	5 transects and 5 quadrats	5
Plantation	N/A	N/A	N/A
Notes: [1]: based on 251- 500 ha category in Table 5-1 and 5-2 of DEC (2004); [2]: based on 51 – 250 ha category in Table 5-1 and 5-2 of DEC (2004); [3]: based on 2 – 50 ha category in Table 5-1 and 5-2 of DEC (2004); [4]: based on < 2 ha category in Table 5-1 and 5-2 of DEC (2004).			
Aquatic Habitat Assessments	NA	42 RARC 52 Aquatic Habitat Assessments	40
Targeted Threatened Flora Survey	20 random meanders[5]	20 random meanders	10
Notes: [5]: based on 30 minutes for each quadrat sampled within the same vegetation community (excludes Open Paster/ Grassland/ Weedy Area and Cleared areas) as outlined in Table 5.1 of DEC (2004).			

Bureau of Meteorology (BOM) records for survey dates are outlined in Table 4-3 below.

Table 4-3 BOM Weather Records for Maitland and Singleton

Location	Date	Day	Temperature (°C)		Rain (mm)
			Maximum	Minimum	
Maitland	13/7/2009	Monday	16.3	6.3	0
	14/7/2009	Tuesday	17.5	6.4	0
	19/8/2009	Wednesday	22.0	0	0
	20/8/2009	Thursday	24.0	3.0	0
	21/8/2009	Friday	26.0	3.0	0
	26/8/2009	Wednesday	22.7	13.0	0
	27/8/2009	Thursday	25.0	9.0	0
	28/8/2009	Friday	18.3	6.3	0
	1/9/2009	Tuesday	23.0	7.0	0
	14/9/2009	Monday	27.4	6.9	0
	15/9/2009	Tuesday	25.3	15.6	0
	18/9/2009	Friday	25.8	16.5	0
	21/9/2009	Monday	21.7	11.4	0
	22/9/2009	Tuesday	30.0	12.1	0
	29/9/2009	Tuesday	23.1	9.4	0
Singleton	13/7/2009	Monday	16.0	8.0	0
	14/7/2009	Tuesday	16.5	8.4	0
	19/8/2009	Wednesday	22.0	-1.0	0
	20/8/2009	Thursday	24.0	1.0	0
	21/8/2009	Friday	26.0	4.1	0
	26/8/2009	Wednesday	22.0	9.3	0
	27/8/2009	Thursday	25.0	7.0	0
	28/8/2009	Friday	26.0	1.0	0
	1/9/2009	Tuesday	22.1	3.2	0
	14/9/2009	Monday	27.0	5.5	0

Location	Date	Day	Temperature (°C)		Rain (mm)
			Maximum	Minimum	
	15/9/2009	Tuesday	26.0	15.5	0
	18/9/2009	Friday	28.2	17.0	0
	21/9/2009	Monday	24.2	8.0	1.6
	22/9/2009	Tuesday	30.1	9.8	0.7
	29/9/2009	Tuesday	24.1	5.5	0

4.4 Limitations

4.4.1 Seasonality

While the field surveys were undertaken over two seasons in an effort to survey for threatened species in optimal detection times, some spring and summer flowering orchids (such as Rough Double Tail (*Diuris praecox*) and Leafless Tongue Orchid (*Cryptostylis hunteriana*)) have very short flowering periods of a couple of weeks or less in any one season. For this reason it is possible that the ecological assessment may not have recorded some cryptic flora species that are difficult to detect when not flowering.

To overcome this limitation, three weeks of spring surveys were staged during September to maximise detection of spring-flowering species. Also, habitat assessments were undertaken throughout the investigation area to assess if suitable habitat for threatened flora occurred. If suitable habitat occurred within the investigation area, the impact assessment was undertaken based on the assumption that the species had the potential to occur. The level of assessment undertaken in this survey is considered to be adequate to provide an overall assessment of the ecological values of the investigation area with particular emphasis on threatened species and endangered ecological communities.

4.4.2 Property Access

Due to property access restrictions, a number of properties (see below) were surveyed from adjacent properties or from within the rail corridor, adjacent to the investigation corridor. It is considered that the resulting vegetation mapping is likely to reflect the true vegetation communities on those properties, and given the open nature of the native vegetation on these sites, searches for threatened flora with a high likelihood of occurring in the investigation area (such as Slaty Red Gum (*Eucalyptus glaucina*) and North Rothbury Persoonia (*Persoonia pauciflora*)) were successfully undertaken from adjacent properties for properties that had access restrictions. Based on habitat assessments and the results of the threatened flora survey, although the following properties have only been surveyed from adjacent properties, it is considered unlikely that threatened flora would occur on these properties.

The following properties that have been surveyed from adjacent properties due to access restrictions are:

- Lot 90 DP 774537.
- Lot 6 DP 634525.
- Lot 23 DP 1105521.
- Lot 1 DP 34389.
- Lot 23 DP 1084911.
- Lot 1 DP 811604.
- Lot 31 DP 1126569.
- Lot 11 DP 1087556.
- Lot 1 DP 1042140.
- Lot 2 DP 542720.
- Lot 1 DP 770416.
- Lot 123 DP 1012402.
- Lot 13 DP 844443.
- Lot 12 DP 1015148.
- Lot 11 DP 1015148.

5. Summary of Results

5.1 Database Searches and Literature Review

5.1.1 DECCW and DEWHA Threatened Species Database Review

The results of the DECCW and DEWHA database review (5 October 2009) indicate that twelve threatened flora species have been previously recorded or have the potential to occur within the locality (DECC 2009b, DEWHA 2009). Several threatened populations, and a large number of Endangered Ecological Communities (EEC) also have the potential to occur in the locality. The results of the DECCW database search are shown in Figure 5.1 (Note that DEWHA does not provide electronic data for mapping). Not all species illustrated are considered likely to occur within the investigation area. Threatened species habitat requirements and an assessment of their likelihood of occurrence within the investigation area are provided in Table 5-3.

5.1.2 Rare or Threatened Australian Plants

Four *Rare or Threatened Australian Plant* (ROTAP) flora species (Briggs and Leigh 1996) have been previously recorded in the local area. Their habitat requirements and likelihood of occurrence within the investigation area are outlined in Table 5-3.

It should be noted that ROTAP species that are not listed under the TSC Act or EPBC Act have no legislative protection.

5.1.3 Threatened Aquatic Species Database Review

The FM Act lists threatened aquatic species, populations and endangered ecological communities. The species distribution ranges and habitat associations of all threatened species, populations and EECs listed under the FM Act were examined during the database review (5 October 2009). Based on species distribution ranges and the lack of potential habitat requirements in the investigation area, no aquatic species, populations or EECs listed under the FM Act are considered likely to occur in the investigation area.

A search of the BioNet database (5 October 2009), comprising records from the Australian Museum, Department of Primary Industries (Fisheries), DECC and State Forests indicated that no threatened species listed on the FM Act have been recorded within Cessnock or Maitland LGAs. There are three records of Silver Perch (*Bidyanus bidyanus*) in Singleton LGA, associated with Lake St Clair, a dam approximately 30 kilometres north-northwest of Branxton. The Silver Perch is listed as a vulnerable species under the FM Act. This species is native to the Murray-Darling river system. As the investigation area does not include Murray-Darling river system and does not drain towards this area, it is considered unlikely that the Project would impact the species.

Furthermore, the EPBC Act Protected Matters Search did not identify any aquatic species listed under the EPBC Act with the potential to occur in the investigation area.

General impacts on aquatic habitat and processes are considered in Section 6.6.

5.1.4 LHCCREMS Vegetation Mapping Review

LHCCREMS vegetation mapping by House (2003) extends along the Project route as far west as Branxton. This vegetation mapping does not cover the Project route from Belford toward Singleton. LHCCREMS (2003) mapped this section of the investigation area (refer to Figure F-1 included in Appendix F) as:

- Lower Hunter Spotted Gum-Ironbark Forest (Map Unit 17).
- Hunter Lowland Redgum Forest (Map Unit 19).
- Seaham Spotted Gum-Ironbark Forest (Map Unit 16).
- Central Hunter Riparian Forest (Map Unit 13).

Lower Hunter Spotted Gum-Ironbark Forest is widespread throughout the central to lower Hunter Valley with forests between Cessnock and Beresfield forming the core of its distribution. Spotted Gum (*Corymbia maculata)* and Red Ironbark (*Eucalyptus fibrosa)* typically dominate the canopy.

Hunter Lowland Redgum Forest extends from Muswellbrook to the Lower Hunter where it appears on gentle slopes arising from depressions. Much of its former extent has been depleted for agricultural activities. Forest Red Gum (*E. tereticornis*) and Grey Gum (*E. punctata*) typically dominate the canopy.

Seaham Spotted Gum Open Forest is a dry open forest with a grassy understorey, and occurs on Carboniferous sediments north of the Hunter River. Typically, the canopy is marked by the dominance of Spotted Gum often with codominant stands of Narrow-leaved Ironbark (*E. crebra),* Grey Gum and Red Ironbark (*E. fibrosa)*.

Central Hunter Riparian Forest remains only as small heavily disturbed patches along tributaries of the Hunter Valley. The remaining areas contain some large old trees comprising Forest Red Gum*,* Rough-barked Apple *(Angophora floribinda),* Cabbage Gum *(E. amplifolia),* and River Red Gum *(E. camalduensis)* in association with Yellow Box (*E. melliodora)* and Grey Box (*E. molucanna)*.

The LHCCREMS mapping appears to be broadly correct for the investigation area at the scale at which it was prepared, but individual patches of vegetation mapped for this study may be classified slightly differently due to the finer scale at which this study was undertaken.

5.1.5 Cessnock City Council Vegetation Mapping Review

Cessnock City Council has mapped the Project route within the Cessnock Local Government Area (refer to Figure F-2 included in Appendix F) as:

- Sclerophyll Grassy Woodlands.
- Semi-mesic Forests.
- Freshwater Wetlands.

Little information can be gained from this mapping due to the coarse scale and limited ground-truthing that was involved.

5.2 Vegetation Communities

During the field surveys undertaken for this assessment, eight distinct vegetation communities were recorded in the investigation area (refer to Figure 5.2). These are:

- Lower Hunter Spotted Gum Ironbark Open Forest.
- Forest Red Gum Open Forest.
- Swamp Oak Riparian Forest.
- Grey Box Spotted Gum Ironbark Open Forest.
- Freshwater Wetland.
- Hakea Scrub.
- Cleared with Scattered Trees / Open Pasture / Weedy Area.
- Plantation.

A description of the vegetation communities is presented in Table 5-1 below.

One hundred and ninety six species were recorded during field surveys, of which 66, (39%) were introduced species. The majority of exotic species were recorded from within the existing rail corridor. Vegetation within the rail corridor is generally devoid of native vegetation and dominated by noxious and environmental weeds. Native vegetation is generally limited to small areas of Swamp Oak (*Casuarina glauca*) and Hickory (*Acacia implexa*) regrowth.

Vegetation on private land ranges from remnant and regrowth native vegetation in varying stages of clearing and grazing, through to sites that have been cleared of all native vegetation and are dominated by pasture grasses, vineyards or plantations. Areas of native vegetation occur in Rutherford, Lochinvar, Allandale, Greta, Branxton and Belford. The eastern section of the investigation area has been cleared of virtually all native vegetation. The full list of flora species recorded within the investigation area is outlined in Appendix C. A description of each of the vegetation communities is provided in Table 5-1.

Table 5-1 Description of Vegetation Communities within the Investigation Area

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Lower Hunter Spotted Gum Ironbark Open Forest				Habitat: Well-drained slopes and more elevated areas. Structure / Characteristics: Woodland to open forest dominated by species adapted to or tolerant of drier or well-drained conditions. Young to mature regrowth with most trees 40-90 cm dbh. Condition and Presence of Weeds: Most areas have been previously cleared and some are subject to grazing pressures, resulting in a patchy midstorey and groundcover that includes common environmental weeds such as *Hypochaeris radicata* and *Senecio madagascariensis*. The noxious Prickly Pear occurs in low density.	
Canopy	15-20	50-70	*Corymbia maculata* *Eucalyptus fibrosa* *Eucalyptus siderophloia* *Eucalyptus crebra*		
Midstorey	1-3	5-30	*Pultenaea spinosa* *Acacia parvipinnula* *Daviesia ulicifolia* *Bursaria spinosa* subsp. *spinosa* *Ozothamnus diosmifolius*		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Groundcover	To 1 m	90-100	*Dianella revoluta* *Themeda australis* *Wahlenbergia communis* *Echinopogon ovatus* *Austrodanthonia sp.* *Cymbopogon refractus* *Pratia purpurascens* *Entolasia stricta* *Hardenbergia violacea* *Lomandra multiflora* *Pomax umbellata*		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Forest Red Gum Open Forest				Habitat: Lower slopes, drainage lines, shallow gully and upper floodplain areas with restricted drainage adjoining riparian areas. Structure / Characteristics: Open forest dominated by species adapted to or tolerant of moister or less well-drained conditions. Trees young to mature regrowth, dbh 20-110 cm. Condition and Presence of Weeds: This vegetation community has been previously cleared, with some areas still subject to grazing pressures. Most patches of the community are generally in a modified condition, with varying degrees of clearing and/or underscrubbing. The level of weed invasion is moderate in the groundcover, with common environmental weeds such as *Hypochaeris radicata, Senecio madagascariensis* and *Verbena bonariensis*. The noxious Prickly Pear occurs in low density. Conservation Status: Characteristic of Hunter Lowland Redgum Forest, listed as an EEC under the TSC Act. One RoTAP species, Mountain Grevillea (*Grevillea montana)*, occurs as both scattered individuals and dense concentrations in this community. Distribution Within the Investigation Area: Moderate to large areas adjacent to drainage lines and floodplains throughout the investigation area.	
Canopy	15-20	50-70	*Eucalyptus teretricornis* *Eucalyptus moluccana* *Eucalyptus crebra* ***Eucalyptus glaucina***		
Midstorey	1-3	5-30	***Grevillea montana*** *Breynia oblongifolia* *Acacia irrorata* *Daviesia ulicifolia* *Hakea sericea* *Leucopogon juniperinus* *Jacksonia scoparia*		
Groundcover	To 1 m	80-100	*Austrodanthonia sp.* *Glycine tabacina* *Pratia purpurascens* *Dianella revoluta* *Lomandra multiflora* *Cheilanthes sieberi* subsp. *sieberi* *Themeda australis* *Wahlenbergia communis*		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Swamp Oak Riparian Forest					
Canopy	10-15 m	50-80	*Casuarina glauca* *Eucalyptus teretricornis*	Habitat: Floodplains, banks and fringe areas of creeks, major drainage lines and watercourses. Structure / Characteristics: Forest to open forest of young trees 40-60 cm dbh. Dominated by trees and/or shrubs adapted to or tolerant of wet or waterlogged conditions. Condition and Presence of Weeds: The canopy of this vegetation community is relatively intact, however high levels of weeds occur in the understorey and groundcover. The community has been largely cleared apart from adjacent to major creeklines. The noxious weeds, Lantana, Blackberry, Mother of Millions and Green Cestrum, occur and are dominant in parts. Environmental weeds such as Wandering Trad are common to dominant groundcover species. Conservation Status: Characteristic of Swamp Oak Floodplain Forest, an EEC listed under the TSC Act. Distribution Within the Investigation Area: Occupies narrow linear areas directly associated with creeks and watercourses.	
Midstorey	2 m	60-70	*Bolboschoenus caldwellii* *Typha orientalis* *Phragmites australis* *Lantana camara** *Rubus laciniatus** *Cestrum parqui**		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Groundcover	To 1 m	60-80	*Pennisetum clandestinum**		
			*Verbena bonariensis**		
			*Paspalum dilatatum**		
			Imperata cylindrica		
			*Tradescantia fluminensis**		
			*Juncus acutus**		
			Juncus usitatus		
			*Cirsium vulgare**		
			Oplismenus aemulus		
			Hydrocotyle peduncularis		
			Lomandra longifolia		
			Microlaena stipoides		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Grey Box Spotted Gum Ironbark Open Forest					
Canopy	10-15 m	50-60	*Eucalyptus moluccana* *Eucalyptus crebra* *Eucalyptus fibrosa* *Corymbia maculata* *Eucalyptus siderophloia*	Habitat: Well-drained slopes and more elevated areas. Structure / Characteristics: Woodland to open forest dominated by species adapted to or tolerant of drier or well-drained conditions. Young to mature regrowth with most trees 40-80 cm dbh. Condition and Presence of Weeds: This vegetation community has been previously cleared, with some areas still subject to grazing pressures. Most patches of the community are generally in a modified condition, with varying degrees of clearing and/or underscrubbing. The level of weed invasion is moderate in the groundcover. The noxious weed Prickly Pear occurs in low density. Conservation Status: Characteristic of Central Hunter Ironbark- Spotted Gum – Grey Box Forest, subject to a determination for listing as an EEC under the TSC Act. Distribution Within the Investigation Area: Occupies elevated slopes throughout the investigation area west of Greta.	
Midstorey	2 m	15-20	*Breynia oblongifolia* *Daviesia ulicifolia* *Hakea sericea* *Ozothamnus diosmifolius*		
Groundcover	To 1 m	60-80	*Leucopogon juniperinus* *Pomax umbellata* *Themeda australis* *Wahlenbergia communis* *Austrodanthonia* sp. *Glycine tabacina* *Cymbopogon refractus* *Hardenbergia violacea* *Lomandra multiflora* *Dianella revoluta* *Eremophila debilis*		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Freshwater Wetland					
Canopy	6 m	5	*Casuarina glauca*	Habitat: Fringes permanent creeks at low elevations. Structure / Characteristics: Wetland with dense fringing and instream reeds and sedges. Scattered canopy of regenerating *Casuarina glauca* in parts. Condition and Presence of Weeds: No noxious weeds occur, although the groundcover is highly invaded by introduced pasture grasses and *Juncus actutus.* Conservation Status: Characteristic of Freshwater Wetland, an EEC listed under the TSC Act. Distribution Within the Investigation Area: Small areas of freshwater wetlands occur within low-lying permanent creeks, swamps and floodplains.	
Midstorey	Absent	Absent	NA		
Groundcover	1 m	60-70	*Bolboschoenus caldwellii* *Typha orientalis* *Eleocharis cylindrostachys* *Phragmites australis* *Pteridium esculentum* *Paspalum dilatatum** *Juncus acutus** *Juncus usitatus*		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Hakea Scrub					
Canopy	Absent	NA	NA	Habitat: Adjacent to moist sclerophyll and riparian forest, on floodplains and lower slopes. Structure / Characteristics: Low dense scrub. Condition and Presence of Weeds: No noxious weeds occur, although pasture grasses occur in the groundcover. Conservation Status: Not characteristic of any EEC listed under the TSC Act or EPBC Act. Distribution Within the Investigation Area: Two small areas west of Greta.	
Midstorey	2 m	40-60	*Hakea sericea* *Callistemon rigidus*		
Groundcover	1 m	60-70	*Dianella revoluta* *Lomandra multiflora* *Cheilanthes sieberi* subsp. *sieberi* *Themeda australis* *Wahlenbergia communis*		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Cleared with Scattered Trees / Open Pasture / Weedy Area					
Canopy	10-15 m	5	Various *Eucalypts* sp.	Habitat: All areas, dominates the existing rail corridor on the up and down track. Structure / Characteristics: Grassland with scattered canopy trees. Condition and Presence of Weeds: This vegetation community has been highly modified due to clearing for agriculture and infrastructure. Environmental weeds and pasture grasses dominate the groundcover. Numerous noxious weeds occur, including Green Cestrum, Lantana, Blackberry, Pampas Grass, Coolatai Grass and Mother of Millions. Conservation Status: Not characteristic of any EEC listed under the TSC Act or EPBC Act. Distribution Within the Investigation Area: Widespread, dominant.	
Midstorey	2 m	10	*Olea europaea* subsp. *europaea**		
			Acacia implexa		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Groundcover	To 1 m	80-100	*Austrodanthonia* sp.		
			*Pennisetum clandestinum**		
			*Cynodon dactylon**		
			*Paspalum dilatatum**		
			*Senecio madagascariensis**		
			Themeda australis		
			*Chloris gayana**		
			*Verbena bonariensis**		
			*Lantana camara **		
			Rubus fruticosus sp. *agg.**		
			*Bryophyllum delagoense**		
			Opuntia stricta var. *stricta**		
			*Salix babylonica**		
			*Cestrum parqui**		
			*Hyparrhenia hirta**		
			*Cortaderia selloana**		

Stratum	Height (m)	% Cover	Dominant species	Comments	Photo
Plantation					
Canopy	NA	NA	Absent	Habitat: All areas. Structure / Characteristics: Vineyards and Olive Plantation. Condition and Presence of Weeds: This vegetation community has been largely cleared of native vegetation for cultivation. The level of weed invasion is high in the groundcover. No noxious weeds occur. Conservation Status: Not characteristic of any EEC listed under the TSC Act or EPBC Act. Distribution Within the Investigation Area: Scattered occurrences.	
Midstorey	1-2 m	NA	Olive Plantation/ Vineyard.		
Groundcover	To 1 m	80-100	*Trifolium repens** *Pennisetum clandestinum** *Cynodon dactylon** *Paspalum dilatatum** *Digitaria ciliaris** *Senecio madagascariensis**		

Notes: * indicates introduced species; threatened species shown in **bold.**

dbh: diameter at breast height

5.2.1 Endangered Ecological Communities

Several Endangered Ecological Communities (EECs) (refer to Figure 5.2) have been recorded within the locality or have the potential to occur in the locality (LHCCREMS 2003, DEWHA 2009). Table 5-3 lists the EECs recorded within the locality and their conservation status. Five EECs listed under the TSC Act were identified within the investigation area during the field surveys and are described below.

No EECs listed under the EPBC Act occur in the investigation area.

Hunter Lowland Redgum Forest EEC

Forest Red Gum Open Forest mapped within the investigation area is characteristic of Hunter Lowland Redgum Forest EEC (NSWSC 2002), listed under the TSC Act. This EEC occurs from Muswellbrook to the Lower Hunter in the Sydney Basin and North Coast bioregions. It has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton LGAs, but may occur elsewhere in these bioregions. Less than 27% of the community remains with much of it disturbed and fragmented (NSWSC 2002).

This community is dominated by Forest Red Gum (*Eucalyptus tereticornis)* and Grey Gum (*E. punctata*). Other frequently occurring canopy species include Smooth-barked Apple (*Angophora costata)*, Spotted Gum (*Corymbia maculata)*, Narrow-leaved Ironbark (*E. crebra)* and Grey Box (*E. moluccana)*. The mid-storey is open and characterised by sparse shrubs such as Coffee Bush (*Breynia oblongifolia)*, Prickly Beard-heath (*Leucopogon juniperinus)*, Gorse Bitter Pea (*Daviesia ulicifolia)* and Dogwood (*Jacksonia scoparia)*. The ground cover typically comprises grasses and herbs (NSWSC 2002).

Parts of the investigation area mapped as Redgum Open Forest are characteristic of Hunter Lowland Redgum EEC. Of the 36 species from this assemblage that are listed in the Final Determination as characterising the EEC, 29 species (81%) are present in the investigation area. This community occurs throughout the investigation area, associated with creeks, drainage lines and floodplains. The majority of occurrences of the threatened Slaty Red Gum occur within this vegetation community. The ROTAP Mountain Grevillea also occurs in both scattered and dense concentrations within this community.

Lower Hunter Spotted Gum Ironbark EEC

Spotted Gum- Ironbark Forest within the investigation area is characteristic of Lower Hunter Spotted Gum-Ironbark Forest EEC (NSWSC 2005a), listed under the TSC Act. This EEC is restricted to a range of approximately 65 kilometres by 35 kilometres centred on the Cessnock - Beresfield area in the Central and Lower Hunter Valley. Within this range, the community was once widespread. A fragmented core of the community still occurs between Cessnock and Beresfield (NSWSC 2005a).

This community is dominated by Spotted Gum (*Corymbia maculata)* and Broad-leaved Ironbark (*Eucalyptus fibrosa)*, with occasional Grey Gum (*E. punctata)* and Grey Ironbark (*E. crebra)*. The understorey is marked by the tall shrub, *Acacia parvipinnula*, and by the prickly shrubs, *Daviesia ulicifolia, Bursaria spinosa, Melaleuca nodosa* and *Lissanthe strigosa*. The ground layer is diverse; frequent species include *Cheilanthes sieberi, Cymbopogon refractus, Dianella revoluta, Entolasia stricta, Glycine clandestina, Lepidosperma laterale, Lomandra multiflora, Microlaena stipoides, Pomax umbellata, Pratia purpurascens, Themeda australis* and *Phyllanthus hirtellus* (NSWSC 2005a).

Parts of the investigation area mapped as Spotted Gum Ironbark Open Forest are characteristic of Lower Hunter Spotted Gum Ironbark EEC. Of the 55 species from this assemblage that are listed in the Final Determination as characterising the EEC, 34 species (62%) are present in the investigation area. This community occurs throughout the investigation area, associated with drier ridgetops. The ROTAP species Mountain Grevillea occurs in both scattered and dense concentrations within this community.

Swamp Oak Floodplain Forest EEC

Swamp Oak Riparian Forest mapped within the investigation area is characteristic of Swamp Oak Floodplain Forest EEC (NSWSC 2005b) listed under the TSC Act. This community is found on the coastal floodplains of NSW. The extent of the community prior to European settlement has not been mapped across its entire range. However, the remaining area of Swamp Oak Floodplain Forest is likely to represent much less than 30% of its original range.

This community is dominated by a sparse to dense layer of Swamp Oak (*Casuarina glauca*). Lilly Pilly (*Acmena smithii*), Cheese Trees (*Glochidion* spp.) and Paperbarks (*Melaleuca* spp.) may also be present as subdominant species. The understorey is characterised by frequent occurrences of vines, including Common Silkpod (*Parsonsia straminea),* Scrambling Lily *(Geitonoplesium cymosum)* and Snake Vine (*Stephania japonica* var. *discolor)*, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter (NSWSC 2005b).

Parts of the investigation area mapped as Swamp Oak Riparian Forest are characteristic of Swamp Oak Floodplain EEC. Of the 45 species from this assemblage that are listed in the Final Determination as characterising the EEC, 14 species (31%) are present in the investigation area. This community occurs throughout the investigation area, associated with permanent creeks and tributaries.

Freshwater Wetland EEC

Freshwater Wetlands are associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. This community typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Freshwater wetlands are dominated by herbaceous plants and have very few woody species. This community has been extensively cleared and modified, with approximately 3,500 hectares remaining in the lower Hunter – Central Hunter region (in 1990s) (NSWSC 2004).

Parts of the investigation area mapped as Freshwater Wetland are characteristic of Freshwater Wetland EEC listed under the TSC Act. Of the 66 species from this assemblage that are listed in the Final Determination as characterising the EEC, 14 species (21%) are present in the investigation area. This community occurs in small patches throughout the investigation area, associated with low-lying areas of permanent creeks.

Central Hunter Ironbark - Spotted Gum - Grey Box Forest EEC

Central Hunter Ironbark - Spotted Gum - Grey Box Forest generally occurs on Permian sediments in the Hunter Valley and typically forms an open forest to woodland dominated by Narrow-leaved Ironbark *(Eucalyptus crebra)*, Spotted Gum (*Corymbia maculata)* and Grey Box (*Eucalyptus moluccana)*. A sparse layer of small trees may be present in some areas, typically including Bulloak (*Allocasuarina luehmannii)* or Silver-stemmed Wattle (*Acacia parvipinnula)*. The shrub layer is typically sparse or absent in some cases, through to moderately dense. Common shrub species include Gorse Bitter Pea *(Daviesia ulicifolia* subsp. *ulicifolia)*, Grey Bush Pea (*Pultenaea spinosa)*, Coffee Bush *(Breynia oblongifolia)*, Bushy Neddlebush (*Hakea sericea)*, and Native Blackthorn (*Bursaria spinosa* subsp. *Spinosa)* (NSW Scientific Committee 2009).

Ground cover can be sparse to moderately dense, and consists of numerous forbs, a few grass species, and a limited number of ferns, sedges or other herbs. Common species include Poison Rock Fern (*Cheilanthes sieberi* subsp. *Sieberi)*, Barbed Wire Grass (*Cymbopogon refractus)*, Whiteroot (*Pratia purpurascens)*, Many-flowered Mat-rush) (*Lomandra multiflora* subsp. *Multiflora)*, Pomax (*Pomax umbellata)*, Variable Glycine (*Glycine tabacina)*, Blue Flax Lily (*Dianella revolute)* (Peake 2006, NSWSC 2009).

Parts of the investigation area mapped as Grey Box Spotted Gum Ironbark Open Forest are characteristic of Central Hunter Ironbark - Spotted Gum - Grey Box Forest EEC. Of the 44 species from this assemblage that are listed as characterising the EEC, 33 species (75%) are present in the investigation area. This community occurs in the western section of the investigation area, associated with drier ridgetops.

5.3 Noxious and Environmental Weeds

Eleven of the flora species recorded in the investigation area are declared Noxious Weeds in the Singleton, Cessnock and Maitland LGAs, pursuant to the NW Act. These, together with their relevant control classes are outlined in Table 5-2:

Table 5-2 Noxious Weeds Recorded in the Investigation Area

Noxious Weed	Class	Location
Blackberry (*Rubus fruticosus* sp. aggr.)	4	Recorded in low density adjacent to creeklines.
Bridal Creeper (*Asparagus asparagoides*)	5	Recorded in low density within agricultural lands.
Green Cestrum (*Cestrum parqui)*	3	Recorded in several high-density patches within drainage lines east of Wollombi Road.

Noxious Weed	Class	Location
Lantana (*Lantana camera*)	4	Recorded in almost all creeks at low density, and in high density on Lot 1 DP 66212.
Mexican Poppy (*Argemone ochroleuca*)	5	Recorded in low density within the rail corridor.
Mother of Millions (*Bryophyllum delagoense*)	3	Recorded in low density within the rail corridor.
Pampas Grass (*Cortaderia selloana)*	4	Recorded in several high-density patches within drainage lines east of Wollombi Road.
Paterson's Curse (*Echium plantagineum*)	4	Recorded in low density within cleared agricultural land.
Common Prickly Pear (*Opuntia stricta* var. *stricta*)	4	Recorded in low density within Grey Box Spotted Gum Ironbark Open Forest.
Tiger Pear (*Opuntia aurantica*)	4	Recorded in low density within Grey Box Spotted Gum Ironbark Open Forest.
Weeping Willow (*Salix babylonica*)	5	Recorded in several high-density patches within drainage lines east of Wollombi Road.

In addition to being listed under the NW Act for Maitland, Cessnock and Singleton LGAs, Blackberry, Bridal Creeper, Lantana and Weeping Willow are listed as Weeds of National Significance.

An explanation of actions required in relation to notifiable weeds pursuant to the NW Act is outlined in Appendix E.

5.3.1 Environmental Weeds

Numerous environmental weed species were recorded within the investigation area, the most common being Flatweed (*Hypochaeris radicata),* Common Olive *(Olea europaea* subsp. *europaea),* Fennel (*Foeniculum vulgare)*, Balloon Cotton Bush (*Gomphocarpus physocarpus)*, Cobblers Pegs (*Bidens pilosa)*, Spear Thistle (*Cirsium vulgare)*, Fireweed (*Senecio madagascariensis)*, Caster Oil Plant (*Ricinus communis)*, Purpletop (*Verbena bonariensis)*, Trad (*Tradescantia fluminensis)*, Paspalum (*Paspalum dilatatum)*, Couch (*Cynodon dactylon*) and Kikuyu (*Pennisetum clandestinum)*. These weeds were widespread within the rail corridor and on private land cleared for agriculture.

5.4 Threatened Flora Recorded, or Likely to Occur, Within the Investigation Area

Slaty Red Gum (*Eucalyptus glaucina*) is listed as a vulnerable species under the TSC Act and EPBC Act. Slaty Red Gum occurs in grassy woodland and dry eucalypt forests, on deep, moderately fertile and well-watered soils (DECCW 2009a). Examination of DECCW (2009b)

records for Slaty Red Gum within 10 kilometres of the investigation area indicates the majority have been previously recorded between Singleton and Belford. The species is widespread in the Singleton Military Area where the population is estimated to comprise in the order of 1,000,000 individuals (Hunter 2004 cited in Peake 2006).

In the investigation area, Slaty Red Gum occurred in dense areas associated with Forest Red Gum Open Forest, and as scattered individuals associated with creeks and drainage lines (refer to Figure 5.2). It was generally absent from ridgetops. Samples sent to the Royal Botanic Gardens were confirmed as Slaty Red Gum.

Slaty Red Gum and Forest Red Gum are known to intergrade in the local area, and have been recorded in Thornton North (Bell, 2003). Within the investigation area, numerous trees were recorded that displayed intermediate characteristics between the two species, likely to represent hybrid or intergrade forms. Several samples of a possible Slaty Red Gum / Forest Red Gum intergrade were also sent to the Royal Botanic Gardens and were confirmed as Forest Red Gum with probable genetic influence of Slaty Red Gum. Stands comprising the intergrade and isolated individuals have been mapped in Figure 5.2 as Slaty Red Gum in order to take a precautionary approach in terms of assessing impacts on this threatened species. Additionally, both *E. glaucina* and *E. tereticornis* var *glaucina* are both listed on the EPBC Act as vulnerable.

The Project would clear 2.7 hectares of dense stands and 50 individual Slaty Red Gum, however the species was observed extending well beyond the limits of the investigation area. Additionally, the species showed excellent regenerative potential, with an abundance of regenerating saplings observed on sites without, or low, grazing pressures.

Plate 1 Regenerating Slaty Red Gum

Plate 2 Slaty Red Gum Buds

No other threatened flora were recorded in the investigation area during the field surveys undertaken for this ecological assessment, and based on an assessment of the habitat available in the investigation area and species habitat requirements, it is considered unlikely that any other threatened flora would occur in the investigation area (refer to Table 5-3).

5.4.1 Other Flora Species of Conservation Significance

Mountain Grevillea (*Grevillea montana*) was recorded within scattered and dense concentrations within Forest Red Gum Open Forest, and in scattered concentrations within Grey Box Spotted Gum Ironbark Forest throughout the investigation area (refer to Figure 5.2). This species grows in open forest in sandy soils over mixed sedimentary substrates; in the southern part of Hunter Valley from Denman to Kurri Kurri (PlantNET 2009). Mountain Grevillea is not protected under State or Commonwealth legislation but is listed in Rare or Threatened Australian Plants - ROTAP (Briggs and Leigh 1996). The occurrence of this species was observed to extend well beyond the boundaries of the investigation area, particularly on sites not subject to grazing.

Plate 3 Mountain Grevillea

5.5 Threatened Aquatic Species

The FM Act lists threatened aquatic species, populations and endangered ecological communities. Based on species distribution ranges and habitat requirements, no aquatic species, populations and endangered ecological communities are likely to occur in the investigation area. Further assessment under the FM Act is not required for the Project.

5.6 Aquatic Habitat Assessment

There are six named creeklines in the investigation area, Stony Creek, Lochinvar Creek, Anvil Creek, Sawyers Creek, Black Creek and Jump Up Creek. Sweetwater Creek also runs adjacent to the investigation area. These named creeks that intersect the investigation area have been assessed separately; with the results of the RARC assessment (Jansen *et al*. 2005) outlined in Table 5-2. The investigation area also includes numerous permanent and ephemeral unnamed tributaries to these creeks. Permanent unnamed tributaries have been assessed collectively in Table 5-2, due to the high number of permanent unnamed tributaries that occur in the investigation area. Additionally, habitat values between permanent unnamed tributaries were similar at all locations within the investigation area. Similarly, ephemeral unnamed tributaries have been collectively assessed in Table 5-2.

Most named creeks within the investigation area have been rated as average by the RARC assessment (Jansen *et al*. 2005), due to the width of riparian vegetation, fragmented nature of the native vegetation in the local area, high level of weeds in the groundcover, and lack of fauna habitat features such as hollow-bearing trees and fallen logs. Some of the named creeks have been rated as very poor or poor, due to lack of native riparian vegetation, discontinuous native vegetation, lack of regenerating vegetation and lack of habitat features. The unnamed permanent tributaries have been rated either poor or average by the RARC assessment, and the unnamed ephemeral tributaries have been rated as poor by the RARC assessment due to lack of cover and continuity of riparian vegetation, high levels of weeds and lack of habitat features.

There are several small freshwater wetlands within the investigation area, and a large freshwater wetland associated with Stony Creek near Wollombi Road. These wetlands have been rated as very poor in the RARC assessment. Several unnamed tributaries of Wentworth Swamp occur in the eastern section of the investigation area, which have been highly degraded and are rated as very poor in the RARC assessment.

There are numerous small and large farm dams within the investigation area, which are typically characterised by little or no native riparian vegetation. Those farm dams that do have some native reeds are dominated by Common Reed (*Phragmatis australis*), Broad-leaf Cumbungi (*Typha orientalis*) and *Eleocharis* sp. These farm dams are unlikely to be providing important habitat for fish and macroinvertebrates due to the lack of riparian vegetation, isolation from other waterways and high levels of disturbance due to agricultural activities. The farm dams are likely to be providing habitat for mobile native fauna only, such as birds and possibly bats. Note that no RARC assessments were undertaken for the farm dams, as this assessment is designed for transects along riparian corridors.

A Surface Water Assessment has been undertaken for the Project and is included in Appendix L of the Environmental Assessment.

Table 5-3 Assessment of Threatened Flora and Communities Recorded Within a 10 km radius of the Investigation Area (DECC 2009b, DEWHA 2009, BioNet 2009) and Likelihood of Occurring in the Investigation Area

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
FLORA					
Black-eyed Susan *Tetratheca juncea*	V	3VCa	V	Usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. Characteristic overstorey species include Smooth Bark Apple (*Angophora costata)*, Red Bloodwood and Brown Stringybark (DECC 2009a).	Unlikely. Suitable habitat, soil characteristics and overstorey vegetation absent in investigation area. Database searches (DECCW 2009b) indicate the closest known population is approximately 9.5 km southeast of the eastern most extent of the Project.
Bynoe's Wattle *Acacia bynoeana*	E	3VC-	V	Found in central eastern NSW. It occurs in heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leafed Apple (DECC 2009a).	Unlikely. Suitable habitat, soil characteristics and overstorey vegetation absent in investigation area. Database searches (DECCW 2009b) indicate the closest record 3 km south of Branxton. The species is likely to occur in the wider locality, but not within the investigation area.
Charmhaven Apple *Angophora inopina*	V	2R-	V	Occurs in four main vegetation communities: (i) *Eucalyptus haemastoma–Corymbia gummifera–Angophora inopina* woodland/forest; (ii) *Hakea teretifolia–Banksia oblongifolia* wet heath; (iii) *Eucalyptus resinifera–Melaleuca sieberi–Angophora inopina* sedge woodland; (iv) *Eucalyptus capitellata–Corymbia gummifera–Angophora inopina* woodland/forest (DECC 2009a).	Unlikely. Suitable habitat and overstorey vegetation absent in investigation area. Database searches indicate no recent local records (DECCW 2009b).

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Earp's Gum *Eucalyptus parramattensis* subsp. *decadens*	V	2V	V	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey, and as an emergent in dry or wet heathland (DECC 2009a).	Unlikely. Suitable soil characteristics and vegetation communities absent from investigation area. Database searches (Bionet 2009) indicate the closest known population is approximately 9 km south of Allandale.
Heath Wrinklewort *Rutidosis heterogama*	V	2VCa	V	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides (DECC 2009a).	Unlikely. Suitable soil characteristics absent from investigation area. Database searches (DECCW 2009b) indicate a single record 2.5 km northeast of the eastern most extent of the investigation area and a population 8 km south of Lochinvar.
Leafless Tongue-orchid *Cryptostylis hunteriana*	V	3VC-	V	The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community (DECC 2009a).	Unlikely. Suitable soil characteristics and vegetation communities absent from investigation area. Database searches indicate no recent local records (DECCW 2009b).
Magenta Lilly Pilly *Syzygium paniculatum*	V	3CVi	V	Subtropical to littoral rainforest on sandy soils or stabilised sand dunes near the sea, and gallery rainforest on alluvial soils. On the south coast, occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the Central Coast occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (DECC 2009a).	Unlikely. Suitable soil characteristics and vegetation communities absent from investigation area. Database searches indicate no recent local records (DECCW 2009b).

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
North Rothbury Persoonia *Persoonia pauciflora*	E	2E	CE	Found in dry open forest or woodland dominated by Spotted Gum (*Corymbia maculata*), Broad-leaved Ironbark (*Eucalyptus fibrosa*) and/or Narrow-leaved Ironbark (*E. crebra*) and supporting a moderate to sparse shrub layer and grassy groundcover. The majority of the population is known to occur on silty sandstone soils derived from the Farley Formation (DECC 2009a).	Possibly. Potentially suitable habitat is present and database searches indicate records less than a kilometre south of the investigation area (DECCW2009b). A large population exists in North Rothbury, 5 km south of Branxton. However, the species is distinctive and would have been recorded in the investigation area had it been present. The species occurs in the wider local area, but not within the investigation area.
Pokolbin Mallee *Eucalyptus pumila*	V	2VCi	V	Currently known only from a single population west of Pokolbin in the Hunter Valley. Present as a mid-canopy species to a height of 6 m within dry sclerophyll woodland which has a canopy comprising *Eucalyptus fibrosa*, *Callitris endlicheri* and, to a lesser extent, *Corymbia maculata*. It is thought to flower in April-May, but like many eucalypts does not flower every year (DECC 2009a).	Unlikely. Investigation area is outside species known distribution range.
Singleton Mint Bush *Prostanthera cineolifera*	V	2K	V	Grows in open woodlands on exposed sandstone ridges. Usually found in association with shallow or skeletal sands (DECC 2009a).	Unlikely. Suitable soil characteristics and vegetation communities absent from investigation area. Database searches (DECCW 2009b) indicate records 8.5 km south of Singleton. The species is likely to occur in the wider locality, but not within the investigation area.

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Slaty Red Gum *Eucalyptus glaucina*	V	3VCa	V	Slaty Red Gum grows in grassy woodland and dry eucalypt forests. It occurs on deep, moderately fertile and well-watered soils. The species has a limited distribution including Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland (DECC 2009a).	**Species recorded in dense areas within drainage lines, particularly west of Hermitage Road. Scattered occurrences throughout the investigation area, associated with Redgum Open Forest. An intergrade of *Eucalyptus glaucina* and *Eucalyptus tereticornis* also occurs associated with Red Gum Open Forest throughout the investigation area.**
Small-flower Grevillea *Grevillea parviflora* subsp*. parviflora*	V	-	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest (DECC 2009a)..	Unlikely. Suitable soil characteristics and underlying geology absent from investigation area. Database searches (DECCW 2009b) indicate a large population associated with Werakata National Park, 7 km south of Lochinvar. The species is likely to occur in the wider locality, but not within the investigation area.

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
ENDANGERED POPULATIONS					
Cymbidium canaliculatum population in the Hunter Catchment	E	-	-	Grows in the hollows of trees in dry sclerophyll forest or woodland; north from the Hunter Valley. Flowers in September to October (PlantNet 2009).	Unlikely. Not identified during field surveys. Database searches indicate no recent local records (DECCW 2009b).
Leionema lamprophyllum subsp. *obovatum* population in the Hunter Catchment	E	-	-	The Hunter Catchment population of *L lamprophyllum* subsp. *obovatum* occurs east of Maitland near Pokolbin in the Hunter Valley. It occurs in dry eucalypt forest on exposed rocky terrain. The Hunter Catchment population is considered to be highly genetically isolated due to the distance to the nearest recorded occurrence of this taxon, and the lack of specialised mechanisms for long distance dispersal of seed or pollen. The species flowers late winter to spring (DECC 2009a).	Unlikely. Investigation area is outside species known distribution range. Database searches indicate no recent local records (DECCW 2009b).
River Red Gum Population in the Hunter Catchment	E	-	-	May occur with *Eucalyptus tereticornis*, *Eucalyptus melliodora*, *Casuarina cunninghamiana* subsp. *cunninghamiana* and *Angophora floribunda* Most of the occurrences are on private land and there are no known occurrences in conservation reserves (DECC 2009a).	Unlikely. Not identified during field surveys. Species is distinctive and would have been recorded if present.
Weeping Myall Population in the Hunter Catchment	E	-	-	A disjunct population of fewer than 1000 individuals that occurs in the Hunter Valley at the eastern limit of this species' distributional range. Within the Hunter catchment the species typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations (DECC 2009a).	Unlikely. Investigation area is outside species known distribution range. Database searches indicate no recent local records (DECCW 2009b).

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
ROTAP SPECIES					
Bulga Wattle *Acacia bulgaensis*	-	2RC-	-	Grows in sclerophyll woodland/forest, on sandstone or shale, but is restricted to the Bulga-Milbrodale-Broke area. Flowers September to March (PlantNet 2009).	Unlikely. Investigation area is outside species known distribution area.
Eucalyptus fergusonii subsp. *fergusonii*	-	3KC-	-	This species is scattered and sporadic, found in wet sclerophyll forest or woodland on sandy soils between Bulahdelah and Morisset (PlantNet 2009).	Unlikely. Suitable soil characteristics and vegetation communities absent from investigation area. Database searches (Bionet 2009) indicate the closest population 2 km south of Branxton. The species is likely to occur in the wider locality, but not within the investigation area.
Mountain Grevillea *Grevillea montana*	-	2VC	-	Grows in open forest in sandy soils over mixed sedimentary substrates. Occurs in the southern part of Hunter Valley from Denman to Kurri Kurri. Flowers in September and October (PlantNet 2009).	**Scattered and dense occurrences recorded within the investigation area in Redgum Open Forest and Spotted Gum Ironbark open Forest.**
Macrozamia flexuosa	-	2K	-	Occurs in scattered in sclerophyll forests on siliceous soils from Bulahdelah to Lake Macquarie (PlantNet 2009).	Unlikely. Suitable soil characteristics and vegetation communities absent from investigation area. Database searches (Bionet 2009) indicate records 2 km north and south of the Branxton. The species is likely to occur in the wider locality, but not within the investigation area.

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
ENDANGERED ECOLOGICAL COMMUNITIES					
Central Hunter Grey Box- Ironbark Woodland	EEC	-	-	This community generally occurs on Permian sediments in the Hunter Valley and forms a woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra)*, Kurrajong (*Brachychiton populneus* subsp. *populneus)* and Grey Box (*Eucalyptus moluccana*). Other tree species may be present and occasionally dominate or co-dominate, and include Rough-barked Apple (*Angophora floribunda*) and Black Cypress Pine (*Callitris endlicheri*). Continual clearing related to open-cut coal mining, grazing and rural sub-division pose threats to this community.	Community not identified during field surveys and considered unlikely to occur in the investigation area.
Central Hunter Spotted Gum-Ironbark-Grey Box Forest	ECC	-	-	This community generally occurs on Permian sediments in the Hunter Valley and forms an open forest to woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra)* Spotted Gum (*Corymbia maculata*) and Grey Box (*Eucalyptus moluccana*). Other tree species may be present and occasionally dominate or co-dominate, and include Broad-leaved Ironbark *(Eucalyptus fibrosa*) and Forest Red Gum (*Eucalyptus tereticonis)*. Continual clearing related to open-cut coal mining, grazing and rural sub-division pose threats to this community.	**Recorded during field surveys.**

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Freshwater Wetlands on Coastal Floodplains	EEC	-	-	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occurs below 20 m elevation on level areas (DECC 2009a).	**Recorded during field surveys.**
Hunter Lowland Red Gum Forest	EEC	-	-	This community occurs on the Permian sediments of the Hunter Valley floor. It is an open forest, which characterises the gentle slopes of depressions and drainage flats on the Hunter Valley floor. The most common canopy tree species are Forest Red Gum (*Eucalyptus tereticornis)* and Grey Gum (*E. punctata*). Much of the remaining community is disturbed and fragmented (DECC 2009a).	**Recorded during field surveys.**
Hunter Valley Weeping Myall Woodland	EEC	-	CE[1]	Hunter Valley Weeping Myall Woodland of the Sydney Basin bioregion typically has a dense to open tree canopy up to about 15 m tall, depending on disturbance and regrowth history. The most common tree is Weeping Myall (*Acacia pendula*), which may occur with Narrow-leaved Ironbark (*Eucalyptus crebra*), Cooba (*A. salicina*) and/or trees within the *A. homalophylla A. melvillei* complex (DECC 2009a).	Community not identified during field surveys and considered unlikely to occur in the investigation area.

[1] A section of the community which occurs in heavy, brown clay soil at Jerry's Plains in the Hunter Valley is also listed by the Commonwealth as Critically Endangered

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Kurri Sand Swamp Woodland	EEC	-	-	Known to occur in the Kurri Kurri–Cessnock area of the lower Hunter Valley. Occurs on soils developed on poorly-drained Tertiary sand deposits that blanket Permian sediments. Structurally it forms a low open-woodland to low woodland and open scrub, generally with a low open canopy rarely exceeding 15 m in height. *Eucalyptus parramattensis* subsp. *decadens* and *Angophora bakeri*, and occasionally *Eucalyptus signata* and *Eucalyptus sparsifolia*, form the canopy stratum (DECC 2009a).	Community not identified during field surveys and considered unlikely to occur in the investigation area.

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Lower Hunter Spotted Gum - Ironbark Forest	EEC	-	-	This community is dominated by Spotted Gum *Corymbia maculata* and Broad-leaved Ironbark *Eucalyptus fibrosa*, while Grey Gum *E. punctata* and Grey Ironbark *E. crebra* occur occasionally. A number of other eucalypt species occur at low frequency, but may be locally common in the community. One of these species, *E. canaliculata*, intergrades extensively in the area with *E. punctata*. Occurs principally on Permian geology in the central to lower Hunter Valley. The Permian substrates most commonly supporting the community belong to the Dalwood Group, the Maitland Group and the Greta and Tomago Coal Measures, although smaller areas of the community may also occur on the Permian Singleton and Newcastle Coal Measures and the Triassic Narrabeen Group. The community is strongly associated with, though not restricted to, the yellow podsolic and solodic soils of the Lower Hunter soil landscapes of Aberdare, Branxton and Neath. These substrates are said to produce 'moderately fertile' soils (DECC 2009a).	**Recorded during field surveys.**

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Quorrobolong Scribbly Gum Woodland	EEC	-	-	Currently known from only a small area between Quorrobolong and Mulbring in the Cessnock local government area, but may also occur elsewhere within the Hunter Valley. This is a woodland community that differs in floristic composition from other woodland communities on sand deposits within the bioregion in the presence and importance of *Eucalyptus racemosa* in the canopy layer and the presence of *E. piperita*, *E. resinifera* and *Syncarpia glomulifera* (DECC 2009a).	Community not identified during field surveys and considered unlikely to occur in the investigation area.
River-flat Eucalypt Forest on Coastal Floodplains	EEC	-	-	This community has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include Forest Red Gum *(Eucalyptus tereticornis)*, Cabbage Gum *(E. amplifolia)*, Rough-barked Apple (*Angophora floribunda*) and Broad-leaved Apple (*A. subvelutina*). Blue Box (*Eucalyptus baueriana*), Bangalay (*E. botryoides*) and River Peppermint (*E. elata*). Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains (DECC 2009a).	Community not identified during field surveys and considered unlikely to occur in the investigation area.

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Swamp Oak Floodplain Forest	EEC	-	-	This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which Swamp Oak (*Casuarina glauca)* is the dominant species northwards from Bermagui. Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees (DECC 2009a).	**Recorded during field surveys.**
Swamp Sclerophyll Forest on Coastal Floodplains	EEC	-	-	This swamp community has an open to dense tree layer of eucalypts and paperbarks although some remnants now only have scattered trees as a result of partial clearing. The most widespread and abundant dominant trees include Swamp Mahogany (*Eucalyptus robusta*), Broad-leaved Paperbark (*Melaleuca quinquenervia),* Bangalay (*Eucalyptus botryoides*) and Woollybut (*Eucalyptus longifolia)*. Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation (DECC 2009a).	Community not identified during field surveys and considered unlikely to occur in the investigation area.

Common Name / *Scientific Name*	Conservation Status			Habitat Associations and Requirements	Likelihood of Occurring in the Study Area
	TSC Act	RoTAP	EPBC Act		
Warkworth Sands Woodland	EEC	-	-	Currently known to occur only in the Singleton local government area, but mainly confined to a small area near Warkworth, about 15 km south-east of Singleton in the Hunter Valley. Only approximately 800 hectares of Warkworth Sands Woodland remains. Structurally this community forms woodland – low woodland with trees of *Angophora floribunda* and *Banksia integrifolia*. Shrubs and ground species include *Acacia filicifolia, Pteridium esculentum, Imperata cylindrica, Brachyloma daphnoides* and *Melaleuca thymifolia* (DECC 2009a).	Community not identified during field surveys and considered unlikely to occur in the investigation area.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland	EEC	-	CE	Open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of White Box (*Eucalyptus albens)*, Yellow Box (*E. melliodora)* and Blakely's Red Gum (*E. blakelyi*). Remnants generally occur on fertile lower parts of the landscape where resources such as water and nutrients are abundant (DECC 2009a).	Community not identified during field surveys and considered unlikely to occur in the investigation area.

Key:

E = Listed as an Endangered species under either Schedule 1 of the TSC Act, FM Act or EPBC Act.

V = Listed as a Vulnerable species under either Schedule 2 of the TSC Act, FM Act or EPBC Act.

CE**=** Listed as Critically Endangered under the EPBC Act.

Bold text: Species recorded during survey.

RoTAP Codes

Plant Distribution	2	Restricted distribution - range extending over less than 100 km
	3	Range more than 100 km but in small populations
Conservation Status	E	Endangered - at serious risk in the short term (one or two decades)
	V	Vulnerable - at risk over a longer period (20-50 years)
	R	Rare but with no current identifiable threat
	K	Poorly known species suspected of being at risk
Reservation Status	C	Species is known to occur within a proclaimed reserve
	a	Species is considered to be adequately reserved. 1000 or more plants occur within a proclaimed reserve
	i	Species is considered to be inadequately reserved. Less than 1000 plants occur within a proclaimed reserve
	-	Species is recorded from a reserve but the population size is unknown
	t	Total known species population is within a reserve
	+	Species also occurs outside of Australia

Table 5-4 Aquatic Habitat Assessment

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
The unnamed tributaries of Wentworth Swamp occur in the eastern section of the investigation area and flow under the existing railway south towards Wentworth Swamp. All native vegetation has been cleared, and some concrete channels have been constructed. North of the existing railway landuse is rural; south of the existing railway landuse is agricultural. A small freshwater wetland occurs south of the existing railway, which grade into a large farm dams devoid of native vegetation.	Canopy: *Salix babylonica** Shrub Layer: *Cortaderia selloana** *Cestrum parqui** *Lantana camera** Groundcover/ Macrophytes: *Paspalum dilatatum** *Tradescantia fluminensis** *Bidens pilosa** *Juncus usitatus* *Cynodon dactylon**	These unnamed tributaries are likely to provide ephemeral habitat for common aquatic macroinvertebrates only. There is a lack of suitable habitat for fish and platypus (such as deep pools, woody snags, riparian vegetation for shade and structure). Database searches indicate no threatened aquatic species occur in the investigation area. Classed as minimal fish habitat using NSW Fisheries (1999) guidelines.	**4 – Very Poor** Low levels of native vegetation, no connectivity with native vegetation, no native regeneration, no habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 4 and a rating of very poor. Habitat: 1/11 Cover: 4/12 Natives: 2/9 Debris: 1/10 Features: 0/8 Total: 8/ 50	 The unnamed tributaries of Wentworth Swamp correspond to W1 and W2 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
Stony Creek at Wollombi Road flows under the existing railway south towards Wentworth Swamp. The north side of the creek (top) is approximately 2-4 m wide, dominated by an exotic canopy, shrub and groundcover, and some native reeds. South of the existing railway the creek is 1-2 m wide and characterised by scattered Red Gum Open Forest and *Juncus acutus.* Stony Creek at Lochinvar (bottom) is an ephemeral drainage line with scattered canopy species and low density of *Juncus usitatus.*	<u>Canopy:</u> *Eucalyptus tereticornis* *Salix babylonica** <u>Shrub Layer:</u> *Ligustrum sinense** *Lantana camera** <u>Groundcover/ Macrophytes:</u> *Paspalum dilatatum** *Tradescantia fluminensis** *Pennisetum clandestinum** *Juncus usitatus* *Cynodon dactylon** *Juncus acutus** *Juncus usitatus*	Stony Creek provides permanent habitat for fish and aquatic macroinvertebrates, although structural habitat such as instream woody snags and macrophytes is limited. Water quality appears extremely turbid and poor. The creek is likely to provide habitat for common native fish and macroinvertebrates. The creek and banks are not suitable for platypus foraging or burrows. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as moderate fish habitat using NSW Fisheries (1999) guidelines.	**12 – Very Poor** Low levels of native vegetation, no connectivity with native vegetation, no native regeneration, no habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 12 and a rating of very poor. <u>Habitat:</u> 1/11 <u>Cover:</u> 8/12 <u>Natives:</u> 1/9 <u>Debris:</u> 1/10 <u>Features:</u> 1/8 <u>Total:</u> 12/ 50	  Stony Creek corresponds to W3 (top) and W16 (bottom) in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
Stony Creek freshwater wetland is approximately 30 m wide, and flows south towards the existing rail. The canopy includes scattered *Casuarina glauca*, with dense *Phragmites australis* dominating the groundcover. Surrounding landuse is infrastructure, rural and dense remnant *Casuarina glauca* associated with Stony Creek (outside the investigation area).	Canopy: *Casuarina glauca* Shrub Layer: Absent Groundcover/ Macrophytes: *Paspalum dilatatum** *Phragmites australis* *Pennisetum clandestinum** *Juncus usitatus* *Cynodon dactylon**	Stony Creek wetland provides permanent habitat for amphibians aquatic macroinvertebrates, but is not suitable for fish or platypus due to low water levels. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as minimal fish habitat using NSW Fisheries (1999) guidelines.	**12 – Very Poor** High levels of native vegetation and connectivity with native vegetation, however no habitat features such as hollow-bearing trees, and hollow logs result in an overall score of 12 and a rating of very poor. Habitat: 4/11 Cover: 8/12 Natives: 4/9 Debris: 4/10 Features: 5/8 Total: 26/ 50	 Stony Creek wetland corresponds to W3 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
There are numerous unnamed tributaries of Stony Creek between Wollombi Road and Station Lane. Most have defined channels, although are ephemeral in nature. The canopy is dominated by *Eucalyptus tereticonis*, in dense (pictured), and scattered areas. The shrub and groundcover layer also varies considerably, depending on levels of clearing for agriculture. Surrounding landuse is infrastructure and agriculture.	Canopy: *Eucalyptus moluccana, E. tereticornis, E. crebra.* Shrub Layer: *Acacia irrorata* *Daviesia ulicifolia* *Lantana camera** Groundcover: Scattered, generally introduced spcecies: *Austrodanthonia* sp. *Pennisetum clandestinum** *Cynodon dactylon** *Paspalum dilatatum** *Themeda australis* *Juncus usitatus* Macrophytes: Absent	The unnamed drainage lines are ephemeral and as such provide minimal habitat for aquatic fauna. No permanent habitat for fish, platypus or aquatic macroinvertebrates occurs. Classed as minimal fish habitat using NSW Fisheries (1999) guidelines.	**27 - Poor** Scattered native canopy with a weedy groundcover, generally discontinuous vegetation, low levels of native regeneration, and lack of habitat features such as hollow-bearing trees, hollow logs and reed beds result in an overall score of 27 and a rating of poor. Habitat: 3/11 Cover: 9/12 Natives: 5/9 Debris: 6/10 Features: 4/8 Total: 27/ 50	 Stony Creek tributaries correspond to W4-W16 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
The section of Lochinvar Creek that occurs in the investigation area has been recently cleared of all native vegetation and regraded. Only a small amount of regenerating exotic groundcover remains. The creek appears ephemeral in nature. Surrounding landuse is infrastructure and agriculture.	Canopy: Absent Shrub Layer: Absent Groundcover: *Trifolium repens** Macrophytes: Absent	Lochinvar creek appears ephemeral, has no aquatic or riparian vegetation, and as such provides no habitat for aquatic fauna and no permanent habitat for fish, platypus or aquatic Classed as minimal fish habitat using NSW Fisheries (1999) guidelines. North of the investigation area scattered eucalypts occur in the canopy, the groundcover has not been disturbed and habitat values are greater.	**1 – Very Poor** No native vegetation, no native regeneration, and lack of habitat features such as hollow-bearing trees, leaf litter hollow logs and reed beds result in an overall score of 1 and a rating of very poor. Habitat: 0/11 Cover: 1/12 Natives: 0/9 Debris: 0/10 Features: 0/8 Total: 1/ 50	 Lochinvar Creek corresponds to W23 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
Anvil Creek occurs at Allandale, Harpers Hill and Greta within the investigation area. Anvil Creek is a permanent creek and also includes small freshwater wetlands. At Nelson Street (pictured) the creek is a defined channel, approximately 2-4 m wide, characterised by dense native riparian vegetation. Surrounding land use is rural residential, agriculture and infrastructure.	Canopy: *Casuarina glauca* Shrub Layer: *Casuarina glauca* *Lantana camera** *Ligustrum sinense** Groundcover/ Macrophytes: *Typha orientalis* *Phragmites australis* *Tradescantia fluminensis** *Paspalum dilatatum** *Juncus acutus** *Juncus usitatus* *Pennisetum clandestinum**	Anvil Creek provides permanent habitat for fish and aquatic macroinvertebrates. Deep pools, woody snags and abundant in-stream and overhanging native reeds provide structural habitat. The creek was not flowing during the survey. Water quality appeared turbid but not stagnant. The creek is likely to be providing habitat for common native fish and macroinvertebrates. The banks are not suitable for platypus burrows, however potential foraging habitat for platypus occurs. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as moderate fish habitat using NSW Fisheries (1999) guidelines.	**34 - Average** High levels of native vegetation apart from understorey and groundcover, fairly continuous, good native regeneration, however lack of habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 34 and a rating of average. Habitat: 7/11 Cover: 12/12 Natives: 5/9 Debris: 6/10 Features: 4/8 Total: 34/ 50	 Anvil Creek corresponds to W27 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
The tributaries of Anvil Creek occur at Allandale, Harpers Hill and Greta within the investigation area. The tributaries are all defined channels, however most appear ephemeral. At Harpers Hill (pictured) the creek is a defined channel, approximately 1-2 m wide, characterised by dense native riparian vegetation. Surrounding land use is rural residential, agriculture and infrastructure.	Canopy: *Casuarina glauca* Shrub Layer: *Casuarina glauca* *Lantana camera** Groundcover: *Oplismenus aemulus* *Typha orientalis* *Phragmites australis* *Tradescantia fluminensis** *Paspalum dilatatum** *Juncus acutus** *Juncus usitatus* *Pennisetum clandestinum** Macrophytes: Absent	The unnamed tributaries of Anvil Creek are ephemeral and, and as such provide minimal habitat for aquatic fauna. No permanent habitat for fish, platypus or aquatic macroinvertebrates occurs. Classed as minimal fish habitat using NSW Fisheries (1999) guidelines.	**27 - Average** Dense native canopy with a weedy understorey and groundcover, generally continuous vegetation, high levels of native regeneration, and lack of habitat features such as hollow-bearing trees, hollow logs and reed beds result in an overall score of 27 and a rating of average. Habitat: 5/11 Cover: 11/12 Natives: 6/9 Debris: 5/10 Features: 4/8 Total: 31/ 50	 Anvil Creek tributaries correspond to W28, W36, W38-48 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
Sawyers Creek occurs west of Greta Station, and is characterised by a defined channel approximately 2-4 m wide. Sawyers Creek is a permanent creek and also includes an ephemeral freshwater wetland. Riparian vegetation is a mixture of Red Gum Open Forest dominated by *Eucalyptus tereticornis* and *E. glaucina* and opportunistic native and exotic species. Parts of the creek appear to be recently cleared. Surrounding land use is residential, agriculture and infrastructure.	Canopy: *Eucalyptus tereticornis, E. glaucina, Grevillea robusta.* Shrub Layer: *Leptospermum polygalifolium* *Acacia irrorata* *Acacia longifolia* Groundcover/ Macrophytes: *Verbena bonariensis** *Lepidosperma laterale* *Paspalum dilatatum** *Juncus usitatus* *Pennisetum clandestinum**	Sawyers Creek provides permanent habitat for fish and aquatic macroinvertebrates. Deep pools, woody snags and native reeds provide structural habitat. The creek was not flowing during the survey and was characterised as a series of deep pools. Water quality appeared turbid but not stagnant. The creek is likely to provide habitat for common native fish and macroinvertebrates. The banks are not suitable for platypus burrows, and due to the discontinuous nature of the creek, platypus are unlikely to forage in the creek. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as moderate fish habitat using NSW Fisheries (1999) guidelines.	**27 - Poor** Moderate levels of native vegetation apart from groundcover, fairly continuous, some native regeneration, however lack of habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 27 and a rating of poor. Habitat: 4/11 Cover: 9/12 Natives: 5/9 Debris: 6/10 Features: 3/8 Total: 27/ 50	 Anvil Creek corresponds to W37 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
Black Creek intersects the investigation area at Branxton. Black Creek is a permanent creek with a defined channel, approximately 10 m wide, characterised by a narrow corridor of dense native riparian vegetation within an agricultural area. Surrounding land use is agriculture and infrastructure.	Canopy: *Casuarina glauca* Shrub Layer: *Casuarina glauca* *Cestrum parqui** Groundcover/ Macrophytes: *Lomandra longifolia* *Phragmites australis* *Tradescantia fluminensis** *Paspalum dilatatum** *Senecio madagascariensis** *Juncus usitatus* *Pennisetum clandestinum** *Cirsium vulgare**	Black Creek provides permanent habitat for fish and aquatic macroinvertebrates. Deep pools, woody snags and abundant in stream and overhanging native reeds provide structural habitat. The creek was flowing slowly during the survey. Water quality appeared turbid but not stagnant. There was evidence of an algal bloom. The creek is likely to provide habitat for common native fish and macroinvertebrates. The banks are not suitable for platypus burrows, however potential foraging habitat for platypus occurs. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as moderate fish habitat using NSW Fisheries (1999) guidelines.	**34 - Average** High levels of native vegetation apart from understorey and groundcover, fairly continuous, good native regeneration, however lack of habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 34 and a rating of average. Habitat: 4/11 Cover: 10/12 Natives: 6/9 Debris: 6/10 Features: 5/8 Total: 31/ 50	 Black Creek corresponds to W49 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
There are several permanent unnamed tributaries associated with Sweetwater Creek at Belford. North of the existing railway (see photo), the creek is a defined channel, approximately 2-4 m wide, and includes deep pools and small freshwater wetlands. Surrounding land use is rural residential, native vegetation, agriculture and infrastructure.	Canopy: *Eucalyptus tereticornis* *Casuarina glauca* Shrub Layer: *Casuarina glauca* Groundcover/ Macrophytes: *Bolboschoenus caldwellii* *Triglochin procerum* *Typha orientalis* *Eleocharis cylindrostachys* *Phragmites australis* *Pteridium esculentum* *Paspalum dilatatum** *Juncus acutus** *Juncus usitatus*	The unnamed tributary of Sweetwater Creek provides permanent habitat for fish and aquatic macroinvertebrates. Deep pools, woody snags and abundant in-stream and overhanging native reeds provide structural habitat. The creek was not flowing during the survey and several deep pools, although not connected at the time of survey, would likely be connected during high flow. The creek is likely to provide habitat for common native fish and macroinvertebrates. The banks are not suitable for platypus burrows. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as moderate fish habitat using NSW Fisheries (1999) guidelines.	**32 - Average** High levels of native vegetation apart from groundcover, fairly continuous, good native regeneration, however lack of habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 32 and a rating of average. Habitat: 6/11 Cover: 9/12 Natives: 6/9 Debris: 3/10 Features: 5/8 Total: 29/ 50	 The permanent tributaries of Sweetwater Creek correspond to W50-W55 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
The unnamed tributaries of Jump Up Creek are permanent creeks, and include small freshwater wetlands and ephemeral drainage lines. North of the existing railway (see photo), the creek is a defined channel, approximately 2-4 m wide, which continues north to the New England Highway. Surrounding land use is rural residential, agriculture and infrastructure.	Canopy: *Eucalyptus tereticornis* *Casuarina glauca* Shrub Layer: *Casuarina glauca* Groundcover/ Macrophytes: *Bolboschoenus caldwellii* *Typha orientalis* *Eleocharis cylindrostachys* *Phragmites australis* *Pteridium esculentum* *Paspalum dilatatum** *Juncus acutus** *Juncus usitatus*	The unnamed tributary of Jump Up Creek provides permanent habitat for fish and aquatic macroinvertebrates. Deep pools, woody snags and abundant in-stream and overhanging native reeds provide structural habitat. The creek was not flowing during the survey and water appears stagnant. The creek is likely to provide habitat for common native fish and macroinvertebrates. The banks are not suitable for platypus burrows. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as moderate fish habitat using NSW Fisheries (1999) guidelines.	**32 - Average** High levels of native vegetation apart from groundcover, fairly continuous, good native regeneration, however lack of habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 32 and a rating of average. Habitat: 7/11 Cover: 10/12 Natives: 6/9 Debris: 3/10 Features: 6/8 Total: 32/ 50	 The permanent tributaries of Jump Up Creek correspond to W56, W57 and W59 in the Surface Water Assessment.

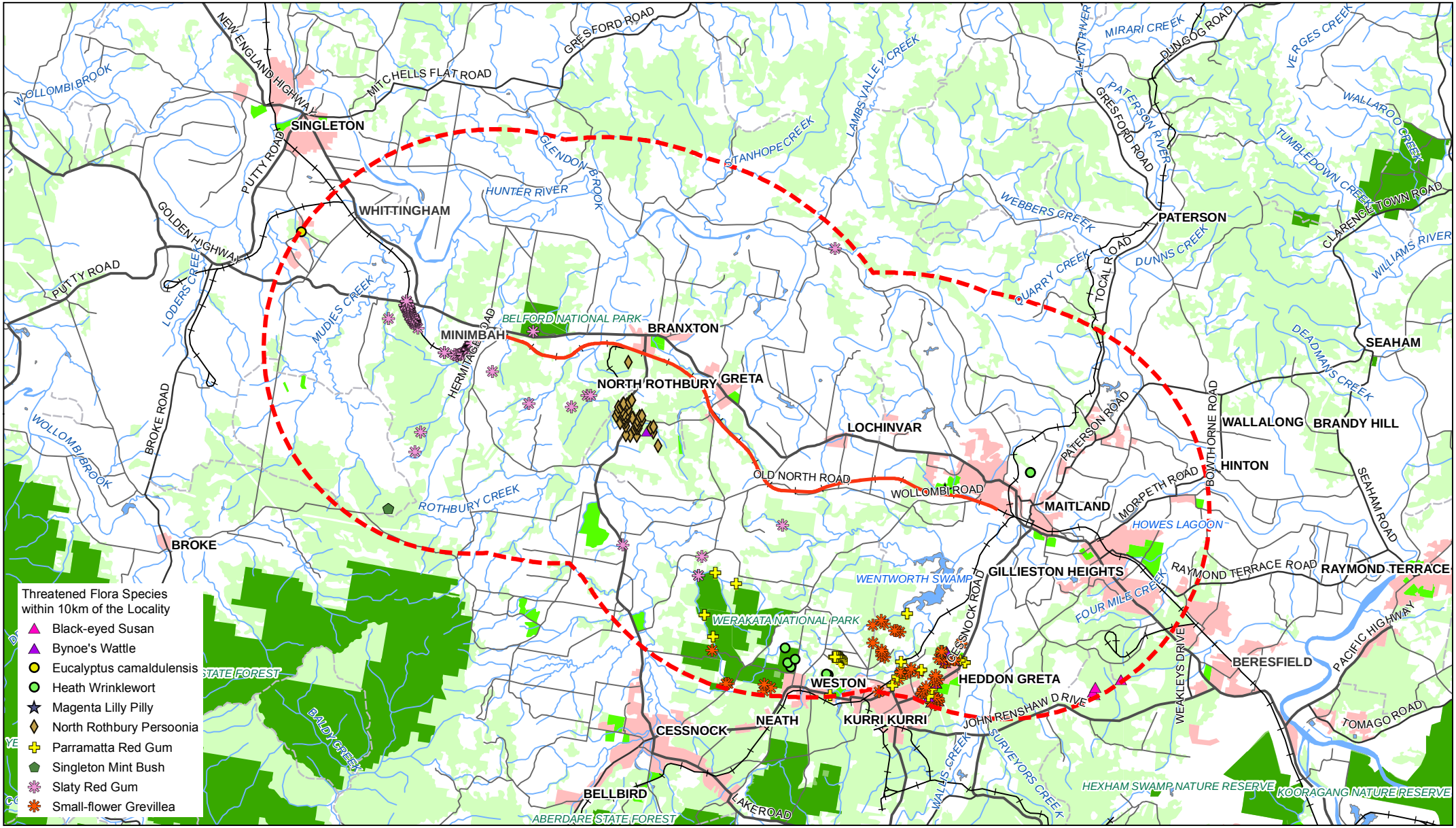
General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
Jump Up Creek is a permanent creek, which flows north from the investigation area through to the New England Highway. The creek is a defined channel, approximately 4-6 m wide. Surrounding land use is rural residential, agriculture and infrastructure.	Canopy: *Eucalyptus tereticornis, E. crebra, Casuarina glauca.* Shrub: *Casuarina glauca.* Groundcover/ Macrophytes: *Lomandra longifolia* *Typha orientalis* *Eleocharis cylindrostachys* *Phragmites australis* *Imperata cylindrica* *Tradescantia fluminensis** *Juncus acutus** *Paspalum dilatatum** *Juncus usitatus*	Jump Up Creek provides permanent habitat for fish and aquatic macroinvertebrates. Deep pools, woody snags and abundant in-stream and overhanging native vegetation provide structural habitat. The creek was flowing slowly during the survey and water did not appear stagnant, although is affected by high turbidity. The creek is likely to provide habitat for common native fish and macroinvertebrates. The creek is suitable for platypus foraging habitat however the banks are not suitable for burrow sites. Database searches indicate no threatened aquatic species occur in the investigation area. Classed as moderate fish habitat using NSW Fisheries (1999) guidelines.	**33 - Average** High levels of native vegetation apart from groundcover, fairly continuous, good native regeneration, however lack of habitat features such as hollow-bearing trees, leaf litter and hollow logs result in an overall score of 33 and a rating of average. Habitat: 8/11 Cover: 10/12 Natives: 6/9 Debris: 4/10 Features: 5/8 Total: 33/ 50	 Jump Up Creek corresponds to W58 in the Surface Water Assessment.

General Waterway Morphology and Characteristics	Riparian Vegetation	Habitat Assessment	RARC Score	Photo
There are numerous ephemeral drainage lines throughout the investigation area. Most have a defined channel, approximately 2-3 m wide, with low levels of native riparian vegetation. Surrounding land use is rural residential, agriculture and infrastructure.	Canopy: Scattered *Eucalyptus moluccana* Shrub Layer: Absent Groundcover: Scattered, generally introduced spcecies: *Austrodanthonia sp.* *Pennisetum clandestinum** *Cynodon dactylon** *Paspalum dilatatum** *Juncus usitatus* *Senecio madagascariensis** *Themeda australis* *Chloris gayana** Macrophytes: Absent	The unnamed drainage lines are ephemeral and characterised by high levels of weed invasion, and as such provide minimal habitat for aquatic fauna. No permanent habitat for fish, platypus or aquatic macroinvertebrates occurs. Classed as minimal fish habitat using NSW Fisheries (1999) guidelines.	**9 – Very Poor** Low levels of native vegetation, discontinuous vegetation, lack of native regeneration, and lack of habitat features such as hollow-bearing trees, leaf litter hollow logs and reed beds result in an overall score of 9 and a rating of very poor. Habitat: 0/11 Cover: 5/12 Natives: 2/9 Debris: 2/10 Features: 0/8 Total: 9/ 50	 Ephemeral drainage lines correspond to W17-22, W24-26 W58 in the Surface Water Assessment.

Notes: * indicates introduced species

5.7 Key Habitats and Corridors

One area of key habitat mapped by NPWS (2005) occurs within the investigation area, west of Farley Station (refer to Figure 5.3). The investigation area also intersects two regional corridors mapped by NPWS (2005). The regional corridors occur south of Belford National Park and south of Greta Station.



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0 1,000 2,000 4,000 6,000 8,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Principal Road
- Secondary Road
- Minor Road
- Track
- Existing Rail
- Water Course
- Project Location
- 10km Radius
- Built Up Areas
- Watercourse Areas
- Recreation Areas
- Nature Conservation Reserve
- State Forest
- Forest Or Shrub

Hunter ALLIANCE

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Threatened Flora Species Recorded within the Locality (10km radius of Investigation Area) (DECC 2009)

Figure 5.1

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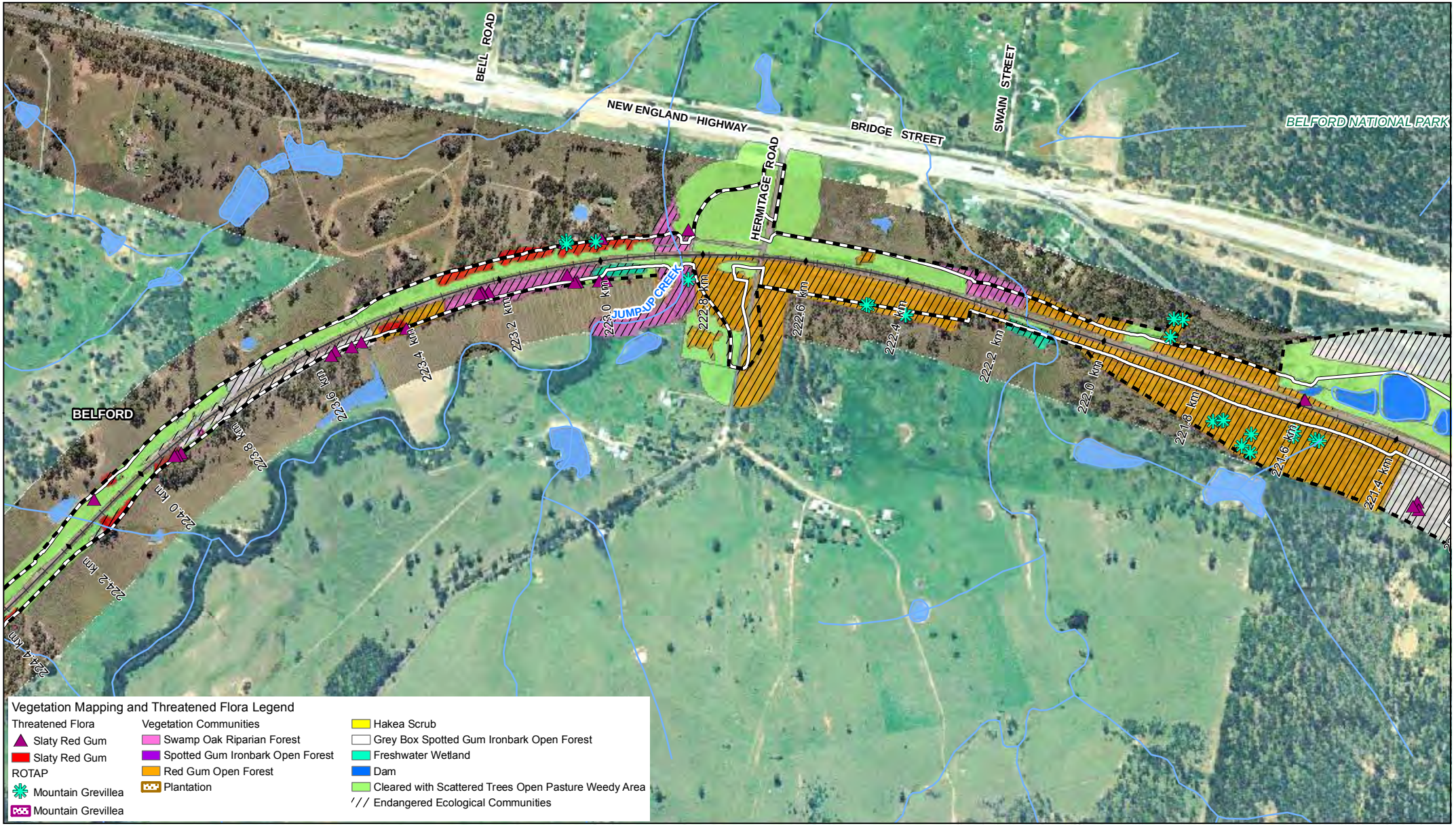
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2003; DECC: Threatened Flora Records - 2009. Created by: fmackay, msmiljkovski, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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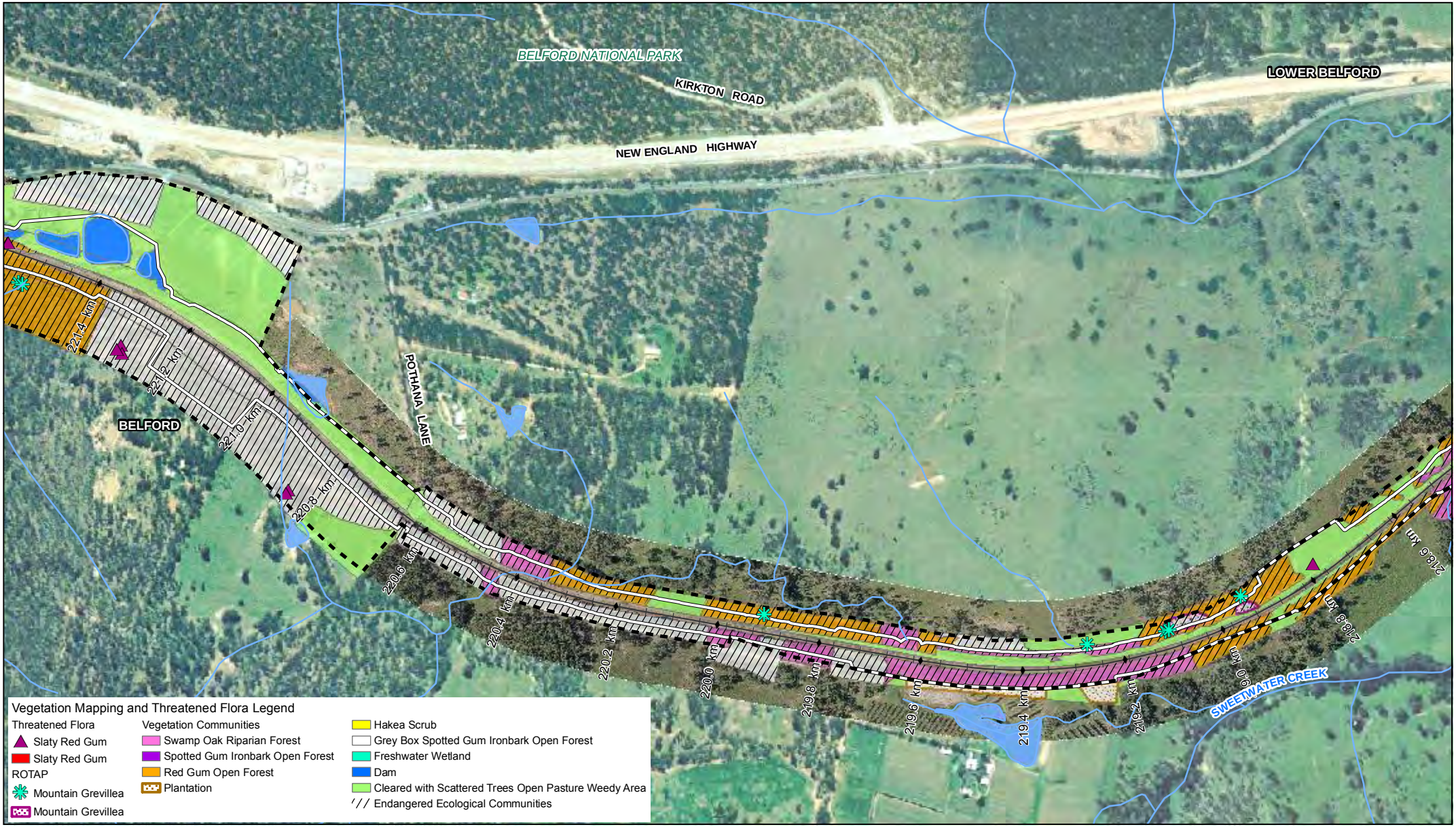
Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2a

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_VegetationMapping_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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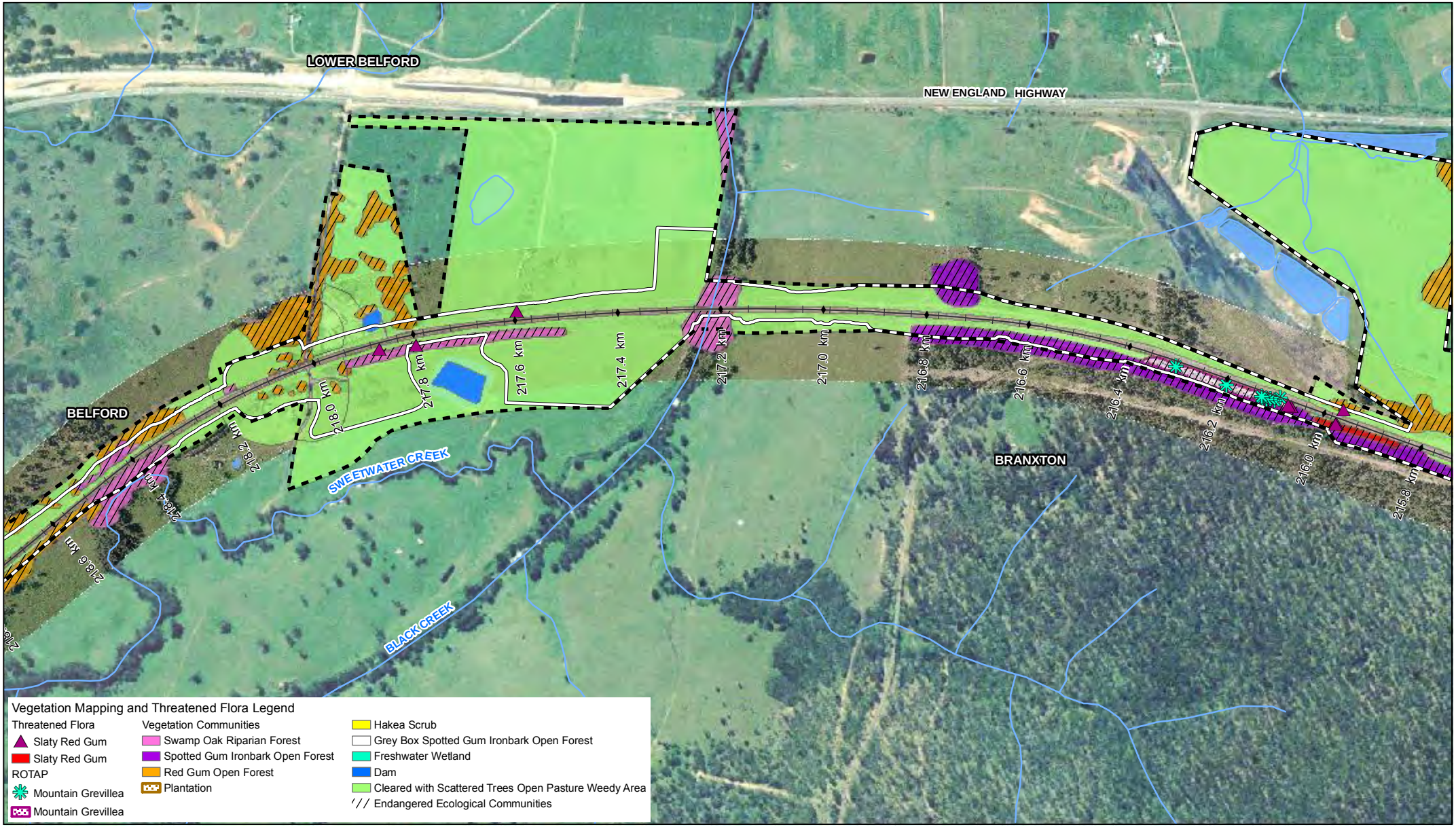
Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2b

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_VegetationMapping_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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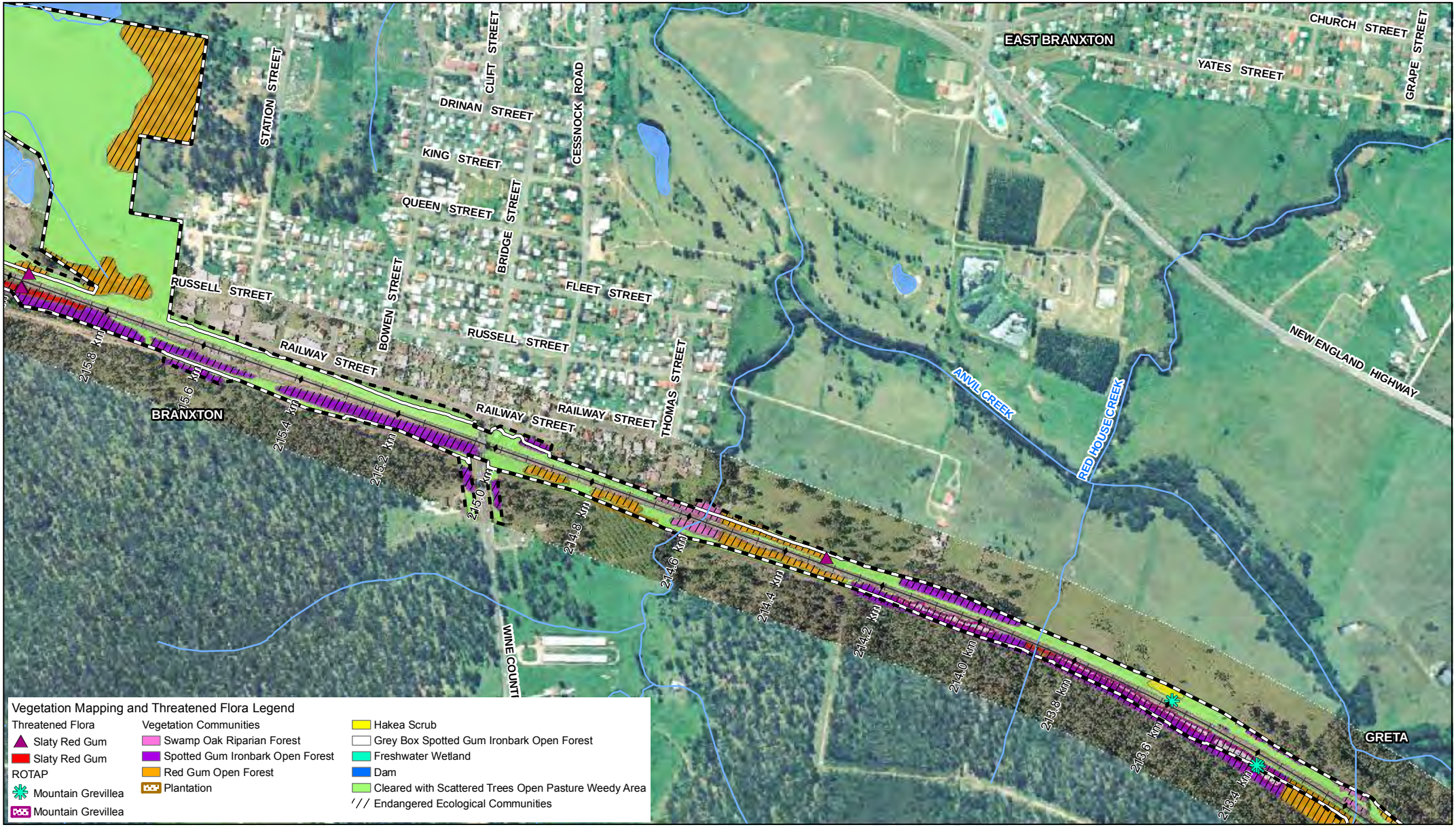
Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2c

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_VegetationMapping_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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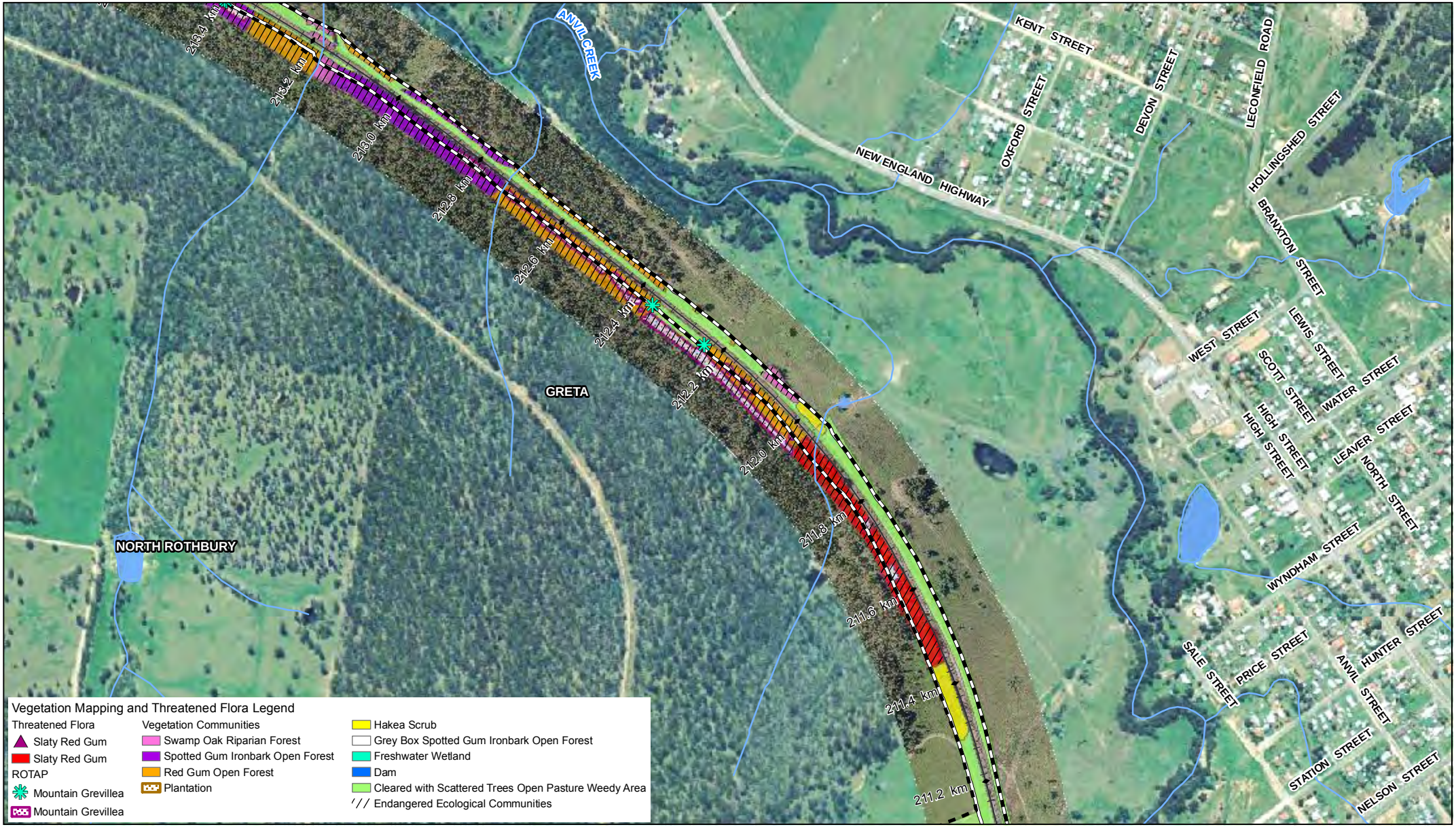
Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2d

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_VegetationMapping_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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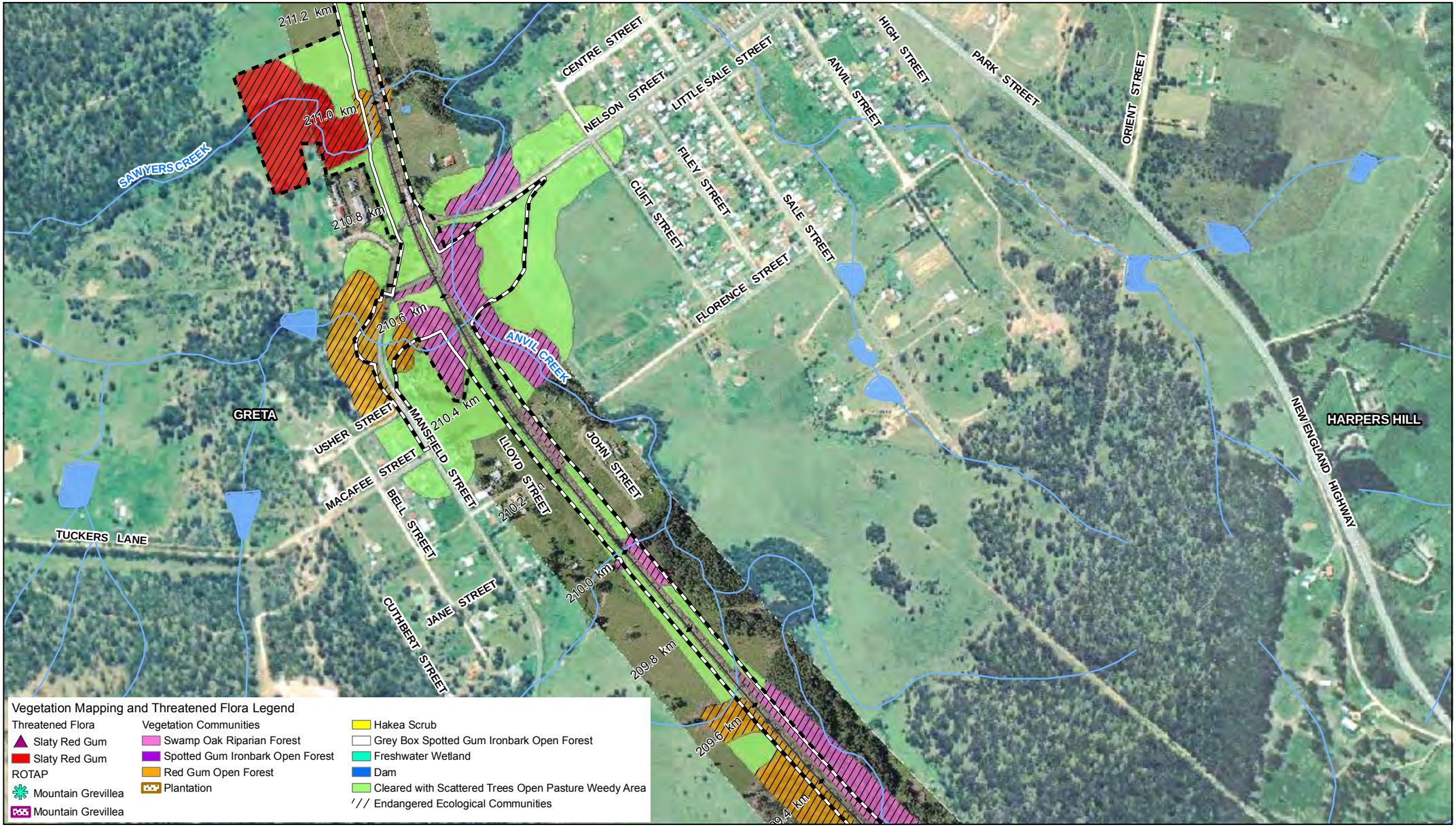
Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2e

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_VegetationMapping_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

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Revision A
Date MAY 2010

Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2f

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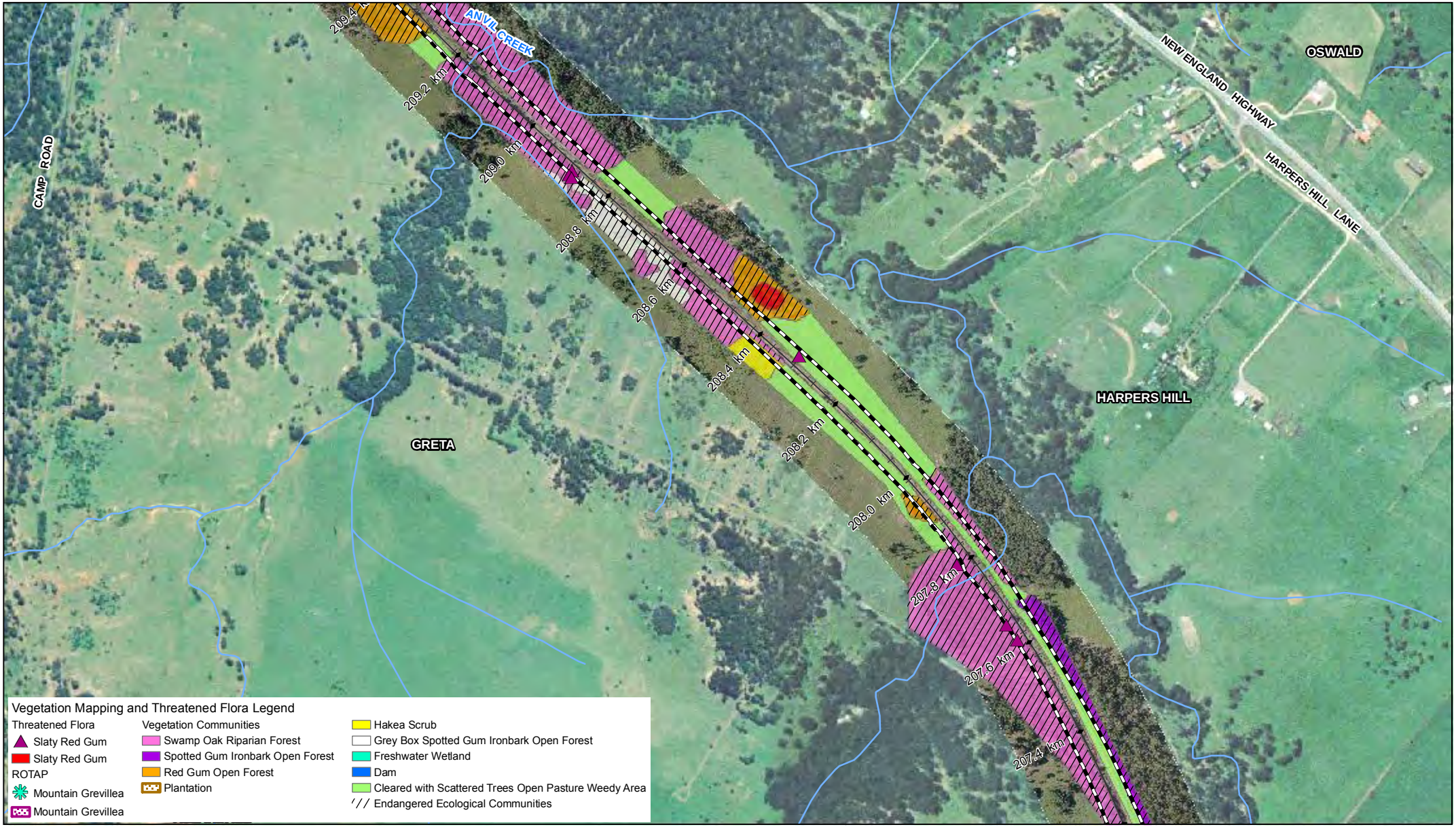
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

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Revision A
Date MAY 2010

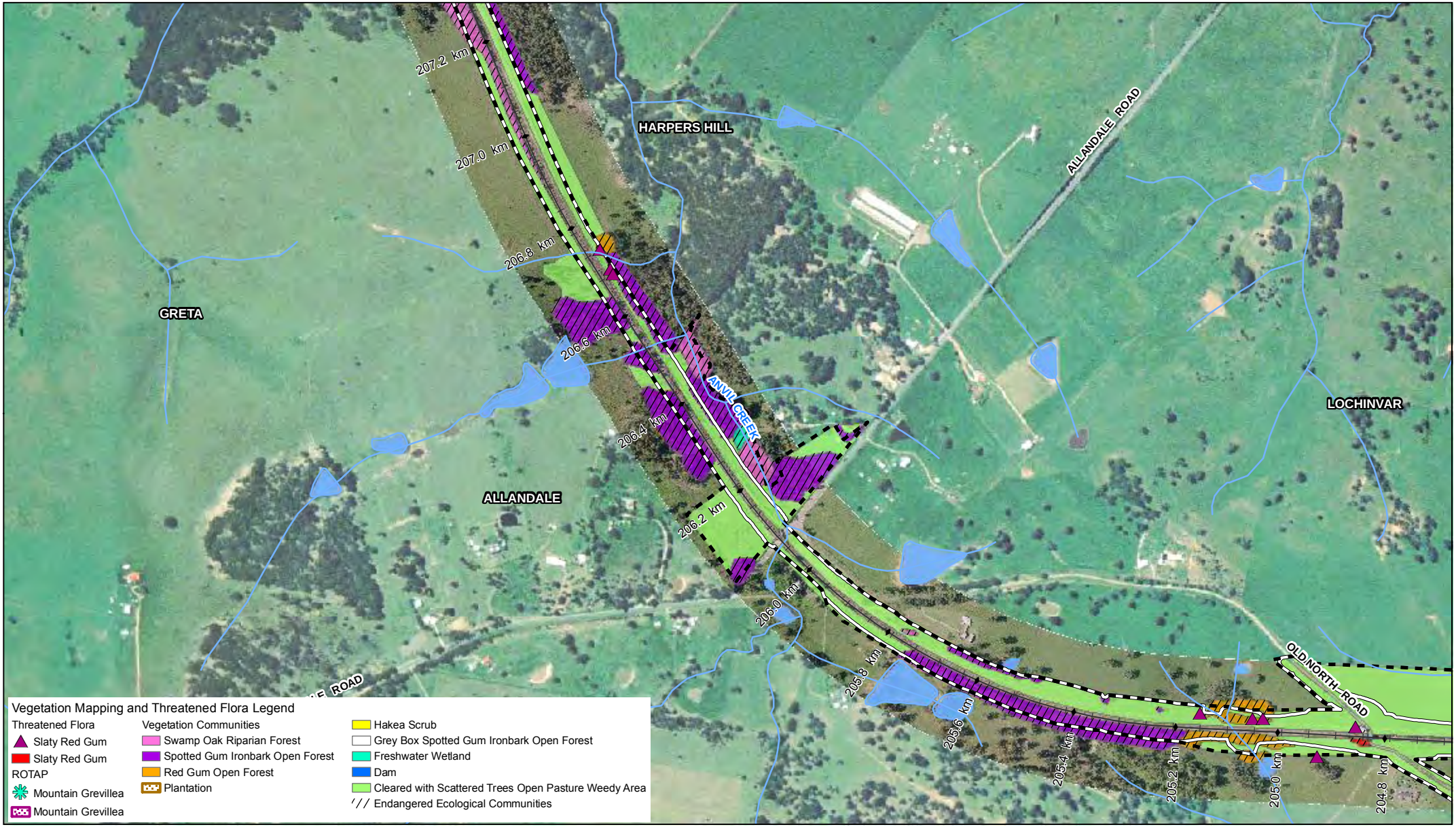
Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2g

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_VegetationMapping_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



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0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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Maitland to Minimbah Third Track
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Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2h

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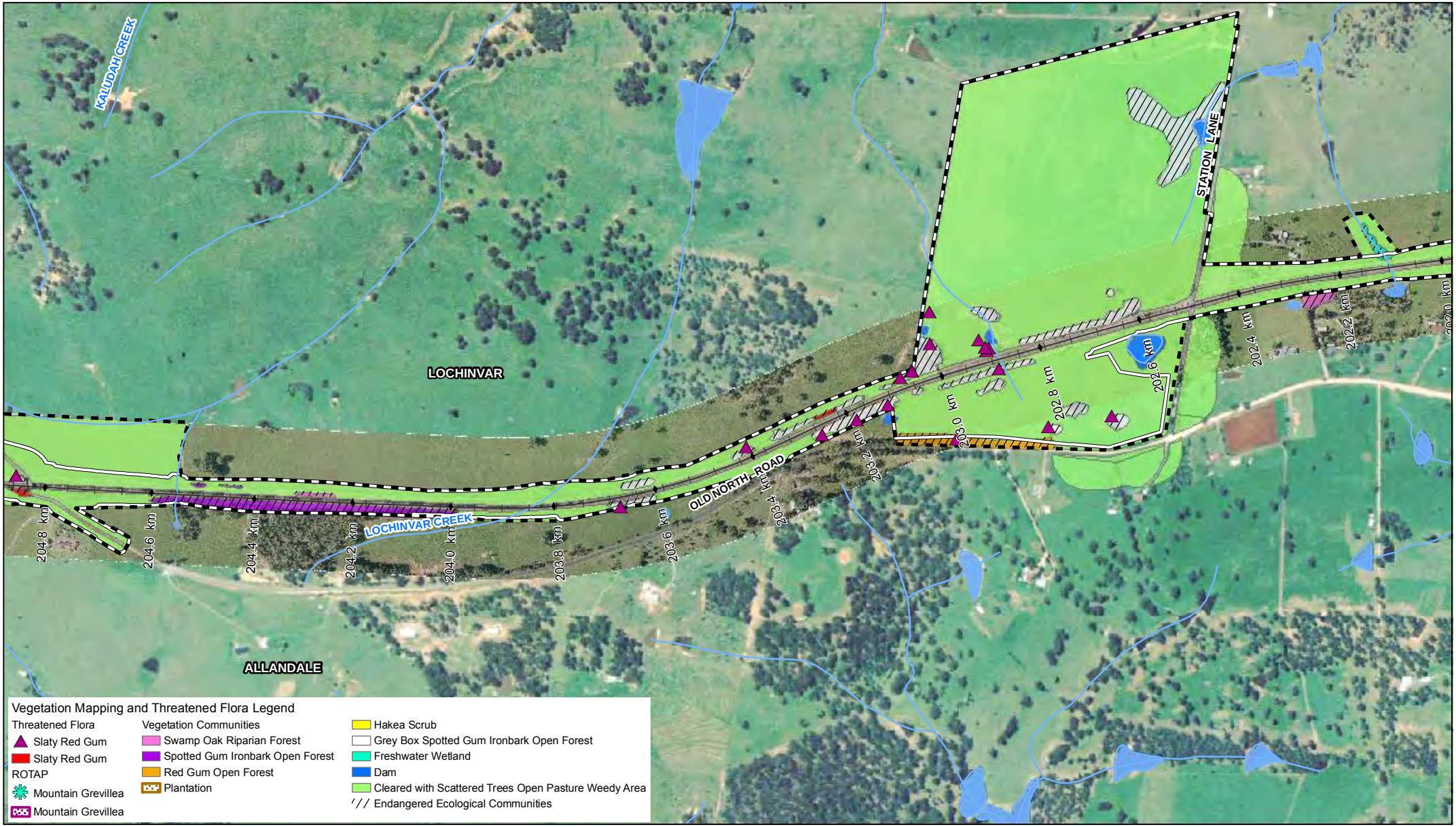
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2i

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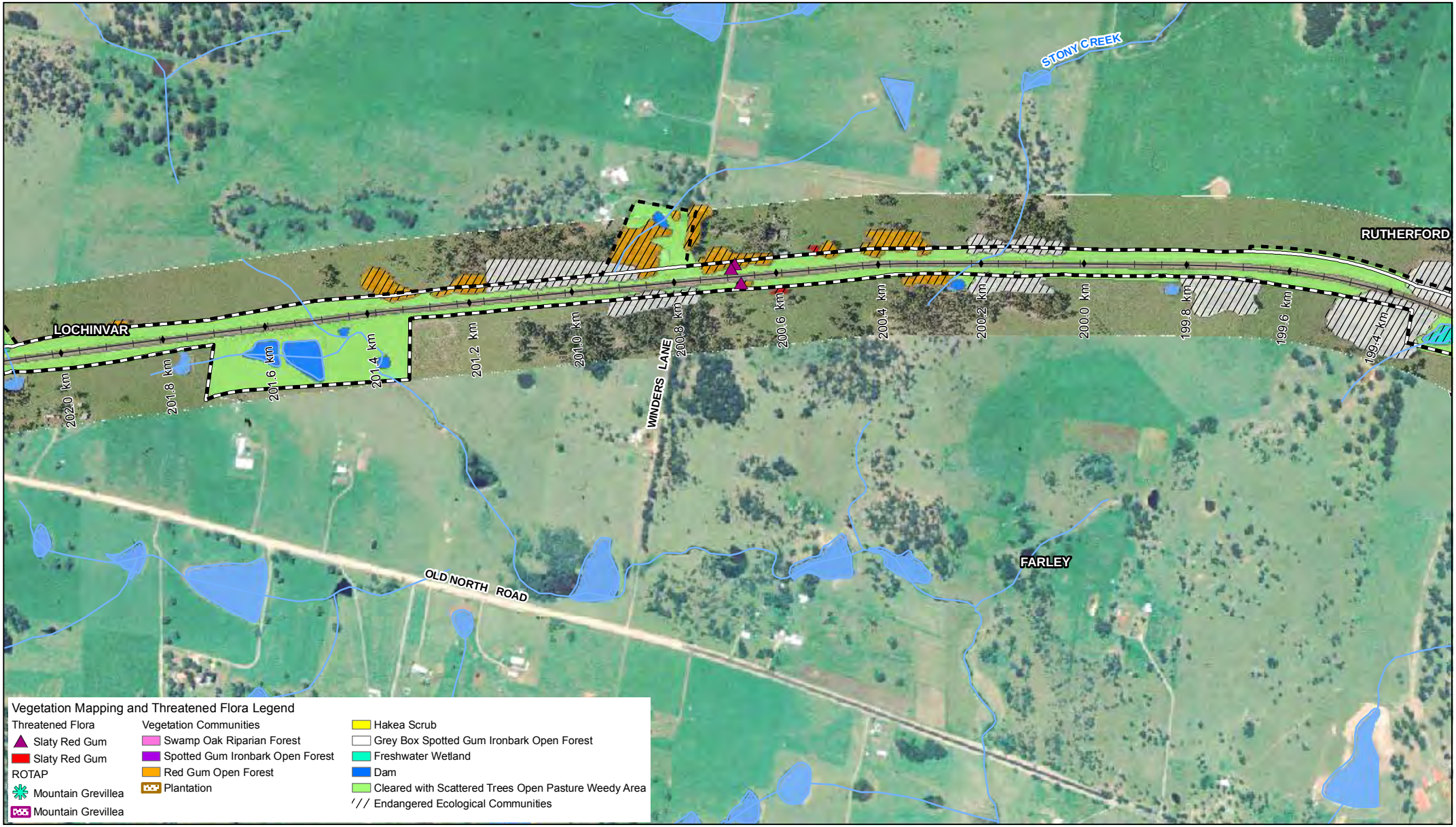
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



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0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2j

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

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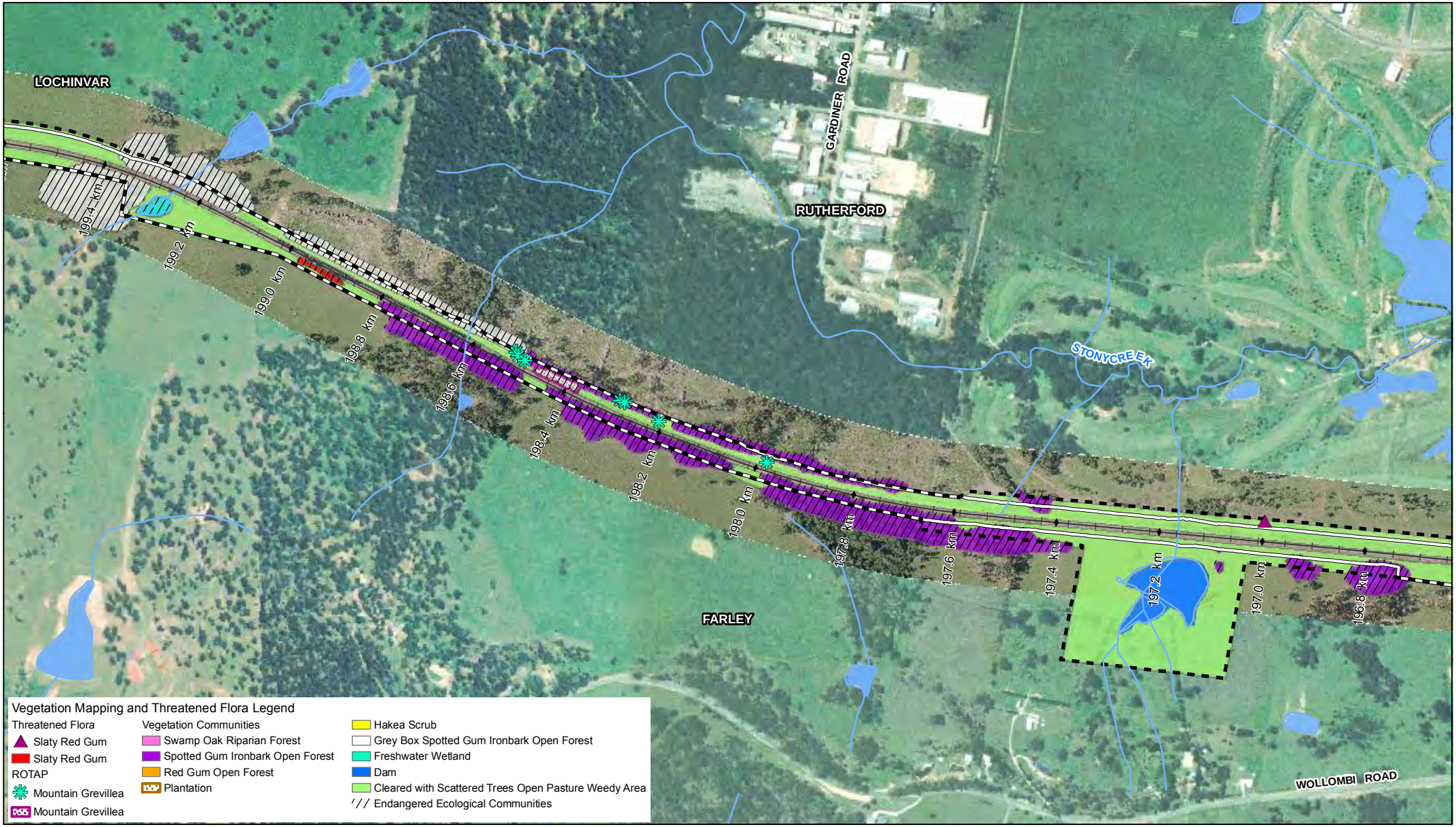

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0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2k

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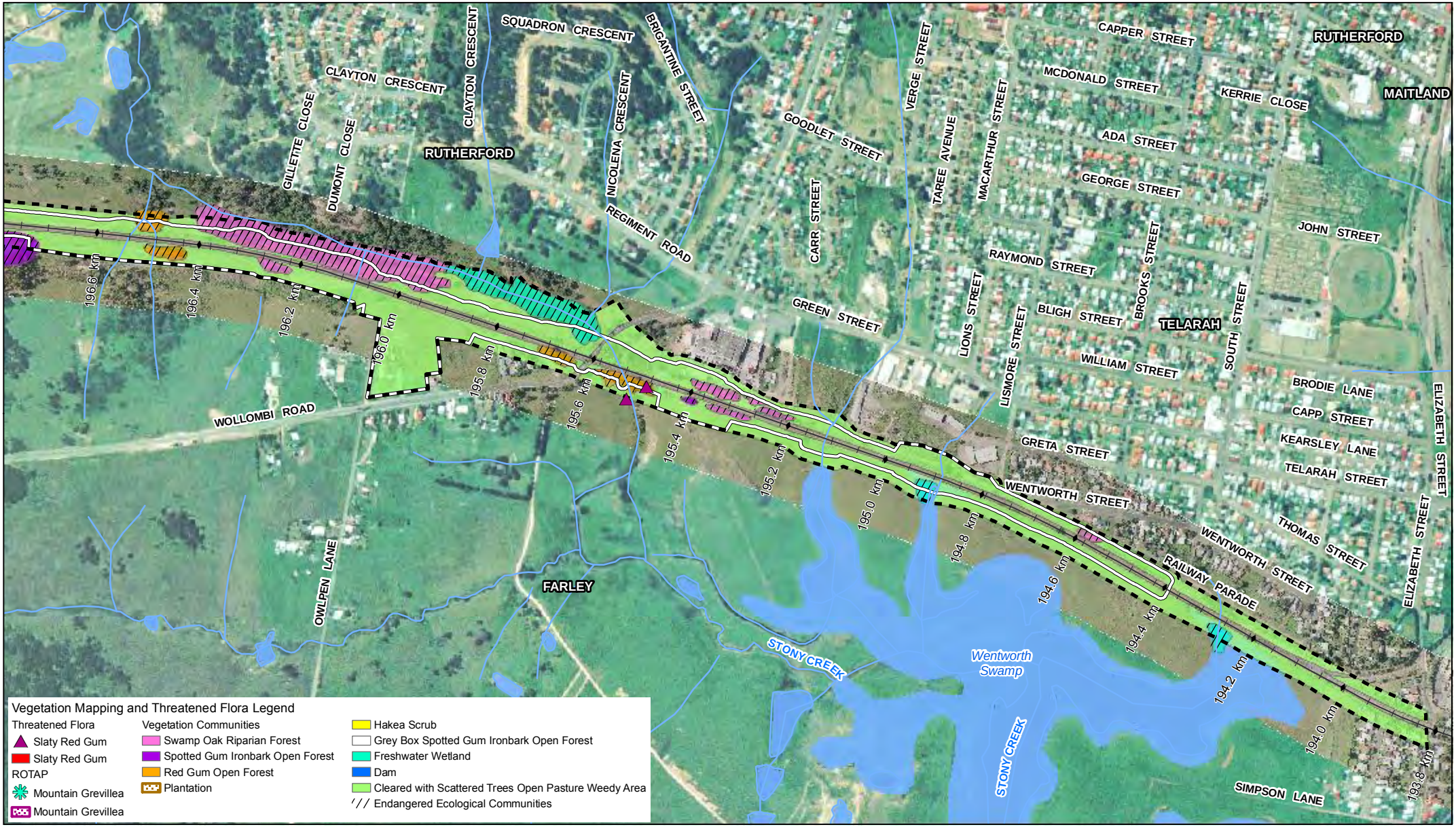
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:10,000 (at A4)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND
- Investigation Area
- Existing Railway
- Construction Impact Zone
- Watercourse
- Watercourse Area

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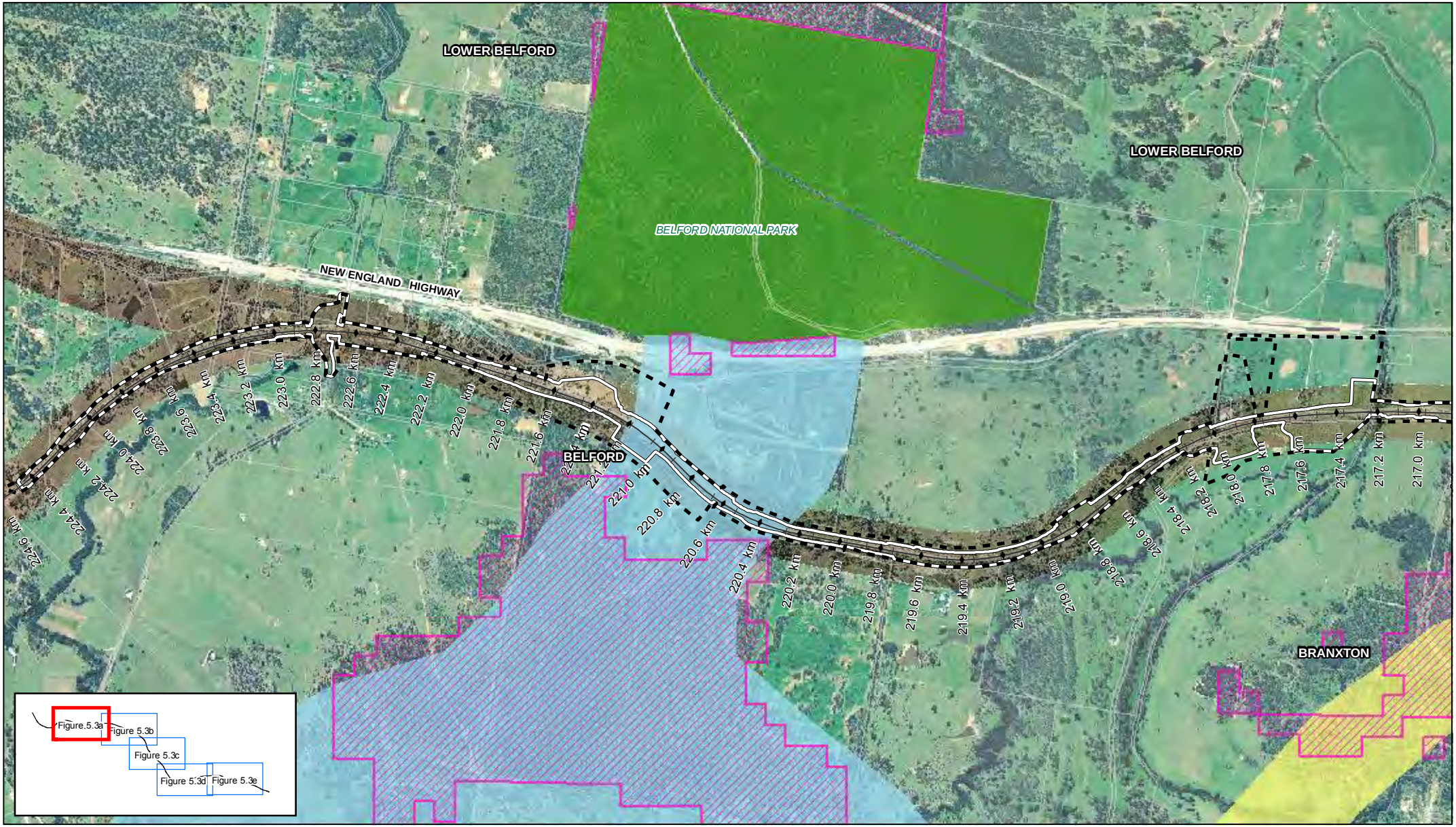
Vegetation Mapping and Threatened Flora in the Investigation Area

Figure 5.2I

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_VegetationMapping_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Department of Lands: Aerial - 2005; Fugro: Aerial - 2008. Created by: fmackay, tmorton



1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Key Corridors
- Regional
- Subregional

Key Habitat
- National Park

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Revision A
Date MAY 2010

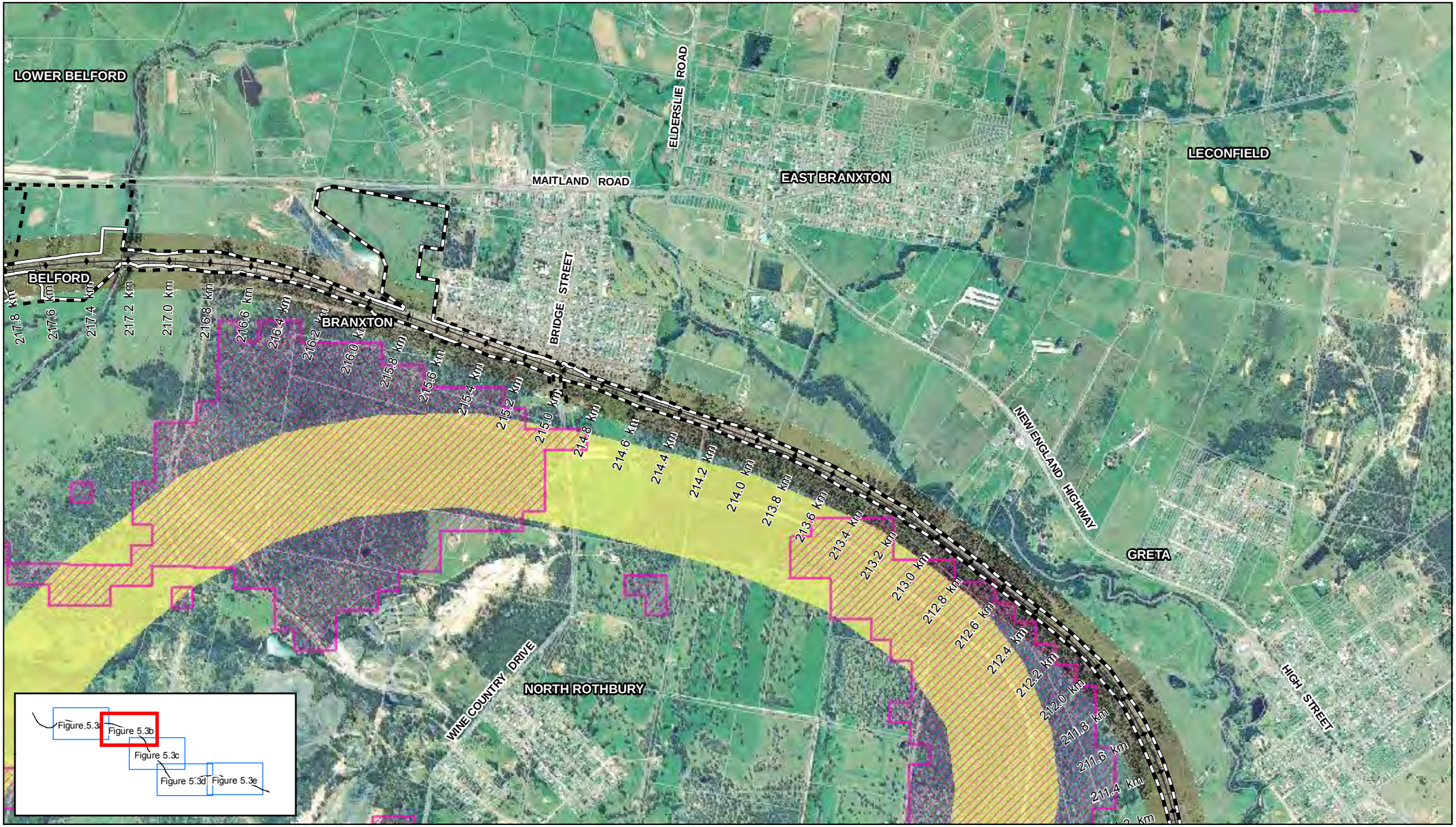
Key Habitats and Corridors in the Investigation Area (NPWS 2005)

Figure 5.3a

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_KeyHabitats_Corridors_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; DECC: Key Corridors & Habitats - 2004. Created by: fmackay, tmorton



1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Key Corridors
- Regional
- Subregional

- Key Habitat
- National Park

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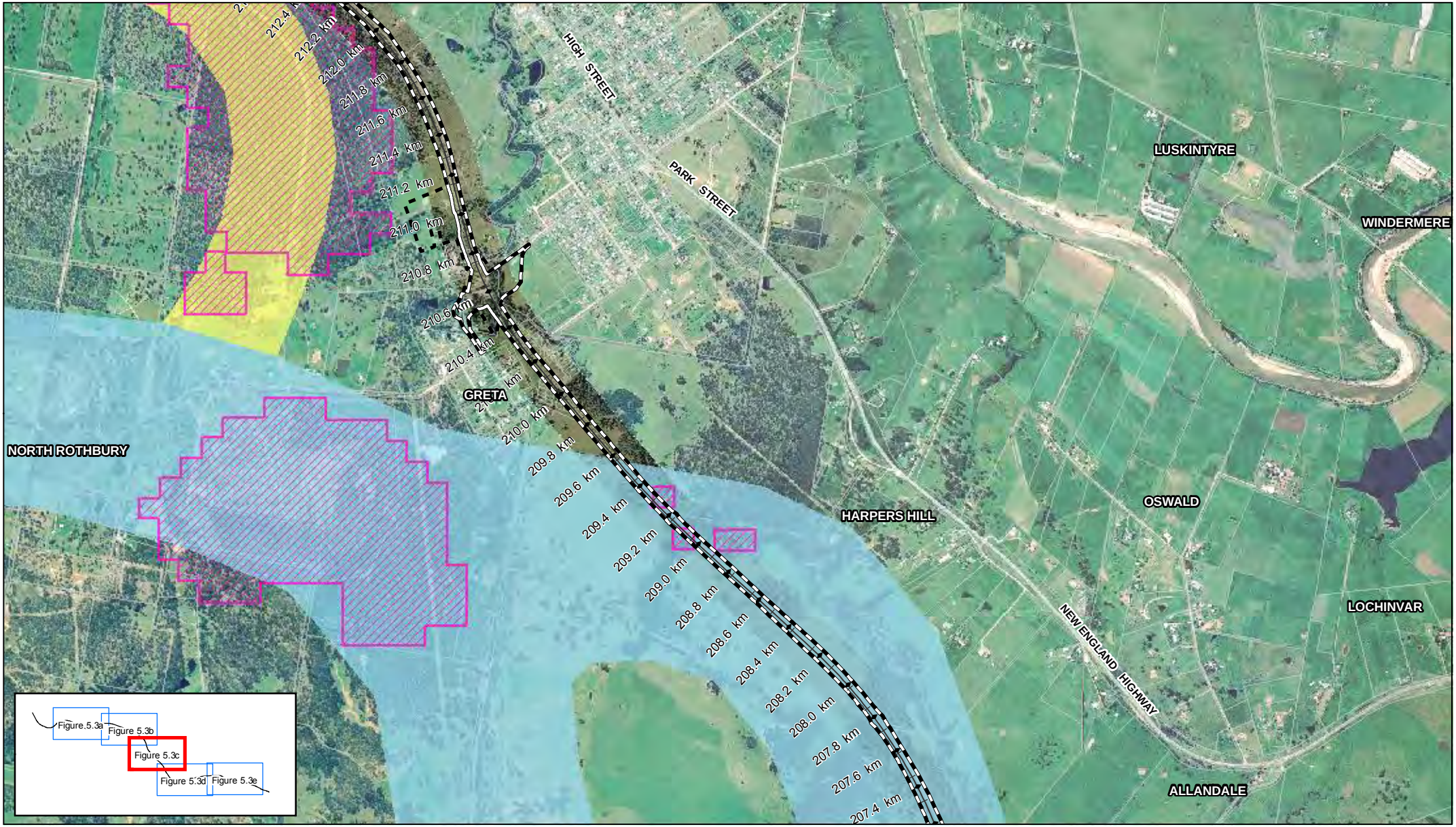
Key Habitats and Corridors in the Investigation Area (NPWS 2005)

Figure 5.3b

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_KeyHabitats_Corridors_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; DECC: Key Corridors & Habitats - 2004. Created by: fmackay, tmorton



1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Key Corridors
- Regional
- Subregional

Key Habitat
- National Park

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

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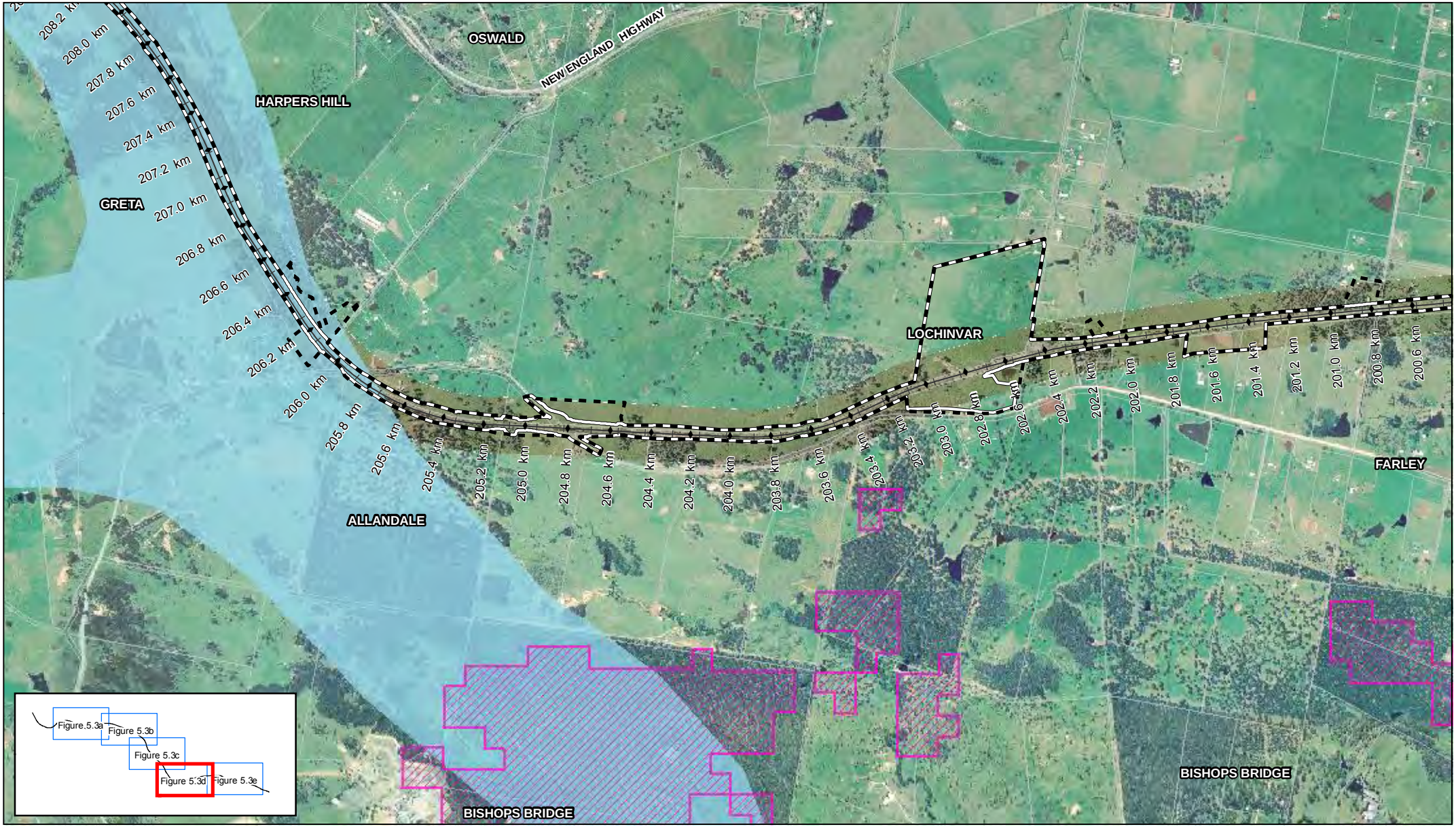
Key Habitats and Corridors in the Investigation Area (NPWS 2005)

Figure 5.3c

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_KeyHabitats_Corridors_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; DECC: Key Corridors & Habitats - 2004. Created by: fmackay, tmorton



1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Key Corridors
- Regional
- Subregional

- Key Habitat
- National Park

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

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Key Habitats and Corridors in the Investigation Area (NPWS 2005)

Figure 5.3d

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_KeyHabitats_Corridors_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; DECC: Key Corridors & Habitats - 2004. Created by: fmackay, tmorton

1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Key Corridors
- Regional
- Subregional

- Key Habitat
- National Park

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Key Habitats and Corridors in the Investigation Area (NPWS 2005)

Figure 5.3e

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_KeyHabitats_Corridors_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial - 2005; Fugro: Aerial - 2008; DECC: Key Corridors & Habitats - 2004. Created by: fmackay, tmorton

6. Impact Assessment

6.1 Environmental Risk Assessment

A detailed Environmental Risk and Impact Assessment (Risk Assessment) has been conducted as part of the Environmental Assessment process to evaluate the potential impacts that the Project could have on a wide range of environmental, social and economic assets and beneficial uses, which has contributed to help form the conclusions of this study.

In summary:

- The Risk Assessment was conducted to identify the potential environmental, social and economic impacts on the wider environment and community of implementing the Project.
- Heighten confidence and provide rigour for decision making and planning.
- The Risk Assessment was based on the Description of the Project included in the Environmental Assessment and the outputs of the risk assessment represent the risk and impacts of implementing the Project as described in the Description of the Project.
- The Risk Assessment was conducted in close consultation with all of the technical specialists and is based on input provided by those technical specialists. All of the Risk Assessment inputs including consequence and likelihood ratings were provided by the technical specialists.
- Incorporates the outputs of the Community Consultation which occurred as part of the Environmental Assessment, although separate to the risk assessment process. The values and outcomes of the community consultation were incorporated to inform the risk assessment process.
- The Risk Assessment approach used a multi-disciplinary group of technical specialists to assess the consequence and likelihood of the identified risks. To assess risks consistently, consequence tables were developed that clearly define levels of consequence, from insignificant to catastrophic, in terms of magnitude, space and time. Consequence, having regard to 'reasonable worst- case scenarios' (considering activity controls), and the likelihood of that consequence occurring are defined for all identified risks and impacts, allowing risks to be ranked.

  The consequence table relevant to this study and the likelihood descriptions are provided in Appendix A. The consequence tables used for estimating diverse consequence types on an even basis were developed specifically for the Project based on consultation and advice from the technical specialists. The likelihood table was developed to incorporate the scoping requirements concept of predicted and potential risks and impacts. The scale ranges from rare to almost certain.
- The risk ranking was calculated via the risk matrix, considering both consequence and likelihood allocations.

The risk matrix and the risk outputs relevant to this report are both presented in Appendix A.

The potential impacts identified as posing an extreme, high or medium risk in the Risk Assessment are:

- Loss of 2.7 hectares of occupied Slaty Red Gum (*Eucalyptus glaucina*) habitat, listed as vulnerable on the TSC Act and EPBC Act.
- Loss of 61.1 hectares of occupied Endangered Ecological Community (EEC) habitat including:
  - Lower Hunter Spotted Gum-Ironbark Forest EEC.
  - Hunter Lowland Redgum Forest EEC.
  - Swamp Oak Floodplain Forest EEC.
  - Freshwater Wetland EEC.
  - Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.

6.2 Impact Assessment

The Project has been designed along the principles of avoidance, mitigation and offsetting in that order of preference. The Project design has been altered numerous times to avoid areas of EECs and Slaty Red Gum as much as possible. Where avoidance of impacts was not possible, the Project has been designed to minimise impacts on EECs and Slaty Red Gum by reducing the construction impact zone corridor and locating site compounds and access tracks in existing cleared areas. A Compensatory Habitat Strategy would be developed in consultation with DECCW to offset areas of habitat for EECs and Slaty Red Gum that are cleared for the Project.

6.3 Vegetation Clearance

The Project would involve clearing remnant and regrowth native vegetation in a construction impact zone, which varies in width from approximately 70 metres to 20 metres from the existing rail, adjacent to existing infrastructure easements and tracks for a distance of approximately 30 kilometres. Approximately 61.4 hectares of native vegetation would be cleared for the Project, including 61.1 hectares of EEC listed under the TSC Act. A further 153.1 hectares of agricultural land would also be cleared for the Project.

All vegetation clearing would occur on the edge of the existing cleared railway easement. The degree of existing disturbance within the vegetation communities to be cleared varies and is mostly associated with edge effects and clearing for both the existing railway, rural residential and agriculture. A condition assessment of vegetation communities is outlined in Table 6-1.

Whilst the Project would clear approximately 61.4 hectares of native vegetation, all vegetation communities recorded during the survey extended well beyond the limits of the investigation area. Approximately 32.2 hectares of native vegetation was recorded during the survey inside the investigation area but outside the construction impact zone, that would not be impacted by the Project.

Site compounds and access tracks are located within the footprint of the construction impact zone as shown in Figure 1.1. The primary site compounds are at Station Lane and between Black Creek and Rix's Road. The secondary site compounds are at Nelson Street, Hermitage Road, Black Creek bridge and Wollombi Road. The location of the site compounds are shown in the Environmental Assessment.

Approximate areas of required vegetation clearing for the Project are shown below in Table 6-1.

Table 6-1 Proposed Vegetation Clearance

Vegetation Community	Hectares to be Cleared for the Project	Percent of Total Vegetation Clearing	Hectares within Investigation Corridor Not Impacted	Conservation Significance
Spotted Gum- Ironbark Open Forest	13.2 ha	6.1 %	3.3 ha	High. EEC listed on the TSC Act. The ROTAP Mountain Grevillea occurs in this vegetation community.
Redgum Open Forest	19.7 ha	9.2 %	11.9 ha	High. EEC listed on the TSC Act. The TSC Act and EPBC Act vulnerable Slaty Red Gum, and ROTAP Mountain Grevillea occurs in this vegetation community.
Swamp Oak Riparian Forest	14.9 ha	6.9 %	4.8 ha	High. EEC listed on the TSC Act.
Grey Box Spotted Gum Ironbark Open Forest	12.7 ha	5.9 %	10.5 ha	High. Listed as EEC on the TSC Act.
Freshwater Wetland	0.6 ha	0.3 %	1.7 ha	High. EEC listed on the TSC Act.
Hakea Scrub	0.7 ha	0.3 %	0.03 ha	Low. Not listed as an EEC on the TSC Act or EBPC Act. No threatened flora occur within this vegetation community.
Plantation	0.06 ha	0.1 %	0.02 ha	None.

Vegetation Community	Hectares to be Cleared for the Project	Percent of Total Vegetation Clearing	Hectares within Investigation Corridor Not Impacted	Conservation Significance
Cleared with Scattered Trees / Open Pasture / Weedy Area	153.1 ha	71.2%	61.4 ha	None.
Slaty Red Gum[1]	2.7 ha	1.3%	3.7 ha	High. Listed as vulnerable on the TSC Act and EPBC Act.
Mountain Grevillea[2]	1.6 ha	0.7%	0.3 ha	Medium. ROTAP species.
Total	215.0 ha	100%	93.65 ha	-

1: The area of Slaty Redgum is included in the Redgum Open Forest vegetation community, but has also been separated out in this table to show relative abundance within the study area.

2: The area of Mountain Grevillea is included in the Redgum Open Forest and Greybox Spotted Gum Ironbark vegetation communities, but has also been separated out in this table to show relative abundance within the study area.

6.4 Clearing Threatened Flora

6.4.1 Clearing of Threatened Flora Species Listed under TSC Act and EPBC Act

The population of Slaty Red Gum that occurs in the investigation area is already fragmented into two parts by the existing railway. The Project would remove incremental areas from the edges of side of the existing railway, which would slightly increase the distance of separation of the two parts, but not to the extent that exchange of genetic material would cease to occur. Factors affecting the breeding cycle of the species would include pollinators, seedbanks and other impacts that may influence pollination and reproduction. The Project is not anticipated to have any impact on these.

The Project would clear approximately 2.7 hectares and 50 individuals of Slaty Red Gum. However, the species is locally abundant, with over 1,000,000 individuals recorded at Singleton Military Area (Hunter 2004 cited in Peake 2006). Additionally, the species extends outside the construction impact zone and investigation corridor, and shows good regenerative potential. Therefore, removal of approximately 2.7 hectares and 50 individuals for the Project is not considered to impact on a key source population for dispersal and maintaining genetic diversity in the local area.

The population of Slaty Red Gum recorded during the field surveys appears to have an eastern-most limit of Lochinvar with Forest Red Gum (*Eucalyptus teretricornis*) becoming more dominant further east. East of Hermitage Road, the population appears to be integrating with Forest Red Gum, as was confirmed by the Royal Botanic Gardens. The 2.7 hectares and 50 individuals of Slaty Red Gum to be cleared for the Project includes the recorded intergrades of Slaty Red Gum with Forest Red Gum. Whilst the Project would clear Slaty Red Gum from within the eastern-most limit of its distribution range, the Project would only clear individuals within the construction impact zone, with the species occurring outside the areas to be cleared. The Project would not clear the only individuals of Slaty Red Gum that occur in the area.

The Project is unlikely to result in an invasive or introduced species becoming established and/or introducing a disease that may cause the species to decline or interfering substantially with the recovery of Slaty Red Gum provided an appropriate weed control and management strategy is implemented.

Current disturbance regimes operating at the Project site include weed invasion, fire frequency, and changes to water flow and flooding regimes. The Project is likely to result in similar disturbances as that currently experienced. The Project is unlikely to permanently increase the impact of weed invasion in the investigation area and surrounds, provided appropriate mitigation measures outlined in the Weed Management Plan as part of the Flora and Fauna Management Plan are implemented. It is not expected that the Project would modify the intensity and frequency of fires in the area. The Project may result in changes to floodplain characteristics. This has the potential to impact floodplain function and increase flow conveyance during peak events. However, this is unlikely to adversely affect Slaty Red Gum, in particular those associated with creeks and low-lying areas. The species preferentially occurs adjacent to creeks and drainage lines.

The Project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the local population of Slaty Red Gum is likely to significantly decline. Extensive areas of occupied and potential habitat exist outside the investigation area and would not be impacted by the Project. These areas include remnant vegetation sites not subject to agriculture or clearing. Provision of offset areas and revegetation works would assist in minimising impacts on Slaty Red Gum. Offsetting areas of Slaty Red Gum to be developed in the Compensatory Habitat Strategy, in consultation with DECCW, is considered adequate to avoid a significant impact to the species.

6.4.2 Clearing Other Flora Species of Conservation Significance

Whilst there are only 122 BioNet (2009) records of Mountain Grevillea in the Singleton area and 163 records of the species in all of NSW, several hundred individuals within six ha of dense aggregations of the species have recently been recorded within the Singleton area as part of the Stage 1 Project. The species is more common than indicated by the BioNet database. Habitat for the species was observed as occurring and continuing well beyond the limits of the investigation area.

Whilst the Project would remove approximately 1.6 hectares of the local population, large areas of habitat would remain unaffected in adjoining land. The species is known to thrive as a result of disturbance, and can establish within newly disturbed areas. Utilisation of the species for revegetation and rehabilitation of bare or disturbed areas would assist in maintaining a local viable population.

6.5 Creeks and Drainage Lines

With the exception of Sawyers Creek, no major trenching or realignment including instream pylons or excavation of banks for any creeks are anticipated. Impacts such as an increase in turbidity on water quality during construction would be managed through the development of a Spoil and Fill Management Plan.

Use of water during construction as a dust suppressant would be detailed within a Water Management Plan, to be developed prior to construction. The amount and source of this water is not known at this stage of the design.

6.5.1 Sawyers Creek Realignment

The works at Sawyers Creek involve realignment of approximately 100 metres of the creekline upstream of the existing rail. The realignment would include trenching a new alignment that would include deep pools, meanders, riffle habitat and revegetation works. In accordance with Department of Primary Industries (Fisheries) requirements, the Sawyers Creek realignment would:

- Maintain existing stream length (including meanders).
- Maintain existing stream gradient.
- Maintain existing channel profile (cross section).
- Reinstate riparian vegetation including suitable habitats (such as slow flow areas).

As the Sawyers Creek works would result in similar flow characteristics as per the existing environment, it is not considered to constitute the key threatening process listed under the FM Act, *Instream structures and other mechanisms that alter natural flow*.

A revegetation plan would be developed to reinstate riparian vegetation characteristic of Red Gum Open Forest, which extends upstream from the works site.

6.6 Aquatic Ecology Impact Assessment

6.6.1 Removal of Aquatic Habitat

The Project would involve clearing and / or filling small areas of freshwater wetland and riparian vegetation, including small areas of Swamp Oak Riparian Forest, macrophyte beds, native reeds and sedges. No instream woody snags would be impacted by the Project.

The Project would involve vegetation clearance adjacent to creeks and drainage lines. Removal of riparian and aquatic vegetation would result in the permanent loss foraging habitat for a range of fauna. The Project would clear several small areas of Swamp Oak Riparian Forest associated with creeks and drainage lines, however this vegetation type is widespread and common in the local adjacent to creeks, and clearing for the Project is considered unlikely to result in a significance impact on this EEC (refer to Appendix B).

6.6.2 Barriers to Fish Passage

Fish passage along waterways is critical to the survival of native fish. Species may move within waterways daily and/or seasonally to access food and habitat resources, avoid predators and seek mates to reproduce. Barriers to fish passage, including physical blockages (dams, weirs, culverts and causeways) and alterations of natural flow conditions (construction and diversions) have been identified as one of the major threats to the survival of Australian native fish (Fairfull and Witheridge 2003).

The existing culverts under the railway would be extended or augmented and would be designed with consideration to Fairfull and Witheridge (2003) for fish friendly crossings. No instream pylons are proposed and, as such, impacts on fish, platypus and macroinvertebrate foraging habitat are considered unlikely. Impacts on aquatic fauna are considered minimal providing appropriate erosion and sedimentation controls are implemented as part of a Spoil and Fill Management Plan.

The Project would not involve dewatering of permanent creeks or drainage lines. Dewatering of minor ephemeral tributaries may be necessary during construction, however this would not impact on fish passage.

6.6.3 Impacts on Aquatic Processes

Existing culverts along the length of the Project would either be extended or augmented to accommodate the third track. These culverts would be designed with consideration to Fairfull and Witheridge (2003) for fish friendly crossings. The new culverts would result in flows similar to that already experienced in the existing environment.

The Project would increase the flow to creeks and drainage lines due to the introduction of more non-porous surfaces through construction of the third track. However, the Project is considered unlikely to significantly alter the timing, duration or velocity of flows to or from wetlands and creeks that intersect the investigation area. Impacts on aquatic process, species and habitat are considered unlikely.

Construction of the Project may result in changes to floodplain characteristics. This has the potential to impact floodplain function and increase flow conveyance during peak events. Patterns of flow may also change, potentially increasing erosion and affecting bank stability. However, this is unlikely to adversely affect aquatic fauna or riparian habitats, in particular those associated with creeks and low lying areas, such as Swamp Oak Floodplain Forest EEC and Freshwater Wetland EEC.

6.7 Groundwater Dependent Ecosystems

The NSW Groundwater Dependent Ecosystem (GDE) Policy defines GDEs as ecosystems, which have their species composition, and their natural ecological processes determined by groundwater (DLWC 2002). The Policy defines groundwater as the water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated (DLWC 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC 2002). With the exception of the Great Artesian Basin's mound springs, the level of scientific understanding of the role that groundwater plays in maintaining ecosystems in Australia is generally low (DLWC 2002).

Principle 5 of the GDE Policy states that planning, approval and management of developments and land use activities should aim to minimise adverse impacts on groundwater dependent ecosystems by:

- Maintaining, where practicable, natural patterns of groundwater flow and not disrupting groundwater levels that are critical for ecosystems.
- Not polluting or causing adverse changes in groundwater quality.
- Rehabilitating degraded groundwater systems where practical (DLWC 2002).

Hatton and Evans (1998) recognize four types of groundwater dependent ecosystems, based mainly on vegetation (DLWC 2002). Of these, the following are relevant to the investigation area:

- Terrestrial vegetation:

  Shallow groundwater can support terrestrial vegetation, such as forests and woodlands, either permanently or seasonally (DLWC 2002). Spotted Gum Open Forest, Redgum Open Forest, Grey Box Spotted Gum Ironbark and Swamp Oak Riparian Forest communities within the investigation area are considered to fall into this category.

- Base flows in streams:

  River flow is often maintained largely by groundwater, which provides base flows long after a rainfall event (DLWC 2002). The base flow typically emerges as springs or as diffuse flow from saturated sediments or rock underlying the stream and banks and may be crucial for in-stream and near-stream ecosystems (DLWC 2002). For example, Platypus feed upon invertebrates, such as dragonfly and mayfly larvae, which live in the riffle habitats. Reducing the base flow to groundwater-fed streams could dry out the riffles and reduce the invertebrate populations. This would have direct impacts on predators of invertebrates, such as the Platypus (DLWC 2002).

  It is estimated that in NSW on average up to 40% of any river's flow duration is made up of groundwater-fed baseflow (DLWC 2002). Ecosystem dependence is not only related to the amount of base flow, but also to other flow factors such as seasonal variability (DLWC 2002). This variability is particularly evident in some coastal alluvial groundwater systems, which empty rapidly and are replenished during high flow events (DLWC 2002).

- Wetlands:

  Some GDE's have a mixture of wetland and terrestrial characteristics, and whilst not all wetlands are groundwater dependent, groundwater plays a role in most of Australia's wetlands (DLWC 2002). Wetland GDEs within the investigation area comprise Freshwater Wetland communities.

  The GDE Policy recognizes five broad types of groundwater systems in NSW (DLWC 2002). The type applicable to the investigation area is *Shallow Alluvial Groundwater Systems*, which are associated with coastal rivers and also the higher reaches of rivers west of the Great Dividing Range. These groundwater systems are often in direct connection with surface water bodies, such as rivers and wetlands (DLWC 2002). The groundwater level can be only a few metres below the ground and go down about 30 m (DLWC 2002). These systems can be quickly recharged and water levels restored when droughts break (DLWC 2002). The groundwater is likely to support various ecosystems, including stream base flows, wetlands and terrestrial vegetation (DLWC 2002). While the natural variability of these systems can make them more robust and able to tolerate fluctuating water levels, significant changes to the water regime, such as levels falling below a threshold or falling too quickly, can lead to ecosystem damage (DLWC 2002).

  Major impacts on groundwater systems can come from:

  – The operation of dams (the effect of capture and discharge regimes).
  – Waterlogging due to the frequent or prolonged bank-full flow associated with delivery of irrigation water.
  – A reduction in the quantity and quality of water recharging aquifers adjacent to rivers as a result of the reduction in flooding events caused by stream flow regulation.
  – Over-extraction for irrigation, especially during dry times, which can lead to a reduction in baseflows.
  – A lack of flushing flows which may lead to river bed clogging and sedimentation that prevent the surface water exchanging with the hyporheic zone, damaging both ecosystems (DLWC 2002).

The Project is not anticipated to impact on availability, depth, quality or flow of groundwater. Construction impacts on groundwater dependent ecosystems are considered unlikely as no dewatering is proposed, apart from at Wollombi Road where localised and temporary lowering of the groundwater would occur during construction. This is considered unlikely to have a significant or lasting impact on GDEs.

Operational impacts are considered unlikely. However, one operational impact that may occur would be associated with water quality due to the use of herbicides within the rail corridor as part of maintenance procedures. It is considered that this impact would be similar to the existing regime.

6.8 Corridor Function

The investigation area intersects two regional corridors mapped by NPWS (2005), south of Belford National Park and south of Greta Station (refer to Figure 5.3). Examination of aerial photographs indicates the investigation area has areas of both fairly continuous native vegetation, and cleared agricultural lands, already fragmented into two parts by the existing railway. The Project would remove incremental areas from the edges of the existing railway, which would slightly increase the distance of separation of habitat, but not to the extent that exchange of genetic material would be substantially compromised. It is considered unlikely that the Project would have a significant impact on corridor function for flora in the local area as vegetation clearing would occur on the edge of existing infrastructure easements that have been previously cleared, disturbed, or have been invaded by weeds.

No impacts on the corridor function of creeks for aquatic species are anticipated. No dredging of creeks, excavation of banks or instream pylons are proposed. Fish passage would not be impacted as a result of the Project. The existing culverts would be extended or augmented and designed with consideration to Fairfull and Witheridge (2003) for fish friendly crossings. The Project would result in the loss of a small amount riparian vegetation associated with creeks, however this is considered unlikely to have a significant impact on the aquatic corridor function associated with creeks in the local area.

6.9 Runoff and Sedimentation

In the absence of appropriate management measures, construction may result in impacts on the adjacent vegetation and watercourses from runoff and sedimentation. There is the potential for nutrients, pollutants and seeds of exotic species to be transported from the construction area to the adjacent bushland area and watercourses. Increased nutrient levels may create conditions more conducive to exotic species and therefore result in an increase in the level of weed invasion within the investigation area. Given that the creeks and drainage lines have high levels of weed invasion, there is the potential for seeds of these species to spread further into remnant native vegetation areas as a consequence of soil disturbance during construction works. Sedimentation can prevent growth of many groundcover species by preventing leaf photosynthesis, and result in detrimental impacts on water quality and aquatic habitat. Furthermore, in areas where sediment loads are high, sprouting of new seedlings may be prevented due to the layer of sediment.

Measures to assist in minimising erosion and sedimentation impacts are outlined in the Environmental Assessment. Providing adequate erosion and sedimentation controls are implemented during construction as outlined in the Environmental Assessment, runoff and sedimentation from the Project are considered unlikely to impact on flora or aquatic ecology within the investigation area.

Operational runoff and sedimentation are considered unlikely to impact on flora or aquatic ecology within the investigation area.

6.10 Edge Effects

The investigation area is currently highly fragmented due to large areas of cleared land for agricultural purposes. Levels of noxious and environmental weed invasion within native vegetation (excluding pasture grasses) in the investigation area were highest adjacent to the existing rail corridor, and within creeks and drainage lines. The groundcover within native vegetation occurring adjacent to the existing railway was also invaded by exotic grasses and weeds. The Project is considered unlikely to result in an increase of weed invasion into the native vegetation surrounding the existing rail corridor. The level of impact is anticipated to be similar to the existing environment. Successful implementation of a weed management plan as an integral part of the Project would minimise the potential impacts of weed invasion due to edge effects. The weed management plan would be developed as part of the CEMP.

6.11 Isolation and Fragmentation

Approximately 61.9 hectares of native vegetation would be cleared for the Project. The Project would result in an incremental increase in the fragmentation of these vegetation communities in the local area, by increasing an existing easement. However, the Project would not result in the isolation of any important areas of native vegetation or habitat. The investigation area is already fragmented into two parts by the existing railway. The Project would remove incremental areas from the edges of the existing railway, which would slightly increase the distance of separation of habitat, but not to the extent that exchange of genetic material would be substantially compromised.

No creeks, drainage lines or wetlands would become isolated as a consequence of the Project.

6.12 Alteration of Light, Noise and Dust Levels

Anthropogenic noise and light levels are likely to increase during construction of the Project. During construction, altered noise and light levels would result in disturbance during daylight hours. Once operational, the Project would result in noise levels similar to the existing environment, at a higher frequency than the existing environment. This is unlikely to impact on flora or aquatic ecology within the investigation area.

Airborne dust levels are likely to increase during the construction phase of the Project. Dust could potentially smother plants and could result in the loss of some species. The accumulation of dust during construction may be washed into streams during rain events, causing increased levels of turbidity and impacts on aquatic fauna. However, mitigation measures outlined in the Environmental Assessment would reduce the likelihood of adverse impacts.

Operational light, noise or dust levels are considered unlikely to impact on flora or aquatic ecology within the investigation area.

6.13 Assessment of Threatened Species and Communities Listed under the TSC Act

An assessment has been undertaken in accordance with the *Draft Threatened Species Assessment Guidelines* (DEC and DPI 2005) and the *Threatened species assessment guidelines: The assessment of significance* (DEC 2007) on the basis that the Project will be assessed under Part 3A of the EP&A Act. The assessment was undertaken to determine if the Project is likely to have a significant impact on threatened species, populations and ecological communities (and their habitats) listed under the TSC Act.

Details of the assessment for Hunter Lowland Redgum EEC, Lower Hunter Spotted Gum – Ironbark Forest EEC, Swamp Oak Floodplain Forest EEC, Freshwater Wetlands on Coastal Floodplains EEC, Central Hunter Ironbark – Spotted Gum – Grey Box EEC and Slaty Red Gum are provided in Appendix B.

The assessment indicated that the Project is considered unlikely to significantly impact on Slaty Red Gum or the above EECs with the implementation of offsetting for EECs and Slaty Red Gum developed in the Compensatory Habitat Strategy.

6.14 Assessment of Threatened Species Listed under the EPBC Act

An Assessment of Significance for species listed under the EPBC Act was undertaken pursuant to the *EPBC Act Policy Statement 1.1: Significance Impact Guidelines* (DEH 2006) to determine whether the Project is likely to have a significant impact on Slaty Red Gum and its habitat. Details of the Assessment of Significance are provided in Appendix C.

The Project is considered unlikely to have a significant impact on Slaty Red Gum given the distribution and abundance of the species in the locality. Additionally, sufficient areas for offsetting of Slaty Red Gum would be developed in the Compensatory Habitat Strategy.

7. Mitigation Measures

The management of adverse impacts arising from the Project has been addressed according to the hierarchy of avoidance; mitigation and offsetting of adverse impacts, consistent with the approach outlined in the *Part 3A Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005).

7.1 Avoidance of Impacts

Impacts of the Project on flora and aquatic ecology have been avoided or minimised where possible through the planning and design process. The majority of the area surrounding the existing rail corridor is cleared for agricultural activities, however areas of remnant to dense vegetation occurs in some parts. The preservation of areas of high conservation significance, such as threatened species and EECs, has been considered during the selection process for compound and spoil areas required for construction of the Project. The locations of these sites has been chosen mainly in areas of cleared or pastureland as to not encroach unnecessarily on significant vegetation.

Undertaking further detailed field surveys during the concept design and environmental assessment phase helped to determine the potential impacts of the Project. This facilitated the amendment of the concept design to minimise potential impacts on threatened species and EECs.

However, there was little scope for further avoidance of ecological impacts for the Project. The Project alignment location is constrained by the location of the existing rail corridor. Therefore there is little scope for locating the Project away from some of the sensitive environmental receptors identified in this assessment. Further mitigation and offset measures are described below in the aim to overcome these constraints.

7.2 Mitigation of Impacts

A number of mitigation measures are recommended to mitigate flora and aquatic impacts of the Project:

- Minimise vegetation clearing and retain mature trees.
- Pre-clearance survey to flag Slaty Red Gum and Mountain Grevillea occurring within and adjacent to the investigation area, with the aim to avoid clearing these individuals.
- Pre-clearance survey to flag the edge of EECs occurring in the vicinity of construction to avoid unnecessary impacts on these stands.
- Habitat features, such as fallen logs, that may be utilised by fauna would be relocated into adjacent bushland.
- Design new culverts with consideration to Fairfull and Witheridge (2003) for fish friendly crossings.

- No instream woody snags are to be removed from creeks or drainage lines except as required for structures or creek realignment. In the case of the Sawyer's Creek realignment, any woody snags that occur within the construction impact zone would be relocated or replaced up or downstream of the construction area dependant on site safety and access considerations.
- Provision of flagging, taping or similar marking method along the edge of the clearance area so that works would not encroach closer than necessary upon remnant bushland and within 40 metres of any permanent creeks to minimise the footprint of construction works.
- Use of existing disturbed corridors such as paddocks, cleared areas, roads, tracks and existing easements, for set up of equipment, machinery turning circles, stockpile areas and site facilities.
- Protocols to prevent introduction or spread of *Phytophthora cinnamomi* would be implemented following DECCW guidelines.
- Development of a Spoil and Fill Management Plan. Erosion and sediment controls would be installed prior to earthworks and vegetation clearing, and would be maintained throughout construction, to minimise sediment entering EECs, creeks and drainage lines.
- Separate stockpiling of topsoil and vegetation removed from various areas to delineate soils containing seeds from native or exotic species. The contractor would be responsible for identifying and spatially tracking the topsoils and vegetation removed from the site during construction.
- Placement of soil stockpiles outside of vegetated areas and outside the drip line of trees.
- Rehabilitation and replanting of native vegetation for areas of newly-created bare soil following construction, such as batters.
- A revegetation plan would be prepared, including particularly strategies for protection and rehabilitation of Slaty Red Gum and EECs that occur in the investigation area. The revegetation plan would also include revegetation with local native species appropriate for riparian areas surrounding creeks and drainage lines. A specific revegetation plan for Sawyers Creek would be developed to reinstate riparian vegetation characteristic of Red Gum Open Forest, which extends upstream from the works site.
- Weeds from areas cleared during construction would be sprayed with appropriate herbicides or removed from the site and not allowed to enter watercourses or moist areas such as drainage lines. A weed management strategy should be implemented, as part of a vegetation management plan, for any retained or rehabilitated natural vegetation within the study area and any offset areas. All noxious weeds within the land should be treated in accordance with their weed Class as per the *Noxious Weeds Act* 1993.

7.3 Offsetting of Impacts

There is the potential for a number of direct and indirect impacts to occur on biodiversity values as a consequence of the Project. While many of these impacts have either been avoided, minimised through design decisions or can be adequately mitigated or managed, there are some impacts that cannot be adequately mitigated.

There are likely to be the following impacts as a result of the Project:

- A loss and degradation of Slaty Red Gum listed as vulnerable under the TSC Act and EPBC Act. The Project would affect approximately 2.7 hectares of dense Slaty Red Gum stands and 50 individuals scattered along the investigation area. These areas of Slaty Red Gum are also considered part of the Hunter Lowland Redgum EEC.
- A loss and degradation of native vegetation including EECs listed under the TSC Act. The Project would affect approximately 61.9 hectares of native vegetation of which approximately 61.1 hectares qualify as EECs.
- A loss of habitat for a variety of native species including threatened fauna species listed under the TSC Act and EPBC Act. These impacts are discussed in a separate Fauna Impact Assessment included in Appendix F of the Environmental Assessment.

To address these impacts, ARTC would implement a Compensatory Habitat Strategy that would contribute to the long term conservation of these EECs, fauna habitat and Slaty Red Gum. The Compensatory Habitat Strategy is being developed in consultation with DECCW with the aim to set aside known habitat for Slaty Red Gum and EECs. The Compensatory Habitat Strategy would be developed to offset the impacts on Slaty Red Gum and EECs and may include a combination of compensatory measures:

- Provision of land for conservation purposes.
- Additional biodiversity management measures.
- Funding of vegetation management or research initiatives.

The Compensatory Habitat Strategy would complement the specific mitigation measures incorporated into the Project design and which would be implemented during the construction and operational phases of the development to further mitigate impacts and contribute to the maintenance and improvement of local and regional biodiversity values.

7.3.1 Principles for use of Biodiversity Offsets in NSW

The following DECCW principles for use of biodiversity offsets in NSW have been considered in the assessment approach and development of the Compensatory Habitat Strategy:

- Impacts must be avoided first by using prevention and mitigation measures: Sections 7.1, 7.2 and 7.3, outlines the Project hierarchy of avoidance; mitigation and offsetting of adverse impacts.
- All regulatory requirements must be met: Section 2 outlines the Project compliance with all regularity requirements.
- Offsets must never reward ongoing poor performance: The areas set aside for the Compensatory Habitat Strategy would have management plans associated with them.
- Offsets will compliment other government programs: The Compensatory Habitat Strategy has been developed in consultation with DECCW, and aims to compliment the existing reserve network.

- Offsets must be underpinned by sound ecological principles: Ecological fieldwork for potential Compensatory Habitat Strategy sites has been undertaken in accordance with Draft Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC and DPI 2005).
- Offsets should aim to result in a net improvement in biodiversity over time: The areas set aside for the Compensatory Habitat Strategy would be of high quality flora and fauna habitat, and aim to compliment the existing reserve network.
- Offsets must be enduring, they must offset the impact of the development for the period that the impact occurs: The areas set aside for the Compensatory Habitat Strategy would be managed in perpetuity.
- Offsets should be agreed prior to the impact occurring: The principles of the Compensatory Habitat Strategy have been agreed to by DECCW prior to construction commencing.
- Offsets must be quantifiable, the impacts and benefits must be reliably estimated: Ecological fieldwork for potential Compensatory Habitat Strategy sites has been undertaken in accordance with Draft Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC and DPI 2005).
- Offsets must be targeted: The Compensatory Habitat Strategy was developed to target biodiversity priorities in the area, based on the conservation status of the ecological communities disturbed by the Project, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats.
- Offsets must be located appropriately: The Compensatory Habitat Strategy has been developed to target biodiversity priorities in the locality of the Project, and aims to compliment the existing reserve network.
- Offsets must be supplementary: The Compensatory Habitat Strategy supplements the existing reserve network and does not utilise existing conservation areas as offset areas.
- Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract: Details regarding enforcement of the Compensatory Habitat Strategy is being developed in consultation with DECCW.

8. Conclusion

8.1 Key Findings

The Project would clear approximately 61.9 hectares of native vegetation, which includes areas of *Lower Hunter Spotted Gum Ironbark Open Forest EEC*, *Hunter Lowland Redgum EEC*, *Swamp Oak Floodplain Forest EEC*, *Freshwater Wetland EEC* and *Grey Box - Spotted Gum - Ironbark Open Forest EEC* on the TSC Act. The Project would also clear approximately 2.7 hectares and 50 scattered individual Slaty Red Gum (as part of *Hunter Lowland Redgum EEC*), listed as a vulnerable species under the TSC Act, and approximately 1.6 hectares of Mountain Grevillea, a ROTAP plant. However, the Project is considered unlikely to have a significant impact on threatened species or EECs listed under the TSC Act or EPBC Act.

Database searches indicate that no threatened aquatic species or EECs listed under the FM Act or EPBC Act are considered likely to occur in the investigation area. With the exception of Sawyers Creek, no trenching, realignment or direct impacts including instream pylons or excavation of banks for any creeks are anticipated. The works at Sawyers Creek involve realignment of approximately 100 metres of the creekline upstream of the existing rail. The realignment would include trenching a new alignment that would include deep pools, meanders, riffle habitat and revegetation works in accordance with Industry and Investment NSW (Fisheries) requirements.

Fish passage would not be impacted as a result of the Project. The existing culverts under the railway would be extended or augmented and would be designed with consideration to Fairfull and Witheridge (2003) for fish friendly crossings. The new culverts would result in flows similar to that already experienced in the existing environment. Impacts on aquatic fauna are considered minimal providing appropriate erosion and sedimentation controls are implemented as part of a Spoil and Fill Management Plan.

The Project is not anticipated to impact on availability, depth, quality or flow of groundwater. Construction impacts on groundwater dependent ecosystems are considered unlikely as no dewatering is proposed, apart from at Wollombi Road where localised and temporary lowering of the groundwater would occur during construction. This impact is considered unlikely to have an impact on groundwater dependent ecosystems. Operational impacts on groundwater dependent ecosystems are considered unlikely. The only operational impact that could occur would be associated with the use of herbicides within the rail corridor as part of maintenance procedures. However, this impact would be similar to the existing environment.

8.2 Key Thresholds

Pursuant to the *Draft Guidelines for Threatened Species Assessment* under Part 3A of the EP&A Act (DEC and DPI 2005), development applications being assessed under Part 3A must address the following key thresholds.

Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.

Impacts of the Project on flora and aquatic ecology have been avoided or minimised where possible through the planning and design process. The preservation of areas of high

conservation significance, such as threatened species and EECs, has been considered during the selection process for compound and spoil areas required for construction of the Project. Further detailed field surveys during the concept design and environmental assessment phase helped to determine the potential impacts of the Project. This facilitated the amendment of the concept design to minimise potential impacts on threatened species and EECs.

The Project alignment location is constrained by the location of the existing rail corridor. Therefore there is little scope for locating the Project away from some of the sensitive environmental receptors identified in this assessment. Environmental management measures to further minimise impacts have been recommended in an aim to overcome these constraints.

The development of a Compensatory Habitat Strategy, in consultation with DECCW, would aim to offset the loss of threatened species and communities and would contribute to the maintenance and improvement of biodiversity values.

Whether or not the proposal is likely to reduce the long-term viability of a local population of any threatened species, population or ecological community.

The Project is expected to require the removal of:

- 19.7 hectares of Hunter Lowland Redgum EEC (inclusive of 2.7 hectares of Slaty Red Gum and 0.8 hectares of Mountain Grevillea which forms part of the EEC).
- 13.2 hectares of Lower Hunter Spotted Gum-Ironbark Forest EEC (inclusive of 0.8 hectares of Mountain Grevillea which forms part of the EEC).
- 14.9 hectares of Swamp Oak Floodplain Forest EEC.
- 0.6 hectares of Freshwater Wetlands EEC.
- 12.7 hectares of Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.
- 2.7 hectares and 50 scattered individual Slaty Red Gum.

The Project would remove up to 61.1 hectares of EECs and 2.7 hectares of Slaty Red Gum. Given the extensive disturbance in the local area due to the existing rail corridor and agricultural activities, this habitat would have considerable value for local populations. However, the Project is unlikely to reduce the long-term viability of a local population of threatened species or community given the approach of avoiding and minimising impacts during the design phase and the proposed implementation of mitigation measures (including development of a Compensatory Habitat Strategy) during the construction and operational stages.

Assessments of the likelihood of significance of the impacts on threatened species and communities have concluded there would not be a significant impact provided that the proposed impact mitigation measures are implemented.

The implementation of offset areas for threatened species and communities would further contribute in maintaining local populations within the locality.

Whether or not the proposal is likely to accelerate the extinction of any species, population or ecological community or place it at risk of extinction.

The Project would not reduce the viability of local populations and is considered unlikely to result in impacts that would accelerate the extinction of the identified threatened species or communities given the following considerations:

- Vegetation that would be cleared is located alongside the existing rail corridor in areas that are highly disturbed and modified due to the rail line and agricultural activities.
- The implementation of specific mitigation measures to minimise adverse impacts on threatened species and EECs would manage the potential impacts resulting from the Project.
- The development of a Compensatory Habitat Strategy, in consultation with DECCW, with the aim to set aside known habitat for threatened species and EECs within the locality of the Project. This would contribute to the long term conservation of these species and communities.

Whether or not the proposal will adversely affect critical habitat.

Critical habitats are listed under both the NSW TSC Act and the Commonwealth EPBC Act. No listed critical habitat occurs within the investigation area and no critical habitat would be removed or adversely affected as a result of the Project.

8.3 Conclusion

This Flora and Aquatic Ecological Assessment has been undertaken by the Hunter 8 Alliance on behalf of ARTC, as part of the Environmental Assessment, for the Maitland to Minimbah Third Track Project. This report has been prepared to assess the existing flora and aquatic ecology of the investigation area, impacts of the Project, and to develop mitigation measures to minimise impacts of the Project.

The flora and aquatic ecology survey and assessment has been prepared with consideration of the *Draft Guidelines for Threatened Species Assessment* under Part 3A of the *Environmental Planning and Assessment Act* 1979 (DEC and DPI, 2005), *Threatened species assessment guidelines: The assessment of significance* (DEC 2007), *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities* (DEC 2004) and the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) *Flora and Fauna Survey Guidelines* (LHCCREMS 2003).

There is the potential for direct and indirect ecological impacts to occur as a result of the Project. While many of these impacts can be minimised through avoidance or management, there are some impacts that cannot be adequately mitigated. To address these impacts, ARTC would implement a Compensatory Habitat Strategy, in consultation with DECCW, to further mitigate impacts and contribute to the maintenance and improvement of local and regional biodiversity values.

An assessment of the significance of impacts on threatened species and EECs has been prepared in accordance with the assessment criteria identified in the *Draft Guidelines for Threatened Species Assessment* under Part 3A of the EP&A Act (DEC and DPI, 2005), *Threatened species assessment guidelines: The assessment of significance* (DEC 2007) and the *Significant Impact Guidelines 1.1: Significant Impact Guidelines Matters of NES* (DEH 2006). Based on the assessments, it is considered unlikely that the Project would result in impacts that would cause a local population of threatened flora or community to become extinct. There is unlikely to be a significant impact on threatened flora species or EECs with the implementation of the proposed mitigation measures in this report.

The Project is unlikely to have a significant impact on the identified threatened flora species and EECs listed under the TSC Act and EPBC Act. Mitigation measures have been recommended to reduce impacts, and the development of a Compensatory Habitat Strategy would offset areas of known habitat for threatened species and EECs in an aim to conserve and improve habitat for these species and communities.

9. References

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Appendix A

Environmental Risk Assessment Tables

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Consequence Table

Aspect	Insignificant	Minor	Moderate	Major	Catastrophic
Flora and fauna species (including EPBC protected species)	Population change not detectable.	Detectable change in population without impact on population viability.	Detectable change in population and impact on population viability that is significant at a local level.	Detectable change in population and impact on population viability that is significant at a regional level.	Detectable change in population and impact on population viability that is significant at a State or Commonwealth level.
Endangered Ecological communities (EEC)	Insignificant loss of native vegetation.	Loss of EEC significant at the local level. Net gain achievable.	Loss of EEC significant at the regional level. Net gain achievable.	Loss of EEC significant at the State level. Net gain achievable.	Loss of EEC significant at the State level. Net gain not achievable.

Likelihood Table

Likelihood	Description
Almost Certain	The event is expected to occur in most circumstances.
Likely	The event will probably occur in most circumstances.
Possible	The event could occur.
Unlikely	The event could occur but not expected.
Rare	The event occurs only in exceptional circumstances.

Risk Matrix

Likelihood Level	Consequence Level				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Low	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Negligible	Low	Medium	High	High
Unlikely	Negligible	Low	Medium	Medium	High
Rare	Negligible	Negligible	Low	Medium	Medium

Environmental Risk Register – Flora and Aquatic Ecology

Risk No	Risk Pathway Description (how the project interacts with assets, values and uses)	Description of Consequences	Planned Controls to Manage Risk (as per Project Description)	Risk Assessment (Control)			Additional Controls Recommended to Reduce Risk	Treated Risk Assessment		
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
1	Construction of the Project impacts on water quality and habitat in creeks, drainage lines and wetlands.	Erosion and sedimentation impacts on aquatic habitat and species. Loss of aquatic and riparian habitat.	◗ Implementation of an Environmental Management Plan (EMP) which includes a Spoil and Fill Management Plan. ◗ EMP to include temporary sediment and erosion controls, with the Project including permanent controls. ◗ Design considerations to replicate existing environment.	**Minor**	**Likely**	**Medium**	Implementation of a revegetation plan that includes revegetation works within disturbed riparian and aquatic habitats.	**Minor**	**Possible**	**Low**
2	Operation of the Project impacts on water quality and habitat in creeks, drainage lines and wetlands.	◗ Erosion and sedimentation impacts on aquatic habitat and species. ◗ Loss of aquatic and riparian habitat.	◗ Implementation of an Environmental Management Plan (EMP) which includes a Spoil and Fill Management Plan. ◗ EMP to include temporary sediment and erosion controls, with the Project including permanent controls. ◗ Design considerations to replicate existing environment.	Insignificant	Likely	Low				
3	Construction of the Project impacts on Groundwater Dependent Ecosystems	◗ An increase or decrease in groundwater can lead to changes in vegetation communities, either becoming drier or wetter. ◗ This may result in loss of EEC habitat.	◗ Design of project elements ◗ Design to have minimal impact on groundwater sources. ◗ Groundwater Management Plan	Insignificant	Unlikely	Negligible				

Risk No	Risk Pathway Description (how the project interacts with assets, values and uses)	Description of Consequences	Planned Controls to Manage Risk (as per Project Description)	Risk Assessment (Control)			Additional Controls Recommended to Reduce Risk	Treated Risk Assessment		
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
4	Construction of the Project results in clearing of native vegetation including 2.7 ha of threatened flora.	◗ Loss of 2.7 ha of Slaty Red Gum (*Eucalyptus glaucina*), listed as vulnerable on the TSC Act and EPBC Act.	◗ Implementation of an Environmental Management Plan (EMP) which includes environmental management plans such as a Spoil and Fill Management Plan. ◗ Implementation of a Flora and Fauna Management Plan, which includes pre-clearance survey protocol, weed management strategy and revegetation plan. ◗ Implementation of a Compensatory Habitat Strategy to offset areas of E. glaucina and G. montana within the locality for realignment of waterways, replicate waterway area where possible and reinstate riparian vegetation and geomorphic features. ◗ Minimise construction footprint.	Minor	Almost Certain	Medium	◗ Narrow construction and clearing corridor in areas of dense *E. glaucina*, where possible. ◗ Locate site compounds and spoil areas in existing cleared areas. ◗ Pre-clearance surveys to identify individuals that may be avoided during construction clearance. ◗ Brush mat native vegetation green waste within adjacent cleared areas (in consultation with land owners) to promote revegetation of native species. ◗ Habitat features that may be utilised by fauna such as fallen logs would be relocated into adjacent bushland. ◗ Protocols to prevent introduction or spread of *Phytophthora cinnamomi* should be implemented, where required, following DECC guidelines. ◗ Separate stockpiling of topsoil and vegetation removed from various areas to delineate soils containing seeds from native or exotic species. ◗ Placement of soil stockpiles away from vegetated areas.	Minor	Almost Certain	Medium

Risk No	Risk Pathway Description (how the project interacts with assets, values and uses)	Description of Consequences	Planned Controls to Manage Risk (as per Project Description)	Risk Assessment (Control)			Additional Controls Recommended to Reduce Risk	Treated Risk Assessment		
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
5	Construction of the Project results in clearing approximately 61.4 ha of native vegetation including 61.1 ha of Endangered Ecological Communities (EEC)	Loss of Endangered Ecological Community (EEC) habitat including: ◗ Lower Hunter Spotted Gum-Ironbark Forest EEC. ◗ Hunter Lowland Redgum Forest EEC. ◗ Swamp Oak Floodplain Forest EEC. ◗ Freshwater Wetland EEC. ◗ Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.	◗ Implementation of an Environmental Management Plan (EMP) which includes environmental management plans such as a Spoil and Fill Management Plan. ◗ Implementation of a Flora and Fauna Management Plan, which includes pre-clearance survey protocol, weed management strategy and revegetation plan. ◗ Implementation of a Compensatory Habitat Strategy to offset areas of EEC habitat within the locality. ◗ Established tracks used where possible to avoid vegetation removal and reduce impacts to vegetation ◗ Minimise construction footprint.	Minor	Almost Certain	Medium	◗ Narrow construction and clearing corridor in areas of dense *E. glaucina*, where possible. ◗ Locate site compounds and spoil areas in existing cleared areas. ◗ Pre-clearance surveys to identify individuals that may be avoided during construction clearance. ◗ Brush mat native vegetation green waste within adjacent cleared areas (in consultation with land owners) to promote revegetation of native species. ◗ Habitat features that may be utilised by fauna such as fallen logs would be relocated into adjacent bushland. ◗ Protocols to prevent introduction or spread of Phytophthora cinnamomi should be implemented, where required, following DECC guidelines. ◗ Separate stockpiling of topsoil and vegetation removed from various areas to delineate soils containing seeds from native or exotic species. ◗ Placement of soil stockpiles away from vegetated areas.	Minor	Almost Certain	Medium

Appendix B

Assessment of Impact on NSW-listed Species and Ecological Communities

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Assessment of Impact on TSC Act-listed Species and Ecological Communities

Table 1 Ecological Communities and Species Included in Assessment

Species / Ecological Community	TSC Act status	EPBC Act status	Potential habitat in investigation area	Identified during field surveys
Endangered Ecological Communities (EECs)				
Hunter Lowland Redgum EEC (*Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast bioregions)*	EEC	-	✓	✓
Lower Hunter Spotted Gum – Ironbark Forest EEC *(Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin bioregion*)	EEC	-	✓	✓
Swamp Oak Floodplain Forest EEC *(Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions)*	EEC	-	✓	✓
Freshwater Wetlands on Coastal Floodplains EEC *(Freshwater Wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions)*	EEC	-	✓	✓
Central Hunter Ironbark – Spotted Gum – Grey Box EEC *(Central Hunter Ironbark – Spotted Gum – Grey Box in the NSW North Coast and Sydney Basin bioregions)*	EEC	-	✓	✓
Threatened Flora				
Slaty Red Gum (*Eucalyptus glaucina*)	V	V	✓	✓

Key:

V = Listed as a Vulnerable species.

EEC = Listed as an Endangered Ecological Community.

Draft Guidelines for Threatened Species Assessment under Part 3A

An assessment of impacts of the Project on threatened species and ecological communities and their habitats according to the assessment criteria identified in the *Draft Guidelines for Threatened Species Assessment* under Part 3A of the EPA Act (DEC and DPI 2005), is provided below.

This impact evaluation considers:

- The magnitude, extent and significance of potential impacts of the proposed activity on relevant threatened biota and their habitats in the investigation area (see Table 1).
- Avoidance and management of impacts through Project design, mitigation and environmental management measures.
- The development of a Compensatory Habitat Policy as part of the proposed activity.

Assessment of Impact Criteria under Part 3A

Slaty Red Gum *(Eucalyptus glaucina)*

Slaty Red Gum grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils. It is a medium-sized tree to 30 m tall. The bark is smooth and mottled white to slaty grey. The buds and fruit are blue-green with a whitish bloom. The flowers are white, or occasionally pink, and are produced between August and December. The fruits are oval-shaped and 7– 10 mm long. The three to five raised valves are surrounded by a domed disk raised above the fruit. The species is found only on the north coast of NSW and in separate districts: near Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland (DECCW 2009a).

Threats to the species includes:

- Clearing for agriculture and development.
- Timber harvesting activities.
- Lack of regeneration through grazing pressure (DECCW 2009a).

Hunter Lowland Redgum EEC

Hunter Lowland Redgum Forest EEC occurs from Muswellbrook to the Lower Hunter in the Sydney Basin and North Coast bioregions. It has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton local government areas, but may occur elsewhere in these bioregions.

Much of the remaining community is disturbed and fragmented. Less than 27% of the community remains. The floristic composition and structure of the community is influenced by both the size and disturbance history of the remaining fragments. Consequently at heavily disturbed sites only some of the species, which characterise the community, may be present (NSWSC 2002).

Threats to the community include:

- Habitat loss and fragmentation due to clearing for agriculture and residential development.
- Habitat degradation resulting from grazing, weed invasion, altered fire frequency and rubbish dumping (DECCW 2009a).

Lower Hunter Spotted Gum – Ironbark Forest EEC

Spotted Gum- Ironbark Forest mapped within the investigation area is characteristic of Lower Hunter Spotted Gum-Ironbark Forest EEC (NSWSC 2005), listed under the TSC Act. The EEC is restricted to a range of approximately 65 km by 35 km centred on the Cessnock - Beresfield area in the Central and Lower Hunter Valley. Within this range, the community was once widespread. A fragmented core of the community still occurs between Cessnock and Beresfield. Much of the remaining community is disturbed and fragmented. Less than 40% of the community remains.

Threats to the community include:

- Further clearing for urban and rural development, and the subsequent impacts from fragmentation.
- Rubbish dumping.
- Off-road vehicle use.
- Arson.
- Weed invasion (especially *Lantana camara* and *Solanum mauritianum*).
- Frequent fires (less than three years).
- Cropping enterprises (such as vineyards).
- Coal mining and activities associated with logging (DECCW 2009a).

Swamp Oak Floodplain Forest EEC

Swamp Oak Riparian Forest mapped within the investigation area is characteristic of Swamp Oak Floodplain Forest EEC (NSWSC 2004) listed under the TSC Act. This community is found on the coastal floodplains of NSW. The extent of the community prior to European settlement has not been mapped across its entire range. However, the remaining area of Swamp Oak Floodplain Forest is likely to represent much less than 30% of its original range.

Threats to the community include:

- Clearing for urban and rural development, and the subsequent impacts from fragmentation.
- Flood mitigation and drainage works.
- Grazing and trampling by stock and feral animals (such as pigs).
- Activation of acid sulfate soils.
- Landfilling and earthworks associated with urban and industrial development.
- Pollution from urban and agricultural runoff.

- Rubbish dumping.
- Climate change.
- Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species (DECCW 2009a).

Freshwater Wetland EEC

Freshwater Wetlands mapped within the investigation area is characteristic of Freshwater Wetlands EEC (NSWSC 2004b). Freshwater Wetlands are associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains.

This community has been extensively cleared and modified, with about 3,500 ha remaining in the lower Hunter – Central Hunter region (in 1990s) (NSWSC 2004b).

Threats to the community include:

- Habitat loss and fragmentation due to clearing and filling associated with urban development.
- Habitat degradation resulting from altered hydrology/nutrient levels, weed invasion, off-road vehicles, illegal waste dumping and sand extraction (DECCW 2009a).

Central Hunter Ironbark - Spotted Gum - Grey Box Forest EEC

On 8 May 2009 the Scientific Committee, established by the Threatened Species Conservation Act, made a Preliminary Determination to support a Project to list the Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions, as an EEC in Part 3 of Schedule 1 of the TSC Act. Grey Box Ironbark Open Forest recorded within the investigation area is characteristic of this EEC (NSWSC 2009).

- ***How is the proposal likely to affect the lifecycle of a threatened species and/or population?***

Slaty Red Gum

Construction of the Project would also remove:

- 2.7 ha of dense stands and 50 scattered individual Slaty Red Gum.

Disrupting the pollination cycle

There is potential for dust to have an impact during construction of the Project, however dust suppression measures would reduce this impact. Dust during operation is not expected to be substantially more than existing dust levels within the investigation area.

Pollinators are likely to be mobile species (such as birds and insects). The Project is not expected to hinder movements of these species in the locality as the new track is unlikely to provide any further barrier to terrestrial fauna than the existing rail corridor.

Disturbing seedbanks

Seedbanks would be retained in areas of retained habitat and vegetation. Additionally, erosion and sedimentation controls would protect soils and seedbanks.

Disrupting recruitment (such as germination and establishment of plants)

The Project is unlikely to significantly affect recruitment potential, given the retention of habitat and individuals/stands within corridor and adjoining areas. Measures to minimise potential adverse indirect impacts on habitat include dust suppression, erosion and sedimentation controls and weed management.

Additionally, Slaty Red Gum appears to have good natural recruitment and regeneration within the investigation area with many juveniles observed during the field surveys undertaken for this assessment.

Affects the interaction between threatened species and other species in the community (such as pollinators, host species, mychorrizal associations)

Factors affecting the pollination cycle of the species would include pollinators, seedbanks and other impacts that may influence pollination and reproduction. The species is already fragmented into two parts by the existing railway. The Project would remove incremental areas from the edges at the side of the existing railway, which would slightly increase the distance of separation of the two parts, but not to the extent that exchange of genetic material would be significantly compromised.

Overall, the Project is unlikely to significantly affect the breeding cycle of Slaty Red Gum. Although 2.7 ha of dense stands and 50 scattered individuals would be removed for the Project, examination of DECCW records for Slaty Red Gum within 10 km of the investigation area indicate the species is locally abundant, with the majority of previous records occurring between Singleton to Belford, with over 1 000 000 Slaty Red Gum estimated on Singleton Military Area (Hunter 2004 cited in Peake 2006). Therefore, the 2.7 ha and 50 scattered individuals to be removed for the Project is considered unlikely to significantly impact the lifecycle or habitat of Slaty Red Gum.

- ***How is the proposal likely to affect the habitat of a threatened species, population and/or ecological community?***

Degrading soil quality

The Project is not expected to degrade soil quality due to the implementation of proposed erosion and sedimentation control measures to be outlined in the Erosion and Sedimentation Control Plan.

Slaty Red Gum

The Project would remove stands of Slaty Red Gum occupying a total area of approximately 2.7 ha and 50 scattered individual trees. Slaty Red Gum and Forest Red Gum (*Eucalyptus teretricornis*) are known to intergrade in the local area, and these forms have been recorded in Thornton North (Bell, 2003) and within the land for the Hunter Economic Zone at Kurri Kurri. Within the investigation area, numerous trees were recorded that displayed intermediate characteristics between the two species, likely to represent intergrade forms. These trees were confirmed by the Royal Botanic Gardens as Forest Red Gum (*Eucalyptus tereticornis*) with some genetic influence from Slaty Red Gum. Stands comprising the intergrade and isolated individuals have been mapped as Slaty Red Gum taking a precautionary approach in terms of assessing impacts on this threatened species.

Construction of the Project would clear known and potential habitat for Slaty Red Gum. Clearing these areas of habitat would result in an incremental increase of fragmentation of Slaty Red Gum habitat. This species is already fragmented into two parts by the existing railway. The Project would remove incremental areas from the edges of side of the existing rail corridor. However, the amount of Slaty Red Gum to be cleared represents a small component of the species apparent occurrence in the locality, including an estimated population of up to 1 000 000 plants at the Singleton Military Area (Hunter 2004 cited in Peake 2006).

EECs

Construction of the Project would impact the habitat of these EECs by removing the following:

- 23.3 ha of Hunter Lowland Redgum EEC (inclusive of 2.7 ha of Slaty Red Gum and 0.8 ha of Mountain Grevillea which forms part of the EEC).
- 13.2 ha of Lower Hunter Spotted Gum-Ironbark Forest EEC (inclusive of 0.8 ha of Mountain Grevillea which forms part of the EEC).
- 14.9 ha of Swamp Oak Floodplain Forest EEC.
- 0.6 ha of Freshwater Wetlands EEC.
- 12.7 ha of Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.

These EECs have been extensively cleared within the locality for mining, residential, infrastructure and agricultural activities which has resulted in degraded and fragmented remnants. The Project would result in an incremental increase in the fragmentation of these vegetation communities in the local area, by increasing an existing easement. However, the Project would not result in the isolation of any important areas of native vegetation or habitat. The investigation area is already fragmented into two parts by the existing railway. The Project would remove incremental areas from the edges of side of the existing railway, which would slightly increase the distance of separation of habitat, but not to the extent that exchange of genetic material would be significantly compromised. All EECs recorded in the investigation area extend well beyond the limits of the construction impact zone.

Clearing would result in the loss of 23.3 ha of Hunter Lowland Redgum Forest EEC. The LHCCREMS (2003) extant of this vegetation type is estimated at 7 047 ha, of which the Project would clear 0.3 %. Although LHCCREMS was based on aerial photography with limited ground-truthing, this is a good estimate of the likely extent of this vegetation community in the lower Hunter.

The Project would result in the loss of 13.2 ha of Lower Hunter Spotted Gum-Ironbark Forest EEC. The LHCCREMS (2003) extant of this vegetation type is estimated at 31 286 ha, of which the Project would clear 0.04 %. Although LHCCREMS was based on aerial photography with limited ground-truthing and contains many errors and inaccuracies, overall this would represent a reasonable estimate of the likely extent of this vegetation community in the lower Hunter.

The Project would result in the loss of 14.9 of Swamp Oak Floodplain Forest EEC. The LHCCREMS (2003) extant of this vegetation type is estimated at 2607 ha, of which the Project would clear 0.6 %. However, this figure is likely to be much lower since the true extent of this map unit has probably been underestimated by LHCCREMS in the lower Hunter. LHCCREMS was based on aerial photography with limited ground-truthing and contains many errors and inaccuracies.

The Project would result in the loss of a very small amount (approximately 0.6 ha) of Freshwater Wetland EEC. The LHCCREMS (2003) extant of this vegetation type is estimated at 3900 ha, of which the Project would clear 0.02 %. Although LHCCREMS was based on aerial photography with limited ground-truthing, this is probably a reasonable estimate of the likely extent of this vegetation community in the lower Hunter.

Central Hunter Ironbark - Spotted Gum - Grey Box Forest occupies an area of less than 2000 km^2 (NSW Scientific Committee 2009). It has been mapped as being recorded in Belford National Park and in the Singleton Military Area (NSWSC 2009). Mapped occurrences of the community include 34 remnants greater than 100 ha and more than 1000 small remnants less than 10 ha indicating a high level of fragmentation (Peake 2006). The mapped area of the community is approximately 18,300 ha which is estimated to be 29% of the pre-European distribution (Peake 2006). Clearing for the Project would therefore remove approximately 0.07 % of the known extent of this vegetation type in the central Hunter.

Introduces weeds, vermin or feral species or provides conditions for them to increase and/or spread

Many weeds are already present within the investigation area, in particular within the existing rail corridor. Given the existing disturbance, the Project would include weed management controls to be addressed within a Weed Management Plan as part of a Flora and Fauna Management Plan to be developed for the Project. The Project is unlikely to introduce weeds or provide conditions for them to increase or spread.

Any feral species, such as rabbits, that may graze or modify regenerating vegetation would already be present and the Project would not introduce more species or provide conditions for them to increase or spread.

Affecting natural vegetation and recolonisation of existing species following disturbance

As discussed for Slaty Red Gum the Project is unlikely to significantly further fragment habitat or disrupt pollination, dormancy, the viability of soil seed banks or other ecosystem processes necessary for regeneration.

The Compensatory Habitat Policy to be developed for the Project would aim to compensate for the loss of Slaty Red Gum and the EECs in the investigation area by retaining and providing long-term protection of known habitat in the locality and assisting in minimising impacts on these species and communities.

- ***Does the proposal affect any threatened species, populations and/or ecological communities that are at the limit of its known distribution?***

Slaty Red Gum

Slaty Red Gum is found only on the north coast of NSW and in two separate districts; near Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland. Locally, DECCW (2009b) records indicate a population occurring from west of Lochinvar to Cessnock. This population intersects the investigation area and field surveys undertaken for this assessment recorded many individuals and dense areas between these locations as discussed in this report. Another local population occurs approximately 20 km northeast of the investigation area.

The population of Slaty Red Gum recorded during the field surveys appears to have an eastern-most limit of Lochinvar with Forest Red Gum (*Eucalyptus teretricornis*) becoming more dominant further east. East of Hermitage Road, the population appears to be integrating with Forest Red Gum. The 2.7 ha dense stands and 50 individual Slaty Red Gum to be cleared for the Project includes intergrades of Slaty Red Gum with Forest Red Gum. According to advice from the Royal Botanic Gardens, many of these individuals would be predominantly *Eucalyptus tereticronis* with some genetic influence from *Eucalyptus glaucina*.

Additionally, an estimated population of up to 1,000,000 individuals of the species occurs within the Singleton Military Area which is located approximately 2 km from the western extent of the investigation area (Hunter 2004 cited in Peake 2006). This indicates a huge local population of the species and the proposed removal of habitat and trees proposed in the investigation area would be highly unlikely to result in long-term decline.

Whilst the Project would clear Slaty Red Gum from within the eastern-most limit of its distribution range in this area, the Project would only clear individuals within the construction impact zone, with the individuals and areas of the species occurring outside the areas to be retained. The Project is expected to clear areas and individuals of Slaty Red Gum at the limit of its known distribution in the locality.

EECs

Hunter Lowland Redgum Forest EEC occurs from Muswellbrook to the Lower Hunter in the Sydney Basin and North Coast bioregions. It has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton local government areas, but may occur elsewhere in these bioregions. LHCCREMS (2003) mapping indicates the community is scattered throughout Hunter Region and centralised around Cessnock. Field surveys undertaken for this assessment indicated the community extends beyond the investigation area. The Project would remove 23.3 ha of Hunter Lowland Redgum Forest EEC along the existing rail line, but would not impact areas of EEC that are at the limit of their known distribution.

Lower Hunter Spotted Gum-Ironbark Forest EEC is restricted to a range of approximately 65 km by 35 km centred on the Cessnock - Beresfield area in the Central and Lower Hunter Valley. A fragmented core of the community still occurs between Cessnock and Beresfield. Remnants occur within the Local Government Areas of Cessnock, Maitland, Singleton, Lake Macquarie, Newcastle, Port Stephens and Dungog but may also occur elsewhere within the bioregion. Field surveys undertaken for this assessment indicated the community extends beyond the investigation area. LHCCREMS (2003) mapping indicates large areas of Lower Hunter Spotted Gum-Ironbark Forest EEC south of the investigation area associated with Werakata National Park and Aberdare State Forest. The Project would remove 13.2 ha of Lower Hunter Spotted Gum- Ironbark Forest EEC along the existing rail line, but would not impact areas of EEC that are at the limit of their known distribution.

Swamp Oak Floodplain Forest EEC is associated with the coastal floodplains of NSW. The occurrence of the community in the locality includes less than 3,200 ha in the lower Hunter - central Hunter region. The community is known in the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers. Field surveys undertaken for this assessment indicated the community extends beyond the investigation area and is widespread along Black Creek, Anvil Creek, Jump Up Creek and Sweetwater Creek (and their tributaries). The Project would remove 14.9 ha of Swamp Oak Floodplain Forest EEC along the existing rail line, but would not impact areas of EEC that are at the limit of their known distribution.

Freshwater Wetlands EEC is known along the majority of the NSW coast with approximately 3,500 ha occurring in the lower Hunter – Central Hunter region. Field surveys undertaken for this assessment identified small areas of Freshwater Wetland EEC within and adjacent to the investigation area, however larger areas of the EEC are known within the locality including areas associated with Wentworth Swamp and Hexham Swamp. The Project would remove 0.6 ha of Freshwater Wetland EEC along the existing rail line, but would not impact areas of EEC that are at the limit of their known distribution.

Central Hunter Ironbark - Spotted Gum - Grey Box Forest has been recorded from the local government areas of Cessnock, Singleton and Muswellbrook but may occur elsewhere within the NSW North Coast and Sydney Basin Bioregion. Field surveys undertaken for this assessment identified large areas of this habitat type extending beyond the limits of the investigation area. The Project would remove 12.7 ha of Central Hunter Ironbark - Spotted Gum - Grey Box Forest EEC along the existing rail line, but would not impact areas of EEC that are at the limit of their known distribution.

- ***How is the proposal likely to affect current disturbance regimes?***

Current disturbance regimes operating at the Project site include weed invasion, fire frequency, flow and flooding regimes. The investigation area is currently highly fragmented due to large areas of cleared land for agricultural purposes. Levels of noxious and environmental weed invasion within native vegetation (excluding pasture grasses) in the investigation area were highest adjacent to the existing rail corridor, and within creeks and drainage lines. The groundcover within native vegetation occurring adjacent to the existing railway was also invaded by exotic grasses and weeds. The Project is not expected to result in an increase of weed invasion into native vegetation with the Development of a Weed Management Plan as part of a Flora and Fauna Management Plan would assist in minimising impacts of the Project.

It is not expected that the Project would modify the intensity and frequency of fires in the area.

The construction of the Project may result in changes to floodplain characteristics. This has the potential to impact floodplain function and increase flow conveyance during peak events. Patterns of flow may also change, potentially increasing erosion and affecting bank stability. However, this is unlikely to adversely affect Slaty Red Gum or EECs within the investigation area. Those EECs associated with creeks and low lying areas, such as Swamp Oak Floodplain Forest EEC and Freshwater Wetland EEC may be modified due to changes to floodplain regimes, but unlikely to be adversely affected.

- ***How is the proposal likely to affect habitat connectivity?***

The construction of the Project in widening the existing rail corridor would result in the incremental increase of fragmentation for the EECs and Slaty Red Gum, as these communities occur as remnants scattered around the rail corridor. Slaty Red Gum and the EECs are already fragmented into two parts by the existing railway. The Project would require the removal of vegetation along the existing edges that are already modified and disturbed by the existing rail corridor and agricultural activities.

Fragmentation effects are likely to be reduced through the implementation of mitigation measures aimed at encouraging the expansion of retained native vegetation, such as revegetation works and offsetting EEC and Slaty Red Gum habitat. Whilst increasing the rail corridor will add to the barrier effect, it is unlikely that it will substantially affect habitat connectivity for those species and communities which have already been impacted by loss of habitat connectivity due to the existing rail corridor. As outlined above, the Project would slightly increase the distance of separation of habitat, but not to the extent that exchange of genetic material would be significantly compromised.

- ***How is the proposal likely to affect critical habitat?***

The Project will not affect any critical habitat defined or listed under the TSC Act.

Conclusion

The Project would result in the clearing of Hunter Lowland Redgum Forest EEC, Lower Hunter Spotted Gum-Ironbark Forest EEC, Swamp Oak Floodplain Forest EEC, Freshwater Wetland EEC, Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC and Slaty Red Gum. The age and level of disturbance of stands to be cleared varies between young regrowth in disturbed agricultural areas, to mature regrowth with intact native vegetation. These vegetation types extend beyond the investigation area on private lands, with Hunter Lowland Red Gum Forest and Lower Hunter Spotted Gum-Ironbark Forest occurring within Belford National Park.

Whist the clearing would contribute on a small scale to further fragmentation, measures identified in this report and the Flora and Fauna Management Plan would assist in minimising impacts of the clearing. These would include minimising vegetation clearing, weed management plans and pre-clearance surveys to identify flora habitat of importance to be avoided, where possible. Additionally, areas of offsetting for EECs and Slaty Red Gum would be developed in the Compensatory Habitat Policy. This would be developed in consultation with DECCW with the aim to set aside known habitat for Slaty Red Gum and EECs within the locality of the Project, which would contribute to the long term conservation of these species and communities.

Based on the consideration of the above listed Part 3A impact criteria, the proposed measures incorporated into the Project to avoid, mitigate and offset impacts are likely to avoid significant impacts on the Slaty Gum and the Endangered Ecological Communities that occur within the investigation area.

Seven-Part Test Threatened Species Assessment

Seven-Part Tests have been undertaken in accordance with DECC's *Threatened species assessment guidelines: The assessment of significance* (DECC 2007) to determine the significance of impacts of the Project on threatened species and endangered ecological communities (EECs) listed on Schedules 1, 1A and 2 of the NSW *Threatened Species Conservation Act 1995* (TSC Act). The Assessment of Significance has been conducted for those EECs or species that were recorded or that are known or considered likely to occur in the investigation area.

Slaty Red Gum

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Project is unlikely to disrupt the lifecycle of Slaty Red Gum such that a viable local population of the species is likely to be placed at risk of extinction. 2.7 ha of dense stands and 50 scattered individual Slaty Red Gum (including intergrade forms of the species with *Eucalyptus tereticornis*) would be cleared for the Project out of estimated local population of over 1, 000, 000 trees within the Singleton Military Area (Hunter 2004 cited in Peake 2006), and is therefore not considered a key source population for dispersal and maintaining genetic diversity in the local area. Factors affecting the breeding cycle of the species would include pollinators and other impacts that may influence pollination and reproduction. The Project is not anticipated to have any impact on these.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable to this threatened species.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable for threatened species.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Examination of DECCW records for Slaty Red Gum within 10 km of the investigation area indicate the majority have been previously recorded between Singleton to Belford, with an estimated population of up to 1, 000, 000 Slaty Red Gum recorded on Singleton Military Area (Hunter 2004 cited in Peake 2006). 2.7 ha of dense stands and 50 scattered individual Slaty Red Gum (including intergrade forms) occur within the investigation area and are expected to be cleared for the Project. These areas are not considered to be important for the long-term survival of the species in the locality. This clearing would contribute on a small scale to further fragmentation.

Based on the above, it is considered unlikely that clearing of these areas of Slaty Red Gum would be considered significant in a local context or have a significant impact on the long-term survival of Slaty Red Gum.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this threatened species have been listed in the Register of Critical Habitat kept by the Director General of Department of Environment Climate Change and Water or the Register of Critical Habitat kept by the Director General of Department of Primary Industries.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

DECCW have not prepared any recovery plans for this species. No threat abatement plans are applicable to this species.

DECCW have developed draft Priorities Action Statements (PAS) for Slaty Red Gum. The broad objectives of the PAS are to promote the recovery of threatened species, populations and ecological communities and manage key threatening processes. The high priority PAS applicable to Slaty Red Gum include protection against clearing, fragmentation, grazing and fire. The Project would clear 2.7 ha of dense stands and 50 scattered individual Slaty Red Gum (including intergrade forms), however as outlined above this clearing is not expected to impact the lifecycle or recovery of this threatened species in the locality.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening process under the TSC Act and/or EPBC Act that would be applicable to Slaty Red Gum and the Project include:

- Clearing of native vegetation (TSC Act and EPBC Act)

Clearing for development and agriculture within known and potential habitat for Slaty Red Gum poses a threat to Slaty Red Gum. However, measures identified in this report would assist in minimising impacts of the clearing. These would include minimising vegetation clearing, weed management plans and pre-clearance surveys to identify Slaty Red Gum in the surrounding area to be avoided where possible.

- Invasion of native plant communities by exotic perennial grasses (TSC Act)

Numerous species of exotic perennial grasses were recorded in the investigation area, including Couch (*Cynodon dactylon*), Kikuyu (*Pennisetum clandestinum)*, Paspalum (*Paspalum dilatatum*), Rhodes Grass (*Chloris gayana*), Red Natal Grass (*Melinis repens*) and others. Many of these species are listed in the Final Determination for the threatening process (NSWSC 2003). These grasses occur in high density and abundance within the railway corridor section of the investigation area, but many species also occur in pasture areas. The potential threat to the native species and communities of the investigation area can be reduced as part of appropriate weed control measures during the rehabilitation of natural vegetation on areas of newly created bare soil.

- Infection of native plants by *Phytophthora cinnamomi* (TSC Act and EPBC Act)

None of the species or vegetation communities in the investigation area are specifically listed by the Final Determination for the threatening process (NSWSC 2002) as being particularly susceptible to this pathogen. However, any native plants could potentially be infected by the disease. Spores of the root-rot fungus *Phytophthora cinnamomi* could be introduced to the site on machinery or equipment that has been in a contaminated area, or in soil or fill imported to the site. Protocols should be established to ensure that machinery or fill brought in from off-site is certified to be free from the disease, or decontaminated before being allowed into the site.

- Invasion, establishment and spread of Lantana (TSC Act)

Lantana was recorded at various locations along the investigation area, in creeklines, eucalypt forests and within agricultural properties across the investigation area. There is the potential for Lantana to spread further into native vegetation following disturbance associated with the Project. This is of particular concern for riparian and rainforest areas. It is recommended that measures to minimise the potential threat of Lantana invasion and spread be incorporated into the CEMP for the Project, and include appropriate weed control measures during the rehabilitation of natural vegetation on areas of newly created bare soil.

Conclusion

2.7 ha of dense stands and 50 scattered individual Slaty Red Gum, including intergrade forms with *Eucalyptus tereticornis*, occur within the investigation area and are expected to be cleared for the Project. Whist the clearing would contribute on a small scale to further fragmentation, measures identified in this report and the Flora and Fauna Management Plan would assist in minimising impacts of the clearing. These would include minimising vegetation clearing, weed management plans and pre-clearance surveys to identify Slaty Red Gum to be avoided, where possible. Additionally, areas of offsetting for Slaty Red Gum would be developed in the Compensatory Habitat Policy. This would be developed in consultation with DECCW with the aim to set aside known habitat for the species within the locality of the Project, which would contribute to the long term conservation of Slaty Red Gum. These measures, taken together, are considered likely to at least maintain and possibly improve the overall conservation status of Slaty Red Gum in the locality.

Consequently, it is considered unlikely that the Project would result in a significant impact on the local population of Slaty Red Gum.

Endangered Ecological Communities

- Hunter Lowland Redgum EEC.
- Lower Hunter Spotted Gum-Ironbark Forest EEC.
- Swamp Oak Floodplain Forest EEC.
- Freshwater Wetlands EEC.
- Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable to endangered ecological communities.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable to endangered ecological communities.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Construction of the Project would impact the habitat of these EECs by removing the following:

- 23.3 ha of Hunter Lowland Redgum EEC.

Hunter Lowland Redgum Forest EEC occurs within and adjacent to the investigation area, including in Belford National Park (Hill and Peake 2005). This vegetation type was once widespread in the lower Hunter but has been extensively cleared since European settlement. The LHCCREMS (2003) extent of this vegetation type is estimated at 7 047 ha, of which the Project would clear 0.3 %.

- 14.9 ha of Swamp Oak Floodplain Forest EEC.

Swamp Oak Floodplain Forest EEC occurs within the investigation area around creeks and drainage lines. The remaining area of Swamp Oak Floodplain Forest is likely to represent much less than 30% of its original range in the Hunter (NSWSC 2005). The LHCCREMS (2003) extent of this vegetation type is estimated at 2 607 ha, of which the Project would clear 0.6 %.

- 13.2 ha of Lower Hunter Spotted Gum-Ironbark Forest EEC.

Lower Hunter Spotted Gum-Ironbark EEC occurs within and adjacent to the investigation area. The community occurs in large areas in Werakata National Park, approximately 5 km south of Allendale (DECCW 2009a). This vegetation type was once widespread in the lower Hunter but has been extensively cleared since European settlement. The LHCCREMS (2003) extent of this vegetation type is estimated at 31 286 ha, of which the Project would clear 0.04 %.

- 0.6 ha of Freshwater Wetlands EEC.

Freshwater Wetlands occur in small scattered areas along the edge of the investigation area. The remaining area of Freshwater Wetland Forest in the Hunter was estimated at less that 66% based on 1990 data (NSWSC 2004). The LHCCREMS (2003) extent of this vegetation type is estimated at 3900 ha, of which the Project would clear 0.02 %. Existing culverts leading from the wetland would be extended and would result in a similar flow to the existing environment. Indirect impacts to the freshwater wetland are therefore considered unlikely.

- 12.7 ha of Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.

Central Hunter Ironbark - Spotted Gum - Grey Box Forest occupies an area of less than 2000 km2 (NSW Scientific Committee 2009). It has been mapped as being recorded in Belford National Park and in the Singleton Military Area (NSWSC 2009). Mapped occurrences of the community include 34 remnants greater than 100 ha and more than 1000 small remnants less than 10 ha indicating a high level of fragmentation (Peake 2006). The mapped area of the community is approximately 18,300 ha which is estimated to be 29% of the pre-European distribution (Peake 2006). Clearing for the Project would therefore clear approximately 0.07 % of the known extent of this vegetation type.

It is considered unlikely that the Project would adversely effect or modify the extent of these ecological communities such that its local occurrence is likely to be placed at risk of extinction, on the basis that:

- These vegetation communities are mapped (LHCCREMS 2003) and known to extend well beyond the investigation area, with Hunter Lowland Redgum Forest EEC and Lower Hunter Spotted Gum-Ironbark Forest EEC conserved in large areas within Belford National Park and Werakata National Park, respectively.
- The areas of EEC to be cleared are located on the edge of the existing rail line easement and access tracks in areas that have been previously disturbed and invaded by exotic species.
- Mitigation measures relating to minimising the spread of weeds would be incorporated in the Construction Environmental Management Plan.
- Areas of offsetting for these EECs would be developed in the Compensatory Habitat Policy in consultation with DECCW with the aim to set aside known habitat for these EECs within the locality of the Project, which would contribute to the long term conservation of these communities.

Indirect impacts resulting from the Project also have the potential to modify these EECs. These include an increase in edge effects, weed invasion, polluted runoff and sedimentation. Development of weed management and revegetation strategies as part of the Environmental Assessment would assist in mitigating these impacts. Provided these measures are implemented, it is considered unlikely to disturb these EECs, or modify their composition to an extent that its local occurrence would be placed at risk of extinction.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Construction of the Project would impact the habitat of these EECs by removing the following:

- 23.3 ha of Hunter Lowland Redgum EEC (inclusive of 2.7 ha of Slaty Red Gum and 0.8 ha of Mountain Grevillea which forms part of the EEC).
- 13.2 ha of Lower Hunter Spotted Gum-Ironbark Forest EEC (inclusive of 0.8 ha of Mountain Grevillea which forms part of the EEC).
- 14.9 ha of Swamp Oak Floodplain Forest EEC.
- 0.6 ha of Freshwater Wetlands EEC.
- 12.7 ha of Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.

The clearing required for the Project would contribute on a small scale to further fragmentation. These communities are already separated and isolated due to the existing rail line and the Project would slightly increase this fragmentation by widening the corridor.

The age and level of disturbance of stands to be cleared varies between young regrowth in disturbed agricultural areas, to mature regrowth with intact native vegetation. All vegetation clearing would occur on the edge of the existing rail line. The degree of existing disturbance within the vegetation communities to be cleared varies and is mostly associated with edge effects and clearing for agricultural activities, roads and access tracks. These areas around the existing rail line are not considered integral to the long term survival of the EECs.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this endangered ecological community have been listed in the Register of Critical Habitat kept by the Director General of Department of Environment and Climate Change or the Register of Critical Habitat kept by the Director General of Department of Primary Industries.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Department of Environment, Climate Change and Water (DECCW) have not prepared any recovery plans for these EECs. No threat abatement plans are applicable to these EECs. However, DECCW have developed Priority Action Statements (PAS) for a range of threatened species and EECs. The broad objectives of the PAS are to promote the recovery of threatened species, populations and ecological communities and manage key threatening processes. The key priority actions for the above EECs are centered around protection of existing fragments, weed and fire control. Whilst the Project would clear a total of 81.7 hectares of EECs, the clearing would occur on the edge of an existing infrastructure easement within native vegetation in varying degrees of disturbance and weed invasion.

These vegetation types would be conserved in the Compensatory Habitat Policy and revegetation works which is consistent with the PAS for these EECs.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening process under the TSC Act and/or EPBC Act that would be applicable to these EECs and the Project include:

- Clearing of native vegetation (TSC Act and EPBC Act)

Clearing for development and agriculture within known and potential habitat for EECs poses a threat to these vegetation communities. However, measures identified in this report would assist in minimising impacts of the clearing. These would include minimising vegetation clearing, weed management plans and pre-clearance surveys to identify EECs in the surrounding area to be avoided where possible.

- Invasion of native plant communities by exotic perennial grasses (TSC Act)

Numerous species of exotic perennial grasses were recorded in the investigation area, including Couch (*Cynodon dactylon*), Kikuyu (*Pennisetum clandestinum)*, Paspalum (*Paspalum dilatatum*), Rhodes Grass (*Chloris gayana*), Red Natal Grass (*Melinis repens*) and others. Many of these species are listed in the Final Determination for the threatening process (NSWSC 2003). These grasses occur in high density and abundance within the railway corridor section of the investigation area, but many species also occur in pasture areas. The potential threat to EECs of the investigation area can be reduced as part of appropriate weed control measures during the rehabilitation of natural vegetation on areas of newly created bare soil.

- Infection of native plants by *Phytophthora cinnamomi* (TSC Act and EPBC Act)

None of the species or vegetation communities in the investigation area are specifically listed by the Final Determination for the threatening process (NSWSC 2002) as being particularly susceptible to this pathogen. However, any native plants could potentially be infected by the disease. Spores of the root-rot fungus *Phytophthora cinnamomi* could be introduced to the site on machinery or equipment that has been in a contaminated area, or in soil or fill imported to the site. Protocols should be established to ensure that machinery or fill brought in from off-site is certified to be free from the disease, or decontaminated before being allowed into the site.

- Invasion, establishment and spread of Lantana (TSC Act)

Lantana was recorded at various locations along the investigation area, in creeklines, eucalypt forests and within agricultural properties across the investigation area. There is the potential for Lantana to spread further into native vegetation following disturbance associated with the Project. This is of particular concern for riparian and rainforest areas. It is recommended that measures to minimise the potential threat of Lantana invasion and spread be incorporated into the CEMP for the Project, and include appropriate weed control measures during the rehabilitation of natural vegetation on areas of newly created bare soil.

Conclusion

Approximately 81.7hectares of EEC within a linear strip would be removed for the Project. The age and level of disturbance of stands to be cleared varies between young regrowth in disturbed agricultural areas, to mature regrowth with intact native vegetation. These vegetation communities extend well beyond the investigation area Whist the clearing would contribute on a small scale to further fragmentation, measures identified in this report and the Flora and Fauna Management Plan would assist in minimising impacts of the clearing. These would include minimising vegetation clearing, weed management plans and pre-clearance surveys to identify flora habitat of importance to be avoided, where possible. Additionally, areas of offsetting for EECs would be developed in the Compensatory Habitat Policy. This would be developed in consultation with DECCW with the aim to set aside known habitat for these EECs within the locality of the Project, which would contribute to the long term conservation of these and communities. These measures, taken together, are considered likely to at least maintain and possibly improve the overall conservation status of the relevant EECs in the locality and beyond.

Consequently, it is considered unlikely that the Project would result in a significant impact on Hunter Lowland Redgum EEC, Swamp Oak Floodplain Forest EEC, Lower Hunter Spotted Gum-Ironbark Forest EEC, Freshwater Wetlands EEC and Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC.

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Appendix C

Assessment of Impact on Nationally-listed Species and Ecological Communities

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Assessment of Significance under the EPBC Act

The field surveys undertaken for this assessment recorded Slaty Red Gum, listed as a vulnerable species under the EPBC Act. No other flora or EECs listed under the EPBC Act were recorded or are considered likely to be impacted by the Project in the investigation area.

In assessing whether a proposal or activity would significantly impact on a species, population or ecological community listed under the EPBC Act, reference is made to the criteria stipulated in the *Significant Impact Guidelines: Matters of National Environmental Significance* (DEH 2006).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of an important population of a species, or reduce the area of occupancy of an important population; or fragment an existing important population into two or more populations.*

An *important population* is defined as one that is necessary for a species' long-term survival and recovery, and includes:

- A key source population either for breeding or dispersal.
- A population that is necessary for maintaining genetic diversity. And/or:
- A population that is near the limit of the species' distribution range.

The Project would clear 2.7 ha of dense stands and 50 scattered individual Slaty Red Gum. Locally, DECCW (2009b) records indicate a population occurring from west of Lochinvar to Cessnock. This population intersects the investigation area and field surveys undertaken for this assessment recorded many individuals between these locations as discussed in this report. Another local population occurs approximately 20 km northeast of the investigation area. The population recorded during the field surveys appears to have an eastern-most limit of Lochinvar with Forest Red Gum (*Eucalyptus teretricornis*) becoming more dominant further east. The 2.7 ha and 50 individuals of Slaty Red Gum to be cleared for the Project includes intergrades of Slaty Red Gum with Forest Red Gum.

Whilst the Project would clear Slaty Red Gum from within the eastern-most limit of its distribution range, the Project would only clear individuals within the construction impact zone, with the species occurring outside the areas to be retained. The Project would not clear the only individuals of Slaty Red Gum that occur in the area. Additionally, the species is widespread in the Singleton Military Area where the population is estimated to comprise in the order of 1,000,000 individuals (Hunter 2004 cited in Peake 2006) indicating the species occurs well beyond the investigation area. This military area is located approximately 2 km from the western extent of the investigation area. This indicates a huge local population of the species and the proposed removal of habitat and trees proposed in the investigation area would be highly unlikely to result in long-term decline.

The species is already fragmented into two parts by the existing railway. The Project would remove incremental areas from the edges of side of the existing railway, which would slightly increase the distance of separation of the two parts, but not to the extent that exchange of genetic material would cease to occur. Development of offset areas and revegetation works would assist in minimising impacts on Slaty Red Gum by providing for long-term maintenance and protection of the species and its habitat.

- *Adversely affect habitat critical to the survival of a species*

Slaty Red Gum is known to occur in grassy woodland and dry eucalypt forests, on deep, moderately fertile and well-watered soils. The Project would clear suitable known and potential habitat for the species, including 2.7 ha and 50 individuals of the species within the investigation area. However, this area of habitat is not considered to be critical for the species as the species occurs in more concentrated areas west of the investigation area.

- *Disrupt the breeding cycle of an important population*

2.7 ha of dense stands and 50 individual Slaty Red Gum would be removed for the Project along the existing rail corridor. Factors affecting the breeding cycle of the species would include pollinators, seedbanks and other impacts that may influence pollination and reproduction. The Project would remove incremental areas from the edges of side of the existing railway, which would slightly increase the distance of separation of the two areas, but not to the extent that exchange of genetic material would cease to occur.

There is potential for dust to have an impact during construction of the Project, which may affect the pollination cycle. However, dust suppression measures would reduce this impact. Dust during operation is not expected to be substantially more than existing dust levels within the investigation area.

Pollinators are likely to be mobile species (such as birds and insects). The Project is not expected to hinder movements of these species in the locality as the new track is unlikely to provide any further barrier to terrestrial fauna than the existing rail corridor.

Seedbanks would be retained in areas of retained habitat and vegetation. Additionally, erosion and sedimentation controls would protect soils and seedbanks. Additionally, Slaty Red Gum appears to have good natural recruitment and regeneration within the investigation area with many juveniles observed during the field surveys undertaken for this assessment.

- *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The Project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Slaty Red Gum is likely to decline. The Project would clear 2.7 ha of dense stands and 50 individual Slaty Red Gum adjacent to the existing rail corridor. These areas are already fragmented, modified and disturbed by the existing rail corridor, agricultural activities and invaded by weeds. Areas of known habitat exist outside the investigation area and would not be impacted by the Project. These areas include remnant vegetation sites not subject to agriculture or clearing.

Proposed mitigation measures including weed control, erosion and sedimentation controls would minimise the potential for adverse indirect impacts on retained habitats and the development of a Compensatory Habitat Strategy would provide for long-term retention and protection of habitat within the locality.

- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; introduce disease that may cause the species to decline*

The Project is unlikely to result in an invasive or introduced species becoming established and/or introducing a disease that may cause the species to decline or interfering substantially with the recovery of Slaty Red Gum. Areas within the investigation area, in particular the rail corridor, are already highly disturbed and invaded by weed species. Measures outlined in a Weed Management Plan to be developed as part of the Flora and Fauna Management Plan would minimise the potential for further impacts.

- *Or interfere substantially with the recovery of the species*

It is considered unlikely that the Project would interfere substantially with the recovery of Slaty Red Gum. Slaty Red Gum appears to have good natural recruitment and regeneration within the investigation area with many juveniles observed during the field surveys undertaken for this assessment.

The development of offset areas aims to set aside known habitat for Slaty Red Gum within the locality of the Project. This would protect and maintain large areas of habitat which will substantially assist in the recovery of the species within the locality. The Compensatory Offset Strategy would complement the specific mitigation measures incorporated into the Project design and which would be implemented during the construction and operational phases of the development to further mitigate impacts and contribute to the maintenance and improvement of local and regional biodiversity values.

EPBC Act Assessment Conclusion

Based on the consideration of the above EPBC Act impact assessment criteria, the proposed measures incorporated into the Project to avoid, mitigate and offset impacts are likely to avoid significant impacts on the Slaty Gum within the investigation area. It is considered that the Project is unlikely to result in a significant impact on Slaty Red Gum listed as vulnerable under the EPBC Act.

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Appendix D

Flora Species List

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Family	*Botanical Name*	Common Name
ACANTHACEAE	*Pseuderanthermum variabile*	
ADIANTACEAE	*Adiantum aethiopicum*	Maiden Hair Fern
AMARANTHACEAE	*Alternanthera pungens**	Khaki Weed
ANACARDIACEAE	*Schinus areira*	Pepper Tree
ANTHERICACEAE	*Laxmannia gracilis*	Slender wire lily
APIACEAE	*Centella asiatica*	
APIACEAE	*Foeniculum vulgare**	Fennel
APIACEAE	*Hydrocotyle bonariensis**	Kurnell Curse
APIACEAE	*Hydrocotyle pedumcularis*	
APOCYNACEAE	*Asclepias fruticosa**	Balloon Cotton Bush
APOCYNACEAE	*Gomphocarpus fruticosus**	Narrow-leaf Cotton Bush
ASPARAGACEAE	*Asparagus asparagoides**	Bridal Creeper
ASPHODELACEAE	*Asphodelus fistulosus*	Onion Weed
ASTERACEAE	*Ambrosia sp.**	
ASTERACEAE	*Bidens pilosa**	Cobblers Pegs
ASTERACEAE	*Brachyscome multifida*	
ASTERACEAE	*Schinus ariera*	
ASTERACEAE	*Cassinina sp*	
ASTERACEAE	*Chrysanthemoides semipapposum*	Yellow Buttons
ASTERACEAE	*Cirsium vulgare**	Spear thistle
ASTERACEAE	*Conyza sp**	Fleabane
ASTERACEAE	*Cotula australis*	Carrot weed
ASTERACEAE	*Hypochaeris radicata**	Cats Ear / Flatweed

Family	*Botanical Name*	Common Name
ASTERACEAE	*Onopordum acanthium**	Scotch Thistle
ASTERACEAE	*Ozothamnus diosmifolius*	Dogwood, Rice flower
ASTERACEAE	*Senecio madagascariensis**	Fireweed
ASTERACEAE	*Sonchus oleraceus**	Milk Thistle
ASTERACEAE	*Tagetes minuta**	Stinking Rodger
ASTERACEAE	*Taraxacum officinale**	Dandelion
ASTERACEAE	*Vittadinia cuneata var cuneata*	Fuzz Weed
CACTACEAE	*Opuntia stricta var. stricta**	Prickly pear
CACTACEAE	*Opuntia aurantica**	Tiger Pear
CAMPANULACEAE	*Wahlenbergia communis*	Tufted Bluebell
CAMPANULACEAE	*Wahlenbergia gracilis*	Australian Bluebell
CAMPANULACEAE	*Wahlenbergia gracilis*	
CAMPANULACEAE	*Wahlenbergia communis*	
CARYOPHYLLACEAE	*Petrohagia velutina*	
CASUARINACEAE	*Allocasuarina leuhmanii*	BullOak
CASUARINACEAE	*Casuarina glauca*	Swamp Oak
CHENOPODIACEAE	*Einadia trigonos*	Fishweed
CHENOPODIACEAE	*Enchylaena tomentosa*	Ruby Salt Bush
COMMELINACEAE	*Tradescantia albiflora**	Trad
CONVOLVULACEAE	*Dichondra repens*	Kidney Weed
CRASSULACEAE	*Bryophyllum delagoense*	Mother-of-millions
CYPERACEAE	*Bolboschoenus caldwellii*	
CYPERACEAE	*Carex appressa*	Tall Sedge

Family	*Botanical Name*	Common Name
CYPERACEAE	*Cyperus eragrostis**	
CYPERACEAE	*Cyperus sanguinolentus*	
CYPERACEAE	*Eleocharis gracilis*	
CYPERACEAE	*Eleocharis sphaceolata*	
CYPERACEAE	*Lepidosperma laterale*	
CYPERACEAE	*Schoenoplectus mucronatus*	
DENNSTAEDTIACAEA	*Hypolepis muelleri*	Harsh Ground Fern
DENNSTAEDTIACEAE	*Pteridium esculentum*	Bracken
DILLENIACEAE	*Hibbertia scandens*	Trailing Guinea Flower
DROSERACEAE	*Drosera pelata*	
ERIACEAE	*Leucopogon juniperinus*	
EUPHORBIACEAE	*Breynia oblongifolia*	Coffee Bush
EUPHORBIACEAE	*Phyllanthus hirtellus*	Thyme spurge
EUPHORBIACEAE	*Ricinus communis**	Castor oil plant
FABACEAE- FABOIDEAE	*Daviesia ulicifolia*	
FABACEAE- FABOIDEAE	*Desmodium varians*	
FABACEAE- FABOIDEAE	*Erythrina sykesii**	Coral Tree
FABACEAE- FABOIDEAE	*Glycine clandestina*	
FABACEAE- FABOIDEAE	*Glycine tabacina*	Love Creeper
FABACEAE- FABOIDEAE	*Hardenbergia violacea*	Purple Twining-pea
FABACEAE- FABOIDEAE	*Jacksonia scoparia*	Jacksonia
FABACEAE- FABOIDEAE	*Kennedia rubicinda*	
FABACEAE- FABOIDEAE	*Oxylobium cordifolium*	Heart-leaved Shaggy Pea

Family	*Botanical Name*	Common Name
FABACEAE- FABOIDEAE	*Pultenaea spinosa*	Spiny Bush-pea
FABACEAE- FABOIDEAE	*Trifolium repens**	White Clover
FABACEAE-MIMOSOIDEAE	*Acacia falcata*	
FABACEAE-MIMOSOIDEAE	*Acacia fimbriata*	
FABACEAE-MIMOSOIDEAE	*Acacia implexa*	Hickory
FABACEAE-MIMOSOIDEAE	*Acacia irrorata*	
FABACEAE-MIMOSOIDEAE	*Acacia longifolia var sophorae*	
FABACEAE-MIMOSOIDEAE	*Acacia parvipinnula*	Silver-stemmed wattle
FUMARIACEAE	*Fumaria muralis spp muralis**	Fumitory
GOODENIACEAE	*Goodenia hederacea*	Forest goodenia
JUNCACEAE	*Juncus acutus**	Spiny Rush
JUNCACEAE	*Juncus usitatus*	Common Rush
JUNCAGINACEAE	*Trigolchin procerum*	Water Ribbons
LAURACEAE	*Cinnamomum camphora**	Camphor Laurel
LOBELIACEAE	*Pratia purpurascens*	White Root
LOMANDRACEAE	*Lomandra multiflora*	Many flowered mar-rush
LOMANDRACEAE	*Lomandra longifolia*	Spiny-headed Mat-Rush
LOMANDRACEAE	*Lomandra filiformis*	A Mat-rush
LUZURIAGACEAE	*Eustrephus latifolius*	Wombat Vine / berry
MALVACEAE	*Modiola caroliniana**	Redflowered Mallow
MALVACEAE	*Sida rhombifolia**	Paddy's Lucerne
MYOPORACEAE	*Eremophila debilis*	Winter apple
MYOPORACEAE	*Myoporum* sp.	

Family	*Botanical Name*	Common Name
MYRTACEAE	*Angophora floribunda*	Rough-barked Apple
MYRTACEAE	*Callistemon rigidis*	
MYRTACEAE	*Corymbia maculata*	Spotted Gum
MYRTACEAE	*Eucalyptus crebra*	Narrow leaved ironbark
MYRTACEAE	*Eucalyptus acmenoides*	White mahogany
MYRTACEAE	*Eucalyptus fibrosa*	Broad-leaved red ironbark
MYRTACEAE	***Eucalyptus glaucina***	**Slaty Red Gum**
MYRTACEAE	*Eucalyptus moluccana*	Grey box
MYRTACEAE	*Eucalyptus paniculata*	Grey Ironbark
MYRTACEAE	*Eucalyptus resinifera*	Red Mahogany
MYRTACEAE	*Eucalyptus siderophloia*	Grey Ironbark
MYRTACEAE	*Eucalyptus tereticornis*	Forest Red Gum
MYRTACEAE	*Eucalyptus umbra*	White Mahogany
MYRTACEAE	*Leptospermum juniperinum*	Heath Tea-tree
MYRTACEAE	*Leptospermum polygalifolium*	Lemon-scented Tea-tree
MYRTACEAE	*Melaleuca decora*	
MYRTACEAE	*Melaleuca linariifolia*	Snow-in-Summer
MYRTACEAE	*Melaleuca nodosa*	
MYRTACEAE	*Melaleuca stypheloides*	Prickly-leaved Paperbark
OLEACEAE	*Ligustrum sinense**	Small Leaf Privet
OLEACEAE	*Notolea longifolia*	Mock Olive
OLEACEAE	*Olea europae cuspidataa**	African Olive
OLEACEAE	*Olea europaea**	Common Olive

Family	*Botanical Name*	Common Name
ONAGRACEAE	*Ludwigia peploides subsp. montevidensis**	Water primrose
ORCHIDACEAE	*Caladenia catenata*	
ORCHIDACEAE	*Diuris punctata*	Purple donkey orchid
ORCHIDACEAE	*Thelymitra decora*	Sun Orchid
OXALIDACEAE	*Oxalis sp.*	
PAPAVERACEAE	*Argemone ochroleuca**	Mexican Poppy
PHORMIACEAE	*Dianella caerulea var. caerulea*	
PHORMIACEAE	*Dianella caerulea var cinerascens*	
PHORMIACEAE	*Dianella revoluta*	
PHORMIACEAE	*Stypandra glaucai*	Nodding blue lily
PITTOSPORACEAE	*Bursaria spinulosa*	
PITTOSPORACEAE	*Pittosporum undulatum*	Sweet Pittosporum
PLANTAGINACEAE	*Plantago lanceolata**	Common Plantain
POACEAE	*Aristida vagans*	Three-awn speargrass
POACEAE	*Austrodanthnia sp*	A Wallaby Grass
POACEAE	*Briza maxima**	Blow-flow Grass
POACEAE	*Briza minor**	Shivery Grass
POACEAE	*Chloris gayana**	Rhodes Grass
POACEAE	*Chloris ventricosa*	Pump Windmill Grass
POACEAE	*Cortaderia selloana**	Pampas Grass
POACEAE	*Cymbopogon refractus*	Barbed-wire Grass

Family	*Botanical Name*	Common Name
POACEAE	*Cynodon dactylon**	Common Couch
POACEAE	*Digitaria sanguinalis**	Summer Grass
POACEAE	*Echinopogon ovatus*	Hedgehog Grass
POACEAE	*Ehrharta erecta**	Panic Veldtgrass
POACEAE	*Entolasia marginata*	
POACEAE	*Entolasia stricta*	
POACEAE	*Eragrostis brownii*	Brown's Love Grass
POACEAE	*Grevillea montana*	Mountain grevillea
POACEAE	*Grevillea robusta*	Silky oak
POACEAE	*Hyparrhenia hirta**	Coolati Grass
POACEAE	*Imperata cylindrica*	Blady Grass
POACEAE	*Lolium sp**	Rye Grass
POACEAE	*Melinis repens**	Red Natal Grass
POACEAE	*Microlaena stipoides*	Weeping Meadow Grass
POACEAE	*Oplismenus aemulus*	Basket Grass
POACEAE	*Oplismenus imbeccilis*	
POACEAE	*Panicum simile*	Two-colour Panic
POACEAE	*Paspalum dilatatum**	Paspalum
POACEAE	*Paspalum urvillei**	Vasey Grass
POACEAE	*Pennisetum clandestinum**	Kikuyu
POACEAE	*Phragmites australis*	
POACEAE	*Poa labillardieri*	Tussock Grass
POACEAE	*Setaria gracilis**	Slender Pigeon Grass

Family	*Botanical Name*	Common Name
POACEAE	*Sporobolus sp*	
POACEAE	*Stenotaphrum secundatum**	Buffalo Grass
POACEAE	*Themeda australis*	Kangaroo Grass
POACEAE	*Triticum aestivum**	Common Wheat
POLYGONACEAE	*Persicaria decipiens*	Slender Knotweed
POLYGONACEAE	*Persicaria hydropiper*	Knotweed
POLYGONACEAE	*Rumex brownii**	Swamp Dock
POLYGONACEAE	*Rumex crispus**	Curly-leaved Dock
PRIMULACEAE	*Anagallis arvensis**	Scarlet Pimpernel
PROTEACEA	*Persoonia linearis*	Narrow-leaf Geebung
PROTEACEAE	***Grevillea montana***	
PROTEACEAE	*Grevillea robusta*	
PROTEACEAE	*Hakea sericea*	Needlebush
RANUNCULACEAE	*Ranunculus inundatus*	River Buttercup
RANUNCULACEAE	*Ranunculus sceleratus**	Celery Buttercup
ROSACEAE	*Rubus fruticosus aggregate**	Blackberry
RUBIACAE	*Pomax umbellata*	
RUBIACEAE	*Galium aparine**	Cleavers / Goosegrass
RUBIACEAE	*Galium sp*	Bedstraw
RUBIACEAE	*Richardia brasiliensis**	Mexican Clover
RUTACEAE	*Acronychia oblongifolia*	White Aspen
SALICACEAE	*Salix babylonica**	Weeping Willow
SCHIZAEACEAE	*Cheilanthes sieberi*	Mulga Fern

Family	*Botanical Name*	Common Name
SCROPHULARIACEAE	*Veronica calycina*	Hairy Speedwell
SCROPHULARIACEAE	*Veronica plebeia*	Trailing speedwell
SOLANACEAE	*Cestrum parqui**	
SOLANACEAE	*Lycium ferocissimum**	African boxthorn
SOLANACEAE	*Solanum nigrum**	Blackberry Nightshade
SOLANACEAE	*Solanum prinophyllum**	Forest night shade
SOLANACEAE	*Solanum pseudocapsicum**	Madiera Winter Cherry
TYPHACEAE	*Typha orientalis*	Broadleaf Cumbungi
VERBENACEAE	*Lantana camara**	Lantana
VERBENACEAE	*Verbena bonariensis**	Purple top
VERBENACEAE	*Verbena rigida**	Veined Verbena
VIOLACEAE	*Viola hedercea*	Native Violet
VITACEAE	*Cayratia clematidea*	Native Grape

Key

* = Introduced species

** = Noxious Weed

Bold = Threatened species listed on the TSC Act and/or EPBC Act and/or RoTAP species.

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Appendix E

Actions Required in Relation to Notifiable Weeds Pursuant to the Noxious Weeds Act 2003

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Section 8 of the amended *Noxious Weeds Act* 1993 classifies noxious weeds into 5 weed control classes as follows:

(a) Class 1 - State Prohibited Weeds.

(b) Class 2 - Regionally Prohibited Weeds.

(c) Class 3 - Regionally Controlled Weeds.

(d) Class 4 - Locally Controlled Weeds.

(e) Class 5 - Restricted Plants.

The characteristics of each class are as follows:

(a) Class 1 noxious weeds are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.

(b) Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.

(c) Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.

(d) Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.

(e) Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

A noxious weed that is classified as a Class 1, 2 or 5 noxious weed is referred to in the Act as a "notifiable weed".

The relevant sections of the Act that define the actions required in relation to notifiable weeds are reproduced below:

Section 15: An occupier of land (other than a local control authority) on which there is a notifiable weed must notify the local control authority for the land of that fact within 3 days after becoming aware that the notifiable weed is on the land. *Maximum penalty (for an occupier other than a public authority): 20 penalty units.*

Section 16: For the purpose of proving in any prosecution under section 15 (1) that an occupier of land was aware that a notifiable weed was located on the land, if it is proved that the occupier or an employee of the occupier or other person using the land ought reasonably to have known that a notifiable weed was located on the land, that is evidence that the occupier was aware that it was on the land.

Section 28:

(1) A person (including a public authority) must not sell or purchase:

(a) Any notifiable weed material or other noxious weed material prescribed by the regulations.

(b) Any animal or thing which has on it, or contains, notifiable weed material or other noxious weed material prescribed by the regulations, knowing it to be, or to have on it or to contain, any such weed material.

(2) An occupier of land (including a public authority) must not knowingly remove or cause to be removed from the land any animal or thing which has on it, or contains, notifiable weed material or other noxious weed material prescribed by the regulations. Maximum penalty: 50 penalty units.

(3) Notifiable weed material:

(a) In subsection (1) extends to the weed material of a weed that is a notifiable weed in any part of the State.

(b) In subsection (2) is limited to the weed material of a weed that is a notifiable weed in that part of the State that includes the land that is relevant for the purposes of that subsection.

Section 29: An occupier of land (including a public authority) must not use or permit the land to be used for the purpose of disposing of, transporting or selling soil, turf or fodder, if the occupier knows, or ought reasonably to know, that there is a weed on the land that is a notifiable weed in any part of the State. *Maximum penalty: 50 penalty units*.

Section 40: An inspector who has reasonable cause to suspect that notifiable weed material of a weed that is a notifiable weed in any part of the State is or may be present in an agricultural machine may require the person apparently in charge of the machine to treat the machine immediately, in the manner specified by the inspector, to remove any such weed material.

For further information about notifiable noxious weeds, contact: Weeds Hotline 1800 680 244 or email: weeds@dpi.nsw.gov.au.

Appendix F

Additional Figures

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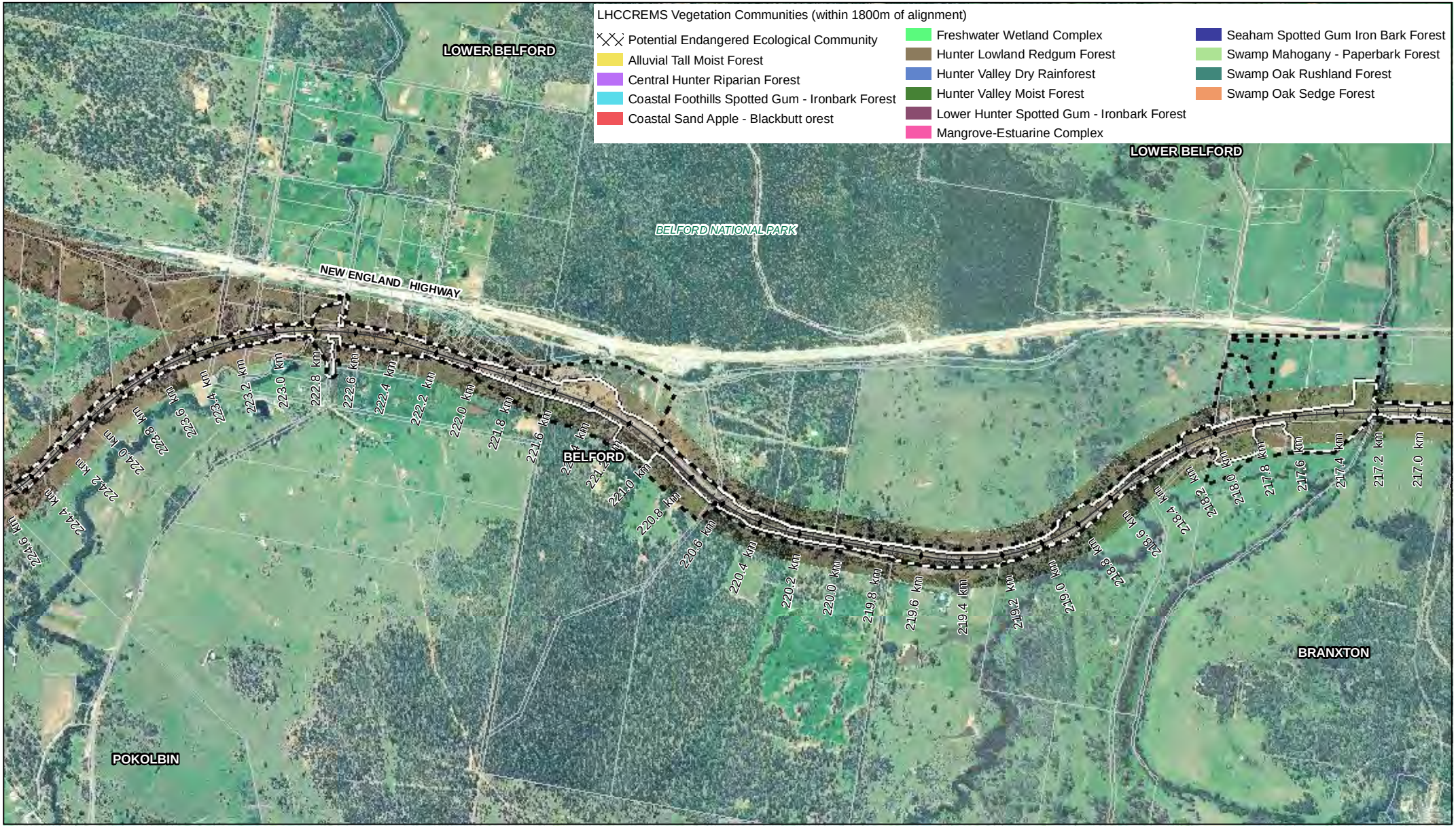

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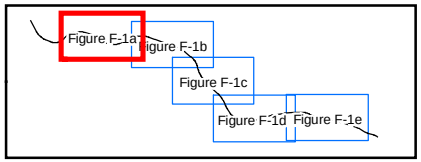
LEGEND
- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone



Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

LHCCREMS Vegetation Mapping of the Investigation Area

Figure F-1a

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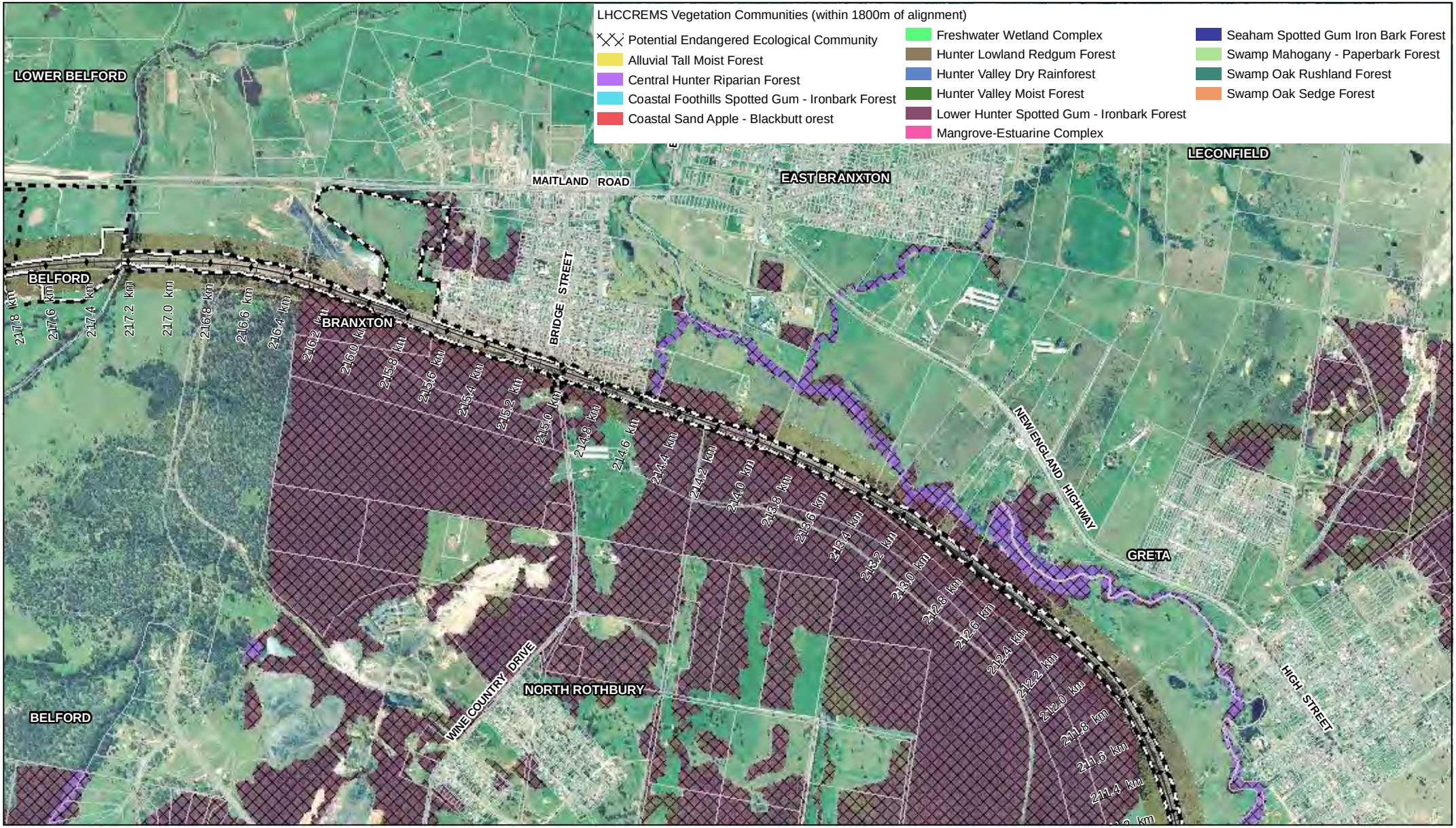
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial & Cadastre - 2005; Fugro: Aerial - 2008; Department of Lands: LHCCREMS Vegetation - 2005. Created by: fmackay, tmorton



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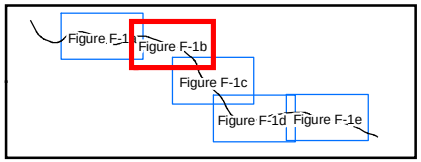

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Flora and Aquatic Ecological Assessment

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Revision A
Date MAY 2010

LHCCREMS Vegetation Mapping of the Investigation Area

Figure F-1b

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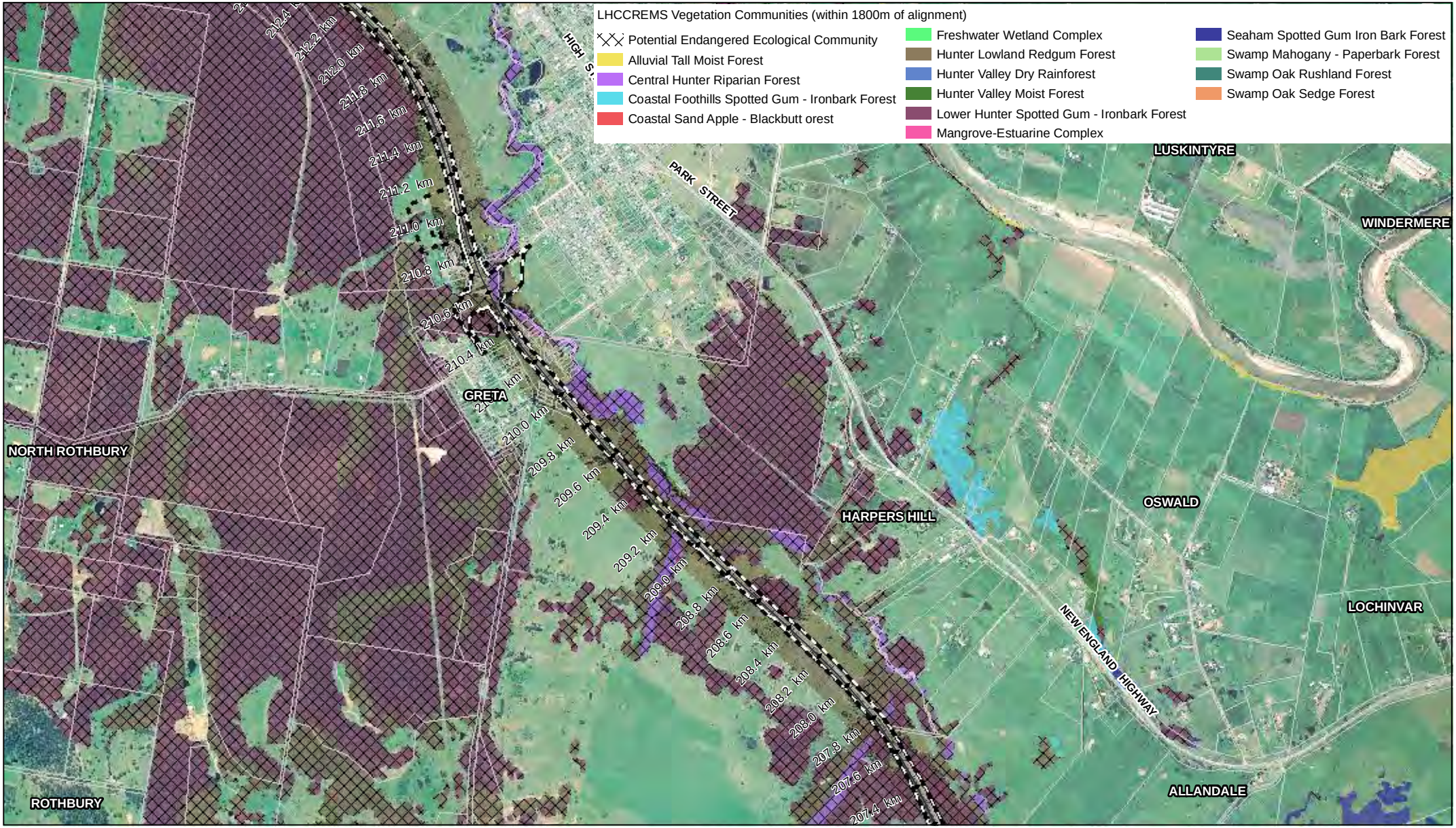

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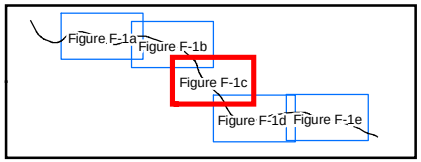

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

LHCCREMS Vegetation Mapping of the Investigation Area

Figure F-1c

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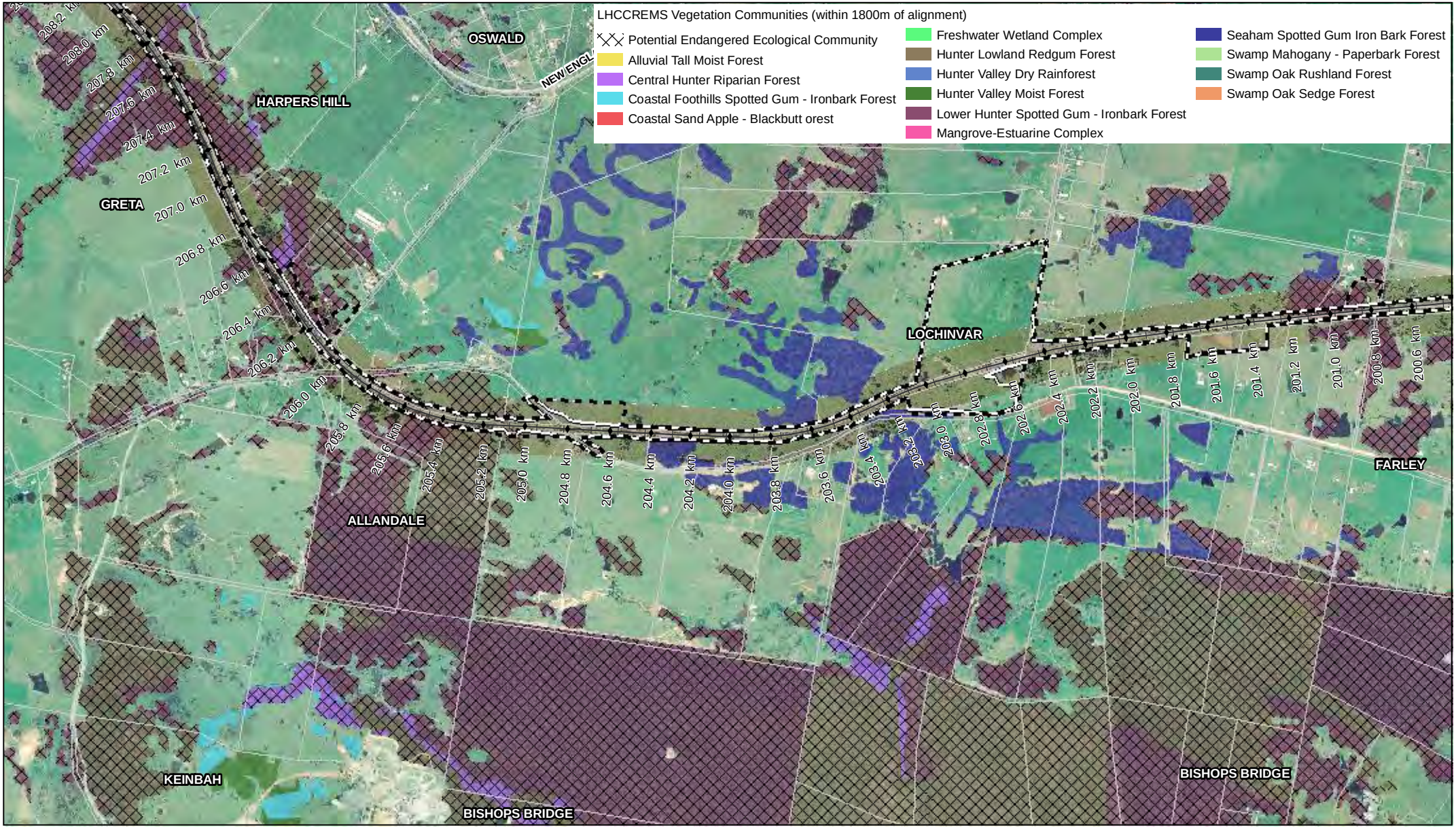

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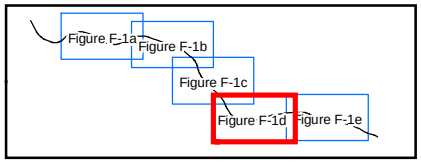

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

LHCCREMS Vegetation Mapping of the Investigation Area

Figure F-1d

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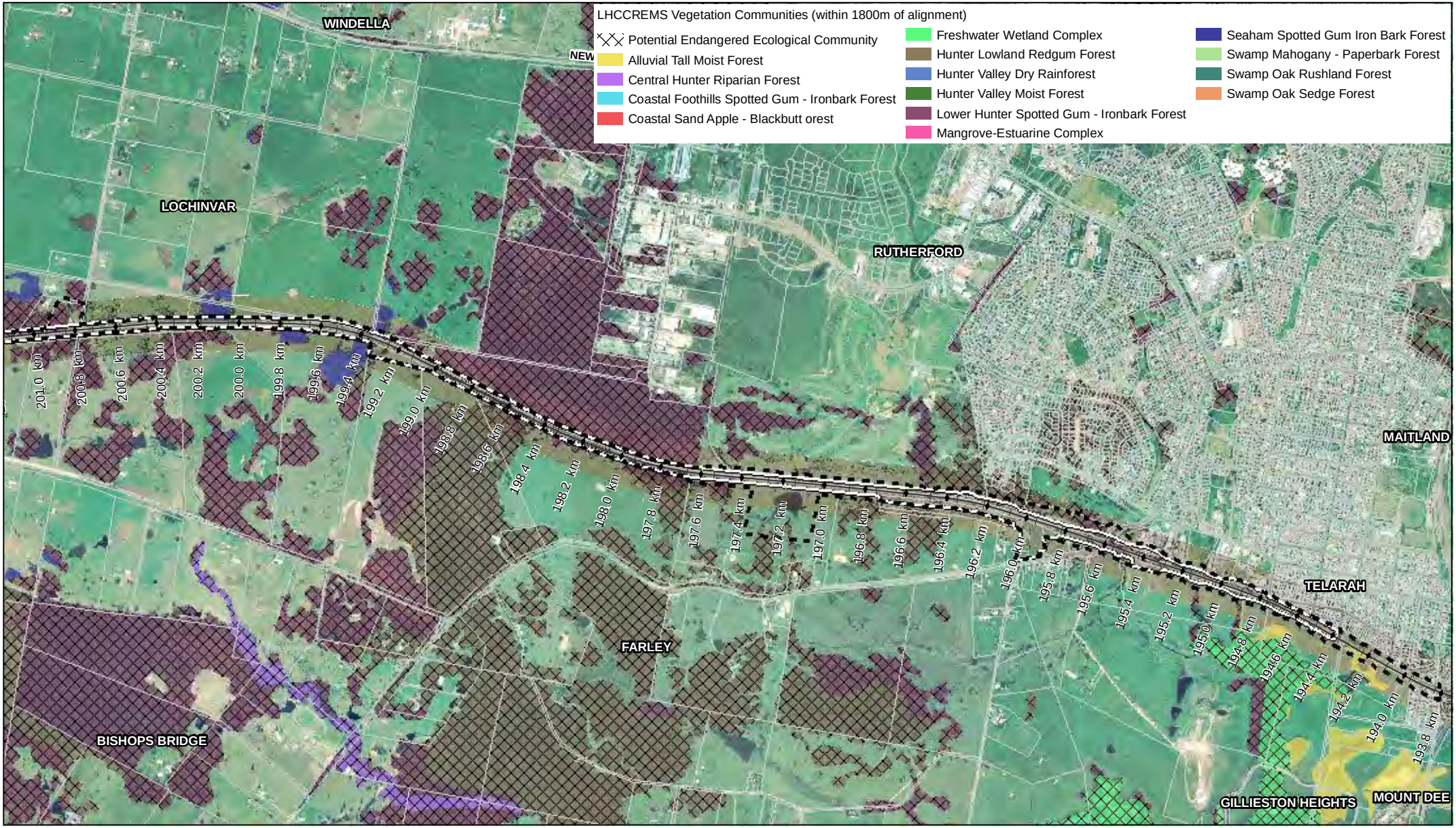

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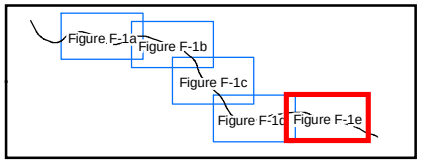
- Investigation Area
- Construction Impact Zone



Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

Job Number 22-14471
Revision A
Date MAY 2010

LHCCREMS
Vegetation Mapping
of the Investigation Area

Figure F-1e

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_LHCCREMS_20091203_A.mxd
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Department of Lands: Aerial & Cadastre - 2005; Fugro: Aerial - 2008; Department of Lands: LHCCREMS Vegetation - 2005. Created by: fmackay, tmorton

1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Cessnock City Council Vegetation

- Dry Sclerophyll Shrub/Grass Forests
- Freshwater Wetlands
- Sclerophyll Grassy Woodlands
- Semi-mesic Forests

Maitland to Minimbah Third Track
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Cessnock City Council Vegetation Mapping of the Investigation Area

Figure F-2a

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_CCCVegetation_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Cessnock City Council: Vegetation mapping - 2004. Created by: fmackay, tmorton

1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Cessnock City Council Vegetation

- Dry Sclerophyll Shrub/Grass Forests
- Freshwater Wetlands
- Sclerophyll Grassy Woodlands
- Semi-mesic Forests

Hunter ALLIANCE

Maitland to Minimbah Third Track
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Cessnock City Council Vegetation Mapping of the Investigation Area

Figure F-2b

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Data Source: Geoscience Australia: Topography - 2002; Cessnock City Council: Vegetation mapping - 2004. Created by: fmackay, tmorton

1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Cessnock City Council Vegetation

- Dry Sclerophyll Shrub/Grass Forests
- Freshwater Wetlands
- Sclerophyll Grassy Woodlands
- Semi-mesic Forests

Hunter ALLIANCE

Maitland to Minimbah Third Track
Flora and Aquatic Ecological Assessment

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Cessnock City Council Vegetation Mapping of the Investigation Area

Figure F-2c

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_CCCVegetation_20091203_A.mxd

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Data Source: Geoscience Australia: Topography - 2002; Cessnock City Council: Vegetation mapping - 2004. Created by: fmackay, tmorton

1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Cessnock City Council Vegetation

- Dry Sclerophyll Shrub/Grass Forests
- Freshwater Wetlands
- Sclerophyll Grassy Woodlands
- Semi-mesic Forests

Hunter ALLIANCE

Maitland to Minimbah Third Track
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Cessnock City Council Vegetation Mapping of the Investigation Area

Figure F-2d

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_CCCVegetation_20091203_A.mxd

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Data Source: Geoscience Australia: Topography - 2002; Cessnock City Council: Vegetation mapping - 2004. Created by: fmackay, tmorton

1:25,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Railway
- Cadastre
- Investigation Area
- Construction Impact Zone

Cessnock City Council Vegetation

- Dry Sclerophyll Shrub/Grass Forests
- Freshwater Wetlands
- Sclerophyll Grassy Woodlands
- Semi-mesic Forests

Hunter ALLIANCE

Maitland to Minimbah Third Track
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Cessnock City Council Vegetation Mapping of the Investigation Area

Figure F-2e

G:\22\14471\GIS\Maps\Deliverables\EA\Ecology Specialist Report\ESR_CCCVegetation_20091203_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: Geoscience Australia: Topography - 2002; Cessnock City Council: Vegetation mapping - 2004. Created by: fmackay, tmorton