11 Nature Conservation: Terrestrial Flora

11.1 Introduction

11.1.1 Background and scope

This chapter reviews the existing vegetation within and adjacent to the project (and related infrastructure) and provides an assessment of potential impacts that will need to be mitigated throughout the design, construction, operation and decommissioning phases of the development.

The project traverses conservation areas (including two national parks) and areas of remnant vegetation. It also traverses modified and developed areas including small rural townships, residential areas, open fields and plantations. The majority of remaining vegetation within the project area is of good quality and as such it has been mapped as remnant vegetation by the Queensland Herbarium and afforded protection under the *Vegetation Management Act 1999* (VMA). The vegetation is concentrated along creeks, ridgelines and within protected areas. These areas have not yet been affected by clearing or urban development. Twenty regional ecosystems will be affected by the project. Of these, three regional ecosystems are 'Endangered' and seven are 'Of Concern'. Several significant flora species that are protected under the *Nature Conservation Act 1992* (NC Act) *or Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are also known from the local area.

11.1.2 Aims

There are essentially three parts to the impact assessment process: establishing baseline data, utilising that information to predict the impacts of the development on existing local conditions and developing appropriate mitigation measures. The specific aims of the baseline investigations were to:

- validate current vegetation mapping and check for the presence of remnant vegetation with the following conservation values:
  - Threatened ecological communities under Commonwealth legislation (EPBC Act)
  - Endangered, Of Concern and not Of Concern Regional Ecosystems (REs) under State legislation *(*VMA*)*
- identify major areas of regrowth or restoration
- identify any plant communities of cultural, commercial or recreational significance
- identify any major weed infestations, particularly those declared under the *Land Protection (Pest and Stock Route Management) Act 2002*
- ascertain the possible presence and/or likely habitat of Rare and Threatened species under Commonwealth and State legislation
- identify other impacts to terrestrial vegetation not covered by the above legislation.

11.1.3 Relevant legislation and policy

A large proportion of the vegetation within the project area is recognised as being significant for conservation under Commonwealth, State or local legislation and policies. The legislation and policies target both vegetation communities and flora species that may be considered under threat. The relevant Commonwealth, State and local legislation or policies are tabulated in **Table 11.1.3**:

Table 11.1.3: Relevant Commonwealth, State and local legislation or policies

Legislation	Implications	Level
Environment Protection Biodiversity Conservation Act 1999 (EPBC *Act*)	This Act aims to protect Threatened vegetation communities and species. It requires referral to the federal government for development that may impact listed communities or species, or areas (Matters of National Environmental Significance).	Commonwealth
Nature Conservation Act 1992 (NC Act) (and Regulations and Conservation Plans)	This Act aims to protect Threatened species and recognised conservation areas. It requires application to the Department of Environment and Resource Management for harm to Threatened flora species.	Queensland
Land Protection (Pest and Stock Route Management) Act 2002 (LP Act)	This Act defines noxious weeds, which are formally referred to in the Act as Declared Plants. It requires management of some Declared Plants.	Queensland
Vegetation Management Act 1999 (VMA)	This Act aims to halt broad scale clearing in Queensland and protect mapped remnant vegetation from unauthorised clearing. It recognises regional ecosystems and has a vegetation community focus. It requires an application to the Department of Environment and Resource Management for clearing of assessable vegetation.	Queensland
Integrated Planning Act 1997 (IPA)	This Act co-ordinates the various Acts described here with other legislation, particularly the local government legislation.	Queensland

Table 11.1.3: continued

Legislation	Implications	Level
Natural Resources Strategy (Maroochy Plan 2000)	This strategy identifies parcels of land for 'Conservation' and 'Rural or Valued Habitat' within the Strategic Plan. These areas have a preferred non-urban use and area associated with vegetation worthy of preservation and significant habitats and wildlife corridors.	Sunshine Coast Regional Council [1]
Code for Nature Conservation and Biodiversity (Maroochy Plan 2000)	This code guides development within the local area with relation to vegetation management. It is associated with a map showing Nature Conservation Management Units, which relate to various vegetation communities.	Sunshine Coast Regional Council
Local Law 19 (Vegetation Protection)	This local law requires a written application prior to clearing in vegetated areas that have been identified (and mapped) as being significant to the local area.	Sunshine Coast Regional Council
Maroochy Biodiversity Strategy 2006	This strategy has three parts. It assesses the natural values of the shire and threats to them. It then evaluates plans and programs operating within Council with respect to protecting these existing natural values. The strategy maps areas of core habitat, mosaic and linkages. It also indicates which of these areas are under threat from urban development.	Sunshine Coast Regional Council
Habitat and Biodiversity Code (Caloundra City Plan 2004)	This code guides development in the local area with respect to conservation of significant vegetation, habitat areas and wildlife corridors. It is associated with maps indicating the location of these features.	Sunshine Coast Regional Council
Local Law 14 (Clearing of Vegetation)	This local law requires a written application prior to clearing in vegetated areas. It applies to vegetation with a circumference of 70 cm or more (at 1 m above ground) and vegetation within 10 m of a watercourse.	Sunshine Coast Regional Council
Caloundra City Biodiversity Strategy 2006	This strategy describes the existing natural values of the city and threats to them. It then makes recommendations for regulations and programs for Council to enact to achieve a sustainable outcome for biodiversity in the city.	Sunshine Coast Regional Council

11.2 Methodology

11.2.1 Review of existing information

Information about the project area was readily available due to work that has already been carried out in the region by various government and private bodies for other projects. It was possible to utilise some of this information in a desktop review of the project area.

Information review (existing reports)

A number of reports pertaining to the project area and surrounds were assessed for relevance and used for general background information, including:

- *South East Queensland Infrastructure Plan and Program* 2008 – 2026
- Landsborough to Nambour Rail Corridor Study – Route Identification Report (2008), undertaken for Queensland Transport, now the Department of Transport and Main Roads.

Spatial data (mapping)

A number of Geographical Information System (GIS) datasets, including the project, were overlaid on rectified aerial photography. The datasets were:

- rectified aerial photography (2007)
- cadastre (Department of Environment and Resource Management, 2007)
- Regional Ecosystem (RE) vegetation mapping by the Queensland Herbarium (Version 5.0 with Dec 2006 Amendments) (Department of Environment and Resource Management, 2005)
- Essential Habitat mapping (Version 5.0 with Dec 2006 Amendments) (Department of Environment and Resource Management, 2005)
- Biodiversity Planning Assessment (BPA) mapping (Version 3.4 – 7th March 2005) (Department of Environment and Resource Management, 2005c)
- WetlandMaps (Department of Environment and Resource Management, 2008).

Additional mapping resources included:

- street directory covering Sunshine Coast area (Gregory's 2007)
- Caloundra City Plan 2004, Habitat and Biodiversity Code overlay mapping
- Maroochy Plan 2000, Nature Conservation and Biodiversity Code overlay mapping.

1 *The project area is within the Sunshine Coast Regional Council (an amalgamation of the former Caloundra, Maroochy and Noosa Shire Councils). The Sunshine Coast Regional Council currently refers to the separate planning schemes and strategies associated with the previous local government areas. Hence, there are local plans and strategies from both Maroochy Shire Council and Caloundra City Council that are relevant to the assessment of vegetation within the project area.*

Regional Ecosystem (Department of Environment and Resource Management, 2005b) (RE) mapping was used to locate the larger patches of native vegetation intersected by the corridor. Air photo interpretation was used to identify any other unmapped patches of native vegetation. Remnant REs were sampled in representative locations along the entire length of the proposed corridor, with the exception of those private properties where access was not granted. Each area of remnant vegetation intersected by the corridor was observed in at least one place, if on RE mapping (Department of Environment and Resource Management 2005b), or if the remnant was of sufficient size or width to be mappable according to Queensland Herbarium mapping methodology (Department of Environment and Resource Management, 2005a). This was done to verify the mapping, and to check for targeted Rare or Threatened flora species known to occur in the area.

Public databases

Two publicly accessible databases with restricted location precision were searched to identify Rare or Threatened flora known to occur, or to have occurred, in the project area and surrounds. Both Rare and Threatened categories are used in the NC Act, and Threatened is used in the EPBC Act. Both searches were done by specifying coordinates (defining a rectangle) that contained the entire project area.

- Wildlife Online

A Department of Environment and Resource Management internet database accessible to the public which stores records of plant collections (and other groups including algae, fungi etc) for a search area defined by the user. Rare and Threatened species can be selected from the data.

- EPBC Act Protected Matters Report.

A Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) internet database accessible to the public that lists Rare and Threatened species for a search area defined by the user.

Likelihood of occurrence of individual Threatened flora species (strictly, they are taxa, since sub-specific levels can apply) were assessed in two ways: firstly whether they were considered likely to occur within close proximity to the corridor (creating a risk of disturbance), and secondly whether the species in question were considered likely to be consistently associated with one or more of the categories defined by the GIS coverage (e.g. a particular RE on the RE mapping).

11.2.2 Field investigations

Vegetation surveys were undertaken in April 2008 in order to ground-truth the remnant vegetation / regional ecosystem mapping conducted by the Queensland Herbarium. Initial investigations were undertaken over the entire project area, so that impacts outside the immediate impact zone could be better understood. This survey was a general reconnaissance where the aims were to:

- assess the accuracy of the regional ecosystem mapping and identify gross errors where the mapping reflected an incorrect RE or incorrectly identified remnant vegetation
- assess the value of small remnants of vegetation (which may not have featured on the RE mapping due to error or scale).

These unmapped remnants included stands of trees, or other communities (including grasslands and wetlands) and significant trees (e.g. old growth).

The majority of this survey was done by traversing the public road network, with occasional walking and/or use of binoculars where road access was limited. An attempt was made to visit as many publicly accessible sampling points within the project area. Access to private property was gained (subject to permission or invitation) for those areas of interest where public access was not possible. A more detailed reconnaissance was undertaken on the alignment (within the project area), involving more focused observation of remnants known to be crossed by the proposed rail corridor.

Detailed site sampling was employed in accordance with Queensland Herbarium methodology (Department of Environment and Resource Management 2005a) and involved entering remnant vegetation in representative locations where it was necessary to confirm the accuracy of RE mapping, and to look for Rare and Threatened species (both conspicuous and inconspicuous).

Two levels of sampling were used depending on the detail needed:

- medium: recording dominant canopy species, indicator and weed species, general structure and condition

This type of site is intermediate in the level of detail obtained in comparison to Queensland Herbarium Tertiary and Quaternary sites. Cryptic (inconspicuous) EVR species were not searched for medium level sites, except rainforest, because they were not expected.

- high: recording all plant species present on-site within a 50 m x 10 m plot, along with structural details such as height and cover.

It is more comprehensive than the level of detail collected in a Queensland Herbarium Tertiary site, in that the majority of, or all, plant species in the plot are recorded. However, stem counts were not included and Bitterlich sweeps were not used because rainforest (or eucalypt forest with dense rainforest understorey) was the predominant community being sampled. Rare and Threatened species were searched for at high-level sites because they were considered possible at those sites.

Photographs were taken of each site to illustrate vegetation structure, and the position of the site was recorded, where possible, with a hand-held GPS. Flora species unable to be identified in the field were collected for later identification.

Further field investigations were conducted in mid October 2008 to provide more detailed information about potential impacts to significant ecological features that may not have been picked up by previous surveys. These investigations involved a targeted site walkover, such that the alignment of the project was traversed on foot. This was undertaken in areas of high environmental significance (i.e. Dularcha National Park, Eudlo Creek National Park, Mooloolah – Eudlo ridgeline etc) where the potential for environmental impacts is greater. This was considered the most effective way of determining impacts at the ground level. Observations of the condition of the vegetation were made and the location of any significant flora species or landscape trees was recorded utilising a hand-held GPS.

The locations of the survey sites are shown in **Figure 11.2**.

11.2.3 Limitations of study

Regional Ecosystem mapping (Department of Environment and Resource Management, 2005b) in the project area is relatively coarse and suitable for general planning only. Mapping for the area is undertaken utilising aerial photography at a scale of 1:50,000, hence it is not suitable for precise location of infrastructure because errors of tens or hundreds of metres can occur depending on the nature of the error. Sources of error that may cause planning problems are:

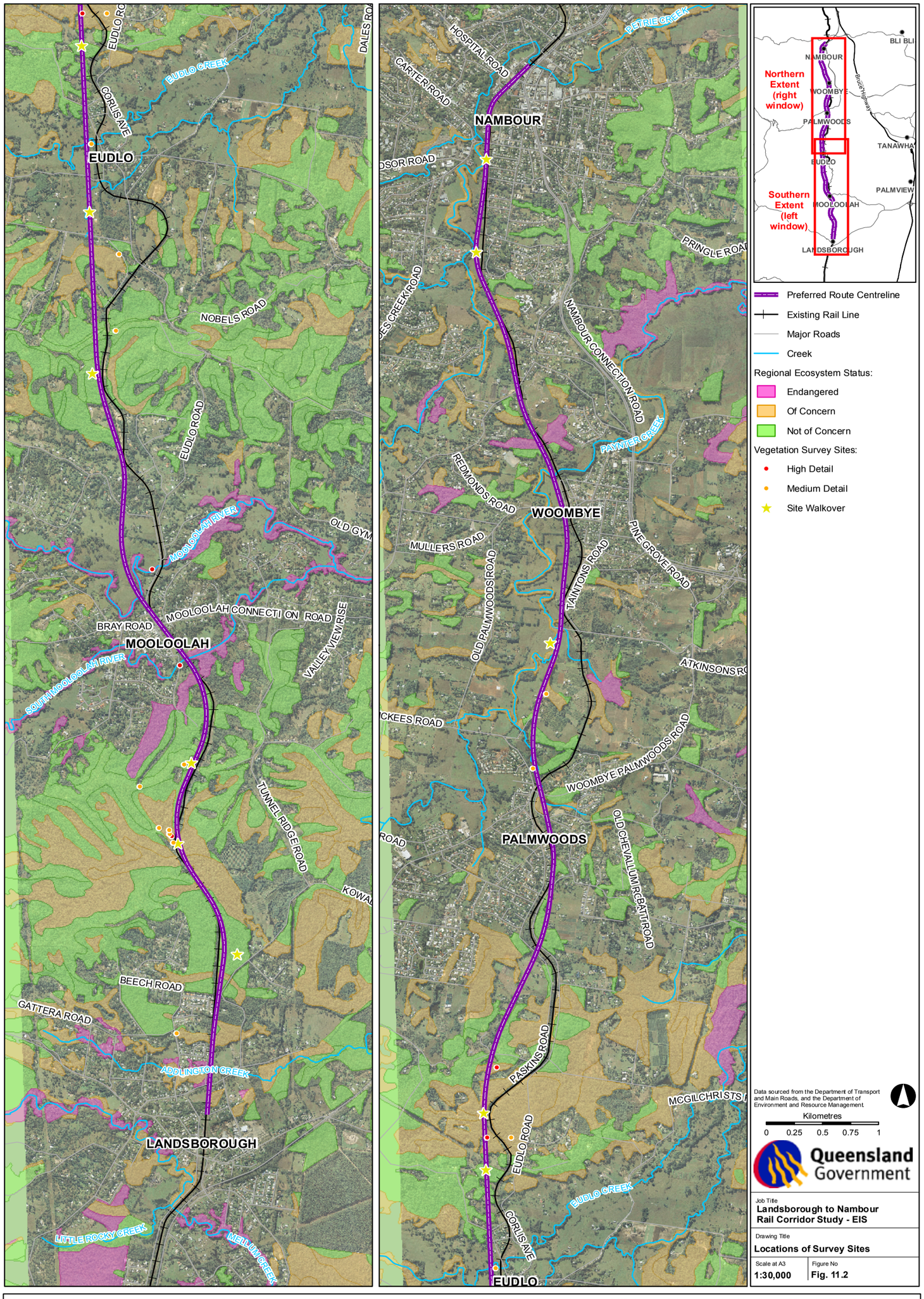
- Scale: Aerial photography utilised by the Queensland Herbarium is at a scale of 1:100,000 or 1:50,000. Base mapping relies on satellite images in many areas, and this is coarser than the aerial photography.
- Time lapse: A considerable amount of clearing or disturbance can occur between the time the remote sensing for the RE mapping was done and when the project begins.
- Remote sensing interpretation error: Often, due to inability of Queensland Herbarium to access ground-truthing areas, this can lead to incorrect REs being applied to vegetation types.
- Local variation in vegetation type can render RE classification too coarse.

Sub-REs are developed for this purpose, but they are being continually revised.

It is for these reasons that field surveys were undertaken to ground-truth the mapping conducted by the Queensland Herbarium. Preliminary site survey by reconnaissance was done in January 2008, with subsequent detailed site survey done in February and March 2008. There was frequent heavy rainfall in the period leading up to and inclusive of reconnaissance. In some cases, this made remote identification of trees more difficult, slightly increasing the chance of misidentification. Areas of uncertainty were returned to wherever possible, during subsequent detailed sampling and the site-walkover in October 2008. The exact extent of some existing vegetation communities is still uncertain due to the time lapse between available aerial photography and fieldwork, and difficulties in remote identification.

Often it is not possible to locate and record all species of flora present within an area under investigation, due to seasonality, weather and absence of flowering parts at the time of survey. It cannot be assumed that species that are not detected during surveys are definitely absent from the area of investigation. The precautionary principle is often adopted in these circumstances to determine the probable presence or absence of significant species and the assessment of potential impacts.

Figure 11.2: Locations of Survey Sites



11.2.4 Assessment of impacts

Table 11.2.4 defines the significance criteria used for assessing impacts on terrestrial flora.

Table 11.2.4: Significance criteria

Significance	Criteria
High Adverse	Impact a major problem. These impacts are likely to be important considerations adversely affecting vegetation of national importance (according to Threatened Ecological Communities listed under the EPBC Act, or State significance (i.e. Endangered or Of Concern communities according to Queensland Herbarium, Remnant Regional Ecosystem Mapping). Impacts are to the extent that the vegetation community is removed indefinitely or can no longer function to provide the ecological services it is valued for (i.e. habitat for Threatened species, protection of land and water resources, etc.). Alternatively, the impact is such that a population of a Threatened species is removed or reduced to a level where its persistence into the future is questionable. These impacts are concerns to the project, depending upon the relative importance attached to the issue during the decision making process. Mitigation measures and detailed design work will not remove the impacts upon the affected vegetation community, Threatened species or ecological value. Adverse residual impacts would predominate.
Moderate Adverse	Impact moderate. These impacts are likely to be important at a national, State, regional (as identified within Department of Environment and Resource Management's Biodiversity Assessment Mapping Methodology - BAMM) or local (as identified within local planning scheme overlays) scale. Impacts are to the extent that the vegetation community is reduced in size or quality and the ecological services it provides (i.e. habitat for Threatened species, protection of land and water resources, etc.) are devalued in the long-term. Alternatively, the impact is such that a population of Threatened species is likely to suffer a permanent decline but still maintain a stable population. These impacts represent issues where adverse outcomes would be experienced, but mitigation measures and detailed design work can ameliorate some of the consequences upon affected vegetation communities, Threatened species or ecological values. Some residual impacts would still arise. The cumulative impacts of such issues may lead to an increase in the overall impacts upon a particular area or resource and hence may become key decision-making issues.
Low Adverse	Impact recognisable but acceptable. These impacts are likely to be important only at a local scale and are unlikely to be of significant importance in the decision making process. Impacts are minor or short term and can be ameliorated by detailed design work and mitigation measures. Residual impacts are minimal or non-existent and do not affect the ability of the vegetation community to provide ecological services (i.e. habitat for Threatened species, protection of land and water resources, etc.). These impacts are generally of relevance for enhancing the subsequent design of the project and in the consideration of mitigation or compensation measures.
Negligible	Minimal change. No impacts or those, which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.
Beneficial	Impact beneficial to the environment. There is an increase in area or quality of vegetation affected by the proposal and / or ability of the vegetation community to provide ecosystem services is enhanced. These impacts are a result of mitigation measures.

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11.3 Description of environmental conditions

The project traverses large modified areas (including rural residential style development and agricultural land) and remnant vegetation. The remnant vegetation that the project intersects is mostly consistent with Regional Ecosystem (RE) mapping (Department of Environment and Resource Management 2005b). Field surveys only located minor discrepancies in the mapping, where an RE had been misrepresented. An effort was made to conduct high-level (detailed) field survey within these areas where RE has had been misidentified.

Information collected via desktop review and field survey is presented in the following sections and is focussed on the topics of:

- remnant vegetation communities
- biodiversity values
- significant species
- old growth trees
- horticultural crops and cultural value
- weeds.

11.3.1 Remnant vegetation communities

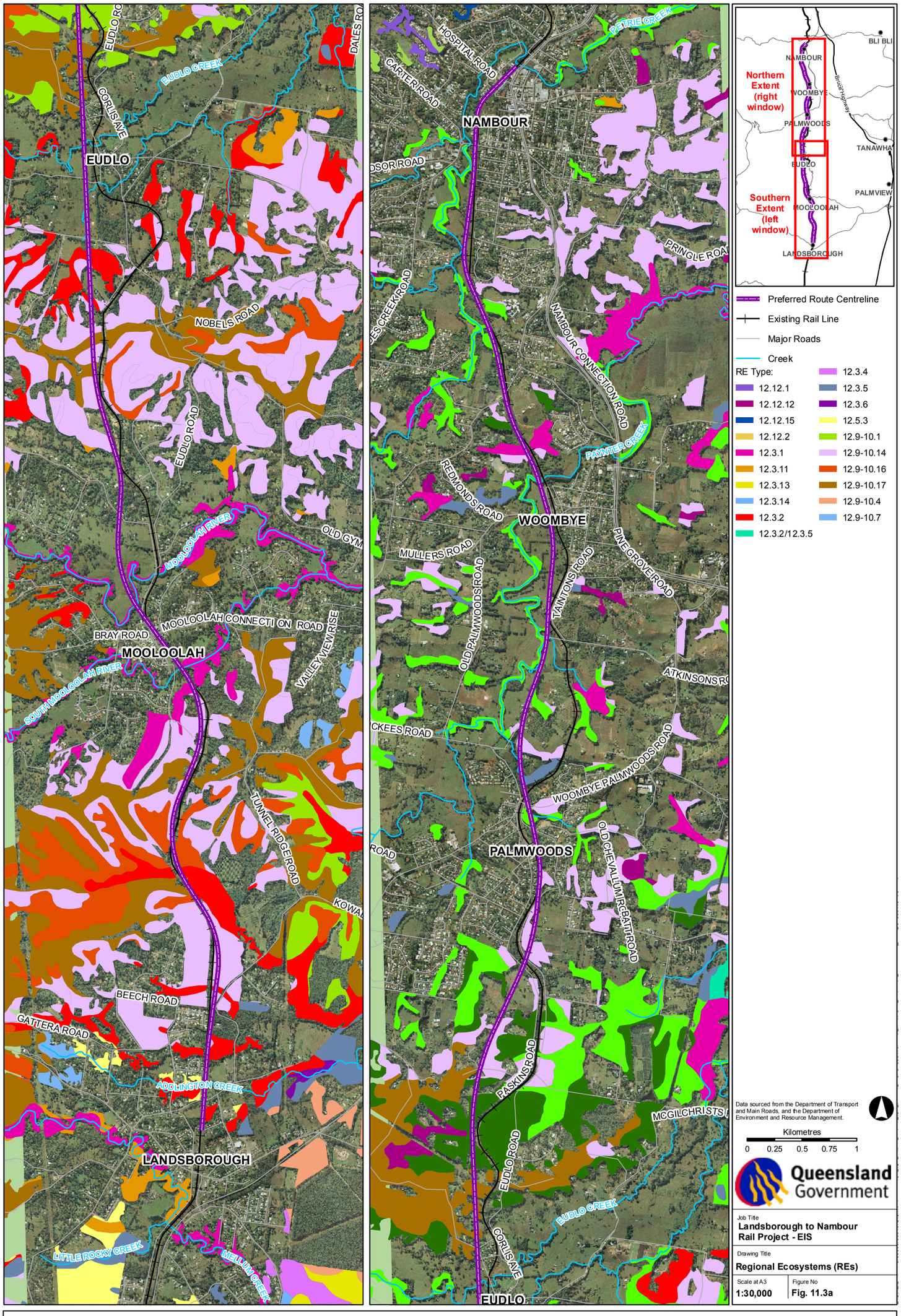
The project traverses 18 regional ecosystems (REs) according to the Queensland Herbarium's remnant vegetation mapping (**Figure 11.3a**). There were a further two regional ecosystems that were identified during survey, but have not been mapped. These regional ecosystems and descriptions are shown in **Table 11.3.1**. Of the 20 REs identified within the project area, two are Endangered, nine are Of Concern and nine are not Of Concern. **Figure 11.3b** shows areas of Endangered, Of Concern and not Of Concern remnant vegetation. All large areas of vegetation are mapped as remnant and there are no significant areas of regrowth in the project area. However, several area within the project area are identified on Department of Environment and Resource Managment 'Moratorium Maps' as 'Moratorium regrowth vegetation areas'. These areas are likely to be subject to further legislative protection in the future.

The Endangered regional ecosystems are RE 12.5.3 (*Eucalyptus tindaliae* and / or *Eucalyptus racemosa* open forest) and RE 12.3.1 (riverine rainforest). The RE 12.5.3 is limited to the south of the project area around Landsborough. It is associated with higher ground surrounding Addlington Creek. The project does not intersect any mapped remnant RE 12.5.3 but may impact upon unmapped edges of the remnant due to its apparent proximity to the mapped vegetation unit. It is not associated with any of the significant flora species likely to occur in the area, although it does provide good fauna habitat as *E. racemosa* readily provides hollows for nesting and den sites. The RE 12.3.1 is associated with many waterways throughout the project area. In many places, Queensland Herbarium has not mapped the presence of RE 12.3.1 due to the small size of the remnant areas and the scale of the mapping. This vegetation type is associated with the majority of the significant flora species that is likely to occur in the area and it provides habitat for several significant fauna species.

Reconnaissance of the project area confirmed that most of the Regional Ecosystem mapping was correct in terms of RE codes and boundaries of remnants. Few REs have been incorrectly mapped and there is only some instances where the presence of small unmapped remnants that are Endangered or Of Concern, may influence the accuracy of the RE map on a smaller scale.

Results of the EPBC Act Protected Matters Report (DEWHA, 2008) for the project area returned no Threatened ecological communities and the nearest Wetland of International Significance was the Moreton Bay Ramsar site (approximately 17 kilometres south-east of the project area).

Figure11.3a: Regional Ecosystems (REs)



Data sourced from the Department of Transport and Main Roads, and the Department of Environment and Resource Management.

Kilometres

0 0.25 0.5 0.75 1

Queensland Government

Job Title	Landsborough to Nambour Rail Project - EIS
Drawing Title	Regional Ecosystems (REs)
Scale at A3	1:30,000
Figure No	Fig. 11.3a

Figure11.3b: Vegetation Management Status

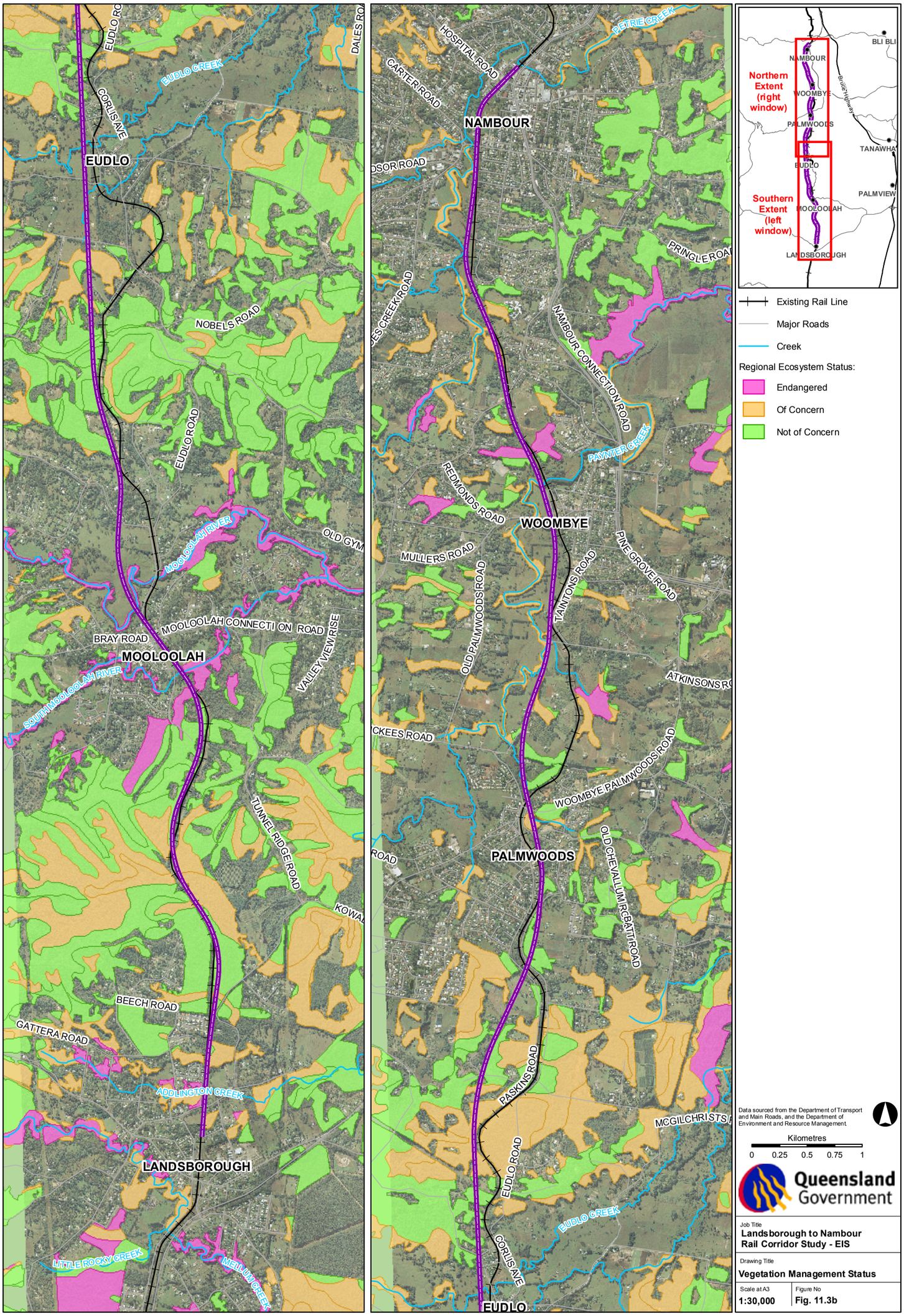
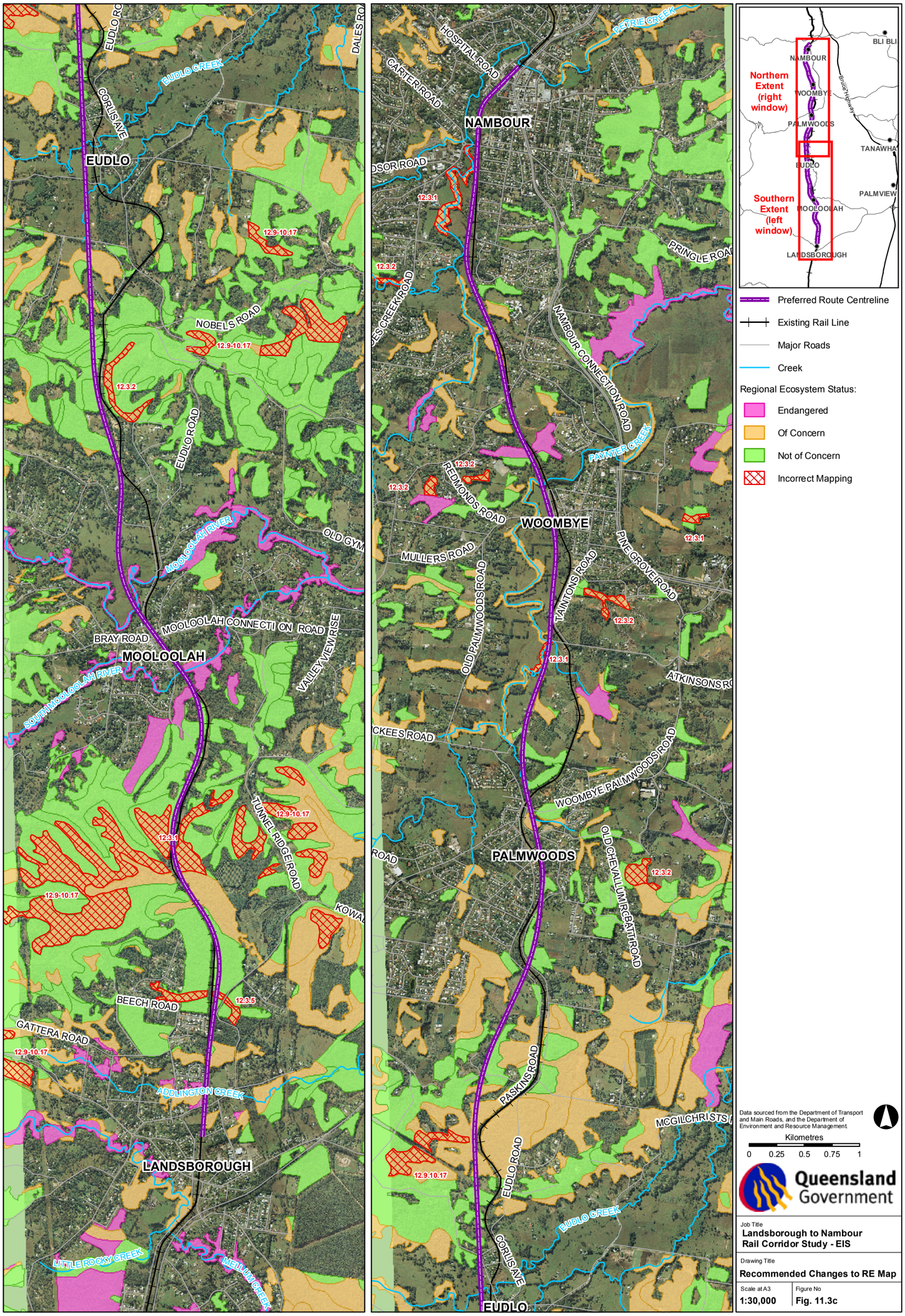


Figure 11.3c: Recommended Changes to RE Map



Recommended revisions to existing RE mapping are shown in **Figure 11.3c**. The only significant error in the RE mapping is the incorrect representation of RE 12.9-10.16 (Araucarian microphyll to notophyll vine forest on sedimentary rocks), which is informally referred to as hoop pine scrub. No hoop pine (*Araucaria cunninghamii*) was observed. This RE was not observed to occur within the project area, and was mostly found to be a variant of the RE 12.9-10.17d. This RE (12.9-10.17d) is eucalypt forest typical of the ranges in SEQ, but in the case of the areas mapped as RE 12.9-10.16 (hoop pine scrub) in the project area, there was observed to be a dense understorey of species commonly found in rainforest communities. RE 12.9-10.16 is Of Concern, and RE 12.9-10.17d is not Of Concern.

There were several areas of incorrectly mapped RE 12.9-10.16 (hoop pine scrub) observed that did not fit the description for RE 12.9-10.17d and these were:

- palm rainforest in gullies in Dularcha National Park, adjacent to the current rail corridor

The RE is 12.3.1 and is described in REDD (Department of Environment and Resource Management 2008a) as 'Gallery rainforest (notophyll vine forest) on alluvial plains' and is Endangered.

- other areas are generally RE 12.3.2, which is described in REDD (Department of Environment and Resource Management 2008a) as 'Eucalyptus grandis tall open forest on alluvial plains'.

This RE is Of Concern and these areas included patches near:

- Taintons Rd south-east of Woombye (outside the project area)
- Moorhouse Rd east of Woombye
- two patches north-west of Woombye
- north side of Coes Creek Rd, east of Nambour (infested with camphor laurel)
- two patches past the end of Nicklin Rd, south-east of Palmwoods.

One patch appears to be a variant of RE 12.3.2, and the other one appears to be an orchard (also adjoining Old Chevallum Rd).

Detailed site information was collected in areas requiring revision, in order to submit, if necessary, a Regional Ecosystem map modification request to the Queensland Herbarium (**Appendix F**). With the exception of the Endangered RE12.3.1 within Dularcha National Park, the implications for the project from these map amendments are minimal as the existing mapping shows the vegetation to be Of Concern. The Endangered RE12.3.1 will be subject to different clearing protocols under the *Vegetation Management Act 1999* and have a greater requirement for offsets.

Table 11.3.1a: Location of RE types and the accuracy of mapping

Regional Ecosystem Code*	Vegetation Management Status**	Short Description from Regional Ecosystem Description Database (Department of Environment and Resource Management 2007b)***	General Area	Mapping comments^
12.3.1	Endangered	Gallery rainforest (notophyll vine forest) on alluvial plains.	Many creeks	Generally correct, but often combined with RE 12.3.2.
12.3.2	Of concern	*Eucalyptus grandis* tall open forest on alluvial plains	Many creeks and terraces	Generally correct, but often combined with RE 12.3.1.
12.3.4	Of concern	*Melaleuca quinquenervia, Eucalyptus robusta* open forest on or near coastal alluvial plains.	Mapped SE of Landsborough at the southern edge of the project area.	No detailed survey, but appears to be correctly mapped.
12.3.5	Not Of Concern (threshold)	*Melaleuca quinquenervia* open forest on coastal alluvium.	Immediately north of Palmwoods, and around Woombye. Also at the eastern edge of the project area, SE of Palmwoods.	Correctly mapped, but Palmwoods remnant needs RE 12.3.8 (swamp) added. Other areas often had RE 12.3.1 (riverine rainforest) intermingled with them.
12.3.6	Not Of Concern	*Melaleuca quinquenervia, Eucalyptus tereticornis, Lophostemon suaveolens* woodland on coastal alluvial plains.	Mapped NE of Landsborough at the edge of the project area.	No detailed survey, but appears to be correctly mapped.
12.3.8	Of concern	Swamps with *Cyperus spp., Schoenoplectus spp.* and *Eleocharis spp.*	Not mapped, but observed in association with 12.3.5 (paperbark swamp) immediately north of Palmwoods.	Observed, but not on RE mapping due to scale limitations.
12.3.11	Of concern	*Eucalyptus siderophloia, E. tereticornis, Corymbia intermedia* open forest on alluvial plains usually near coast	Immediately west of Landsborough, NE of Mooloolah, and east of Eudlo towards the edge of the project area.	Correctly mapped as occurring in association with riverine rainforest (RE 12.3.1) west of Landsborough. The mapped remnants of RE 12.3.11 NE and NW of Mooloolah were not observed due to obscured locations (well away from public access), but are considered as likely to be correctly mapped. The mapped remnant east of Eudlo, in the inside corner of Slaughteryard Road, was not observed, and it was presumed this area must have been cleared relatively recently.
12.5.3	Endangered	*Eucalyptus tindaliae* and/or *E. racemosa* open forest on remnant Tertiary surfaces.	Mapped SE of Landsborough at SE extreme of project area near Addlington Creek.	No detailed survey, but appears to be correctly mapped.
12.9-10.1	Of concern	Shrubby open forest often with *Eucalyptus resinifera, E. grandis, Corymbia intermedia* on sedimentary rocks. Coastal	Mapped extensively in and around Eudlo Creek NP, and on the eastern edge of the project area east of Dularcha NP.	Correctly mapped, but E.grandis is the only dominant species observed from the RE description. *E.resinifera* and *C.intermedia* could occur, but are more likely to be the similar-appearing E.microcorys (tallowwood) and *C.gummifera* (red bloodwood)

Table 11.3.1a: continued

Regional Ecosystem Code*	Vegetation Management Status**	Short Description from Regional Ecosystem Description Database (Department of Environment and Resource Management 2007b)***	General Area	Mapping comments^
12.9-10.4	Not Of Concern	*Eucalyptus racemosa* woodland on sedimentary rocks.	Mapped east of Landsborough at the SE extreme of the project area, along Glasshouse Mountains Rd / Steve Irwin Way.	Observed to be generally correct in this area.
12.9-10.7a***	Of concern	*Eucalyptus tereticornis, E. siderophloia* and/or *E. crebra, Corymbia intermedia* and *Lophostemon suaveolens* woodland. Occurs on Cainozoic and Mesozoic sediments.	Mapped NW of Landsborough at the edge of the project area, near the Landsborough - Maleny Rd. Also mapped SE of Mooloolah at the edge of the project area, north of Lakeview Rd, off the end of Ford Rd.	No detailed survey, but appears to be correctly mapped.
12.9-10.14	Not Of Concern	*Eucalyptus pilularis* tall open forest on sedimentary rocks.	Widespread throughout project area.	Generally observed to be correctly mapped.
12.9-10.14a***	Not Of Concern	Open-forest of *Eucalyptus grandis, Lophostemon confertus, E. microcorys, Syncarpia glomulifera subsp. glomulifera ± E. pilularis*. On Cainozoic and Mesozoic sediments (sandstone) in wet gullies and southern slopes.	Mapped as occurring in wetter areas within 12.9-10.14. These areas were NE of Mooloolah.	Generally observed to be correctly mapped. Observations were made at Eagle View Lane, Eudlo Rd, and Old Gympie Rd.
12.9-10.16	Of concern	Araucarian microphyll to notophyll vine forest on sedimentary rocks.	Mapped mostly NE of Dularcha NP, and in that general area. Also mapped north and NE of Mooloolah, and in isolated patches in the remainder of the project area.	Not observed within the project area. Usually observed to be a variant of the RE 12.9-10.17d (grey gum and other eucalypt species), but with a dense understorey of species commonly found in rainforest. Also observed as RE 12.3.2 (flooded gum) or RE 12.3.1 (riverine rainforest).
12.9-10.17a***	Not Of Concern	Open forest complex often with *Eucalyptus acmenoides, E. major, E. siderophloia ± Corymbia citriodora* on sedimentary rocks.	Small area mapped NNE of Landsborough off Ford Rd and Tunnel Ridge Rd.	No detailed survey, but appears to be correctly mapped.

Table 11.3.1a: continued

Regional Ecosystem Code*	Vegetation Management Status**	Short Description from Regional Ecosystem Description Database (Department of Environment and Resource Management 2007b)***	General Area	Mapping comments^
12.9-10.17d***	Not Of Concern	Open-forest with *Eucalyptus siderophloia, E. propinqua, Corymbia intermedia ± E. microcorys, E. acmenoides or E. portuensis, Lophostemon confertus, Eucalyptus tereticornis, E. moluccana, Angophora subvelutina* and occasional vine forest species. Other species that may be present locally include *Corymbia trachyphloia, E. major, E. fibrosa subsp. fibrosa* and *Angophora leiocarpa* Hills and ranges on Cainozoic and Mesozoic sediments.	Mapped as widespread in the southern two-thirds of the project area, in elevated areas. Main areas are Dularcha NP, West of Mooloolah, Higher country between Mooloolah and Eudlo and West of Eudlo Creek NP.	Generally observed to be correctly mapped.
12.12.1	Of concern	Simple notophyll vine forest usually with abundant *Archontophoenix cunninghamiana* (gully vine forest) on Mesozoic to Proterozoic igneous rocks.	Mapped as NW of Nambour town centre near Nambour hospital.	Appeared to be mostly camphor laurel (*Cinnamomum camphora*).
12.12.2	Not Of Concern	*Eucalyptus pilularis* tall open forest on Mesozoic to Proterozoic igneous rocks especially granite.	Mapped on south side of Howard St, Nambour.	Blackbutt (*Eucalyptus pilularis*) was confirmed. Geology was not confirmed.
12.12.12	Of concern	*Eucalyptus tereticornis, E. crebra* or *E. siderophloia, Lophostemon suaveolens* open forest on granite.	Mapped as NW of Nambour town centre near Nambour hospital.	Observed as correctly mapped, although disturbed due to urban environment RE12.12.15
12.12.15	Not Of Concern	*Eucalyptus siderophloia, E. propinqua, E. acmenoides* open forest on near coastal hills on Mesozoic to Proterozoic igneous rocks.	Mapped as north of Nambour town centre at Selangor Hospital. Also mapped near Bli Bli Rd – Bruce Hwy overpass.	Observed at hospital in low-lying drainage area, with RE more likely to be RE 12.3.11 or RE 12.3.15. Bli Bli Rd remnant not observed, as in extreme NW corner of project area. This remnant is considered to be probably incorrectly mapped.

* *other codes in the project area are non-remnant, including disturbed, plantation, regrowth, and small*

** *as defined in the Vegetation Management Act 1999*

*** *RE sub-type with complete description (e.g. RE 12.9-10.17d is a sub-type of RE 12.9-10.17)*

Detailed survey results

Detailed sample sites were located in order to confirm the correct RE for each of the vegetation remnants along the project and to check for the presence of Rare and Threatened species (if considered likely to occur). Observations and evaluations of detailed sample sites are shown in **Table 11.3.1b**. The locations of detailed survey sites are shown in **Figure 11.2**. Detailed floristic and structural information is shown in **Appendix F**.

Table 11.3.1b: Detailed sample site observation

Site ID	Level of detail	Locality	Refidex ** map ref	Easting	Northing	Observation
1	medium	Dularcha NP.	96 F8	496379	7037577	Dominant RE is RE 12.9-10.17d, lowland areas of RE 12.9-10.14 and RE 12.3.2 in gullies (RE 12.3.1 in places). RE12.9-10.16 is not present and is either RE 12.3.2 or RE 12.3.1. No cryptic EVR species were expected, and no conspicuous EVR species were found.
2	high	Riverine rainforest on creek in Dularcha NP	96 F8	496367	7037638	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest) and not RE 12.9-10.16 (hoop pine scrub) as mapped. No EVR species were found as result of targeted survey.
3	medium	Creek just upstream of riverine rainforest in Dularcha NP	96 F8	496346	7037659	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest) and not RE 12.9-10.16 (hoop pine scrub) as mapped. No EVR species were found as result of targeted survey.
4	medium	Creek through eucalypt forest in Dularcha NP	96 F8	496344	7037694	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest) and not RE 12.9-10.16 (hoop pine scrub) as mapped. No EVR species were found as result of targeted survey.
5	medium	Palm forest in Dularcha NP	96 F8	496253	7037713	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest) and not RE 12.9-10.16 (hoop pine scrub) as mapped. No EVR species were found as result of targeted survey.
6	medium	Addlington Ck	96 F15	496467	7035430	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest). Weed infestation. No EVR species were found in targeted survey.
7	medium	Tributary of Addlington Ck, crossing Myla Rd	96 F14	496410	7035810	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest). No EVR species were found in targeted survey.
8	medium	Rose Rd at western end, and entrance to Dularcha NP.	96 F4	496476	7038300	Dominant species and structure confirm that the RE here is RE 12.9-10.17d. There is advanced regrowth around the tunnel entrance areas on the lower slopes of the saddle on which Rose Road runs. No EVR species were found.
9	medium	Dularcha NP 200 m off end of Rose Rd	96 E4	496084	7038097	Dominant species and structure confirm that the RE here is RE 12.9-10.17d. No EVR species were found.
10	high	South Mooloolah River, across break in Paget St	96 F1	496440	7039220	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest). RE 12.3.2 is also present on terraces. No EVR species were found in targeted survey.
11	high	Mooloolah River, immediately north of Mooloolah	86 E17	496195	7040110	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest). Weed infested in places (Lantana camara at remnant edges, and occasional camphor laurel Cinnamomum camphora). No EVR species were found.
12	medium	The Pinch Lane	86 D8	495870	7042320	Dominant species and structure confirm that the RE here is RE 12.9-10.17d. No EVR species were found.
13	medium	Cogden and Logwoods Rd area	86 D5	495900	7043030	Dominant species and structure confirm that the REs here are RE 12.3.2 and RE 12.9-10.14. No cryptic EVR species were expected, and no EVR species were found.

Table 11.3.1b: continued

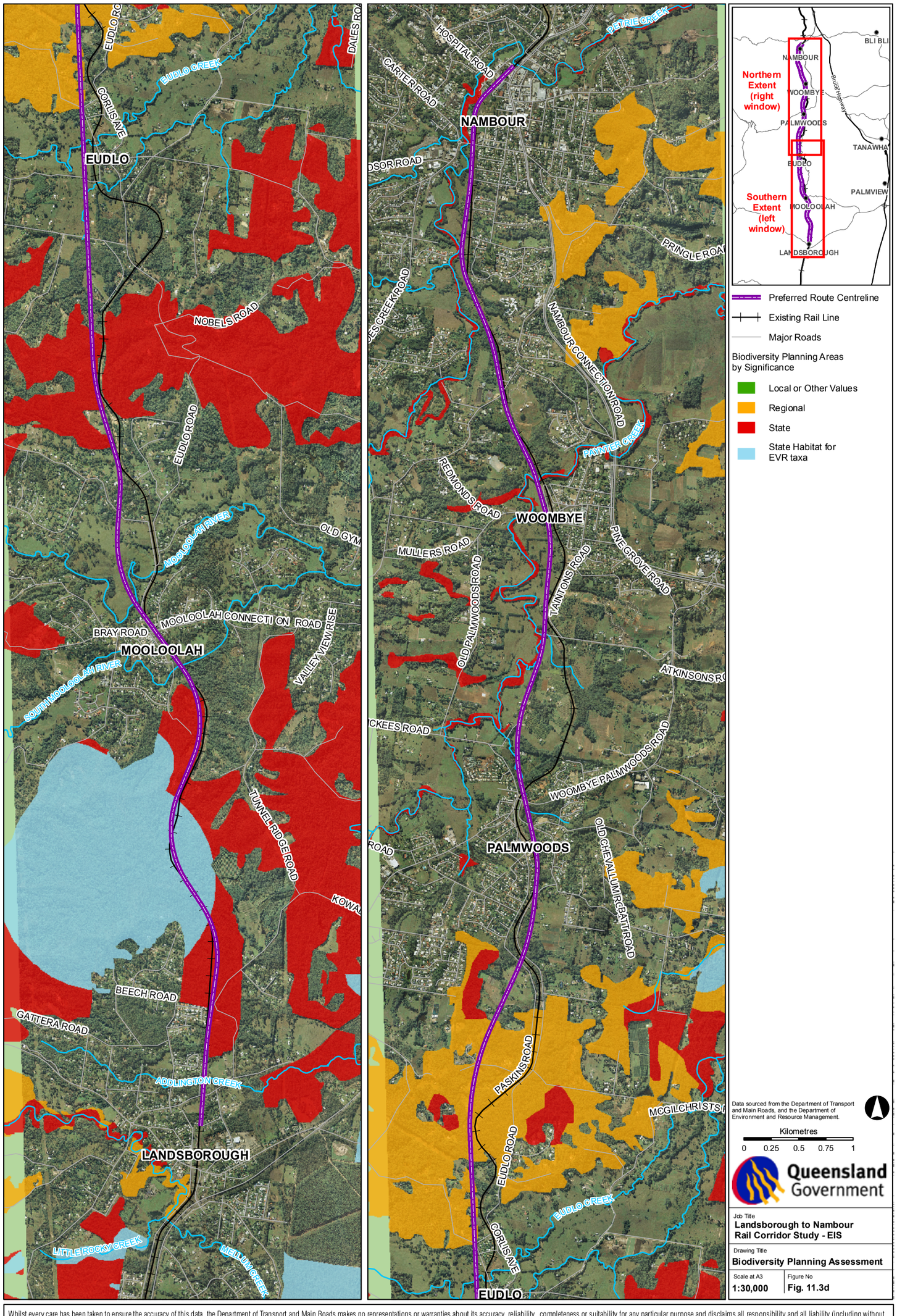
Site ID	Level of detail	Locality	Refidex ** map ref	Easting	Northing	Observation
14	medium	Eudlo, western side of railway station	86 C2	495650	7043900	This was a plantation of mixed rainforest species, and no EVR species were found.
15	medium	Eudlo Creek at Eudlo	86 C1	495650	7044050	Dominant species and structure confirm that the RE here is RE 12.3.1 (riverine rainforest). No EVR species were found.
16	medium	Eudlo Creek NP, on eastern side of railway, opposite Cardinal Court	76 C16	495790	7045260	Dominant species and structure confirm that the RE here is a variant of RE 12.9-10.1, where flooded gum (E.grandis) dominates. Forest grades into RE 12.3.2 and sometimes RE 12.3.1 on lower ground. Western side of railway grades into RE 12.9-10.14 and RE 12.9-10.17d. No EVR species were expected, and none were found.
17	medium	Wetland immediately north of Palmwoods, opposite Dana Court	76 D3	495980	7048680	Dominant species and structure confirm that the RE here is RE 12.3.5 (Melaleuca quinquenervia), but there is also RE 12.3.8 (sedge swamp) and some open water. No cryptic EVR species were expected, and no conspicuous EVR species were found.
18	medium	Spackman Lane	66 D20	496100	7049370	Dominant species and structure confirm that the RE here is RE 12.3.1 with some areas of RE 12.3.2. No cryptic EVR species were expected, and no conspicuous EVR species were found. Note that the remnant is toward the northern end of the lane. The isolated relict 'beech' tree is halfway along the lane in a disturbed area.
19	medium	Paynter Creek, on Back Woombye Rd	66 D13	496070	7051080	Dominant species and structure confirm that the RE here is RE 12.3.2, but there is also RE 12.3.1 along the creek. Some areas appear to be weed-infested (i.e. camphor laurel Cinnamomum camphora). No cryptic EVR species were expected, and no conspicuous EVR species were found. It is possible that EVR species exist elsewhere along the creek.
20	high	Tributary of Eudlo Ck at end of Paskins Rd	76 B16	495575	7045260	Dominant species and structure confirm that the RE here is RE 12.3.1, but it is unmapped due to scale limitations. No EVR species were found.
21	high	Private property off Paskins Rd (Lot 3 on SP115725)	76 C14	495660	7045910	Dominant species and structure partly confirm that the REs here are RE 12.9-10.1 and RE 12.9-10.17d. Blackbutt was also present, indicating the possible presence of RE 12.9-10.14. The mapped boundary between the two REs is inaccurate due to scale limitations, and is diffuse. There was also riverine rainforest on this property associated with a small but deep creek (5 m deep in places). It was found that RE mapping was unable to represent, in adequate detail, the presence of these creeks with rainforest. The orchard on the property is associated with a natural spring. No EVR species were found as result of targeted survey.

* *Level of detail as discussed in methodology. Medium is intermediate of Tertiary and Quaternary, and high is intermediate of Tertiary and Secondary. Cryptic (inconspicuous) EVR species were NOT searched for medium level sites, except rainforest, because they were not expected. All EVR species were searched for at high-level sites because they were considered possible at those sites.*

** *Refidex is Gregory's 2007, map number followed by grid reference. Refidex datum is AGD66 and will be up to approximately 200 m out from GDA94 coordinates in Easting/Northing columns of this table. Use one or the other.*

\# *Easting and northing are GDA94 datum, zone 56. These coordinates are almost the same (within several metres) as WGS84, which is used by Google Earth.*

Figure11.3d: Biodiversity Planning Assessment



11.3.2 Biodiversity values

Biodiversity Planning Assessment (Department of Environment and Resource Management 2005c) mapping was used to identify significant areas of biodiversity (**Figure 11.3d**). Details of these areas and observations made during field survey are summarised in **Table 11.3.2**.

The BPA mapping identifies Criteria B1 (remnant contains at least one Endangered RE) in association with many of the remnant patches in the project area. This likely relates to the presence of RE 12.3.1 (riverine rainforest) along many of the waterways in the project area.

Two locations stand out as having particularly high biodiversity value. Both Dularcha NP and the higher country between Mooloolah and Eudlo (The Pinch Lane area) have the following criterion, which confirms their value as conservation areas:

- remnant contains at least one Endangered or two Vulnerable or Rare species (CRITERIA A)
- remnant is part of a tract that is one of the largest in the bioregion (CRITERIA C)
- vegetation condition is natural (CRITERIA E)
- remnant has ecosystem diversity in the top quartile (CRITERIA F)
- remnant contains core habitat for priority taxa (CRITERIA H)
- remnant forms part of a bioregional corridor (CRITERIA J).

The higher country between Mooloolah and Eudlo (The Pinch Lane area) is also associated with a number of unique biodiversity values, as follows:

- remnant contains an RE that is one of the largest of its type in the bioregion (CRITERIA D1)
- Special Biodiversity Values – high species richness and variation in species composition (CRITERIA I).

Other locations that are associated with high biodiversity values are Eudlo Creek NP, Paskins Road towards the southern end of Palmwoods and the remnant riverine vegetation of Paynter Creek. These locations have been recognised as containing 'Core Habitat for Priority Taxa' (CRITERIA H). Eudlo Creek and Eudlo Creek NP contain Special Biodiversity Values (CRITERIA I) for wildlife refugia. It is noted that Criterion I is normally associated with either Criterion H (Core Habitat for Priority Taxa), or Criterion J (remnant forms part of a bioregional corridor). This appears to indicate that large remnants, or proximity to large remnants, underpin these special biodiversity values.

Wildlife habitat, for both flora and fauna, is enhanced by large tracts of remnant vegetation, where buffering from edge effects occurs and genetic exchange is not hampered. Vegetation structure is also important for wildlife habitat, and large trees (mature and old growth) provide values as nesting / denning sites and seed stock. Dularcha NP, Eudlo Creek NP and the higher country between Mooloolah and Eudlo (The Pinch Lane area), represented the intact tracts of vegetation (i.e. largest remnants in good condition).

Table 11.3.2: Biodiversity Planning Assessment Mapping Summary

Area/ Location	Sub-area	Level/s of Significance	Description of Criteria	Comment or Observation	Sample site
Landsborough (adjacent to Dularcha NP)	Area north of Landsborough	State	CRITERIA B1 (remnant contains at least 1 Endangered RE)	RE 12.5.3 is mapped around Myla Rd and State School area – not directly in preferred corridor	N/A
		State	CRITERIA H (remnant contains Core Habitat for Priority Taxa) CRITERIA J (remnant forms part of a bioregional corridor)	Two (2) areas (polygons) of RE 12.9-10.16.	N/A
Dularcha NP	Watercourses and buffers	State	CRITERIA A (remnant contains at least 1 Endangered or 2 Vulnerable or Rare species)	RE 12.9-10.17/12.3.2	N/A
			CRITERIA H (remnant contains Core Habitat for Priority Taxa) CRITERIA J (remnant forms part of a bioregional corridor)		N/A
Dularcha NP	Core area of NP	State	CRITERIA A (remnant contains at least 1 Endangered or 2 Vulnerable or Rare species) CRITERIA H (remnant contains Core Habitat for Priority Taxa) CRITERIA J (remnant forms part of a bioregional corridor)	RE 12.9-10.17	1
	Northern end of NP	State	CRITERIA A (remnant contains at least 1 Endangered or 2 Vulnerable or Rare species) CRITERIA C (remnant is part of a tract that is one of the largest in the bioregion) CRITERIA E (vegetation condition is natural) CRITERIA F (remnant has Ecosystem diversity in the top quartile) CRITERIA H (remnant contains Core Habitat for Priority Taxa) CRITERIA J (remnant forms part of a bioregional corridor)	RE 12.9-10.17 / 12.3.2	2,3,4,5,8,9
Higher country between Mooloolah and Eudlo (The Pinch Lane area)	Near Eagle View Lane	State	CRITERIA B1 (remnant contains at least one Endangered RE) CRITERIA I (remnant contains Special Biodiversity Values, i.e. areas of high species richness and variation in species composition) CRITERIA J (remnant forms part of a bioregional corridor)	RE 12.3.1 – this RE was not found in significant quantities in this area.	N/A
		State	CRITERIA C (remnant is part of a tract that is one of the largest in the bioregion) CRITERIA D1 (remnant contains an RE that is one of the largest of its type in the bioregion) CRITERIA E (vegetation condition is natural) CRITERIA I (remnant contains Special Biodiversity Values, i.e. wildlife refugia, areas of high species richness, variation in species composition CRITERIA J (remnant forms part of a bioregional corridor)	2 areas of RE 12.9-10.14 / 12.3.2	12

Table 11.3.2: continued

Area/ Location	Sub-area	Level/s of Significance	Description of Criteria	Comment or Observation	Sample site
Eudlo Creek	Eudlo Creek, immediately north of Eudlo	Local or Other Values	Remnant is adjacent to an Endangered RE	RE 12.9-10.17 – this is a large upland area (polygon) that does not extend into the area of interest.	14,15
		Regional	CRITERIA I (remnant contains Special Biodiversity, i.e. wildlife refugia)	As above	14,15
Eudlo Creek NP and surrounds	Eudlo Creek NP and surrounds	Regional	CRITERIA B1 (remnant contains at least one Of Concern RE) CRITERIA H (remnant contains Core Habitat for Priority Taxa) CRITERIA I (remnant contains Special Biodiversity Values, i.e. wildlife refugia)	RE 12.3.11 – this is a large area (polygon) that is not represented as this RE in RE mapping. Field survey found that the RE mapping of 12.9-10.1 and 12.9-10.17d was correct.	16,21
	End of Paskins Rd	Regional	CRITERIA B1 (remnant contains at least one Of Concern RE) CRITERIA H (remnant contains Core Habitat for Priority Taxa) CRITERIA I (remnant contains Special Biodiversity Values, i.e. wildlife refugia)	As above, with 12.3.1 also observed.	16,20
Paynter Creek	Paynter Creek, extending from NW of Palmwoods to just north of Woombye	State	CRITERIA H (remnant contains Core Habitat for Priority Taxa)	Field survey found RE 12.3.2 / 12.3.1	19
Petrie Creek	NW of Woombye, to Nambour	State	CRITERIA H (remnant contains Core Habitat for Priority Taxa)	Field survey found RE 12.3.2 / 12.3.1	N/A

* *BPA Criteria are environmental values that are used internally by the Department of Environment and Resource Management for planning purposes. They are explained in Appendix F.*

11.3.3 Significant species

Results of the EPBC Act Protected Matters Report (DEWHA, 2008) and Wildlife Online search (Department of Environment and Resource Management 2008a) indicated the potential for 20 Threatened species to occur within the project area. The results of these searches are shown combined in **Table 11.3.3**. Records from the EPBC Act database are not recorded occurrences of species within the search area, but are considered likely to occur based on distribution records from State databases and other sources. Records from Wildlife Online database are recorded occurrences of species within the search area. These results are shown in **Appendix F**.

Table 11.3.3: EPBC Act protected matters report

Botanical name	Common name	EPBC Act * status	NCA status	Wildlife Online Record *
Alyxia magnifolia	large-leaved chain fruit		R	4
Baloghia marmorata	marbled baloghia, jointed baloghia	V		
Bosistoa selwynii	heart-leaved bosistoa	V		
Bosistoa transversa	three-leaved bosistoa	V		
Bulbophyllum globuliforme	miniature moss-orchid	V		
Cryptocarya foetida	stinking cryptocarya, stinking laurel	V		
Eucalyptus conglomerata	swamp stringybark	E		
Floydia praealta	ball nut, possum nut, big nut, beefwood	V	V	1
Graptophyllum reticulatum	veiny graptophyllum	E		
Lenwebbia sp.	no common name – a myrtle		R	5
Macadamia ternifolia	small-fruited Queensland nut	V		
Papillilabium beckleri	false tangleroot orchid		R	1
Pararistolochia praevenosa	Richmond Birdwing vine		R	1
Parsonsia tenuis	no common name – a vine		R	1
Phaius australis	lesser swamp-orchid	E		
Ricinocarpos speciosus	Springbrook wedding bush		V	1
Romnalda strobilacea	-	V		
Syzygium hodgkinsoniae	smooth-bark rose apple, red lilly pilly	V		
Taeniophyllum muelleri	minute orchid, ribbon-root orchid	V		
Triunia robusta	-	E		

* *CODES*

EPBC Act Status - Indicates the conservation status of each taxon under the Environment Protection and Biodiversity Conservation Act 1999. The codes are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Wildlife Online Records - Indicates the number of records of the species contained within the database for the area searched.

NCA - Indicates the conservation status of each taxon under the Nature Conservation Act 1992. The codes are Presumed Extinct (PE), Endangered (E), Vulnerable (V), Rare (R), Common (C) or Not Protected (.). NAQ is not an original code used by NCA – it has been added here to indicate that this taxon is not held at the Queensland Herbarium according to AVH, and therefore has no status in the NCA at present.

Plant species that provide habitat and/or food for Rare and Threatened fauna species are also Of Concern:

- *Carronia multisepalea* is a vine that is only located in old growth, lower montane rainforest habitat. This species is a food source for a moth, Phyllodes imperialis (southern subsp. - ANIC 3333), which is known from Nambour south to the Queensland – NSW border (DEWHA 2008). This insect is listed as Vulnerable under the EPBC Act.
- *Pararistolochia praevenosa* (Richmond Birdwing vine) is accounted for in the Wildlife Online records, and is regarded as Rare. It occurs in rainforest habitats. It is of additional interest as it provides a food source for the Richmond Birdwing Butterfly (Ornithoptera richmondia). This insect is listed as Vulnerable under the NC Act.

All the species listed could potentially be found in the rainforests of the project area (e.g. RE 12.3.1), except *Eucalyptus conglomerata*, which is found in more open swampy areas (and so is less likely to occur). The ball nut (*Floydia praealta*) is known to have occurred in the project area. None of the listed rainforest species were found during the surveys. If they are present, they are protected by virtue of their habitat (viz. rainforest) under the VMA.

11.3.4 Old growth trees

Large trees were observed in Dularcha and Eudlo Creek National Parks, especially blackbutt (*Eucalyptus pilularis*) and flooded gum (*Eucalyptus grandis*). Some of these trees had large DBH (diameter at breast height) in excess of approximately 80 cm, but few had old growth characteristics (i.e. trees that have attained sufficient size and age to produce hollows because of decay, damage and limb dropping). The hollows provide valuable habitat for fauna. The large mature trees observed which have not yet reached old growth status, are potentially a valuable source of seed for ecosystem regeneration and provide the over-arching structure, which protects other vegetation. Large trees of this type were also observed on surrounding private property, often in proximity to the national parks.

Many of the watercourses along the corridor had large flooded gum, particularly as rainforest emergents, and sometimes-large blackbutt occurred on the terraces. These large trees had similar ecological values to those observed in the national parks, with the additional value of bank stabilisation.

11.3.5 Cultural value and horticultural crops

Within the project area there are several places where vegetation exists that may not be of high ecological value, but has cultural value or economic value. Large individual trees or stands of trees may have cultural value and agricultural areas often have an economic and lifestyle value. Examples of locations where there is vegetation with cultural value are Spackman Lane and Eudlo Station, described below:

- One large relict rainforest tree (possibly brown beech, *Pennantia cunninghamii*) was observed along Spackman Lane, in a disturbed (non-remnant) area. It has been identified as an important local tree because it is one of few remaining large rainforest trees in the area. Rainforest trees of this size (trunk diameter of approximately 1 m) were found to be uncommon in the project area following reconnaissance.
- There is a significant community vegetation project at Eudlo. The Eudlo and Ilkley Landcare Group have established an advanced rainforest regeneration area (in conjunction with QR Limited) adjacent to Eudlo railway station and Eudlo Creek. It is called 'Federation Walk' and presents as a narrow rainforest planting of about 30 x 300 m.

There are two significant occurrences of horticultural crops in the vicinity of the alignment: an area east of Spackman Lane, Palmwoods and Birdwood Nursery. Birdwood Nursery is located to the north of Woombye on Blackall Range Road. The rear property boundary abuts the existing rail corridor. Birdwood Nursery is a specialist fruit tree nursery based in Nambour, supplying commercial growers and retail nurseries throughout Australia and the world.

The location of these is shown in **Figure 11.3e**

11.3.6 Weeds

The most significant weeds observed within the project area and their impacts and management issues are listed in **Table 11.3.6**. Infestations of lantana (*Lantana camara*), cat's claw creeper (*Macfadyena unguiscati*), silver-leaf desmodium (*Desmodium uncinatum*) and mother-of-millions (*Bryophyllum spp.*) were observed throughout the project area, and regularly along the existing railway corridor. These infestations are consistent with areas that had been cleared in the past, and in several areas, including Eudlo Creek National Park, weed invasions at the edges of railway property were observed (e.g. near Bamboo Rd). A map of weed infestations has not been provided because weeds were consistently throughout the project area and there were no outstanding areas of infestation.

Table 11.3.6: Significant weeds within the project area

Common Name	Botanical Name	Declared Class	Problem Caused	Distribution and Likelihood of Occurrence
lantana	*Lantana camara*	3	Restricts access. Mainly spread by birds.	Widespread along corridor, but particularly in forested areas on better soil, and in riverine areas.
cat's-claw creeper	*Macfadyena unguis-cati*	3	Outcompetes native riverine tree species. Seed spread by wind and water.	Present in most watercourses.
silver-leaf desmodium	*Desmodium uncinatum*	n/a	Outcompetes native plant species. Seed spread by animals.	Widespread along corridor, but particularly in forested areas on better soil.
mother of millions	*Bryophyllum spp.*	2	Outcompetes native plant species. Mainly spread by fragments.	Widespread along corridor, usually on poorer soils.

* *Declared Plant as listed in Land Protection (Pest and Stock Route Management) Act 2002. Class 3 plants only need to be controlled if adjacent to an environmentally significant area. A land owner must take reasonable steps to keep land free from Class 1 and 2 plants.*

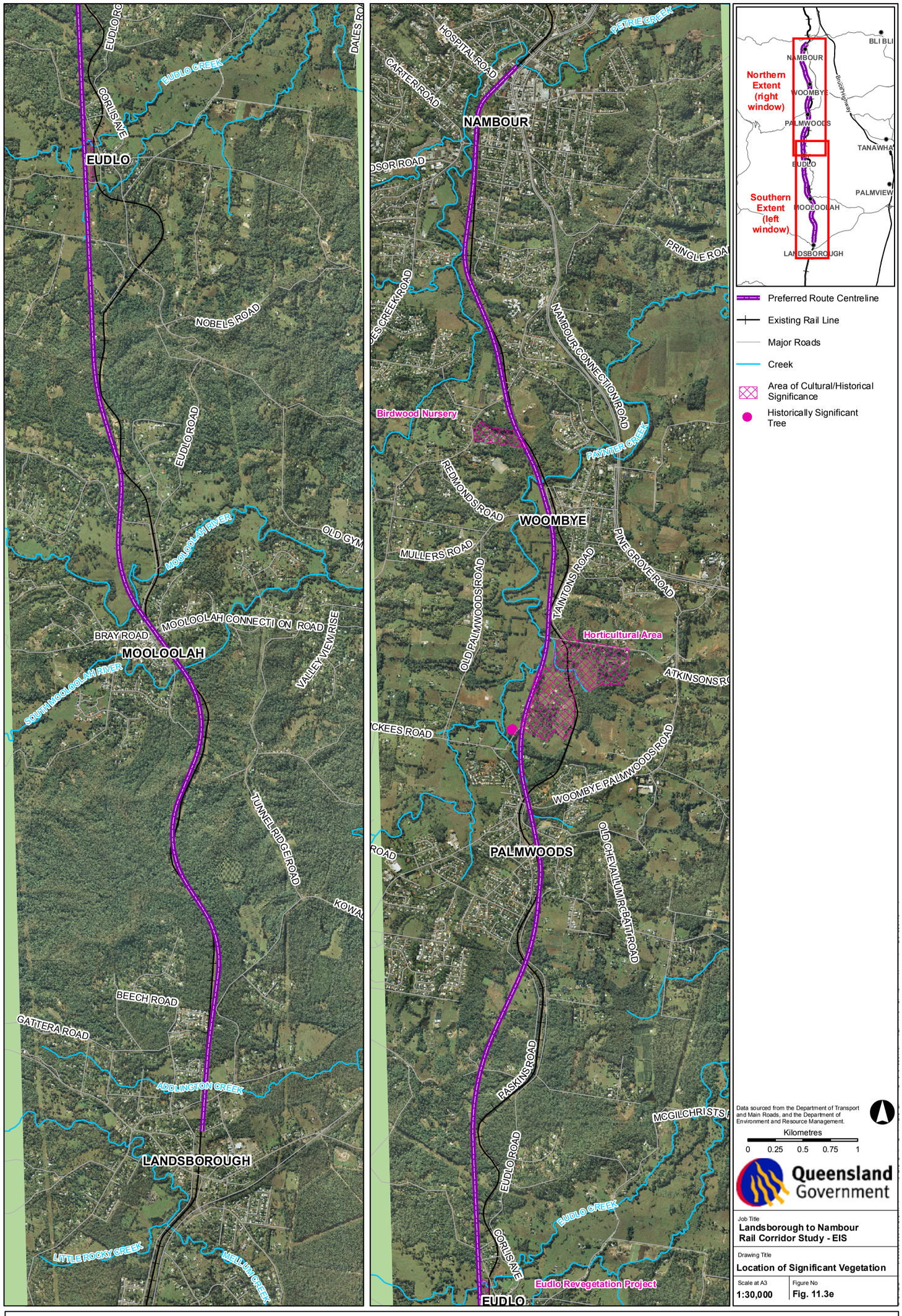
11.4 Information provided by the community

Throughout the project, there has been on-going community consultation. Details of activities and information releases is discussed in **Chapter 1, Section 1.9**. Issues raised to date and considered in both the route identification process and the assessment of the impact of the projects is discussed in **Table 11.4**.

Table 11.4: Issues raised during community consultation

Issues Raised	Response	Section
The proposed rail corridor will result in significant encroachment on remnant and non-remnant vegetation for the construction, operation and maintenance of the rail track.	The encroachment on vegetation was initially addressed in the route selection process that aimed to minimise the area of remnant vegetation affected by the rail corridor. It has subsequently been addressed as an impact within this chapter and some suggested mitigation measures include; minimising the construction footprint where possible, rehabilitating area only required for construction and offsetting any loss of native remnant vegetation.	**Chapter 11, Terrestrial Flora, Section 11.5.1**
Four-track corridor is excessive and unnecessary to accommodate expected passenger volume on this route.	Two tracks are proposed for construction as part of the project. However, the Route Identification Report identified a high quality railway corridor with capacity for up to four rail tracks and associated infrastructure and earthworks. This planning decision taken by the Queensland government allows for the protection of a strategic public transport and freight corridor for the longer term, allowing for a third and fourth track to be developed within the corridor in the future without the need to acquire additional land, if and when further capacity is required. This planning decision also offers a greater level of certainty in the longer-term.	**Chapter 1, Introduction and Chapter 2, Description of the Project**
This extended cutting would result in Dularcha National Park being significantly impacted. National parks are so declared to maintain the unique ecological features. The shape of the Dularcha National Park is long and narrow and clearing of this park will render it Vulnerable to edge effects, and subject to invasive weed species, further reducing the ecological values of the remaining national park.	The project through Dularcha NP has made use of the existing rail corridor where possible. Design speeds have been lowered to enable this to happen. Some clearing within Dularcha NP will still occur, however, this will be offset with rehabilitation of disused parts of the existing rail corridor. In addition, edge effects will be managed through buffer plantings.	**Chapter 21, Special Management Areas, Section 21.5**
The current design proposes a cutting through the length of The Pinch Lane with a much shorter tunnel than previously considered. The vegetation on either side of the tunnel between Mooloolah and Eudlo is a Bioregional Wildlife Corridor of State significance.	The importance of this area as a wildlife corridor has been recognised. A tunnel is proposed in this area. Part of the tunnel will be constructed without surface disturbance and the remainder will undergo cut and cover construction. Tunnels have been lengthened to reduce the extent of cut in these areas. Rehabilitation post-construction will allow the retention of the corridor.	**Chapter 21, Special Management Areas, Section 21.9**
A Natural corridor for Rare Threatened animals extends from Palmwoods through to Eudlo and the proposed railway would cut this corridor.	This refers to the area of Eudlo Creek NP and surrounds. The project is located to the west of Eudlo Creek NP and the decommissioning of the existing rail corridor will allow for the consolidation of the park. Fauna underpasses will be provided in this area to allow continued fauna movement.	**Chapter 21, Special Management Areas, Section 21.12**
Ancient flora sighted in Palmwoods includes the plant Polystichum sp. and the plant Cynthea dealbata (from the Devonium era of ancient ferns). Very large gum trees also survive here, some of which have been here since before settlement.	Flora surveys have been conducted as part of the EIS process. Species or individual plants of significance were noted. A pre-construction survey will also be conducted to ensure significant plants within the construction zone are either transplanted or replaced through the revegetation process.	**Chapter 11, Nature Conservation: Terrestrial Flora, Section 11.5.3**

Figure 11.3e: Location of Significant Vegetation



11.5 Assessment of potential impacts and mitigation measures

The Queensland government is committed to ecologically sustainable development, such that the Department of Transport and Main Roads (and other Transport Portfolio Partners, i.e. QR Limited) must have regard to the Transport Portfolio Environmental Framework (TPEF). The framework guides the work of the State's transport agencies and aims to improve the environmental performance of the transport system, and in the long term, create a transport system that is environmentally sustainable. One of the key outcomes of the TPEF is 'demonstrated reduced impacts from transport on the quality of the environment'.

With regards to the potential impacts of the project on ecological values, the Department of Transport and Main Roads has made an undertaking to strive towards a policy of 'no net loss' for biodiversity. This policy assumes that appropriate compensatory measures will be undertaken by the Department of Transport and Main Roads to ameliorate the impacts of the project on the project area. Acceptable compensatory measures include (but are not limited to) habitat acquisition and rehabilitation. It is the Department of Transport and Main Roads's intent that areas of equal or higher conservation value will be sought for acquisition and / or rehabilitation to compensate for the loss and / or degradation of natural habitat within and adjacent to the project in accordance with the relevant legislation, including the *Vegetation Management Act 1999*.

The impacts of the project on the ecological values of the area will be the result of the construction of a double track railway that stretches 20.9 kilometres between Landsborough and Nambour. The width of the corridor will allow for the safe construction of the ultimate four-track configuration to allow for future upgrades, if and when desired. The extent of earthworks for the construction will vary depending on terrain and design. There are areas of earthworks involving cuttings and embankments and areas where the rail will be required to be built on structure (e.g. over waterways and flood prone areas) or within a tunnel (e.g. under a high ridgeline).

The narrowest parts of the corridor will be where the rail is on structure or where sensitive areas require minimisation of clearing. The footprint may be wider at stations or within areas of difficult topography that require more earthworks. During construction, the area required for earthworks (construction zone) will be cleared of all vegetation and levelled for the laying of the tracks.

The main potential impacting processes to terrestrial flora associated with the construction and operation of the project are:

- clearing of remnant vegetation
- reduction of flora habitat and biodiversity
- removal of individual species of significance
- reduction of corridor functionality
- remnant vegetation edge effects
- riparian vegetation disturbance
- removal of horticultural crops and vegetation of cultural significance.

11.5.1 Clearing of remnant vegetation

Potential impact

Within the southern sector of the project area (from Landsborough north to Palmwoods), the project traverses mostly through areas of remnant vegetation. These tracts of remnant vegetation are of high conservation value as they support high biodiversity. In the northern sector of the project area, there is considerably less remnant vegetation and the landscape is dominated by residential development and rural land holdings. Remnant vegetation is concentrated along waterways. The biodiversity supported within the northern sector of the project area is considerably lower because of a lack of habitat diversity.

Due to the linear nature of the rail corridor, it is practically impossible to avoid the significant areas of remnant vegetation. Despite all efforts made during the design phase, the project will require the removal of areas of remnant vegetation at several points within the project area. The impact will occur during the construction phase, when clearing and earthworks are undertaken. The result will be a constructed railway that will form an open corridor throughout the operational phase of the project. **Table 11.5.1** shows the amount of clearing at various locations along the project for each regional ecosystem.

Table 11.5.1: Areas of clearing within remnant regional ecosystems[1]

Contact Point	Description	RE	Approximate area of Clearing (ha)
1	Landsborough	RE 12.3.2	0.03
2	Addlington Creek – north branch	RE 12.3.2	0.28
		RE 12.9-10.14	0.15
3	Dularcha NP	RE 12.3.2	0.68
		RE 12.9-10.14	2.64
		RE 12.3.1 (mapped as RE 12.9-10.16)	0.51
4	North of Dularcha NP – Rose Road to top of Dularcha NP	RE 12.9-10.14	1.12
		RE 12.9-10.17d	2.00
5	South Mooloolah River	RE 12.3.1	0.18

Table 11.5.1: continued

Contact Point	Description	RE	Approximate area of Clearing (ha)
6	Ridge between former Maroochy Shire and Caloundra City – The Pinch Lane	RE 12.9-10.14	1.69 (0.41 cut and cover)
		RE 12.9-10.17d	0.55
7	Eudlo Creek and tributaries	RE 12.3.2	0.92
		RE 12.9-10.14	0.20
8	Area south of Eudlo NP	RE 12.9-10.17d	1.23 (0.35 cut and cover)
9	West of Eudlo NP	RE 12.9-10.1	3.05
10	North-west of Eudlo NP	RE 12.9-10.14	1.17
11	Palmwoods	RE 12.9-10.14	1.83
		RE 12.3.2	0.45
		RE 12.3.5	0.18
12	Paynter Creek and tributaries	RE 12.3.2	1.09
		RE 12.3.1	0.37
		RE 12.9-10.14	0.19
13	Petrie Creek	RE 12.3.2	1.2
		TOTAL	**21.71 ha**

As previously indicated, the presence of remnant vegetation is a key factor in maintaining levels of biodiversity (which is the focus of the Department of Transport and Main Roads's TPEF). However, the ecological services provided by remnant vegetation actually extend well beyond this function such that it also has a major role in:

- provision of wildlife habitat (including Rare and Threatened species)
- support of old growth trees
- the prevention of erosion and sedimentation
- nutrient cycling
- the provision of oxygen
- the water cycle
- the carbon cycle and climate change
- provision of resources such as timber, medication etc.

The clearing of remnant vegetation has the potential to impact on all of these ecological services, such that the end result is an adverse impact on many aspects of the environment. Hence, it is important to mitigate the clearing of remnant vegetation.

Proposed mitigation

In order to reduce the impacts of remnant vegetation clearing on the local biodiversity and other ecological services, it will be necessary to undertake mitigation strategies within all stages of the project. The mitigation methodology associated with the project is detailed below. These strategies will be carried over into the detailed design phase, where applicable. Remnant riparian vegetation is discussed in **Section 11.5.6**.

Design

Ecological data collated during desktop and field based assessment was utilised to inform the design of the project, especially with regards to minimising the amount of remnant vegetation to be removed. Strategies employed during the preliminary design phase to minimise impacts on vegetation are listed below:

- Sensitive areas were avoided where feasible, i.e. areas of mapped Endangered remnant vegetation (RE12.5.3) were avoided at Landsborough and a small wetland (RE12.3.5) just north of Palmwoods was also avoided.
- The project has been kept as close as possible to the existing rail in Dularcha NP to avoid additional clearing and creation of small, isolated patches of remnant vegetation.
- The railway has been located to the west of Eudlo Creek NP to avoid further fragmentation, which may have decimated the narrow strip of park to the west of the existing rail. This route offers an opportunity for revegetation of the existing rail corridor running through Eudlo Creek NP.
- In areas where the rail corridor must traverse steep, heavily vegetated areas (e.g. Rose Road and The Pinch Lane), tunnels have been proposed to avoid extensive earthworks.
- Stations have been located in areas where remnant vegetation is largely absent.
- The width of the corridor required for the project has been minimised as far as practicable. It is typically 60 m, except in areas where terrain necessitates a greater area for earthworks.
- The width of the corridor is further reduced in places where the rail is required to be built on structure (approximately 20 – 25 m).

During detailed design, the amount of remnant vegetation to be cleared will be refined to the exact areas required for the construction of the rail. Clearing will be minimised where possible through the minimisation of the construction zone, use of retaining walls and steepening of batters and cuttings where possible. The extent of offsets required under the VMA, will be further refined and identified during this stage. The methodology for locating and securing these offset areas will be subject to consultation with EcoFund (which forms part of the Department of Environment and Resource Management that will deal with offsets).

Construction

Due to the linear nature of the rail corridor, it is not possible to avoid impacting on areas of remnant vegetation completely. In places where clearing of remnant vegetation will occur, clearing will need to be managed to ensure it is limited to that which is necessary to minimise harm to areas of retained vegetation. In order to document the proposed management of the vegetation clearing on site, a Vegetation Management Plan (VMP) has been prepared for the project. The key focus of the plan is to minimise vegetation clearing wherever possible, to conserve remnant vegetation and minimise the loss of individual significant species (Threatened species, and possibly old-growth trees, if encountered). The Vegetation Management Plan (VMP) has been developed, as part of **Chapter 22, Environmental Management Plan**, in order to address potential impacts of the construction phase of the project.

The construction phase must be overseen by an environmental officer who will monitor contractor activity for compliance with the Vegetation Management Plan and liaise regularly with the on-site construction supervisor. Liaison will incorporate an induction for all site workers, where details of the VMP will be discussed. This will help to increase the awareness of vegetation management issues on site. The VMP incorporates mitigation measures as listed:

- A Vegetation Clearing Permit/s will be obtained from the Department of Environment and Resource Management as required under the *Vegetation Management Act 1999*.
- Surveyors shall be instructed to notify the environmental officer if remnant vegetation requires clearing for line-of-site, location of pegs etc. The environmental officer shall conduct an inspection to ensure that the vegetation to be removed does not consist of Threatened species.
- Clearing along the proposed rail corridor shall be limited to the amount necessary to undertake earthworks and shall aim to minimise the construction corridor where possible.
- Installation of vegetation clearance markers (e.g. flagging tape, marker paint, high visibility poly-web fencing) prior to the commencement of vegetation clearance. Vegetation clearing shall be limited to the construction footprint. Construction equipment and personnel will not be permitted outside the construction footprint.
- Where possible, lopping or pruning of trees within the clearing zone is preferable to completely removing them. Pruning shall be undertaken in accordance with Australian Standard AS 4373-2007 – Pruning of Amenity Trees.
- Within areas where clearing must occur for construction purposes (but is outside of the actual footprint of the track and safety zones), clearing to ground level shall be minimised. If possible, slashing of existing vegetation layers or clearing with minimal ground disturbance (e.g. chain saw) shall be undertaken so that the soil seed bank is retained.
- A fauna spotter-catcher shall be employed prior to clearing remnant vegetation.
- Felled vegetation shall be economically salvaged as appropriate, such as mulching of smaller stems and branches, and sale of larger timber to contractors.
- Hollow logs, rocks and large debris shall be salvaged for use for habitat enhancement within areas for rehabilitation.
- Limiting any necessary slashing to a minimum height of 200 mm, to allow for the retention of ground layer and understorey vegetation elements in all areas not directly utilised for infrastructure construction or access track purposes.
- Access tracks shall be located in conjunction with the environmental officer to avoid mature, remnant trees as much as possible.
- Intended vehicle access tracks to and along the infrastructure route shall be identified and marked at the commencement of the construction phase, to prevent the development of multiple access tracks.
- Locating features such as fill stockpiles, access tracks site facilities etc. within the construction zone or in areas of existing disturbance.
- Storage of all materials and wastes (including general human waste) shall be restricted to designated areas that are at least 50 m away from waterway corridors. These shall be designed to ensure no off-site impacts occur (e.g., bunding should be placed around fuel and chemical storage areas).
- Soil stability shall be maintained in all disturbed areas, by means of erosion control mechanisms, including sediment barriers, berms, batters, fabric covers and/or mulching, temporary and permanent drains, etc.
- Penalties shall be imposed for unauthorised clearing of defined protected vegetation.

Operation

Once the rail has been constructed, there will be no need for further clearing of remnant vegetation. The rail corridor will be maintained on a regular basis through weed management and pruning of overhanging branches. During the operational phase, the focus on remnant vegetation will shift to the management of the offsetting and rehabilitation program. The location and securing of areas required for offsetting remnant vegetation as per VMA shall be undertaken prior to operation. However, these areas will be then become the focus of the rehabilitation and on-going management mentioned in the Vegetation Management Plan (VMP) once design and construction is complete as described in **Chapter 22, Environmental management plans**. Mitigation will be as follows:

- Management of vegetation offsets to replace areas of remnant regional ecosystems removed by the proposed railway development. Offsets will be in line with the

policy of the Department of Environment and Resource Management for Vegetation Management Offsets, which is triggered under the *Vegetation Management Act 1999*. Refer to **Section 11.6** for more information regarding offset requirements. The final extent of offsets required and offset areas will be defined during the detailed design phase once the amount of clearing required has been finalised.

- Control and/or removal of any weeds in the corridor that have been introduced or exacerbated as a result of the works, with the aim being to leave the site in equivalent condition (or better, in terms of weeds) to prior to construction. The environmental officer shall take before and after photographs and site notes to verify the condition of the site.
- Preventing weed establishment on bare ground and in areas of revegetation.
- Rehabilitation of areas necessary for construction, but not required for the operational phase of the railway. For example, areas disturbed by construction of the bridges. Rehabilitation will aim to re-establish the original regional ecosystems present prior to disturbance.
- Rehabilitation shall be more specifically addressed within the VMP for detailed design, particularly: progressive staging of rehabilitation, recommended native species, incorporation of Threatened flora, recommended planting densities, incorporation of understorey where canopy species are excluded by structure and monitoring.

The operational phase shall also be overseen by an environmental officer, who would periodically monitor weed cover, replanting success, and report necessary maintenance.

Decommissioning of existing railway

The decommissioning of the existing railway will not have a negative impact on remnant vegetation, but instead offers an opportunity for rehabilitation and reconnection of previously fragmented remnants. There are many options for reuse of the decommissioned rail corridor, including retention for historic value, community use, rehabilitation and conversion into a recreational trail. Within areas that have been highlighted as significant from a biodiversity perspective, the priority use for the decommissioned rail corridor will be to rehabilitate it. The creation of a recreational walking trail will still allow for rehabilitation of the majority of the corridor.

Areas along the existing rail corridor highlighted for rehabilitation are:

- Addlington Creek (north)
- Dularcha NP
- north of Dularcha NP – Rose Road and surrounds
- Mooloolah River
- The Pinch Lane (bioregional corridor)
- Eudlo Creek NP.

These areas are also discussed in **Chapter 21, Special management areas**. The existing rail corridor is approximately 20 – 25 metres. In order to rehabilitate the corridor, the following activities will need to be conducted:

- removal of any fencing or sound proofing
- removal of rail infrastructure (including track and overhead powerlines)
- removal of embankment, i.e. ballast
- removal of contaminated materials.

It should be noted that there is potential for the rail verges to be contaminated due to almost 100 years of weed control, including spraying of herbicide. It is likely that the contaminated material will need to be removed from site prior to rehabilitation. This is further dealt with in **Chapter 5, Geology and soils.**

- restoration of topography to suit existing landscape
- delineation of any recreational tracks
- site preparation (decompacting / ripping and topsoil) in area for planting
- mulching in area for planting
- planting (tube stock or seeding or hydro mulching)
- regular maintenance (e.g. weed management) and monitoring.

Residual impact

Given the amount of clearing of remnant vegetation (i.e. 21.71 ha on a 85.3 ha corridor or 25%) and the mitigation measures to be employed, especially with respect to offsets and rehabilitation, it is considered that the impact on remnant regional ecosystems will be **moderate adverse** in short term and **low adverse** in long term (refer to **Table 11.2.4**).

11.5.2 Reduction of flora habitat and diversity

Potential impact

Habitat diversity is often linked to diversity of species, such that an area with a wider variety of available habitat will support a higher diversity of native species. There is a diversity of habitat types in the area surrounding the proposed rail upgrade. Remnant vegetation mapping and field survey have confirmed a total of 20 regional ecosystems in the project area, including open forest, woodland, wetland and riparian communities. The project will impact upon all of these habitats in some way (e.g. vegetation clearing or bridge crossing), but will not result in the removal of an entire regional ecosystem or waterway from the locality.

On a smaller scale, species diversity in each habitat is influenced by its maturity (and subsequent structural diversity) and condition (i.e. weeds reduce the number of native species through competing for limited resources). Also relating to

vegetation condition is the ability for species to expand their range to other habitats along corridors. Corridor functionality is discussed in **Section 11.5.4**.

Proposed mitigation

As the impacts on flora habitat and diversity are largely a result of the clearing of remnant vegetation, the mitigation measures described in **Section 11.5.1** will be effective. Some additional mitigation has been proposed to target the more specific impacts on flora species habitat and diversity. These strategies will be carried over into the detailed design phase, where applicable.

Design

Ecological data collated during desktop and field based assessment was utilised to inform the design of the project, especially with regards to minimising the amount of remnant vegetation to be removed. Strategies employed during the preliminary design phase to minimise impacts on flora habitat and diversity are listed below:

- avoid sensitive areas where the rail may have deleterious impacts on a regional ecosystem in the area, i.e. where the construction of the railway would reduce the remnant patch to a size where it is not viable
- minimise impacts on known high quality habitat or structurally diverse habitat through the use of existing track; avoidance or use of tunnels e.g. Dularcha NP, Eudlo Creek NP, the areas around Rose Road and The Pinch Lane
- avoid lengthy crossings of riparian corridors and ensure bridge heights allow for retention of groundcover or understorey vegetation.

Construction

Clearing on site will need to be managed to minimise harm to areas of retained vegetation and ensure it is limited to the area that is necessary. Although the location of the rail corridor will not be altered during the construction phase of the development, it may be possible to amend construction methods on site to minimise the construction footprint or impact on highly valuable areas, where species diversity is likely to be higher. Opportunities to further minimise impacts include:

- Areas of vegetation that have the lowest diversity of native species and / or are weed infested shall be selected for clearing where options exist, i.e. for construction zones.
- An ecologist / botanist shall assist contractors determine the best possible access track and / or construction zone in order to conserve habitat of a higher quality.
- Restriction of access to rail corridor, construction zones and access tracks will prevent trampling and minimise the chances of weed infestation.
- During construction, certification shall be required to identify of the origin of construction materials, machinery and equipment. Vehicles and machinery shall be subject to inspection, and if necessary, wash-down before entering sites. Vehicles and machinery shall also be subject to wash-down immediately off-site when departing from areas known to be infested with weed species. Wash-down facilities shall be situated so as not to allow mud to adhere to vehicles and machinery on exit from key weed-affected sites. Consideration of these requirements has been addressed when determining site access routes as noted in **Chapter 7, Transport**.

Further information on weed management is outlined in **Section 11.5.5**. The Vegetation Management Plan (VMP) prepared for the project documents the proposed management of the vegetation clearing on site. See **Chapter 22, Environmental Management Plans**.

Operation

During the operational phase, the focus on remnant vegetation will shift to the management of the offsetting and rehabilitation program. There will be several elements of the revegetation strategy that relate to maintaining a high floristic diversity, as follows:

- The rehabilitation program shall incorporate a wide variety of species endemic to the area and typical of the regional ecosystem being rehabilitated.
- Plant stock shall be locally sourced, where possible, to maintain genetic identity of local communities.
- Due to the large number of plants likely to be required for the revegetation program, it is recommended that a native plant nursery be established to supply the project or an arrangement made with a local nursery to source the required plants.
- Weed management will be essential to prevent the incursion of highly competitive weed species into establishing areas of rehabilitation.
- Regular monitoring to ensure that threats to the success of the revegetation are controlled, i.e. grazing, weed infestation, trampling etc.

The operational phase shall also be overseen by an environmental officer, who would periodically monitor replanting success, and report necessary maintenance to operational management.

Decommissioning of existing railway

As mentioned in **Section 11.5.1**, the decommissioning of the existing railway will not have a negative impact on remnant vegetation because it offers an opportunity for rehabilitation. The mitigation measures mentioned will also help integrate floristic diversity into the decommissioning phase of the project by incorporating a wide variety of native species into rehabilitation conducted as part of the decommissioning of the existing rail.

Residual impact

As the project is not resulting in the removal of any regional ecosystems from the local area or removal of large tract of remnant vegetation, the impact of the proposed railway development on flora species habitat and diversity is considered to be **low adverse** (refer to **Table 11.2.4**).

11.5.3 Removal of individual species of significance

Potential impact

For the purposes of this report, individual species of significance can constitute old-growth trees and Threatened species as listed under the Nature Conservation (Wildlife) Regulation 2006 and/or *Environment Protection and Biodiversity Conservation Act 1999*. There were several old growth trees observed within the national parks and along waterways within the project area. These trees generally contain hollows. A similar situation was found with regards to Rare and Threatened species. The majority of species indicated as likely to occur within the project area were associated with rainforest habitat and are particularly sensitive to disturbance. Hence, they are most likely to occur along vegetated waterways and in national parks. Although field surveys did not locate old-growth trees or Threatened species within the project, these surveys are associated with an element of risk due to the limitations discussed in **Section 11.2.3**. It is possible that some of the old-growth trees and Threatened species will fall within the project. For this reason, it is particularly important to incorporate mitigation strategies into the design and construction phase of the railway, so that subsequent findings can be managed.

Proposed mitigation

As the impacts on individual flora species of significance is largely a result of the clearing of remnant vegetation, the mitigation measures described in **Section 11.5.1** will be effective. Some additional mitigation has been proposed to target impacts on individual flora species of significance as listed. These strategies will be carried over into the detailed design phase, where applicable.

Design

Ecological data collated during desktop and field based assessment was utilised to inform the design of the project, especially with regards to minimising the probability of impacting upon Threatened species. Strategies employed during the preliminary design phase to minimise impacts on vegetation are listed below:

- avoid impacts on known high quality habitat or structurally diverse habitat where possible, e.g. Dularcha NP and Eudlo Creek NP
- avoid lengthy crossing of waterways and ensure bridge heights allow for some vegetation retention
- bridges over waterways where riparian vegetation is prominent have been designed to reduce the amount of clearing required. Clearing will only be required for the establishment of piers and structures. This is essential at Addlington Creek (north), South Mooloolah River and Mooloolah River.

It should also be noted that the width allowed for the corridor incorporates some scope to allow for minor adjustments in the area required for construction (i.e. a few metres to avoid a significant plant). This may become necessary should the pre-construction survey identify old-growth trees or significant species within the fringes of the construction corridor. These will be assessed on an individual basis.

Construction

It is important to note that this project will have a lengthy lead-time between design and construction; hence, it is possible for environmental conditions to change slightly. Any plants picked up in pre-construction survey will be those, which may not have been recorded at the time of original survey for this report, due to seasonality or subsequent growth. To accommodate the possibility that individual species of significance may be located in the rail corridor during pre-construction survey, the following mitigation methods have been integrated into the VMP (**Chapter 22, Environmental Management Plans**):

- In remnant areas, an environmental officer shall traverse the area by foot immediately prior to clearing (in conjunction with a fauna spotter-catcher) to check for any Threatened plant species or old-growth trees on or directly adjacent to the corridor.
- Areas of vegetation containing Threatened species or old-growth trees that could be affected by the construction of the rail corridor will be flagged.
- Areas of vegetation containing Threatened species or old-growth trees directly adjacent to the construction zone shall be defined with exclusion fencing prior to construction works. Access will not be permitted to these areas.
- Where Rare or Threatened species are encountered within the construction footprint, work in that immediate area must stop and arrangements be made for the translocation of that (or those) plant(s) using recognised landscaping techniques, and undertaken by appropriately skilled staff. Plants shall be removed keeping the root ball intact, and stored ready for replanting using accepted nursery practices. When works in that area have finished, they shall then be planted as near as practicable to the original location, where they will not be disturbed in future (e.g. by future activity on the corridor). Watering in shall occur immediately after planting. The ground around the plant in its new location shall be mulched during watering.

- An ecologist or botanist shall assist the contractors to determine the best possible access track and/or construction zone in areas of remnant vegetation.
- Location of tracks to be cleared for machinery access shall be determined according to the need for conservation of significant species or old-growth trees. For example, where options are available for clearing particular areas, the option selected shall be the one that conserves any significant flora.
- Construction personnel shall be educated on the value and appearance of old-growth trees and, unless these are located directly within the proposed rail corridor, they will be protected from removal, damage or interference.
- As identification of Threatened species is generally difficult for untrained personnel, training in identification should be provided for distinctive species where practicable, in the form of colour photographs and descriptions written in lay terms.
- Penalties shall be imposed for unauthorised clearing of defined protected vegetation in accordance with State and federal legislation.

Operation

During the operational phase, the focus will shift to the management of the offsetting and rehabilitation program. There will be several elements of the revegetation strategy that relate to reducing impacts on individual flora species of significance, as follows:

- Any translocated specimens shall become an integral part of the monitoring element of the rehabilitation program.
- The rehabilitation program shall incorporate Threatened species endemic to the area and typical of the regional ecosystem being rehabilitated, where possible.
- If any old growth trees cannot be avoided, mass replanting, or rehabilitation of nearby bushland, or use of offsets, shall be implemented as compensation.
- Weed management will be essential to prevent the incursion of highly competitive weed species into establishing areas of rehabilitation (refer to **Section 11.5.5**).
- Regular monitoring to ensure that threats to the success of the revegetation are controlled, i.e. grazing, weed infestation, trampling etc.

Offsetting and rehabilitation have been integrated into the VMP (**Chapter 22, Environmental Management Plans**). The operational phase shall also be overseen by an environmental officer, who would periodically monitor replanting success, and report necessary maintenance to operational management.

Decommissioning of existing railway

As mentioned in **Section 11.5.1**, the decommissioning of the existing railway will not have a negative impact on remnant vegetation because it offers an opportunity for rehabilitation. The mitigation measures mentioned will also help integrate floristic diversity into the decommissioning phase of the project, e.g. incorporating Threatened species into rehabilitation conducted as part of the decommissioning of the existing rail.

Residual impact

With the low expectation of encountering Threatened species and old growth trees along the preferred corridor, and with inspection of accurately, marked areas immediately prior to construction, it is expected that the residual impact would be **negligible** to **low adverse** (refer to **Table 11.2.4**).

11.5.4 Reduction of corridor functionality

Potential impact

Vegetated wildlife corridors are essential to the maintenance of biodiversity in a fragmented landscape. They can help to alleviate the impact of development on biodiversity by providing an area where flora and fauna can continue to disperse between remaining areas of remnant vegetation. Allowing the migration of fauna and flora is essential to:

- maintain an exchange of individuals between populations
- increase the pollination success of plants (particularly those pollinated by birds and bees)
- lower inbreeding within populations
- enable species to respond to environmental variability (e.g. move between nutrient and water sources or move from overpopulated areas)
- facilitate re-establishment of populations that have been decimated or eliminated due to random events
- contribute to the species richness and biodiversity value of remnant patches.

Two major wildlife corridors within the project area have been identified in the State's BPA mapping. There is a bioregional corridor towards Landsborough (Rose Road) that encompasses Dularcha National Park and Mooloolah Forest Reserve further to the west. The second bioregional corridor is towards the centre of the project and occurs on the ridgeline that separates the former local government areas of Caloundra and Maroochy (around The Pinch Lane). Both these areas have been recognised as bioregional corridors that are of State significance. In addition to this, there is a third, area that could function as a wildlife corridor, but the remnant vegetation here is more fragmented. This area incorporates Eudlo Creek National Park and areas to the east and west. All these corridors function to permit fauna movement and exchange of genetic material in an east-west direction. There are other smaller, locally significant corridors radiating in various directions from these larger areas of remnant vegetation.

These local corridors are generally created by waterways, namely Addlington Creek, South Mooloolah River, Mooloolah River, Eudlo Creek, Paynter Creek and Petrie Creek. Paynter Creek and Petrie Creek provide an opportunity for wildlife movement in a north-south direction. Refer to **Figure 12.3a**, **Chapter 12**, **Terrestrial Fauna**.

The project will traverse all these corridors at some point, potentially creating a break within the corridors that may hamper the migration of flora and have the following negative impacts:

- reduce or prevent exchange of individuals between populations and increase chance of inbreeding or self-pollination
- decrease the pollination success of plants, especially those pollinated by insects or small birds that do not travel larger distances
- prevent species from responding to environmental variability (e.g. changes in hydrology or nutrient resources), which may result in a species becoming locally Threatened
- prevent re-establishment of species in areas that have suffered acute short-term disturbance (e.g. severe storm, flooding etc)
- ultimately, lead to reduction in species richness within remnant patches and lower biodiversity.

Generally speaking, maintaining vegetation connectivity is most effective in designing corridors for flora. However, fauna underpasses and overpasses may allow movement of animals that act as pollinators and hence contribute to distribution of flora. Fauna movement is discussed in more detail in **Chapter 12**.

Proposed mitigation

As the impacts on individual flora species of significance is largely a result of the clearing of remnant vegetation, the mitigation measures described in **Section 11.5.1** will be effective. Some additional mitigation has been proposed to target impacts on wildlife corridors as listed. These strategies will be carried over into the detailed design phase, where applicable.

Design

Ecological data collated during desktop and field based assessment was utilised to inform the design of the project, especially with regards to minimising the probability of impacting upon wildlife corridors. Strategies employed during the preliminary design phase to minimise impacts on vegetation are listed below:

- Minimisation of corridor width will facilitate pollen vectors.
- In areas where the rail corridor must traverse sensitive areas (e.g. Dularcha NP), the project has been kept as close as possible to the existing rail to avoid additional clearing and the creation of small, isolated patches of remnant vegetation.
- The railway has been located to the west of Eudlo Creek NP to avoid further fragmentation, which may have decimated the narrow strip of NP west of the existing rail. This route offers an opportunity for revegetation of the existing rail corridor running through the park.
- Tunnels will be utilised where the rail dissects bioregional corridors due to terrain, hence an area of intact vegetation is maintained to assist flora distribution.
- Cut and cover construction methods (i.e. creation of land bridges) have been proposed in other steep areas where there would otherwise be an extensive cut. For example, just south of Eudlo Creek National Park (**Drawing No. CO14**).
- Bridges over waterways where riparian vegetation is prominent have been designed to reduce the amount of clearing required. Clearing will only be required for the establishment of piers and structures. Bridge heights will be maximised where possible to increase the amount of sunlight under the bridge for vegetation growth. This is essential at Addlington Creek (north), South Mooloolah River and Mooloolah River.
- Lengthy and compound crossings running directly over major waterways that are known to be functional wildlife corridors have been avoided.
- Provision of fauna underpasses and overpasses along the length of the project (refer to engineering drawings for locations).

Construction

Clearing on site will need to be managed to minimise harm to areas of retained vegetation and ensure it is limited to the area that is necessary. Although the location of the rail corridor will not be altered during the construction phase of the development, it may be possible to amend construction methods on site to minimise the construction footprint. The key impact mitigation measures that are outlined in the VMP (**Chapter 22**, **Environmental Management Plans**) and will be implemented for terrestrial corridors are:

- construction to be fully contained within the corridor at the sections affecting the bioregional corridors
- the construction corridor shall be minimised here as much as possible, whilst still allowing the appropriate setbacks of the railway from vegetation for operational safety purposes
- minimisation of cleared nodes along the corridor, especially any tracks which break up the continuity of the vegetation corridor
- minimisation of access tracks external to the corridor
- service tracks for the railway shall be kept within the corridor

- the use of an ecologist or botanist to assist the contractors determine the best possible access track and/or construction zone in areas of remnant vegetation
- minimisation of steep embankments wherever possible, as these provide a barrier to genetic exchange of plant material by vectors such as wind and fauna.

Operation

During the operational phase, the focus will shift to the management of the offsetting and rehabilitation program. There will be several elements of the revegetation strategy that relate to maintaining connectivity, as follows:

- rehabilitation of the construction zones to minimise the width of the railway corridor as far as possible
- rehabilitation of existing rail corridor within areas associated with wildlife corridors (e.g. in the vicinity of Rose Road and The Pinch Lane) to prevent the creation of two barriers to flora and fauna movement
- weed management essential to prevent the incursion of highly competitive weed species into establishing areas of rehabilitation
- long-term weed management (non-chemical) under bridges to prevent weed establishment after construction
- regular monitoring to ensure that threats to the success of the revegetation are controlled, i.e. grazing, weed infestation, trampling etc.

Offsetting and rehabilitation has been incorporated into the VMP (**Chapter 22, Environmental Management Plans**). The operational phase shall also be overseen by an environmental officer, who would periodically monitor replanting success, and report necessary maintenance to operational management.

Decommissioning of existing railway

As mentioned in **Section 11.5.1**, the decommissioning of the existing railway will not have a negative impact on remnant vegetation because it offers an opportunity for rehabilitation. The complete decommissioning process will be a lengthy one and will depend on the rate at which rehabilitation areas establish and become independent of management.

Residual impact

The implementation of bridges and tunnels together with the rehabilitation of the existing rail route will allow the continued use of the bioregional and local wildlife corridors by many species of flora and fauna. Dispersal of flora will largely be limited to these avenues, due to the large width of the rail corridor. An exception will be for those flora species that are dispersed by birds. It is expected that the residual impact would be **low** to **moderate adverse** (refer to **Table 11.2.4**).

11.5.5 Remnant vegetation edge effects

Potential impact

Edge effects occur when previously intact remnant vegetation is cleared in part, leaving a new boundary of vegetation that becomes exposed to some form of disturbance. Edge effects can include the establishment of weeds, immigration of pest fauna species, colonisation of aggressive native species (especially birds), exclusion of more sensitive native species, greater light intensity, wind penetration, lower humidity and greater fire susceptibility. In this instance, the new rail corridor will traverse several remnant patches and result in clearing of a narrow, linear strip of vegetation from the interior of the remnant. This will leave a scar where two edges are created on either side of the rail corridor. The narrow, linear nature of the rail corridor may reduce the severity of edge effects somewhat because the remnant edges on either side of the corridor will face each other and reduce exposure. This will particularly relate to wind penetration and fire susceptibility.

The rail corridor will result in the creation of 4,850 metres of new edge that is susceptible to edge effects. The majority of these edge effects will influence the RE 12.9-10.14. Edge effects have been defined as an area where the route dissects remnant vegetation and there has been no edge previously in that location. Some small clumps of remnant vegetation may become unviable due to the construction of the rail corridor.

Remnant patches that fall below 2 ha and / or less than 35 metres in width have been defined as 'unviable', based on Queensland Herbarium's definition of an un-mappable area. Remnant areas influenced by edge and those that may become unviable are indicated in **Figure 11.5**.

Figure 11.5: Potentially Unviable Remnant Vegetation

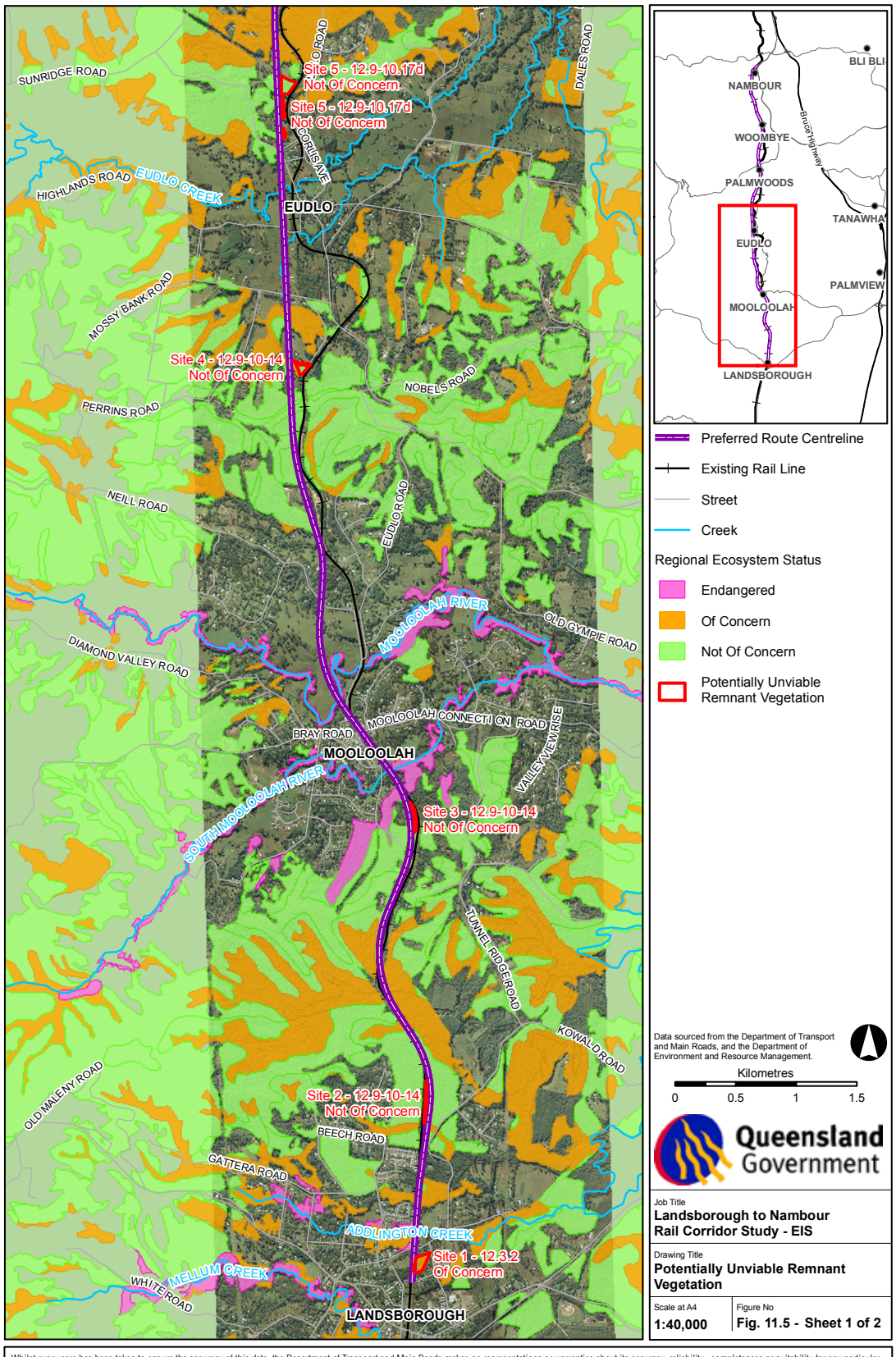
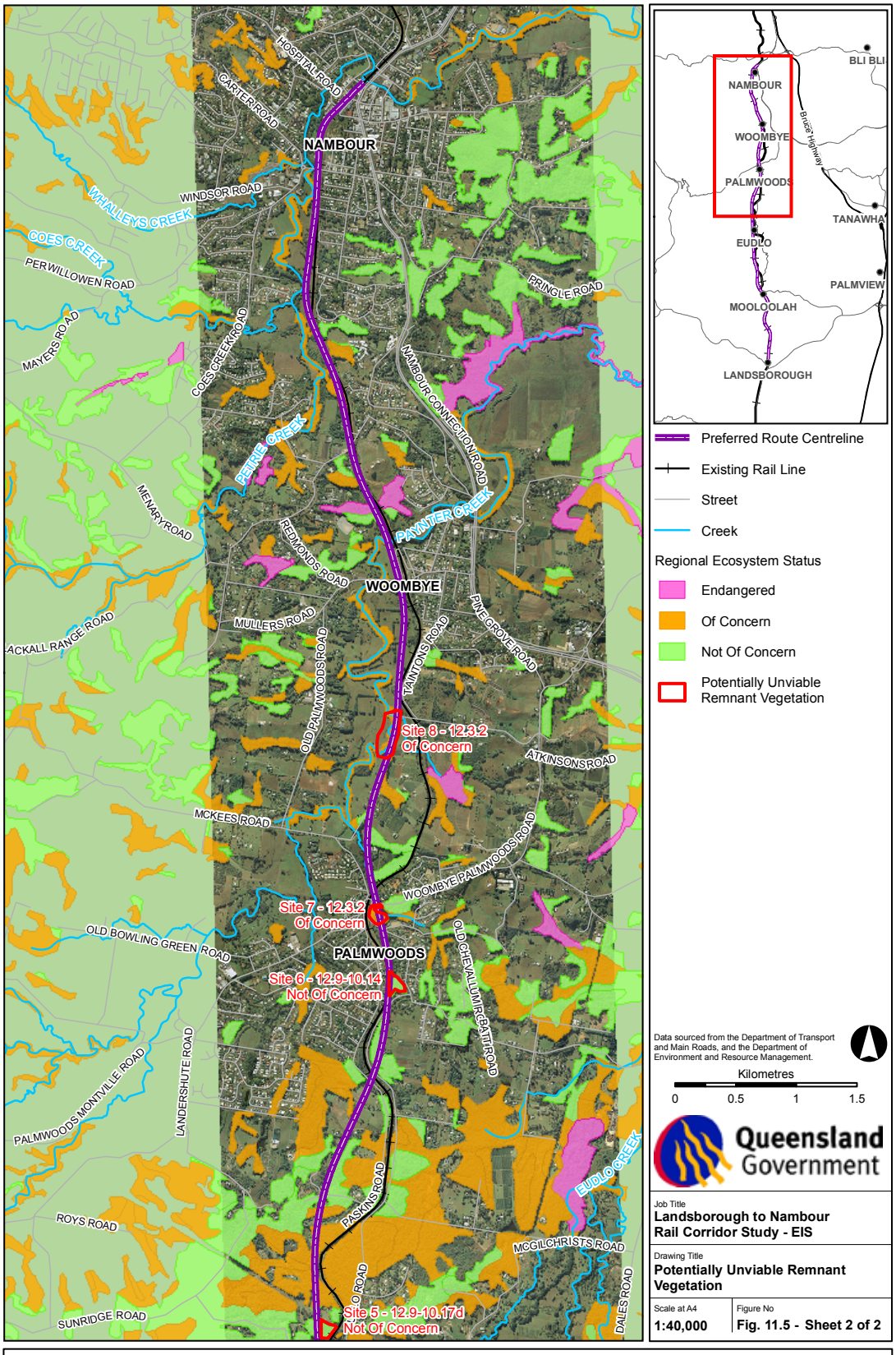


Figure 11.5: Potentially Unviable Remnant Vegetation



Proposed mitigation

As the impacts on individual flora species of significance is largely a result of the clearing of remnant vegetation, the mitigation measures described in **Section 11.5.1** will be effective. Some additional mitigation is proposed to target edge effects as listed below. These strategies will be carried over into the detailed design phase, where applicable.

Design

Ecological data collated during desktop and field based assessment was utilised to inform the preliminary design of the project. It is difficult to reduce impacts of edge effects due to the fixed length of the proposed rail corridor between Landsborough and Nambour. Alterations in the width of the corridor will not influence the amount of edge effects only the severity. Strategies employed during the preliminary design phase to reduce the potential for edge effects to impact upon remnant vegetation are listed below:

- The corridor width through remnant vegetation has been minimised to reduce severity of edge effects.
- In areas where the rail corridor must traverse sensitive areas (e.g. Dularcha NP), the project has been kept as close as possible to the existing rail to avoid additional clearing and the creation of small, isolated patches of remnant vegetation. This will result in no worsening of edge effects currently experienced.
- Tunnels will be utilised where the rail dissects bioregional corridors so that an area of intact vegetation is maintained, i.e. Rose Road and The Pinch Lane.
- Cut and cover construction methods (i.e. creation of land bridges) will be utilised in other steep areas where there would otherwise be an extensive cut. For example, just south of Eudlo Creek National Park (**Drawing No. CO14**).
- Small remnants (< 2 ha) are avoided where possible, such that edge effects result in an unviable remnant patch.

Construction

Clearing on site will need to be managed to minimise harm to areas of retained vegetation and ensure it is limited to the area that is necessary. The key impact mitigation measures that have been outlined in the VMP in **Chapter 22, Environmental Management Plans** and implemented for management of edge effects are:

- construction to be fully contained within the corridor at the sections affecting the bioregional corridors

The construction corridor shall be minimised here as much as possible, whilst still allowing the appropriate setbacks of the railway from vegetation for operational safety purposes.

- minimisation of cleared nodes along the corridor, especially any tracks which break up the continuity of the vegetation corridor
- minimisation of access tracks external to the corridor and service tracks for the railway to be kept within the corridor
- prior to construction, specific site surveys to be done by the environmental officer in areas before construction teams enter the site

A weed report shall be provided to the site manager and access prohibited to infested areas not essential for access. If infested areas need to be cleared, then appropriate weed control or containment measures shall be implemented by the environmental officer. Depending on the type of weeds, this could entail slashing, burning, poisoning, landfill etc.

- staff / operator education programs run by the environmental officer to be implemented as part of the general site induction process, including distribution of fact-sheets to staff (e.g. colour photos, precautions, procedures)
- during construction, certification to be required to identify of the origin of construction materials, machinery and equipment

Vehicles and machinery shall be subject to inspection, and if necessary, wash-down before entering sites. Vehicles and machinery shall be subject to wash-down immediately off-site when departing from areas known to be infested with weed species. Wash-down facilities shall be situated so as not to allow mud to adhere to vehicles and machinery on exit from key weed-affected sites.

- weeds not mulched for use on site, but disposed of in the appropriate facility off-site
- chemical control of weeds to be done only where the site is at least 50 m from a waterway and to be carried out by trained and/or qualified operators, approved by the environmental officer, preferably prior to mechanical clearing to reduce seed set.

Operation

During the operational phase, the focus will shift to the management of the offsetting and rehabilitation program. There will be two major elements of the revegetation strategy that relate to reducing edge effects: buffer plantings and weed management. The details on buffer plantings will be incorporated into the rehabilitation and landscaping strategy within the construction VMP and will focus on implementing buffer plantings along the newly exposed forest edges. These plantings will be of appropriate native understorey species such as those present within the remaining forest itself, and will be planted at the forest edges at a level of density that will provide adequate protection to the forest in terms of shading, weed inhibition and microclimate control in general.

Weed management will be essential to prevent the incursion of highly competitive weed species into establishing areas of rehabilitation and to prevent weed establishment under bridges after construction. A targeted approach to individual weed

species is possible given the limited number of weed species, and this should prove to be more effective than a broad-based approach (e.g. for herbicide selection). Lantana (Lantana camara) is the most significant weed along the preferred corridor, and a focus on this species by weed control contractors should control the majority of weed biomass.

The other weed species encountered (particularly silver-leaf desmodium – Desmodium uncinatum and mother of millions – Bryophyllum spp.) on the corridor will need to be controlled, but they are not considered as destructive as lantana.

A Weed Management Plan has been developed, as part of the **Chapter 22, Environmental Management Plans** for ongoing management of Declared Plants and other weeds. Any weed species declared under the *Land Protection (Pest and Stock Route Management) Act 2002*, must have reasonable steps taken to control it.

The plan focuses on minimising the potential for the introduction and/or spread of weeds or plant disease, and outlines an ongoing weed control program with the following elements:

- prioritisation of weed infestation or weed species
- strategies for preventing weed spread
- weed removal strategies
- weed monitoring protocols
- follow-up weed control methods and protocols
- integration of weed management into rehabilitation plans (e.g. consideration of treatment of area with 'Goal' or similar weed retardant prior to planting, scraping top soil to remove weed seed bank prior to planting).

QR Limited has standard Fire Management Plans associated with the operation of rail infrastructure, as mentioned in **Chapter 22, Environmental Management Plans**, to help control weed infestations and fuel loads in close proximity to the corridor, and protect adjacent native remnant vegetation. This applies mainly to the eucalypt forests around the two national parks.

Decommissioning of existing railway

As mentioned in **Section 11.5.1**, the decommissioning of the existing railway will not have a negative impact on remnant vegetation because it offers an opportunity for rehabilitation. The complete decommissioning process will be a lengthy one and will depend on the rate at which rehabilitation areas establish and become independent of management.

The decommissioning phase should also be overseen by an environmental officer, who should periodically monitor replanting success, and report necessary maintenance to operational management.

Residual impact

Whilst the mitigation measures proposed will reduce some impacts that will be created by edge effects, it is not possible to avoid degradation of the habitat qualities of the remaining remnant areas. Essentially, the proposed railway development will result in the replacement of large remnants with good habitat quality with smaller remnants with a higher edge to area ratio. The extent of new edge created by the project is 4.85 kilometres. For this reason the impact of the rail corridor is considered to be **moderate adverse** (refer to **Table 11.2.4**).

11.5.6 Riparian vegetation disturbance

Potential impact

Riparian vegetation functions to: stabilise creek banks, reduce stormwater flows, reduce influx of sediment and chemical contaminants, moderate water temperature, provide habitat for flora and fauna species and provide a movement corridor for wildlife. The removal of riparian vegetation can reduce the ability of the riparian zone to function to protect the waterway. There are several areas of potential impact on well-established riparian zones: Addlington Creek, South Mooloolah River, Eudlo Creek, Paynter Creek and Petrie Creek. The project crosses the Mooloolah River on a bridge at a point where there is no mapped remnant vegetation. The total amount of riparian vegetation impacted along each of these waterways is:

- Addlington Creek – 0.28 ha (RE 12.3.2) – bridge (as per EPBC Act referral)
- Dularcha NP (waterways) – 0.68 ha (RE 12.3.2) and 0.51 ha (RE12.3.1) – fauna friendly culverts
- South Mooloolah River – 0.18 ha (RE 12.3.1) –bridge (as per EPBC Act referral)
- Eudlo Creek – 0.92 ha (RE 12.3.2) – structure
- Paynter Creek – 1.09 ha (RE 12.3.2) and 0.37 ha (RE 12.3.1) – structure
- Petrie Creek – 1.2 ha (RE 12.3.2) – structure.

A total of 5.23 ha of riparian vegetation will be cleared due to the construction of the rail corridor. Of these waterways, three have been recognised as habitat for EPBC Act listed Giant Barred Frog (Mixophyes iteratus), i.e. Addlington Creek, South Mooloolah River and Eudlo Creek. This is discussed further in **Chapter 12, Terrestrial fauna**. The project is directly in line with Eudlo Creek in some locations. A structure will be built over the Eudlo Creek floodplain from Logwoods Road to where Eudlo Creek passes under the project. The bridge will have approximately 7 – 8 m clearance. This will reduce the impact on the riparian vegetation, in that the understorey can be maintained. It should be noted that the condition of the riparian vegetation on Eudlo Creek in this section is poor in that it is sparse and dominated by weed species.

The main potential impacts on riparian vegetation from the proposed railway corridor are the loss of the function of the riparian zone, the interruption of local wildlife corridors and the loss of significant individual riparian species.

Proposed mitigation

As the impacts on individual flora species of significance is largely a result of the clearing of remnant vegetation, the mitigation measures described in **Section 11.5.1** will be effective. Some additional mitigation has been proposed to target impacts on riparian vegetation are listed below. These strategies will be carried over into the detailed design phase, where applicable:

Design

Ecological data collated during desktop and field based assessment was utilised to inform the design of the project. Due to the linear nature of the corridor, it is not possible to avoid crossing waterways and impacting riparian vegetation in some form. The mitigation measures are necessary to minimise these impacts. Strategies employed during the design phase to reduce the potential impacts on riparian vegetation are listed below:

- The width of the corridor required for the project has been minimised at crossing points because the rail is required to be built on structure.
- In areas where the rail corridor must traverse sensitive areas, the project has been adjusted to avoid lengthy crossings (i.e. Mooloolah River).
- Bridges over waterways where riparian vegetation is prominent have been designed to reduce the amount of clearing required. Clearing will only be required for the establishment of piers and supporting structures. This is essential at Addlington Creek (north), South Mooloolah River and Mooloolah River.
- Bridges shall be designed to maximise vegetation retention, such that piers and supporting structures are placed outside of riparian vegetation and bridge height is maximised, where possible.
- The use of culverts has been limited to smaller drainage lines where existing riparian vegetation is minimal or highly disturbed.
- For smaller drainage lines, where bridging structures are not feasible, the use of large dry cell tunnels or culverts is to be encouraged. The appropriate size, characteristics and location of structures will be determined in consultation with the project ecologist and hydrologist during detailed design. The main consideration is the conservation of the existing flow regime so as not to adversely affect the hydrology of downstream riparian vegetation.

Construction

Clearing on site will need to be managed to minimise harm to areas of retained vegetation and ensure it is limited to the area that is necessary. The key impact mitigation measures that shall be implemented for management of riparian vegetation are:

- constraining corridor clearing widths to the minimum necessary to allow construction of bridges or culverts to minimise riparian vegetation disturbance
- avoid damming or realigning waterways during construction

The construction methodology shall allow for continued normal ecosystem function (e.g. flow regimes).

- bunding to be utilised during works where necessary to avoid disturbance to remnant riparian vegetation and allow for continued normal ecosystem function (e.g. riparian corridors and flow regimes)
- where possible lop or prune trees, with complete-to-ground clearing being avoided
- avoiding construction of separate crossings for access tracks.

Additional crossings for access tracks at each crossing site would be considered an unnecessary additional disturbance to the fragile riparian ecosystem.

Operation

Once the rail has been constructed, there will be no need for further clearing of riparian vegetation. During the operational phase, the focus in riparian areas will shift to the management of areas under bridges and the offsetting and rehabilitation program, as follows:

- preventing weed establishment where construction has resulted in bare ground
- control and/or removal of any weeds which have been introduced or exacerbated as a result of the works, with the aim being to leave the site in equivalent condition (or better, in terms of weeds) to prior to construction

The environmental officer shall take before and after photographs and site notes to verify the condition of the site.

- mulching of site after construction and prior to replanting
- supplementary planting under bridge structures to encourage recovery of riparian vegetation
- rehabilitation of areas necessary for construction, but not required for the operational phase of the railway

For example, areas disturbed by the construction of the bridges. Rehabilitation will aim to re-establish the original regional ecosystems present prior to disturbance.

- management of vegetation offsets to replace areas of remnant regional ecosystems removed by the proposed railway development.

Offsets will be in line with the Department of Environment and Resource Management Policy for Vegetation Management Offsets, which is triggered under the *Vegetation Management Act 1999*. The final extent of offsets required and offset areas will be defined during the detailed design phase once the amount of clearing required has been finalised. Refer to **Section 11.6** for more information regarding offset requirements.

Offsetting and rehabilitation have been incorporated into the VMP (**Chapter 22, Environmental Management Plans**). The operational phase shall also be overseen by an environmental officer, who would periodically monitor replanting success, and report necessary maintenance to operational management.

Decommissioning of existing railway

As mentioned in **Section 11.5.1**, the decommissioning of the existing railway will not have a negative impact on remnant vegetation because it offers an opportunity for rehabilitation. The complete decommissioning process will be a lengthy one and will depend on the rate at which rehabilitation areas establish and become independent of management.

The decommissioning phase shall also be overseen by an environmental officer, who should periodically monitor replanting success, and report necessary maintenance to operational management.

Residual impact

It is considered that the design and mitigation strategies for the proposal can adequately manage the potential impacts of riparian disturbance, except in one location (Eudlo Creek) where the resultant structure runs parallel to a waterway for approximately 550 metres. Hence it is considered as a **low adverse** impact (refer to **Table 11.2.4**).

11.5.7 Removal of horticultural crops and vegetation of cultural significance

Potential impact

Three areas have been indicated to have significant horticultural crops or vegetation of cultural significance: Spackman Lane at Palmwoods, Eudlo Station and Birdwood Nursery, Woombye. The area around Spackman Lane contains several horticultural crops and an historical Antarctic Beech tree, which is of a great size. Eudlo Station is the site of an advanced community rehabilitation project. Birdwood Nursery is a regionally significant nursery supplying fruit trees throughout Australia and overseas.

An inspection of Birdwood Nursery was made on request of the proprietor to assess the potential impact on mature fruit trees used as rootstock for cuttings. The rootstock trees in the orchard nearest the existing rail property were within 50 m of the western edge of the rail property. These fruit tree species were predominantly avocado and citrus varieties, with relatively large trunk diameters, indicating mature trees of advanced age. Many trees had trunk diameters in excess of 30 cm at a height of approximately 1 m (DBH was not measured due to low branching).

Birdwood Nursery has a 'mother block', which is an area of mature fruit trees used as rootstock to support new cuttings. This area is adjacent to the current railway corridor, and the proposed corridor would encroach onto the property. The use of these mature trees, which are approximately 20 years old, is a core part of the operation of Birdwood Nursery (personal communication The Proprietor of Birdwood Nursery). The removal of some or all of these trees would have a significantly detrimental effect on the viability of the nursery, and its ability to meet commitments to long-term customer orders (personal communication The Proprietor of Birdwood Nursery).

The project may have the potential to negatively impact on these areas of significance, if earthworks are not managed appropriately.

Proposed mitigation

The potential impacts on significant horticultural crops or vegetation of cultural significance is largely related to the clearing and construction associated with the project. Hence, the alignment of the project has been designed to avoid or minimise these impacts. Where these impacts are unavoidable construction and operational mitigation will be put in place to minimise the impacts.

Design

The following design measures have been put in place to minimise impacts on significant horticultural crops or vegetation of cultural significance. These strategies will be carried over into the detailed design phase, where applicable:

- The project will pass to the east of the historic Antarctic Beech tree on Spackman Lane.
- The project has avoided the majority of the area to the east of Spackman Lane that is affected by horticultural crops. The exception to this has been a small portion of land at 60 Spackman Lane, which is used for growing citrus and ginger.
- The new Eudlo station layout has allowed for the retention of the majority of trees (with the exception of the access way) in the rehabilitated area and will only require general thinning for station safety.
- The position of the project in the vicinity of the Birdwood Nursery was restricted due to the angle of the approaches required to Woombye station. The project has been located as far as possible from Birdwood Nursery; however, earthworks will still result in a small encroachment.

Construction

To avoid unnecessary impacts on Birdwood Nursery and the culturally significant vegetation at Eudlo the following mitigation methods will be employed during construction:

- The project has been located as far as possible from Birdwood Nursery; however, earthworks will still result in a small encroachment. This encroachment will be reduced as far as possible at the time of construction by the implementation of retaining walls to avoid removal of rootstock trees from the 'mother block'.
- During construction, an exclusion fence will be placed around the trees being retained adjacent to Eudlo station to prevent damage to trees and root systems. The exclusion fencing should be placed at a distance of 10 x DBH (Diameter at Breast Height) from the tree.

Operation

The management of the vegetation near Eudlo station will be ongoing. Whilst the project does not directly result in the removal of the planted vegetation at Eudlo station, the redevelopment of the station will necessitate the thinning of these trees for access and safety requirements. These trees will need to be maintained in a thinned state to avoid safety issues for the operation of the rail and Eudlo station.

Decommissioning

The decommissioning of the existing railway will not have a negative impact on significant horticultural crops or vegetation of cultural significance because it offers an opportunity for rehabilitation. The community may be interested in becoming involved in rehabilitation within the Eudlo area due to previous involvement near the existing station.

Residual impact

It is considered that the design and mitigation strategies for the proposal can adequately manage the potential impacts on significant horticultural crops or vegetation of cultural significance. Hence it is considered as a **low adverse** impact (refer to **Table 11.2.4**).

11.6 Offsets policy

Environmental offsets are a mechanism that can be used in environmental management to compensate for the impacts of developments on ecologically significant features. They are used to counterbalance unavoidable negative environmental impacts, where all other steps have been taken to avoid or minimise an impact but the residual impact still remains. Offsets are usually available through an environmental impact and approvals process. Offsets are a relatively recent requirement that has been written into several federal, State and local governmental policies. The federal government released a '*Draft Environmental Offsets Policy for the Environment Protection and Biodiversity Conservation Act 1999*' for public consultation in August 2007.

The consultation period finished in November 2007, but the policy is still in draft format. It is anticipated that offset requirements under EPBC Act can be satisfied by offsets put in place as a result of State legislation or policies, provided that the offsets harbour the appropriate environmental values.

The Queensland government has developed an Environmental Offsets Policy (QGEOP) that came into effect on 1 July 2008. This policy sets up a co-ordinated framework for an offsets scheme to operate in Queensland. Under the policy there are several 'specific issues' policies, namely Marine Fish Habitat, Vegetation Management, Koala Habitat and others to be developed (including biodiversity and waste water). The framework also includes an underlying offset fund, which has been named EcoFund. The Ecofund aims to be operational by January 2009 and will be the body responsible for identifying and securing offsets on the ground with the project proponents. In reference to 'significant projects' under the SDPWO Act; if these projects trigger a specific issue offsets policy (after all efforts have been made to avoid or minimise impacts), the need for offsets should be considered at the EIS assessment stage. For significant projects, the proponent may also be required to provide offsets for impacts not currently covered by a specific-issue offsets policy (e.g. biodiversity). In this case, the principles and guidelines of the QGEOP are to be followed in setting offset conditions.

In relation to the Landsborough to Nambour Rail Upgrade, the vegetation clearing in relation to the rail corridor will trigger the Vegetation Management Offsets Policy within the QGEOP. Under the *Vegetation Management Act 1999,* the establishment of the rail corridor is assessable development. Hence, the future clearing of remnant vegetation resulting from the construction must be assessed by the Department of Environment and Resource Management if the project is declared as Community Infrastructure Development (CID) or when clearing permits are sought. The clearing will be assessed under Part P, Regional Vegetation Management Code for SEQ. There are various parts of the code that the project will not be able to satisfy without providing an offset in accordance with the Vegetation Management Offsets Policy. Seven criteria within the policy have to be met by the proposed offsets.

Vegetation must not be currently protected:

1. The area cannot currently be mapped as remnant vegetation (unless it has been approved for clearing or is suffering an immediate threatening process).
   - The area cannot be protected by conditions within a Development Application.
   - The area must not be identified as protected vegetation as highlighted on a Property Map of Assessable Vegetation (PMAV).
   - The area must not be protected already by any other legislation.

2. Vegetation must be in the same geographical area (i.e. same bioregion) and be the same RE if the vegetation is Endangered or Essential Habitat or at least have the same status in other scenarios.
3. Vegetation must be at least 2 hectares in area and be capable of attaining remnant status within a maximum of 20 years unless otherwise specified.
4. The vegetation offset must be 'Ecologically Equivalent' to the area proposed for clearing. This considers all things that make a patch of vegetation self-sustaining, i.e. area to perimeter ratio, condition, age, connectivity, size. Generally, removal of high quality vegetation will necessitate a much larger area of regrowth vegetation as an offset OR a smaller area of high quality regrowth to compensate for the risk / uncertainty associated with establishment.
5. A Vegetation Management Plan must be presented to describe how the offset will be managed to ensure it attains and retains remnant status.
6. Offset must be legally secured, i.e. purchased and subject to a covenant, under an agreement or handed to State or Local government as conservation area.
7. A financial contribution is not considered an offset.

The particular requirements for the project are set out in more detail in **Table 11.6**.

Table 11.6: Vegetation offsets required under VMA

Code	Project Impact	Offset Required
Maintain the current extent of Endangered or Of Concern regional ecosystems proposed to be cleared that are listed in Table 3 of the 'Policy for Vegetation Management Offsets'.	There are no regional ecosystems listed in Table 3 that will be impacted by the project.	Nil
Maintain the current extent of Endangered regional ecosystems proposed to be cleared that are not listed in Table 3 of the 'Policy for Vegetation Management Offsets'.	The project will result in the removal of 1.06 ha of Endangered RE 12.3.1	3.18 ha of RE 12.3.1
Maintain the current extent Of Concern regional ecosystems proposed to be cleared that are not listed in Table 3 of the 'Policy for Vegetation Management Offsets'.	The project will result in the removal of 4.63 ha Of Concern RE 12.3.2 and 3.05 ha Of Concern RE 12.9-10.1	13.89 ha of RE 12.3.2 9.15 ha of RE 12.9-10.1
Maintain the current extent of Essential Habitat proposed to be cleared.	The project will result in the removal of 4.51 ha of Essential Habitat (i.e. REs 12.3.5, 12.9-10.14, 12.9-10.1, 12.9-10.17)	13.53 ha of Essential Habitat (only 1.28 ha is not Of Concern)
Maintain the current extent of assessable vegetation associated with any natural significant wetland and / or natural wetland proposed to be cleared.	The project will result in the removal of 0.18 ha of RE 12.3.5.	0.54 ha of RE 12.3.5
Maintain the current extent of assessable vegetation associated with any watercourse or wetland proposed to be cleared.	The project will result in the removal of 5.23 ha of riparian vegetation (REs 12.3.1 and 12.3.2) and 0.18 ha of wetland (RE 12.3.5)	15.69 ha of riparian vegetation 0.54 ha of wetland
Maintain the current extent of regional ecosystems proposed to be cleared that are at risk of – a) the remnant extent of the regional ecosystem falling below 30% of its pre-clearing extent; or b) having a remnant extent of less than 1000 hectares; As listed in the equivalent table of the applicable VMA, code.	There are no threshold regional ecosystems that will be impacted by the project.	Nil
	Sub-total	**56.52 ha**
	TOTAL (after subtracting offsets that are satisfied elsewhere, i.e. waterways / wetlands and Endangered or Of Concern Essential Habitat)	**27.50 ha**

The offset requirement indicated is based on the worst-case scenario (1:3), where the offset must:

- be the same pre-clearing regional ecosystem as the area proposed for clearing
- be within 20 kilometres of the area proposed for clearing
- be non-remnant vegetation
- have less than 25% weed cover
- with management, attain remnant status within 20 years
- not require revegetation across more than 10% of the offset area
- provide connectivity or a buffer to other remnant vegetation.

The offset requirements can be combined, such that it is possible to consolidate the offset requirements for Endangered, Of Concern, waterways, wetlands, Essential Habitat and threshold RE. For example, the offset proposed for RE 12.3.1 and RE 12.3.2 will satisfy both the 'Endangered' or 'Of Concern' and waterways codes. Similarly, the offset proposed for RE 12.3.5 will satisfy both the wetland and threshold REs codes. In some cases, the Department of Environment and Resource Management may consider the rehabilitation of the existing rail corridor as an acceptable offset.

This is more likely in areas where the rehabilitation of the existing corridor would contribute significant value for conservation. For example, where the existing rail is located within a national park.

Subsequently, the Department of Transport and Main Roads will have to enter into an offset agreement with the Department of Environment and Resource Management. An offset agreement describes the ways in which an offset will meet the requirements on the applicable specific-issue policy and will include:

- a description of the impact that will be offset
- the offset that is being provided to meet the requirement
- timeframes and milestones for providing the offset
- when the environmental impact can commence
- the duration of the offset requirement
- the offset management plan
- the monitoring and reporting plan
- any payments and contributions allocated for the offset, management plan
- and monitoring and reporting plan
- reference to the mechanism for legally securing the offset
- when and how the proponent (i.e. the Department of Transport and Main Roads's) responsibility for the offset will be extinguished.

It is anticipated that the Department of Transport and Main Roads will engage with Ecofund once an offset agreement is finalised to source, secure and manage the offset requirement for the project. This process will involve a review of offset requirements with the intention of applying 'advance offsets' to the project. An 'advance offset' is one that is acquired and established prior to the completion of the project. This implies that proposed offset areas are then in advanced stages of recovery at the completion of the project and the proponent is not subject to higher impact to offset ratios (e.g. 1:3 to 1:5). Establishing advance offsets involves securing an offset, developing any necessary management actions and obtaining approval in principle by the regulator of the applicable specific-issue offsets policy (in this case the Department of Environment and Resource Management). An advance offset should be registered, to be a recognised offset under a specific-issue offsets policy.

11.7 Summary and conclusions

The project stretches approximately 22 kilometres through large areas of rural residential style development, agricultural land and remnant vegetation. The remnant vegetation that the project intersects is largely consistent with Regional Ecosystem (RE) mapping (Department of Environment and Resource Management 2005b). Field survey only located minor discrepancies in the mapping, where an RE had been misrepresented. The project traverses 18 regional ecosystems (REs) according to the Queensland Herbarium's remnant vegetation mapping. There were a further two regional ecosystems that were identified during survey, but have not been mapped. The majority of the remnant vegetation in the project area is considered to be 'Of Concern'. The 'Endangered' regional ecosystems are associated with waterways and concentrated in the south of the project area, particularly around Landsborough. The southern portion of the project area has a larger area of remnant vegetation and higher biodiversity values than the area north of Palmwoods.

Whilst the project has endeavoured to avoid significant areas of mapped vegetation, there are several sections where such values could not be avoided due to existing development, topography and the nature of the rail as linear transport infrastructure. Clearing in these areas will be managed to ensure it is limited to that which is necessary and minimise harm to areas of retained vegetation. An offsets and rehabilitation program will be implemented to reduce the loss of remnant vegetation in the long term. Under the VMA, the project is associated with a requirement to offset approximately 27.5 ha.

A summary of impacts of the project on terrestrial vegetation, proposed mitigation and rating of impacts after mitigation is shown in **Table 11.7**.

Table 11.7: Summary of impacts and mitigation (vegetation)

Potential Impact	Mitigation Strategy	Residual Impact Significance
Clearing of remnant vegetation	▪ avoid significant areas where possible ▪ engage environmental officer for construction phase ▪ limit clearing to that which is necessary and clearly indicate construction zone ▪ enforce penalties for clearing protected vegetation ▪ limit access tracks ▪ rehabilitation and offsets.	Moderate Adverse (short-term) and Low Adverse (long-term)
Reduction of flora habitat and diversity	▪ avoid clearing high quality habitat (i.e. national parks) ▪ locate construction zone in degraded areas ▪ botanist / ecologist to guide the location of construction zones and access tracks ▪ weed management ▪ rehabilitation to include endemic native flora.	Low Adverse
Removal of individual species of significance	▪ pre-clearing survey ▪ translocation of significant species where necessary ▪ bridges over riparian areas where required by EPBC Act referral, i.e. Addlington Creek (north), South Mooloolah River and Mooloolah River ▪ education of construction workers ▪ rehabilitation to include significant species.	Negligible to Low Adverse
Reduction of corridor functionality	▪ minimise rail corridor width in remnant areas ▪ tunnels and bridges to reduce fragmentation of bioregional corridors ▪ minimise construction footprint ▪ minimise use of steep embankments in vegetated areas ▪ weed management ▪ rehabilitation.	Low to Moderate Adverse
Remnant vegetation edge effects	▪ avoid clearing in small (< 2 ha) remnant patches, where possible ▪ weed management along new edges ▪ buffer plantings along new edges.	Moderate Adverse
Riparian vegetation disturbance	▪ avoid lengthy crossings of remnant riparian vegetation and reroute of waterways ▪ bridges to maximise height clearances ▪ minimise use of culverts ▪ sediment and erosion control ▪ rehabilitation.	Low Adverse