

5. Terrestrial flora

This section describes the existing environment, potential impacts and mitigation measures within the proposed MLARP area in terms of the terrestrial flora values. The assessment has been based on a review of existing information and the outcomes of supporting field investigations.

It should be noted that the information regarding legislation is current at the time of writing this section but may be subject to change. Legislation requirements covered in the EIS have been cited from:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Nature Conservation Act 1992* (NC Act)
- *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation)
- *Vegetation Management Act 1999* (VM Act)
- *Land Protection (Pest and Stock Route Management) Act 2002*
- *Land Protection (Pest and Stock Route Management) Regulation 2003*

The currency of such information will be checked during the detailed design phase of the Project and prior to commencement of construction activities within the project area. Currently the designation of threatened species under the NC Act and NC Regulation is being reviewed to conform with international classification and as such species listed as rare will be reassessed and classified as least concern, vulnerable, near threatened, endangered or critically endangered.

5.1 Site description

The project area has been divided into five sections (refer Figure 5.1) to assist in describing the existing environment and identifying potential impacts and mitigation measures. They are:

- North Coast Line (including proposed Aldoga Rail Yard)
- East End Mine Branch Line
- Moura Link North
- Moura Link Eastern Option
- Moura Link Western Option

As part of the flora survey the Aldoga Bank Deviation area was also investigated (refer Figure 1.1). As this area is outside the scope of the study an assessment of the potential impacts has not been conducted, however this area has been described in the existing environment.

A substantial proportion of the vegetation within the project area contains mixed eucalypt communities. These communities have been subjected to previous disturbance through selective clearing, localised clearing, clearing for infrastructure, utilities and access tracks and other anthropogenic disturbances such as fire.

5.2 Methodology

A number of existing studies and databases were reviewed for the ecological assessment to provide information relevant to the project area. This included:

- The Department of Environment, Water, Heritage and the Arts (DEWHA) EPBC Act Protected Matters Report (EPBC Report)
- The EPA Wildlife Online database
- The EPA Regional Ecosystem (RE) Description Database
- The Queensland Herbarium HERBRECS database
- Aldoga Aluminium Smelter EIS (Connell Wagner 2002)

- Gladstone Pacific Nickel EIS (URS 2007)
- Ecological monitoring in the Calliope and Boyne Rivers as well as Baffle Creek: terrestrial riparian communities (CQU 2001)

Regional vegetation mapping (eg DEWHA's National Vegetation Information System (NVIS), the EPA's RE Mapping) and aerial photography was also reviewed during the desktop study.

Legislation applicable to the clearing of vegetation and threatened species was reviewed in conjunction with the Regional Vegetation Management Code (RVMC) for Brigalow Belt and New England Tablelands (BBNET) and the RVMC for South East Queensland (SEQ), (NRW 2006). It should be noted that where applicable, certain exemptions may apply to clearing for rail infrastructure and have been discussed further in Section 3.

Targeted vegetation communities within and adjacent the project area were traversed by qualified Connell Hatch staff during August 2007 (IAS Phase) and March and April 2008 to gather information such as vegetation structure and composition (species richness), dominant species present and plant identification to genus and/or species level. This was carried out by collecting secondary or tertiary information from representative sites by creating 50 m x 10 m temporary survey plots and quaternary information during spot observations.

This information as well as vegetation structures of the vegetation communities were recorded using methods described by Neldner *et al* (2005) in the Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland, Version 3.1. The structural compositions of the vegetation communities were classified as per Specht (1970) and other relevant classification systems where relevant (ie NVIS).

The heights (using a clinometer) and tree diameter at breast heights (DBH) of large trees potentially within the area of direct disturbance were also recorded and have been noted where relevant.

The majority of species observed were identified using appropriate field guides and taxonomic keys. Samples for specimens not readily identifiable were obtained during the survey and forwarded to Queensland Herbarium for identification and/or verification. Botanic and common names used in the report to describe flora were obtained from Melzer and Plumb (2007), Stanley & Ross (1983, 1986 and 1989), Harden *et al* (2006), Anderson (2003), Stephens *et al* (2002) and Johns (2006).

It is important to note that due to seasonal limitations, all flora species within the project area may not have been recorded. This could be attributed to the extent of the area, plants being unidentifiable due to lack of fertile material, or plants lying dormant (eg terrestrial orchids) at the time of the survey.

5.3 Existing environment

5.3.1 Desktop results

Landforms and vegetation structure

The project area traverses three general landform patterns. These landforms are:

- Low rises and sandy alluvial plains
- Low rolling hills of sedimentary and metamorphic origin. Vegetation in this area predominantly consists of open woodland to open forest communities with a sparse understorey of shrubs and grasses on silty clay soils. Understorey vegetation however, occurred in greater densities in and around dry gullies and ephemeral creeks existing between hills and rises.
- Mountains occurring on sedimentary and/or metamorphic rock

A vegetation community type (eg Woodland) is a term used to identify the particular vegetation structure. Vegetation structures observed within the project area are:

- Grassland¹/Open Woodland which contains a sparse tree and/or shrub layer (<10%) with a lower stratum density between 10% to 100%
- Woodlands which contain a canopy cover of 10% to 30% and trees to a height of 30 m
- Open Forests which contain a canopy cover of 30% to 70% and trees to a height of 30 m
- Notophyll/Microphyll² Rainforest and Semi-evergreen Vine Thicket (SEVT). It consists of a canopy height up to 25 m with trees that are buttressed/non-buttressed with simple leaves toothed to 12.5 cm in length (notophyll). Lichen is also usually present.

Regional Ecosystems

REs are significant remnant vegetation communities gazetted under the *Vegetation Management Act 1999* (VM Act). This ensures appropriate protection measures are undertaken when development of a site occurs. In most instances, prior to clearing vegetation within an RE a vegetation clearing permit (issued by DNRW) is required.

To qualify as remnant vegetation the community must have the following characteristics:

- >50% of the predominant canopy cover that would exist if the vegetation community were undisturbed
- >70% of the height of the predominant canopy that would exist if the vegetation community were undisturbed
- Be comprised of the same floristic species that would exist if the vegetation community were undisturbed

There are currently three categories by which vegetation communities matching the remnant criteria may be classified under the VM Act. Table 5.1 outlines these categories along with the additional criteria they are required to meet in order to achieve that status.

Table 5.1 Regional Ecosystem categories

RE Status	Characteristics of classification
Endangered	<10% of its pre-clearing extent remains across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is <10,000 ha.
Of Concern	10-30% remains of its pre-clearing extent across the bioregion; or >30% of its pre-clearing extent remains and the remnant extent is <10,000 ha.
Not of Concern	>30% of its pre-clearing extent remains across the bioregion, and the remnant extent is >10,000 ha.

Source: EPA 2008

However, the EPA may consider the biodiversity status³ of a RE to be Endangered if <10% of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss, or 10-30% of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is <10,000 ha, or it is a rare RE subject to a threatening process; or Of Concern if only 10-30% of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.

¹ Is considered pastoral as result of clearing to accommodate stock grazing in the area.

² Refers to leaf length for rainforest species (eg notophyll = 7.5 – 12.5 cm and microphyll = 2.5 – 7.5 cm).

³ The overall condition of the RE in relation to current threatening processes it may face.

The project area encroaches on approximately 113 ha of mapped vegetation communities pursuant to the VM Act, including approximately 0.3 ha of endangered ecological communities pursuant to the EPBC Act. This total is comprised of:

- 0.8 ha of Endangered/threatened ecological communities
- 59 ha of Of Concern communities
- 53 ha of Not of Concern communities

A RE code is an abbreviation used by the EPA to describe a vegetation community according to its bio-region classification, its land zone classification and its species composition.

Table 5.2 summarises the RE types mapped within and adjacent the project area, whilst Figure 5.2 displays their approximate locations.

Table 5.2 Regional Ecosystems mapped within/adjacent to the project area

Regional Ecosystem code	Status		Short description of community	Location
	VM Act	EPBC Act		
11.3.4	OC	-	<i>Eucalyptus tereticornis</i> ± other <i>Eucalyptus</i> spp. tall woodland on alluvial plains.	All areas
11.3.25	NOC ¹	-	<i>E. tereticornis</i> or <i>E. camaldulensis</i> open forest to woodland fringing drainage lines.	North Coast Line Aldoga Bank Deviation
11.3.26	NOC	-	<i>E. moluccana</i> or <i>E. microcarpa</i> woodland to open forest on margins of alluvial plains.	North Coast Line Bruce Highway Moura Link Western Option Aldoga Bank Deviation
11.7.6	NOC	-	<i>Corymbia citriodora</i> ± <i>E. crebra</i> woodland.	Aldoga Bank Deviation
11.11.3	NOC	-	<i>Corymbia citriodora</i> , <i>E. crebra</i> and <i>E. acmenoides</i> open forest generally occurring on sub-coastal hills and ranges.	North Coast Line Bruce Highway Aldoga Bank Deviation
11.11.4	NOC	-	<i>Eucalyptus crebra</i> woodland generally occurring on coastal hills and ranges.	North Coast Line Moura Link Eastern Option Moura Link Western Option Aldoga Bank Deviation
11.11.4a	NOC	-	<i>E. tereticornis</i> dominated woodland generally occurring on coastal hills and ranges.	Moura Link Eastern Option Moura Link Western Option
11.11.5	NOC	-	Microphyll rainforest (with or without <i>Araucaria cunninghamii</i> emergents) and semi-evergreen vine thicket occurring on hilly terrain with slopes ranging from 55 and up to 80% locally.	Moura Link Eastern Option
11.11.5a	NOC	-	Vine thicket, usually with no <i>Araucaria cunninghamii</i> emergents occurring on hilly terrain with slopes ranging from 55 and up to 80% locally.	Aldoga Bank Deviation
11.11.15	NOC	-	<i>E. crebra</i> woodland occurring on undulating rises and low hills.	North Coast Line Bruce Highway Moura Link Eastern Option Moura Link Western Option
11.11.18	E	E ²	Semi-evergreen vine thicket occurring on undulating plains, rises and gentle slopes of ranges.	North Coast Line

Regional Ecosystem code	Status		Short description of community	Location
	VM Act	EPBC Act		
11.12.1	NOC	-	<i>Eucalyptus crebra</i> ± <i>E. melanophloia</i> ± <i>Corymbia erythrophloia</i> shrubby woodland occurring on ranges on igneous rocks.	Aldoga Bank Deviation
12.11.6	NOC	-	<i>Corymbia citriodora</i> woodland to open forest with <i>Eucalyptus crebra</i> ± other <i>Eucalyptus</i> spp.	North Coast Line
12.11.14	OC	-	<i>Eucalyptus crebra</i> and <i>E. tereticornis</i> grassy woodland occurring on mid and lower slopes.	North Coast Line

Table notes:VM Act = *Vegetation Management Act 1999*

E = Endangered

NOC = Not of Concern

OC = Of Concern

¹ Biodiversity status is considered to be 'Of Concern' by the EPA if further clearing is carried out within this RE Type² Listed as 'Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions' Threatened Ecological Community.

Semi-evergreen Vine Thickets (SEVT) are a form of dry, seasonal, subtropical rainforest that occurs throughout Queensland, New South Wales and Victoria. Due to anthropogenic changes in our landscape, the SEVT communities occurring within the Brigalow Belt bioregion have been reduced to approximately 17% of their original extent (EPA 2007). For this reason, many of them (including RE11.11.18) are now listed as endangered under the EPBC Act.

As stated by the DEWHA, the main objective in listing the SEVTs of the Brigalow Belt (North and South) and Nandewar Bioregions under the EPBC Act as endangered is to help prevent its further decline and assist in efforts toward the recovery of the communities.

Threatened flora species

The EPBC Report identified eight (8) threatened (ie critically endangered, near threatened, endangered, vulnerable, rare under EPBC Act) species as potentially inhabiting the project area. HERBRECS (up to 1,600 m accuracy only), Wildlife Online and Essential Habitat mapping confirmed the presence of four (4) of these species within the region (refer Figure 5.2 and 5.3).

HERBRECS (up to 1,600 m accuracy only), Wildlife Online and Essential Habitat mapping also confirmed the presence an additional 21 threatened species within the region.

Appendix E1 contains the database results and Appendix E3 provides the threatened species assessment of endangered, vulnerable or rare flora species listed in all database searches undertaken. This assessment includes information pertaining to their habitat requirements and likelihood of occurrence within the project area.

It is also important to note that certain REs (eg RE11.11.5) within and adjacent to the project area are also considered to contain suitable habitat for some threatened flora species (refer Appendix E3).

5.3.2 Field results

During the field investigations approximately 243 plant species were identified from 37 locations (refer Figure 5.1). A comprehensive species list from each site has been included in Appendix E2.

The vegetation types observed as occurring throughout the project area include agricultural pastures, a DPIF plantation, dry sclerophyll open woodland to open forest, dry rainforest, SEVT and riparian communities. Of these communities, approximately 113 ha are mapped as REs (refer Figure 5.2).

In summary, the floristic integrity of the ecological communities present within the project area has been reduced significantly due to anthropogenic changes (eg clearing for pastoral grazing and linear disturbances such as roads). These changes have caused the landscape to become highly attenuated and as such, have significantly reduced the area of intact remnant vegetation.

A detailed breakdown of the vegetation communities present within the project area is outlined below.

Open woodland/open forest vegetation communities

A native hardwood plantation encompassing an area of approximately 25 ha has been established west of Larcom Creek (North Coast Line section) by the DPIF. This stand is a research plantation aimed at developing *Corymbia* hybrids into a high value, short rotation product for the plantation hardwood industry in Queensland.

The dominant sclerophyll communities are a combination of *Eucalyptus moluccana* (Gum-topped box) dominated open forest on alluvial floodplains and *E. crebra* (Narrow-leaved ironbark) and *Corymbia tessellaris* (Moreton bay ash) dominated woodlands to open forests on low hills and mountains. In most cases, the species richness of the sclerophyll communities generally increased as the slope increased.

The *E. moluccana* (<24 m) dominated communities contained a sparse mid stratum of *Carissa ovata* (Currant bush) and/or *Lantana camara* (Lantana) and a lower stratum containing species generally abundant only after rain (refer Photo 5.1). These species include *Cyperus gracilis* (Slender sedge), *fimbristylis dichotoma* (Common fingerush) and *Eremophila debilis* (Winter apple).



Photo 5.1 *Eucalyptus moluccana* open forest

E. crebra and *C. tessellaris* were present in two woodland and open forests variations on low rolling hills and steep hills throughout the project area (refer Section 4). The first as a co-dominant simple community and the second as part of a mixed sclerophyll community containing *C. erythrophloia* (Red bloodwood), *C. intermedia* (Pink bloodwood), *E. exserta* (Qld peppermint) and *Lophostemon suaveolens* (Swamp mahogany).

The mid stratum of these communities was generally comprised of *Alphitonia petriei* (White ash), *Sida subspicata* (Spiked sida), eucalypt regrowth and *Acacia* spp. whilst the lower stratum contained *Grewia latifolia* (Dysentry plant) and a dense grassy cover of species such as *Themeda triandra* (Kangaroo grass), *Chloris gayana* (Rhodes grass) and *Melinis repens* (Red natal grass).

However, *Xanthorrhoea johnsonii* (Forest grass tree) and *Macrozamia miquellii* (Zamia palm) were present as a dense lower stratum on the southern slopes abutting the Aldoga Bank Deviation area (refer Photo 5.2) whilst the northern slopes contained *Erythrina vespertilio* (Bat's wing coral tree) in the mid stratum.



Photo 5.2 *Xanthorrhoea* and *Macrozamia* spp. in *Eucalyptus crebra* woodland

It should be noted that significant dieback of mixed sclerophyll communities due to a combination of drought and other anthropogenic factors was observed within the Moura Link Eastern and Western Option sections of the project area (refer Photo 5.3).



Photo 5.3 Dieback within the Moura Link Eastern Option

The geology and vegetation of areas mapped as RE11.3.25 appears consistent with the vegetation observed. These areas contained a dominant upper stratum of species *E. tereticornis* (Forest red gum) and *E. crebra* and a mid-dense mid and lower strata containing Eucalypt regrowth and *Acacia* spp. (eg *Acacia salicina*) and grass species such as *Themeda triandra* and *Sporobolus* spp.

Another sclerophyll community observed was the *C. citriodora* (Spotted gum) and *E. crebra* open forest located between the proposed Aldoga Rail Yard and Flynn Road (refer Photo 5.4). This community also contained a single specimen of the endangered species *Cycas megacarpa* (NCN) (refer Figure 5.3 and Photo 5.5). The specimen was located in the riparian zone of an unnamed watercourse that extends from the western side of the Mount Larcom Range approximately north-east the proposed Aldoga Rail Yard.



Photo 5.4 *Corymbia citriodora* and *Eucalyptus crebra* open forest



Photo 5.5 Endangered species *Cycas megacarpa*

As noted in the Threatened Species Matrix, previous ecological studies undertaken by others have located an additional three specimens from the vegetation communities aligning this drainage line. It seems likely however, that they have been dispersed from the Mount Larcom Range as a result of overland runoff and are not part of an unknown local/regional population.

The Recovery Plan for this species revealed the closest significant populations (those providing long-term viability) which are also considered to contain critical habitat to occur west of the project area near Biloela and Kroombit.

Cycas megacarpa commonly occurs on rocky soils (rarely alluvium) in eucalypt woodlands/open forests and rainforest margins with grassy lower stratus. Suitable habitat for this species occurs throughout the majority of the project area, in particular the North Coast Line section.

However, relevant REs in which important populations have been recorded previously include RE11.3.25, RE11.3.4, RE11.11.15, RE11.11.4 and RE11.11.3. Whilst only one specimen was located, these REs which are considered suitable habitat in the area all occur within and adjacent the project area (refer Table 5.2).

A locally significant community observed within the northern extent of the Moura Link Eastern Option was the pure stand of *E. tereticornis* on melonhole Gilgai (refer Section 4) to a height of approximately 21 m. The sparse mid stratum contained *E.tereticornis* regrowth and *Cymbidium caniculatum* (Black orchid), whilst the lower stratum contained pasture grasses and *Cyperus* spp.

Significantly large trees within the project area were also present within the project area. Examples are shown in Figure 5.4 and include a small stand of *E. tereticornis* in the North Coast Line section, one specimen of *E.tereticornis* adjacent the Calliope River and the abovementioned *E.tereticornis* community in the Eastern Option. The *E.tereticornis* adjacent to the Calliope River had an approximate height of 32 m and a DBH of 1.86 m (refer Figure 5.4). Other trees observed include an *E.crebra* that measured a height of approximately 26 m and a DBH of 1.02 m.

Dry rainforest, SEVT and riparian communities

Notophyll/microphyll dry rainforests and SEVT communities were predominantly present as small disjunct pockets throughout the project area (refer Insert 5 Figure 5.5). However, major communities are mapped (RE11.11.5 and RE11.11.18) along the Moura Link Eastern Option and adjacent Flynn Road. In most instances, the riparian zones of watercourses (eg Scrubby Creek) and drainage lines (upper and lower slopes) appeared to provide niche habitats for these communities.

The majority of these communities were commonly comprised of species such as *Mallotus philippensis* (Red kamala), *Cryptocarya triplinervis* (Three-veined cryptocarya), *Cupaniopsis anacardioides* (Tuckeroo), *Strychnos psilosperma* (Strychnine tree), *Diospyros fasciculosa* (Grey ebony), *Alectryon conatus* (Alectryon), *Alyxia ruscifolia* (Chain fruit), *Alchornea ilicifolia* (Native holly), *Jasminum didymium* (Native jasmine), *Jasminum volubile* (Stiff jasmine), *Abrus precatorius* (Gidee gidee), *Cissus hypoglauca* (Five-leaved native grape) and *Ficus* spp. at different levels of maturity.

Acacia salicina (Sally wattle) was usually present on the margins of these pockets as was *Melaleuca quinquinervia* (Broad-leaved paperbark) where tributaries contained semi-permanent water.

Within the watercourse (Sandy Creek) mapped RE11.11.18 (refer Figure 5.5), the dominant species present within the narrow pocket of vegetation were *Cryptocarya triplinervis*, *Exocarpus latifolius* (Broad-leaved cherry), *Mallotus philippensis*, *Melia azedarach* (White cedar), *Mallotus claoxyloides* (Green kamala) and *Jagera pseudorhus* (Foambark tree) with *Melaleuca quinquinervia* as emergent species (<22 m) in the riparian zone.

Due to its width (<30 m), the high level of fragmentation and overall degree of disturbance to areas adjacent and upstream, it is considered to be of moderate integrity only.

Samples of two specimens resembling *Alyxia magnifolia* (Large-leaved alyxia), a species listed as rare under the NC Act were collected from two locations within and adjacent the project area (refer Figure 5.3). However, due to lack of fertile material on each of the specimens a formal identification is not able to be made at this time.

Both habitats are considered to be of high conservation value due to the presence of suitable habitat for threatened species; their species richness and their overall ecological integrity (refer Photo 5.6). This may be due to their isolated location and in one instance difficult to access location, helping them to remain intact.



Photo 5.6 Rainforest habitat for *Alyxia magnifolia* within adjoining the project area

In addition to the pockets of rainforest/SEVT vegetation within the riparian zones of watercourses and drainage lines (refer Photo 5.7), tree species such as *Melaleuca bracteata* (Black teatree), *Casuarina cunninghamiana* (River oak), *E. tereticornis* ± *Callistemon viminalis* (Weeping bottlebrush) ± *Melaleuca quinquinervia* were also present (refer Photo 5.8). The lower stratum of these areas contained a high level of degradation due to past and current land uses.



Photo 5.7 Dry rainforest/SEVT pocket within the riparian zone



Photo 5.8 Other significant riparian zones within the project area

Declared pest flora

A number of flora species observed within the project area are declared pest plants under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) and listed in the *Land Protection (Pest and Stock Route Management) Regulation 2003* (LP Regulation). These species, along with the general locations they were observed have been listed in Table 5.3.

Table 5.3 Declared pest flora within the project area

Scientific Name	LP Act Status	Approximate location (section)
<i>Cryptostegia grandiflora</i> (Rubber vine)	C2	North Coast Line Bruce Highway
<i>Hymenachne amplexicaulis</i> (Hymenachne)	C2	Moura Link Western Option
<i>Lantana camara</i> (Lantana)	C3	All sections
<i>Lantana montevidensis</i> (Creeping lantana)	C3	Aldoga Bank Deviation North Coast Line Bruce Highway
<i>Macfadyena unguis-cati</i> (Cat's claw creeper)	C3	Moura Link Eastern Option
<i>Opuntia stricta</i> (Common prickly pear)	C2	North Coast Line Bruce Highway
<i>Parthenium hysterophorus</i> (Parthenium weed)	C2	Moura Link Western Option
<i>Salvinia molesta</i> (Salvinia)	C2	Moura Link Eastern Option
<i>Sporobolus</i> spp. (Giant rats tail grass)	C2	North Coast Line Bruce Highway

Table note:

LP Act = *Land Protection (Pest and Stock Route Management) Act 2002*

Reasonable steps to keep the land free of Class 2 and Class 3 declared species is required under the LP Act. A person must not, without reasonable excuse, introduce a declared pest to any of the following areas unless a declared pest permit has been obtained:

- The owner's land
- Unfenced land comprising part of a road or stock route that adjoins or is within the owner's land
- Other land that is fenced within the owner's land
- The bed, banks and water of a watercourse on the owner's land
- The bed, banks and water to the centre-line of a watercourse forming a boundary, or part of a boundary, of the owner's land

To gain an appreciation of the prevalence of such flora in relation to the project area and the Calliope region, the Gladstone Regional Council's pest flora mapping (2007) is shown in Figure 5.6.

Hymenachne amplexicaulis, *Cryptostegia grandiflora*, *Lantana camara*, *Parthenium hysterophorus* and *Salvinia molesta* are considered to be weeds of national significance due to their invasive nature and their potential impacts to the environment and the economy (Weeds Australia 2000).

Of the species listed above, the *Sporobolus* spp. (Giant rats tail grass) was the most abundant within the project area. Reaching heights up to 2 m and usually found in grazing areas (refer Photo 5.9 and Photo 5.10), Giant rats tail grass is a perennial species that where already present lowers the production rate / carrying capacity of infested areas by up to 80% and loosens the teeth of grazing stock (DPIF 2007).



Photo 5.9 Lower stratum of an open forest impacted by Giant rats tail grass



Photo 5.10 Grazed pastureland dominated by Giant rats tail grass

Currently modelling by the DPIF suggests that approximately 60% of Queensland contains suitable habitat for this species and approximately 30% nationally. Common ways in which the seeds are spread include vehicles and machinery, fast flowing water, via livestock and via native and feral fauna. It should also be noted that the seed is viable for up to 10 years after dispersal.

5.4 Potential impacts

Vegetation in the landscape is important for reasons such as carbon sequestration, maintaining biodiversity levels and helping to sustain an ecosystems assimilative capacity. As discussed in Section 4, vegetation also aides in buffering anthropogenic activities by providing natural solutions to issues such as soil stability, erosion and excess sedimentation, keeping the water table below the surface and minimising overland flow. As discussed in Section 6, vegetation also provides habitat for fauna.

In general, the loss of native vegetation within the existing rail corridor and associated easements is expected to be minimal. This is due to the majority of existing flora in these sections being either introduced grass or common species distributed from nearby woodlands and open forest communities. These species appear to have adapted to modified or disturbed ecosystems and are expected to recolonise these areas.

However, there is approximately 640 ha of vegetation not within existing corridors or easement present within the project area (including both Moura Link Options).

Key threatening processes to vegetation communities and threatened species within and adjacent the project area include vegetation clearing, fire, increased attenuation through disturbance, the removal of core habitat, weeds and the redirection of overland flow away from flow dependant vegetation communities present on the alluvial floodplains.

Vegetation clearing has the capacity to increase atmospheric temperatures during drought periods (refer Section 10) and reduce biodiversity levels, habitat values and connectivity. For example, the clearing of populations of insect and bird pollinated flora can reduce density and numbers of such species to a level where their ability to reproduce successfully is diminished (Morgan and Scacco 2006). This can be particularly important for small isolated populations of rare and threatened species such as *Cycas megacarpa* and rainforest and SEVT communities codependant on this dispersal method within the project area.

The rainforest and vine thicket communities throughout the project area represent a particular type of habitat that has been substantially reduced from its original cover. These communities reside in areas that offer a degree of fire-protection, high moisture availability (both atmospheric and soil), nutrient availability and free draining soil types (DEH 2006). Findings by Hopkins *et al* (1990) also revealed the SEVT communities studied contain significantly few pioneer and secondary species in the soil seed bank which are considered essential to natural regeneration of such a community. High quantities of agricultural and non-native seed were present. Therefore, any remaining habitat of this type is of inherent value.

The floodplain woodlands, open forests and riparian zones that occur across at least 50% of the project area are considered valuable for the ecosystem services and habitat values they provide. These communities typically occur where seasonal flooding is relatively brief and often in association with other floodplain and wetland communities. In addition to fragmentation, specific threats to these communities include changes to overland flow⁴ through the creation of embankments for new rail infrastructure which may impede flow and weed invasion due to disturbance to the soil seed bank.

5.4.1 Construction

Regional Ecosystems

The removal and/or disturbance to REs within the project area is pursuant to the VM Act. Table 5.4 outlines the approximate areas of remnant, non-remnant and other vegetation communities proposed to be directly impacted by the Project. This is based on the clearing of the entire project area (worst case-scenario). Figure 5.7 shows their locations.

Table 5.4 Approximate areas of vegetation to be cleared

Section	Mapping status	Regional Ecosystem/vegetation type	Approximate area to be cleared (ha)
North Coast Line	Endangered	RE11.11.18/11.11.15/11.11.4	0.83
	Of Concern	RE11.3.4/11.11.3	6.23
	Of Concern	RE11.3.4/11.3.26	18.02
	Not of Concern	RE11.3.25	0.20
	Not of Concern	RE11.11.5	0.06
	Not of Concern	RE11.11.15	7.26
		Sub Total	32.60
	-	DPIF Native hardwood plantation	25.34
	-	All other vegetation present	305.93
		Sub Total	363.87

⁴ changes to floodplain functions can result in loss of species richness and the functional capacity of persisting remnant communities

Section	Mapping status	Regional Ecosystem/vegetation type	Approximate area to be cleared (ha)
Moura Link North	Of Concern	RE11.3.4/11.3.26	10.78
	Not of Concern	RE11.11.3/11.11.15	12.70
	Not of Concern	RE11.11.15	1.20
	Not of Concern	RE11.3.26/11.11.15	7.11
		Sub Total	31.79
	-	All other vegetation present	98.24
		Sub Total	130.03
East End Mine Branch Line	-	All other vegetation present	3.15
		Sub Total	3.15
Moura Link Eastern Option	Of Concern	RE11.3.4	16.41
	Of Concern	RE11.3.4/11.3.25	2.27
	Not of Concern	RE11.11.15/RE11.11.4 (including RE11.11.4a)	12.19
		Sub Total	30.87
	-	All other vegetation present	38.69
		Sub Total	69.56
Moura Link Western Option	Of Concern	RE11.3.4/11.3.25	3.71
	Of Concern	RE11.3.4/11.3.26	1.23
	Not of Concern	RE11.11.15/ RE11.11.4 (including RE11.11.4a)	12.36
		Sub Total	17.30
	-	All other vegetation present	60.26
		Sub Total	77.56
Total including Moura Link Eastern Option (mapped REs)			
		Mapped REs	95.26
		Other vegetation	471.35
Total including Moura Link Western Option (mapped REs)			
		Mapped REs	81.69
		Other vegetation	492.92

RE11.11.18 is a relatively small endangered SEVT community occurring amongst woodland and open forest communities to the west of the township of Yarwun (refer inset 5 Figure 5.5). Anthropogenic changes have greatly reduced this RE type to less than 10% of its pre-clearing extent⁵.

RE11.3.4 is an Of Concern RE present across the majority of the project area. Anthropogenic changes have reduced this RE type to less than 30% of its pre-clearing extent.

Further attenuation of these RE types may exacerbate edge effects already present and increase the potential for an increase in fire frequency and weed species to infiltrate the community's core habitat. For example, weed species such as *Lantana camara* promote the spread of fire within the communities they invade via their physical structure, overall bulk and ability to shed their leaves and thus increase lower strata fuel loads.

⁵ As at September 2003. Please note that further clearing is likely to have occurred since that date.

Whilst dry sclerophyll communities have a greater tolerance of low to medium intensity fires, these factors inherently increase the threat of fire to dry rainforest and SEVT communities which are fire sensitive. As a result, the dry rainforest and SEVT community's ability to recolonise after such events is greatly diminished.

The clearing of both Endangered and Of Concern REs is pursuant to the appropriate RVMCs and the Policy for Vegetation Management Offsets as outlined under the VM Act.

It should also be noted that the status of RE11.3.25 (Not of Concern) is currently subject to the provision of no further clearing. Should further clearing occur, the VM Act status may be amended to Of Concern. It is therefore recommended that the status of REs be re-checked during the approvals phase.

Carbon release/sequestration

Terrestrial ecosystems are considered to be major contributors to carbon sequestration (up to 75%). Of this biomass, up to 95% may be found in trees (ARCS Date unknown).

Key threatening processes to carbon sequestration within the project area include the clearing of vegetation and the disturbance of soil. Both impacts lead to oxidation and release of carbon dioxide back into the atmosphere which in turn contributes to an increase in atmospheric temperatures.

However, it is difficult to accurately determine how much carbon may be released due to variation of age, composition and structure of the vegetation communities present. As suggested by Sales *et al* (2004) "*Biomass and carbon density values are found to vary with age, type of species, site conditions and silvicultural treatments (in relation to forestry management)*". It should be noted however, that large trees such as those eucalypts found with the project area are considered significant due to their ability to sequester vast quantities of carbon (eg hundreds of tonnes).

Impact on plant-pollinator associations

Some wildlife such as invertebrates and plants co-exist in symbiotic relationships that are mutually advantageous to the succession in both species. For example, the ability of a vegetation community to successfully regenerate is often highly dependant upon these pollinators and seed dispersers such as beetles, bees and birds.

Many pollinators rely on the sequential flowering of vegetation which in turn ensures food sources are available year round (with the exception of other environmental conditions, for example drought), whilst seed dispersers may nest, roost and forage within the vegetation community itself (refer Section 6).

However, local populations of pollinators and seed dispersers are often highly susceptible to habitat degradation and fragmentation which is associated with vegetation clearing and the use of certain chemicals (eg pesticides and herbicides).

Specific impacts to these relationships and subsequently populations may include, but not be limited to, the elimination of key components in their foodweb, impairments to their reproductive ability, a reduction in genetic variation of a local community (flora), starvation due to lack of available food source and death via direct contact with a poison.

It should also be noted that discussions with landholders and leasees within and adjacent the project area have identified the spread and uncontrolled management of declared pests to be a key threatening process to the viability of their land use (grazing).

Weed proliferation

Weed proliferation is exacerbated by clearing activities that disturb and expose the soil. Activities of personnel and vehicles carried out within the project area increases the potential for the movement and introduction of weed species into other locations where they do not currently occur.

Such activities include importing fill, slashing and soil disturbance from earth works and grading. Weed propagules may also be introduced on footwear, machinery, vehicles and equipment moving in and out of the project area from other locations as well as translocating them within the project area.

Weeds may out-compete less disturbance-tolerant native species and/or smother native vegetation. This in turn may alter the species composition of the vegetation community they encroach upon.

As shown in Figure 5.6, a large portion of the project area contains C2 declared pest Giant rats tail grass. This area is currently under a weed management programme carried out in collaboration with the landholders and local and state government agencies (eg the Department of Infrastructure and Planning).

Giant rats tail grass is a particularly aggressive weed whose dispersal is conducive to construction activities and rail movement. If an adequate weed management strategy is not produced and adequately implemented, this species has the potential to populate the entire local area and create further environmental and economic impacts to the region.

Regular chemical treatment via aerial spraying is currently carried out by an independent contractor to areas both within and adjacent to the project area. A reduction or elimination of this practice prior to the control or eradication of this infestation is likely to create serious long term impacts to vegetation communities (including pastoral) currently affected.

The potential for weed species such as *Cryptostegia grandiflora*, *Parthenium hysterophorus*, *Hymenachne amplexicaulis* and *Salvinia molesta* to further invade creeklines and waterways is also greatly increased if a weed management strategy is not properly implemented to address the risk of seeds and/or spores entering waterways and becoming established downstream.

Increasing edge effects

Edge effects can penetrate from 15 to 50 m into an area of remnant and non-remnant woody vegetation depending on the topography, physical processes and vegetation type involved (Catterall *et al* 1991; Big Scrub Conservation Strategy 1987). This reduces the interior (core) habitat through the migration of the communities 'edge' inwards.

Edge effects are likely to occur across all woody vegetation communities adjacent the project area of direct disturbance. In addition, edge effects have the potential to create changes to the species composition of woody vegetation communities and increase the presence of introduced and disturbance dependant native species in the area. Previously intact areas may also become exposed and vulnerable to threatening processes due to fragmentation.

When this occurs, the integrity of the floristic structure within the vegetation communities is likely to be compromised. This will create edge effects and attenuate areas of significance such as the riparian zones, remnant vegetation and notophyll/microphyll rainforest and SEVT communities adjacent to the areas of direct disturbance.

In terms of edge effects and fragmentation, the areas where potential impacts are significant include notophyll/microphyll rainforest and SEVT communities such as those adjacent Flynn Road and the remnant microphyll vine forest (RE11.11.5) located along the Moura Link Eastern Option (refer inset 6 Figure 5.5).

A notophyll/microphyll rainforest and SEVT communities was identified along a drainage line extending from RE11.11.5 in the Mount Larcom Range down towards Flynn Road (refer inset 4 Figure 5.5). This community is established, intact and appears to have been excluded from threatening process such as clearing, fire, weed infiltration and other anthropogenic impacts (refer Photo 5.6). This community also contains threatened species and suitable habitat for threatened species and is therefore considered to be of high conservation value.

Endangered RE11.11.18 was identified to the west of the township of Yarwun (refer inset 5 of Figure 5.5). RE mapping and aerial photography identified communities on the southern slope with the northern slope primarily open Eucalypt woodland. This community has been reduced and disturbed as a result of existing quarrying operations. The proposed quadruplication of the NCL will require large cuts within this area which are likely to encroach further into this RE increasing the risk of edge effects. The cutting operations will primarily be located on the northern slopes where the community is primarily open Eucalypt woodland.

Intact remnant microphyll vine forest is present on steep slopes within and surrounding the Moura Link Eastern Option. Evidence at the location indicates that the vegetation type may have once covered the south facing slopes prior to anthropogenic changes (eg clearing) and is now restricted to the steep slopes considered unsuitable for agriculture. Further attenuation of this area is likely to lead to an increase in weed infiltration (currently minimal) and fire frequency, particularly reaching the core habitat due to the surrounding fuel loads of the dry sclerophyll communities.

Bushfire

Bushfires may be the result of natural and/or anthropogenic processes. The project area is located in a low-medium bushfire area.

The impact of bushfire on a given ecosystem will vary depending upon its intensity, the season, the time since the last fire, the vegetation structure as well as the species composition involved. Many plant species have developed specific mechanisms to survive periodic bushfire, while some species depend on fire regimes to stimulate flowering, seed release or to provide optimal conditions for seed germination (eg *Eucalyptus* spp.). However, species such as those found in notophyll/microphyll rainforest and SEVT communities are extremely fire sensitive.

Specific impacts that occur to these communities as a result of fire include a reduction in total area, a loss of biodiversity and a loss of soil nutrients through a reduction in available organic matter from the forest floor. This reduction in system health also promotes the infiltration of weeds which further reduce the capacity for the system to adequately recover. These impacts are particularly relevant to RE11.11.5, RE11.11.18 and other areas currently too small to be mapped (refer Figure 5.5).

Whilst bushfire is an important factor in shaping the dynamics and health of dry sclerophyll systems, too frequent fire can alter the species composition of the communities and facilitate weed infestation and dieback. Uncontrolled fire also poses a significant risk to the neighbouring landholders and leasees as their livelihood is reliant upon pastures for stock.

Activities which may increase the risk and frequency of bushfires occurring within the project area include the careless discarding of matches and cigarette butts, littering and the operation of equipment (eg sparks associated from heavy machinery).

The effects of dust

In general, dust deposition from construction activities has the potential to impact upon vegetation if excessive quantities are sustained over extended periods of time. Excessive dust deposition on foliage reduces photosynthetic processes which in turn stunts floral growth rates and reduces the overall health of the remaining remnant communities within and adjacent to the project area.

Dust may also carry nutrients which can lead to algal blooms in nearby waterways. Section 10 contains further information on air quality.

Threatened species

A single specimen of *Cycas megacarpa* and a potential specimen of *Alyxia magnifolia*⁶ were observed to the east of the proposed Aldoga Rail Yard (refer Figure 5.3). These species may be impacted as a result of edge effects, an overall reduction of suitable habitat for their progeny to occupy or through their removal.

Vegetation clearing may also promote changes to local pollinator populations (eg beetles for *Cycas megacarpa*), microclimates and soils conditions in which these species are reliant upon. Construction activities may also increase competition with weeds and prevent natural succession within the local area. It should be noted however, that localised impacts to the long term viability of *Cycas megacarpa* is considered to be minimal due to the presence of only one species within and adjacent the project area.

Cycas megacarpa is listed as endangered⁷ under the EPBC Act and the NC Act, whilst *Alyxia magnifolia* is listed as rare⁸ under the NC Act only. The removal of both species is subject to applicable permits under the NC Act.

As noted in Appendix E3, *Alyxia magnifolia* is restricted to rainforest and SEVT communities and the removal or reduction of these communities increases the threat to suitable habitat for present and future local populations of this species.

5.4.2 Operation

Weed control

The movement of trains as well as the activities carried out by personnel and vehicles within and adjacent the project area increases the potential for the movement and introduction of weed species into other locations where they do not currently occur.

This includes the potential for weed species such as *Cryptostegia grandiflora*, *Parthenium hysterophorus*, *Hymenachne amplexicaulis* and *Salvinia molesta* to further invade creeklines and waterways and become established downstream. There is also potential for Giant rats tail grass to further establish itself across the Calliope region.

Regular chemical treatment via aerial spraying is currently carried out by an independent licensed contractor to areas both within and adjacent the project area. A reduction or elimination of this practice prior to the control or eradication of this infestation is likely to create serious long term impacts to vegetation communities (including pastoral) currently affected. Conversely, the imprudent use of herbicides for weed control within and adjacent the project area may inadvertently cause harm to non-target native species and their pollinators.

The effects of dust

The coal dust from passing coal wagons is likely to be minimal (refer Section 10). Therefore no significant impact to the overall health of nearby remnant vegetation is likely.

⁶ Due to lack of fertile material

⁷ Thorough searches have not been conducted but the species has not been seen in the wild for a period of time; species is in danger of becoming extinct in the wild due to a reduction in natural habitat/distribution range; the survival of the wild populations is unlikely if threatening processes continue.

⁸ Large population with a restricted distribution; or small populations scattered across a wide distribution; or the species is in danger of becoming vulnerable in the wild due to a reduction in natural habitat.

5.5 Mitigation measures

The measures proposed to mitigate potential terrestrial flora impacts of the Project are discussed in Section 20.

5.6 Conclusion

During the field investigations approximately 243 plant species were identified from 37 locations. The vegetation types observed as occurring throughout the project area include agricultural pastures, a DPIF plantation, dry sclerophyll open woodland to open forest, dry rainforest, SEVT and riparian communities. Of these communities, approximately 113 ha are mapped as REs within the project area.

The floristic integrity of the ecological communities present has been reduced significantly in many areas due to anthropogenic changes (eg clearing for pastoral grazing and linear disturbances such as roads). These changes have caused the landscape to become highly attenuated and as such, have significantly reduced the area of intact remnant vegetation.

In addition, a number of flora species observed within the project area are declared pest plants under the LP Act. Of these species, the Giant rats tail grass was the most abundant throughout project area.

Based on a worst case scenario, the construction of rail infrastructure and supporting infrastructure will result in the clearing of:

- Approximately 95 ha of mapped REs and 471 ha of other vegetation for the Project which includes the Moura Link Eastern Option
- Approximately 82 ha of mapped REs and 493 ha of other vegetation for the Project which includes the Moura Link Western Option

Key threatening processes to vegetation communities and threatened species within and adjacent the project area include vegetation clearing, fire, increased attenuation through disturbance, the removal of core habitat, weeds and the redirection of overland flow away from flow dependant vegetation communities present on the alluvial floodplains.

The implementation of mitigation and management measures will ensure that potential impacts to terrestrial flora within the general area are minimised.

5.7 Commitments

The terrestrial vegetation commitments relevant to the Project include:

- Clearing of remnant vegetation will be restricted to the minimum required to enable the safe construction, operation and maintenance of the railway line, Aldoga Rail Yard and supporting infrastructure.
- The preparation and implementation of a Vegetation Rehabilitation and Management Sub Plan (VRMSP) based on designated revegetation/rehabilitation locations (including buffer zones) which are to be determined during the detailed design phase. This plan will be implemented during the construction and operation phases of the Project.
- The development of a site specific Weed Management Sub Plan (WMSP) for implementation during construction and operational phases of the Project. This strategy is to be prepared in consultation relevant State and Local government agencies and is to be implemented during the construction and operational phases of the Project.