Statement of Evidence

Black-throated Finch (southern)

Prepared for the Land Court of Queensland

Adani Mining Pty Ltd v Land Services of Coast and Country & Inc. & Anor

Prepared by
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Attachment 2: Instructions

A Qualifications and Curriculum Vitae

I have Bachelor of Science (Forestry) and Master of Science degrees.

I am currently a Senior Ecologist with the environmental consultancy firm Eco Logical Australia Pty Ltd (ELA). I have over 25 years' experience in the management and delivery of major vegetation survey, mapping, monitoring, research and assessment projects across Queensland and the Northern Territory. Before working for ELA I was the Science Leader at the Queensland Herbarium with responsibility for the delivery of a range of projects including the Regional Ecosystem, Wetland and Groundwater Dependent Ecosystem mapping projects.

My *Curriculum Vitae* was included as Appendix A to my previous statement of evidence for springs ecology and *Livistona lanuginosa*, which is exhibit BW-1 to my affidavit affirmed 12 February 2015 in these proceedings.

B Material Relied on to Prepare this Statement

I have relied on the following information in preparing this statement

- The first fauna joint expert report (JER), Black-throated Finch (southern) (BTF) by Lindsey Agnew (**LA**), Adrian Caneris (**AC**), Mike Olsen (**MO**) and Bruce Wilson (**BW**), dated 15 January 2015. (**First BTF JER**)
- The second fauna joint expert report, Black-throated Finch (southern) by LA, AC, MO, BW, dated 27 February 2015. (**Second BTF JER**)
- Birdlife Australia, Letter to LA dated 28 January 2015. (**Birdlife Australia Letter**).
- Black-throated Finch Recovery Team (2007). National recovery plan for the black-throated finch southern subspecies *Poephila cincta cincta*. Report to the Department of the Environment and Water Resources, Canberra. Department of Environment and Climate Change (NSW), Hurstville and Queensland Parks and Wildlife Service, Brisbane. (**BTF Recovery Plan**)
- Coordinator-General of Queensland (2014) Carmichael Coal Mine and Rail Project. Coordinator-General's evaluation report on the Environmental Impact Statement. May 2014. (**Coordinator-General's Report**)
- Department of Environment and Heritage Protection (2014) Draft environmental authority EPML014705153 – Carmichael Coal Mine (**Draft EA**)
- Department of the Environment (2014). Decision under the *Environment Protection and Biodiversity Conservation Act 1999* – Approval – Carmichael Coal Mine and Rail Infrastructure Project, Queensland (EPBC 2010/5736) (**EPBC Approval)**
- DERM (2011). Ecological Equivalence Methodology Guideline. Policy for Vegetation Management Offsets. Queensland Biodiversity Offset. Policy Version 1 3 October 2011. Department of Environment and Resource Management, Brisbane (**EE Method**).

  The EE method is provided as **Attachment 1** to this report.

- ELA (2014a). Carmichael Coal Mine Ecological Equivalence Assessment Stage 2. A report prepared by Ecological Australia for Adani Mining Pty Ltd. (**EE assessment mining leases)**
- ELA (2014b). Moray Downs West Ecological Equivalence Assessment Stage 2. A report prepared by Ecological Australia for Adani Mining Pty Ltd. **(EE assessment offset site)**
- Eyre TJ, Ferguson DJ, Hourigan CL, Smith GC, Mathieson MT, Kelly, AL, Venz MF, Hogan, LD & Rowland, J. 2014. Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland. Department of Science, Information Technology, Innovation and the Arts, Queensland Government, Brisbane.
- Queensland Herbarium Biodiversity status of pre-clearing regional ecosystems – Central Qld. Version 8.0, 31 August 2012. **(state-wide pre-clearing regional ecosystem mapping)**
- State Land and Tree Study - Foliage Projective Cover 2013 – Laglan. Downloaded from Data Queensland web site February 4 March 2015. (**SLATS woody cover)**

In addition:

- I carried out a reconnaissance survey of the Carmichael Mine lease and surrounding areas in November 2014.
- Previous to my engagement as an expert witness for these proceedings, I developed the updated regional ecosystem mapping and took part in the condition assessment field work as part of the ELA project “Carmichael Coal Mine Ecological Equivalence Assessment Stage 2” (report dated 30 January 2014). This project was led by Brad Dreis with the assistance of Alana Burley and Chays Ogston as well as myself.
- I also compiled draft regional ecosystem mapping and other advice as part of the ELA project “Moray Downs West Ecological Equivalence Assessment Stage 2” (report dated 9 October 2014). This project was led by Brad Dreis with the assistance of Katrina Cousins and Chays Ogston as well as myself.

I do not believe that access to any readily ascertainable additional facts would assist me in reaching a more reliable conclusion. As far as I am aware I have consulted all readily available information on the areas relevant to my statement.

C Background to Statement

- I have been directly involved in two projects (lines 30-37 above) that were used to support the development of the proposed Carmichael Mine.
- I have provided ad hoc advice on a range of matters to consultants and government staff relating to the Carmichael Mine.
- Since carrying out the above work I have been engaged by McCullough Robertson Lawyers, on behalf of Adani, to provide an expert report in the Land Court proceedings.
- In compiling this statement I have received and read the letter of instruction from McCullough Robertson that is included in the **Attachment 1** to this statement.
- I understand my duties to the Land Court as an expert witness (see **Section E**).
- Notwithstanding my previous relationship with the mine, I consider that I am able to provide an informed, independent opinion about the matters contained within this statement.

D Summary

The Ecological Equivalence (EE) assessments of the mining lease areas and offset site, documented in ELA 2014a and ELA 2014b, are appropriate at this stage of the Project.

A more detailed assessment using grass species survey information would not add to this assessment in relation to BTF habitat at this time.

I consider it unlikely that the gross area identified as BTF habitat on the Carmichael Mine in the ELA assessment (ELA 2014a) is an underestimate. The current gross area identified as BTF habitat includes over 92% of the remnant vegetation area on the mining lease. The non-remnant areas on the mining lease are mainly exotic grasslands with some areas of sparse woody shrub cover. Therefore these areas are unlikely to provide substantial BTF habitat.

The EE assessments, documented in the ELA 2014a and ELA 2014b reports, provide an appropriate indication of the BTF habitat within the mining lease areas and offset site at this stage of the project. This includes the stratification into Assessment Units using Broad Vegetation Groups.

The intensity of sampling for the assessments within the mining lease areas and offset site is adequate for this stage of the project.

The identification of BTF habitat on the mine lease takes a precautionary approach. The conditions in the draft EA for the project include requirements to undertake further work to increase the understanding of BTF habitat, any impacts on BTF habitat by the mine and appropriate management required to address these impacts. These measures are designed to prevent loss of BTF habitat and are therefore consistent with the precautionary principle.

The issues raised in the CAT submission are not relevant to the issues that I have considered in relation to BTF habitat.

E Opinion on Objections

E.1 Grass species used by BTF

LA has stated that:

- There is 'a large body of information available in regard to BTF foraging habitats in other parts of its distribution' (First BTF JER, paragraph 6.7.7).
- He is aware of 22 genera which provide known feeding resources (First BTF JER, paragraph 6.18.5).
- There is evidence of BTF feeding on 23 different grass species (Second BTF JER, paragraph 6.6.1).

I have stated in the First BTF JER (paragraph 6.7.6) that more intensive surveys of grass species may not provide a lot more additional guidance about BTF habitat at this time.

E.1.1 Opinion

The Ecological Equivalence assessments of the mining lease areas and offset site documented in ELA 2014a and ELA 2014b are appropriate at this stage of the Project.

A more detailed assessment using grass species survey information would not add to this assessment in relation to BTF habitat at this time.

E.1.2 Justification

I am not aware of the large body of information referred to by LA in the First BTF JER (paragraph 6.7.7).

I am also not aware of the source of the 22 genera listed by LA in the First BTF JER (paragraph 6.18.5). Attachment 3 to Second BTF JER included a response from the BTF Recovery Team to a request from LA to provide a view on the general relevance of these grass genera to BTF in the Carmichael area. The BTF Recovery Team reply did not make a response to this request.

The 23 grass species listed in the Second BTF JER (paragraph 6.6.1), correspond to column 2 of Attachment 2 in the Second BTF JER. This column is labelled "Reported Observation – Confirmed Species Only" of grass species within the BTF diet, prepared by LA. I am not aware of the source of this information.

There is also a list of grass species that are "suspected" to be part of the BTF diet in column 3 of Attachment 2. There are 12 additional species in this column that are not in the "confirmed" column 2. Thus the total number of species of "confirmed" or "suspected" in column 2 or 3 of Appendix 2 is 35. It is unclear to me why this number is different to the 25 grass species recorded as "confirmed or suspected of forming part of the diet of the BTF" that was referred to by LA (paragraph 6.6.3) and echoed by myself (paragraph 6.11) in the Second BTF JER.

It is difficult to see how the information provided on grass species in the First and Second BTF JERs could be used to improve on the EE assessments of the mine and offset areas reported in ELA 2014a and ELA 2014b.

It is not clear if all species on the known or suspected species and genera lists are of equal weighting and what differences in the relative abundance of different species would mean. For example if one site had a total cover of 20% consisting of one "confirmed" species while

another site had a total cover of 40% made up of 2 suspected species (or genera which provide known feeding resources), it is not possible to say which site would be more important.

There is also no indication of how the results from a site based assessment of grass species can be extrapolated across the entire study site. The regional ecosystem mapping used on the EE assessments at the mine and offset sites in the ELA 2014a and ELA 2014b are considered the most appropriate and freely available means of generalising habitat information at this point in time.

I agree that more detailed studies of the offset sites are required (First BTF JER, paragraph 6.10.23). However, the broad scale identification of habitat at the mine site reported in ELA 2014a is adequate for primary approval of the project. The habitat on the mine and offset site is required to be studied in more detail under the conditions in the Draft EA.

E.2 Total area of BTF habitat on mine lease

LA stated in the First BTF JER (paragraph 6.10.2.3) that revision of the habitat values assessment will likely indicate that previous impact calculations have underestimated the offset liability.

I have stated in the Second BTF JER (paragraph 6.11) that a reassessment using grass species is likely to identify less BTF habitat than the approach using the Broad Vegetation Groups in the ELA 2014a assessment.

LA stated in the First BTF JER (paragraph 6.10.19) that non-remnant vegetation could provide BTF habitat and because non-remnant areas were not included in the mapping of the mining lease, the area of BTF habitat was underestimated. I stated in the same report (paragraph 6.10.20) that much of the non-remnant regrowth on the mining leases was relatively open/short with a ground layer dominated by the exotic grass *Cenchrus ciliaris.*

E.2.1 Opinion

I consider it unlikely that the gross area identified as BTF habitat on the mining lease areas in the ELA assessment (ELA 2014a) is an underestimate.

E.2.2 Justification

I stated in the Second BTF JER that the ELA 2014a study identified Assessment Units 1-6 as BTF habitat. The area of these Assessment Units from Table 2 of the ELA 2014a report is listed in **Table 1** below. The area of remnant vegetation in the Assessment Units identified as BTF and non-BTF habitat are shown in **Figure 1** below. This shows that the vast majority of the area mapped as remnant vegetation on the mining leases has been identified as BTF

habitat. The total area of the Assessment Units listed as BTF habitat in **Table 1 is** 29,814 ha. This area is 92%[1] of the total area of remnant vegetation on the mining leases.

The Assessment Units 1-6 that are identified as BTF habitat are mainly eucalypt grassy woodlands and open woodlands. My understanding, from the BTF Recovery Plan (Table 1), is that these areas provide habitat for BTF. The areas identified as non-BTF habitat are *Acacia* dominated woodland and shrub-lands on black clay soils and other woodlands on rocky hills that are remote from water. My understanding, from the BTF Recovery Plan (Table 1), is that these vegetation types do not provide habitat for BTF.

The Birdlife Australia letter to LA has stated that "*Triodia* covered sandstone ranges may be the critical dry season food and water resources". These areas were not included in the identified BTF habitat in the EE assessment of the mine or offset site. However on the mine site these areas are a small component of the 615 ha of "Other" assessment unit (ELA 2014a, Table 2) which is about 2% of the 29,816 ha total area of remnant vegetation. *Triodia* covered sandstone ranges equate to assessment units 11 and 13 on the offset site. These assessment units cover 5,760 ha which is 14% of the total area of remnant vegetation (ELA 2014b, table 2). Therefore if *Triodia* covered sandstone ranges are included as BTF habitat then more areas would be added on the offset site than on the mining lease areas. Sandstone ranges are also generally remote from water indicating they may not provide the water resources that the Birdlife Australia letter states are critical.

I have agreed (Second BTF JER, paragraph 6.11) that many of the grass species that are confirmed or suspected to be part of the BTF diet are present on the mine site. However, I also expressed the opinion that these grass species are not evenly distributed across the mining leases. This means that an assessment based on the distribution of grasses is likely to result in less than 100% of the areas identified as BTF habitat using the Broad Vegetation Groups approach outlined above.

In addition my understanding, from the BTF Recovery Plan, is that BTF habitat is mainly in the vicinity of water. Many of the areas identified as BTF habitat would be remote (> 5 km) from water. These areas have not been excluded from the gross area identified as BTF habitat on the mining lease areas.

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[1] In the paragraph 6.10 of the Second BTF JER I stated that the ELA 2014a report identified 94% of remnant vegetation on the Carmichael Mine lease as BTF habitat. This was based on the total area in Table 2 of the ELA 2014a report, which did not include the 615 ha "other" category. However, the "other" category includes remnant vegetation and should have been included in the total area. Therefore I have included this category here to derive the amended figure of 92%.

Therefore I do not consider that the gross area of BTF habitat within the areas of remnant vegetation underestimate the area of BTF habitat. More detailed studies are more likely to show that this is an overestimate rather than an underestimate of BTF habitat.

Table 1 Area of BTF Habitat Carmichael Mine

(Source ELA 2014a, Table 2)

Assessment Unit	Area on mine lease (ha)	Identified as BTF habitat
1	13	Yes
2	407	Yes
3	56	Yes
4	20823	Yes
5	5754	Yes
6	385	Yes
7	851	No
8	912	No
Other	615	No
Total Area	29,816	
Total Area identified as BTF habitat (AU1-6)	27,438 or 92% of total remnant area	

About 36% of the Carmichael Mine lease is mapped as non-remnant vegetation. The state-wide pre-clearing regional ecosystem mapping shows that about 46% of this non-remnant area (or 17% of the total mining leases) is mapped as *Acacia* shrubland and woodland on black soil (purple areas on **Figure 1**). I observed these areas in my field work undertaken as part of the ELA 2014a study, as cleared of woody vegetation and converted to an exotic grasslands dominated by *Cenchrus ciliaris*. Therefore, these areas are unlikely to provide significant BTF habitat.

In addition many areas of woody cover that were not mapped as remnant vegetation on the state-wide regional ecosystem mapping were included as remnant vegetation in the updated regional ecosystem mapping that was compiled as part of the EE assessment. This included the remapping of all areas on the mining leases that were previously mapped as High Value Regrowth under the *Vegetation Management Act 1999* as remnant.

The woody vegetation cover, as mapped by the State Land and Tree Study, of areas on the mining leases mapped as remnant vegetation in the EE assessment on the mining lease areas is shown in **Figure 2**. This shows that areas mapped as remnant vegetation are mainly shaded green, indicating they have a woody cover that is greater than 10%. There are some areas of remnant vegetation with low woody vegetation cover (<10% cover) that are shaded brown and yellow on **Figure 2.** These areas correspond to more open woodlands and shrub lands including some area that are not classified as BTF habitat on **Figure 1.** For example the area indicated by the number 1 on **Figure 1** is an area of *Eucalyptus persistens* and *Acacia cambagei* open woodlands that is not included as BTF habitat. The area indicated by the number 2 on **Figure 1** is an area of *Eucalyptus similis*/*Grevillea pteridifolia* open woodland/shrubland that was included as BTF habitat.

The woody vegetation cover, as mapped by the State Land and Tree Study, of areas on the mining leases mapped as non-remnant vegetation in the EE assessment is shown in **Figure 3**. This shows that areas mapped as non-remnant vegetation are mainly shaded brown, indicating they have zero woody cover or yellow, indicating less than 10% woody cover. There are some areas of non-remnant vegetation with denser (>10%) woody cover indicated by the light green shading on **Figure 3.** These areas are still often dominated by low shrubs with a substantial exotic component in the ground layer. For example, I observed the vegetation in the vicinity of the point indicated by the number 1 on **Figure 3** in my field work undertaken as part of the EE assessing of the mining leases. Most of the vegetation in this area was low (< 3 m high) shrubs often with a high cover of the exotic grasslands dominated by *Cenchrus ciliaris.* Areas with such sparse and or low woody cover are also unlikely to provide appropriate woody habitat for either perching for nesting for the BTF and grass species that from my understanding are required BTF habitat factor (Second BTF JER paragraph 7.8).

Therefore, the areas of non-remnant vegetation on the mining leases are unlikely to provide substantial areas of BTF habitat.

E.3 Ecological Equivalence Method

The Ecological Equivalence (EE) assessments have been undertaken of the Carmichael mining leases and the proposed offset site at Moray Downs West. These are documented in the reports by ELA 2014a (mine lease) and ELA 2014b (offset site).

MO has questioned the use of Broad Vegetation Groups and regional ecosystems used in the EE assessments as surrogates for BTF habitat in the First BTF JER (paragraph 6.7.5).

LA has questioned the reliance on the EE method to identify BTF habitat (e.g. First BTF JER, paragraph 6.10.4 and 6.10.24).

LA has questioned the sampling intensity used in the EE assessments, particularly in the proposed offset area on Moray Downs West (First BTF JER, paragraph 6.10.11).

E.3.1 Opinion

The EE assessments, documented in the ELA 2014a and ELA 2014b reports, provide an appropriate indication of the BTF habitat at the mining lease area and offset site at this stage of the project. This type of assessment is commonly used to indicate broad habitat at the approval stage of a project.

The stratification into Assessment Units using Broad Vegetation Groups is appropriate for the delineation of BTF habitat.

The intensity of sampling at on the mining leases and offset site is adequate for this stage of the project.

E.3.1 Justification – Use of EE method

I have stated in the Second BTF JER (paragraph 6.16) that under the processes operating at the time that the studies were carried out, the Queensland Government required the EE assessment to be used to compare impacts areas (in this case the mining lease lease) with offset areas (in this case the Moray Downs West). The EE method is similar to methods used in other parts of Australia to compare ecological values on impact and offset sites. It is also similar to the "Draft Guide to Determining Terrestrial Habitat Quality" that replaced in the EE method in Queensland in April 2014.

The Second BTF JER (paragraph 7.7) lists the BTF habitat factors as water supply, woody habitat and selected grass species. The EE method includes the measurements of a range of attributes that are directly relevant to these factors including tree height and cover, weed cover, perennial grass cover and grass species richness. Therefore the EE assessment will have a broad relationship to the BTF habitat factors for woody habitat and grass food sources specified in the Second BTF JER (paragraph 7.8). This is also supported by the statement by LA in the First BTF JER (paragraph 6.10.9) that the EE assessment provides a basis to compare broad fauna habitat attributes.

As I have stated in the Second BTF JER (paragraph 6.10) the target grass species information collected as part of the EE assessments was not used to provide detailed habitat information but to provide a qualitative verification of habitat types. This information was used to verify that at least some target species were present and therefore support the classification of the Broad Vegetation Groups used to indicate BTF habitat. The absence of these species was not used to rule out any areas as BTF habitat.

The supply of water year round was also identified as a BTF habitat factor in the Second BTF JER (paragraph 7.8). This factor was used on the mining leases to provide a qualitative verification of BTF habitat but was not used to rule out any areas within the Assessment Units identified as BTF habitat on the mining lease. The distance from water was used to define different levels of BTF habitat on the offset site. The grassy woodland assessment units 1, 2, 9 and 12 were identified as high value BTF habitat based on a qualitative assessment of the habitats. Areas within these assessment units that occurred with 3 km of permanent water were redefined as very high quality BTF habitat based on the known importance of year round water supply to the BTF (Second BTF JER 7.8). Assessment units 3, 10, 13 and 15 were assigned medium BTF habitat value based on a qualitative assessment of these habitat types.

This broad level of BTF habitat identification is appropriate for this stage of the development of the current BOS. The EE assessment of the offset site was carried out in September 2014, which was after the release of the Coordinator-General's report and the EPBC Act Approval. As the project progresses more detailed work to identify the BTF habitat and define more precisely the objectives and criteria more measuring the success of the offset site are required under the conditions in the Draft EA.

Attachment 3 to Second BTF JER included a response from the BTF Recovery Team to questions from LA. These questions included a specific question about the appropriateness of

the EE method for identifying BTF habitat (page 7, paragraph 4.2, Attachment 3, Second BTF JER). The response (paragraph 4.2.1) was that there is no single proven assessment guideline and provided an example of a habitat modelling approach based on climate and regional ecosystem mapping data. There is likely to be little variation in climate across the Carmichael Mine lease and offset site. Therefore, this example is primarily reliant on the regional ecosystem data and is similar to the EE methods used for the mine and offset sites. Therefore, the response from the BTF Recovery Team does not provide an alternative method and supports the use of the EE method.

E.3.2 Justification - Definition of Assessment Units

The EE assessment at both the mining lease area and offset site was based on updated regional ecosystem mapping for the areas. This regional ecosystem mapping was updated following ground truthing of the areas as part of the ELA 2014a and ELA 2014b studies. This included field data collected from quaternary sites across the areas and remapping based on high resolution 2012 imagery.

The Assessment Units (AUs) that underpin the EE assessments are used to stratify the mining lease area and offset site. EE samples are then established in the field in areas that are considered representative of the AU. The EE score at each sample is averaged across the AU site and multiplied by the area of the AU to give an overall value for that AU.

AUs were primarily defined by Broad Vegetation Groups. These are defined by the Queensland Herbarium based on regional ecosystems with similar dominant species and vegetation structure. The dominant species used in this classification are mainly tree species and the different regional ecosystems within a Broad Vegetation Group generally have ground layer with a similar composition. Therefore, variations between regional ecosystems within one BVG are unlikely to lead to an underestimation of BTF habitat.

An exception to the above derivation of AUs is that the *Eucalyptus populnea* (BVG17a) and the *Eucalyptus melanophloia* (BVG17b) were combined into one assessment unit. The dominant tree species in these Broad Vegetation Groups are closely related, are associated with ground layers with similar composition and often occur in the same area. In addition the entire combined assessment unit was treated as BTF habitat. Therefore this is also unlikely to have resulted in an underestimate of BTF habitat.

The Queensland Fauna Survey Guidelines (Eyre *et al*. 2014, page 14) state that it may be appropriate to use Broad Vegetation Groups as a basis for defining AUs. The development of AUs (and the associated sampling intensity) was approved by the Queensland Department of Environment and Heritage Protection before the assessment of the Carmichael Mine documented in ELA 2014a commenced.

E.3.1 Justification - Sampling Intensity

I stated in the First BTF JER that the sampling intensity used in the EE assessments in ELA 2014a and 2014b met or exceeded the specifications in DERM (2011) (paragraph 6.10.8).

The EE method (page 11 first paragraph) provides a guideline for the number of EE sites that should be aimed for within each assessment unit. This states that, as a guide, it is best to aim for two to five sampling sites per assessment unit depending on the size of the assessment unit. At least two samples should be aimed for where the assessment unit is less than 60 ha and five samples should be aimed for where the assessment unit is greater than 500 ha.

The EE method also sets out conditions where “a reduced number of sampling sites may be possible if it can be demonstrated that different assessment units containing the same regional ecosystem are in the same condition” (EE method, page 11, paragraph 1). Evidence required to support a case for reduced sampling includes recent remote sensing imagery combined with on-ground GPS located photos to show that assessments units are in the same general condition. This information was collected (and supplied to the Department of Environmental and Heritage Protection) in the course of the regional ecosystem ground truthing that was carried out as a component of the EE assessments. This meant that EE sites within each discrete patch of an assessment unit were not required.

In the case of the mining leases there were over 5 EE sites for all assessment units except AU1 and 3. AU 3 was only 59 ha and had 3 EE sites and therefore met the specification that at least 2 sites be established in assessment units that has a total area less than 500 ha. AU1 only has one EE site. This is because the total area of this assessment unit was only 13 ha and was assessed during the ground truthing of the regional ecosystem mapping to be in a uniform condition. The EE sampling and ground truthing of this AU was carried out by myself as part of the ELA 2014a study.

On the offset site, 5 EE sites were established in AU 1, 3 and 4. All other assessment units had between 1-4 EE sites which is fewer than should be aimed for in the EE sampling intensity guidelines. However, as I have detailed in the First BTF JER (paragraph 6.10.12) sampling intensity should also be based on an assessment of variability within the assessment units. Sampling of EE sites is purposive meaning that sites are selected to be representative of each assessment unit by the people carrying out the survey. This allows for an accurate assessment of an area with fewer sites than using a random sampling strategy and is a common approach used in broad scale surveys such as the EE assessments on the mining leases and offset sites.

The assessment units with fewer than the number of sites aimed for in the EE guideline are small or show relatively minor variation in the EE values at each site (Appendix C of the ELA 2014b document which lists the EE score at each sites within each assessment unit). This means that the establishment of additional EE sites in these units is unlikely to change the overall EE score for each assessment unit.

The EE assessment of the offset site was carried out in September 2014, which was after the release of the Coordinator-General’s report and the EPBC Act Approval. Therefore this assessment was undertaken with the knowledge that further work will be carried out. This further work includes the development of a BTF Species Management Plan under condition I6 of the Draft EA and supported by condition 11 of the EPBC approval. There is also the requirement to undertake more detailed assessment of BTF habitat on the offset area, with review by an appropriate expert under conditions I2-I7 of the draft EA.

Therefore, although more detailed work on the BTF habitat values of the offset site is required, I consider that the EE assessment documented by ELA 2014b provides an adequate indication of values at this stage of the process.

Table 2 Number of EE sites by assessment unit, Carmichael Mine

(Source ELA 2014a, Table 2)

Assessment Unit	Area on mine lease (ha)	Number of EE sites
1	13	1
2	407	10
3	56	3
4	20,823	9
5	5754	5
6	385	6
7	851	6
8	912	6
Other	615	Not sampled

Table 3 Number of EE sites by assessment unit, Moray Downs West Offset Site

Source ELA 2014b, Table 2

Assessment Unit	Area on offset site (ha)	Number of EE sites
1	17,248	7
2	1351	2
3	10,340	5
4	456	5
5	1,889	3
6	1843	3
7	81	1
8	27	1
9	734	3
10	9	1
11	4752	3
12	922	3
13	1028	2
14	138	2
15	7	1

E.1 Precautionary principle and requirements for further information

MO has stated that the precautionary principle must be “invoked” in relation to this project in the First (paragraph 6.7.5) and the Second (paragraph 6.19) BTF JERs, in relation to knowledge of grass species used as food by the BTF.

LA (First BTF JER, paragraph 6.8.4) has quoted the Coordinator-General’s report that further work is required to fully understand a number of matters about BTF in the project area.

MO has stated that it would be “cavalier” to remove known habitat from the proposed mine without a deeper understanding of why BTF are feeding there based on spatial or auto ecological data.

I have agreed that further information is required to effectively manage the BTF habitat (Second BTF JER paragraph 6.12) but that it is appropriate to obtain this information in work required under the conditions in the Draft EA.

E.1.1 Opinion

The identification of BTF habitat on the mining leases takes a precautionary approach.

The conditions specified in the draft EA require further work in relation to the identification and management of grass species and BTF habitat and this is an ecologically appropriate approach to take.

E.1.2 Justification

My understanding is that the precautionary principal requires that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

I have agreed that there is a lack of certainty about the habitat requirement in relation to grass species used by the BTF (First BTF JER, paragraph 6.7.6).

However, as I have pointed out above, the identification of BTF habitat on the mining lease areas using Broad Vegetation Groups has been inclusive rather than exclusive. More detailed studies are more likely to show that this is an overestimate rather than an underestimate of BTF habitat. I therefore consider the identification of BTF habitat on the Mine Site has been consistent with a precautionary approach.

As I have previously stated in the Second BTF JER (paragraph 6.12), the Draft EA for the project includes conditions (I6 and I7) that require research on BTF habitat. This includes the requirement to develop a BTF Species Management Plan (SMP) which must include research into BTF nesting and feeding requirements, updates to the BTF habitat classification and details of impacts to BTF habitat. There is also a requirement for the SMP to provide details of actions to be undertaken to manage any impacts on BTF habitat from the mine.

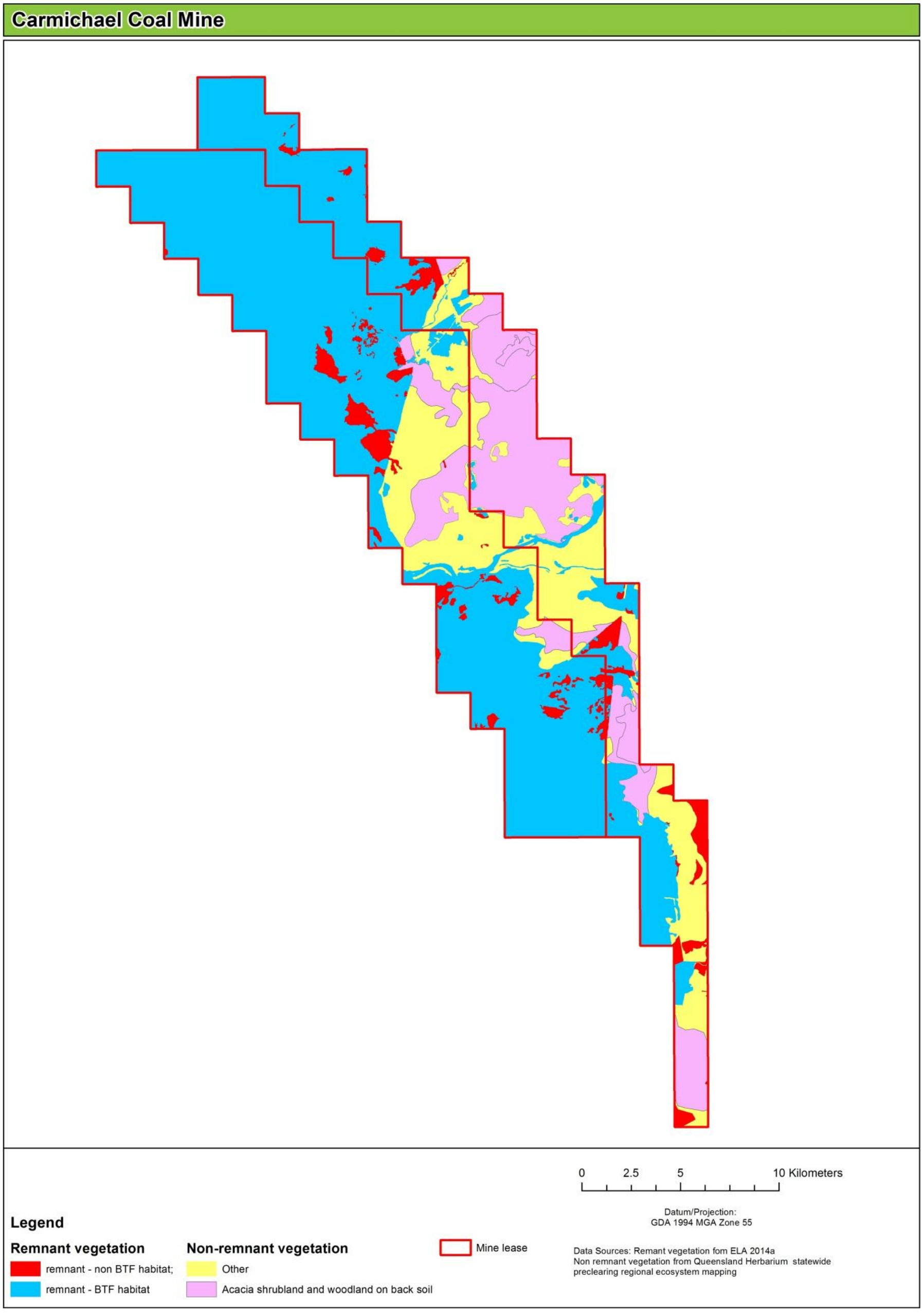
Therefore the conditions in the draft EA for the project include requirements to undertake further work to increase the understanding of BTF habitat, any impacts on BTF habitat by the mine and appropriate management required to address these impacts. These measures are designed to prevent loss of BTF habitat and are therefore consistent with the precautionary principle.

I agree with the MO statement in the Second BTF JER (paragraph 6.13) that more specific spatial and auto-ecological data on the relationship between BTF and grass species is required. Many of the grass species and genera listed as part of the BTF diet in Attachment 3 of the Second BTF JER are widespread and often weeds. Therefore there is need for further understanding of the role these species play in defining BTF habitat. The requirement under the condition I6 to research into BTF nesting and feeding requirements addresses this issue.

The incremental approach to collection of the information required under the conditions in the Draft EA, with associated review by regulators and appropriately qualified experts, is likely to provide a more effective way of gaining a fuller understanding of BTF habitat requirements compared to acquiring all this knowledge before primary approvals for the project are granted.

E.2 CAT submission

The issues raised in the CAT submission are not relevant to the issues that I have considered in relation to BTF habitat.



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453 **Figure 1 Area of remnant and non-remanent vegetation identified as BTF habitat in the ELA 2014a assessment.**

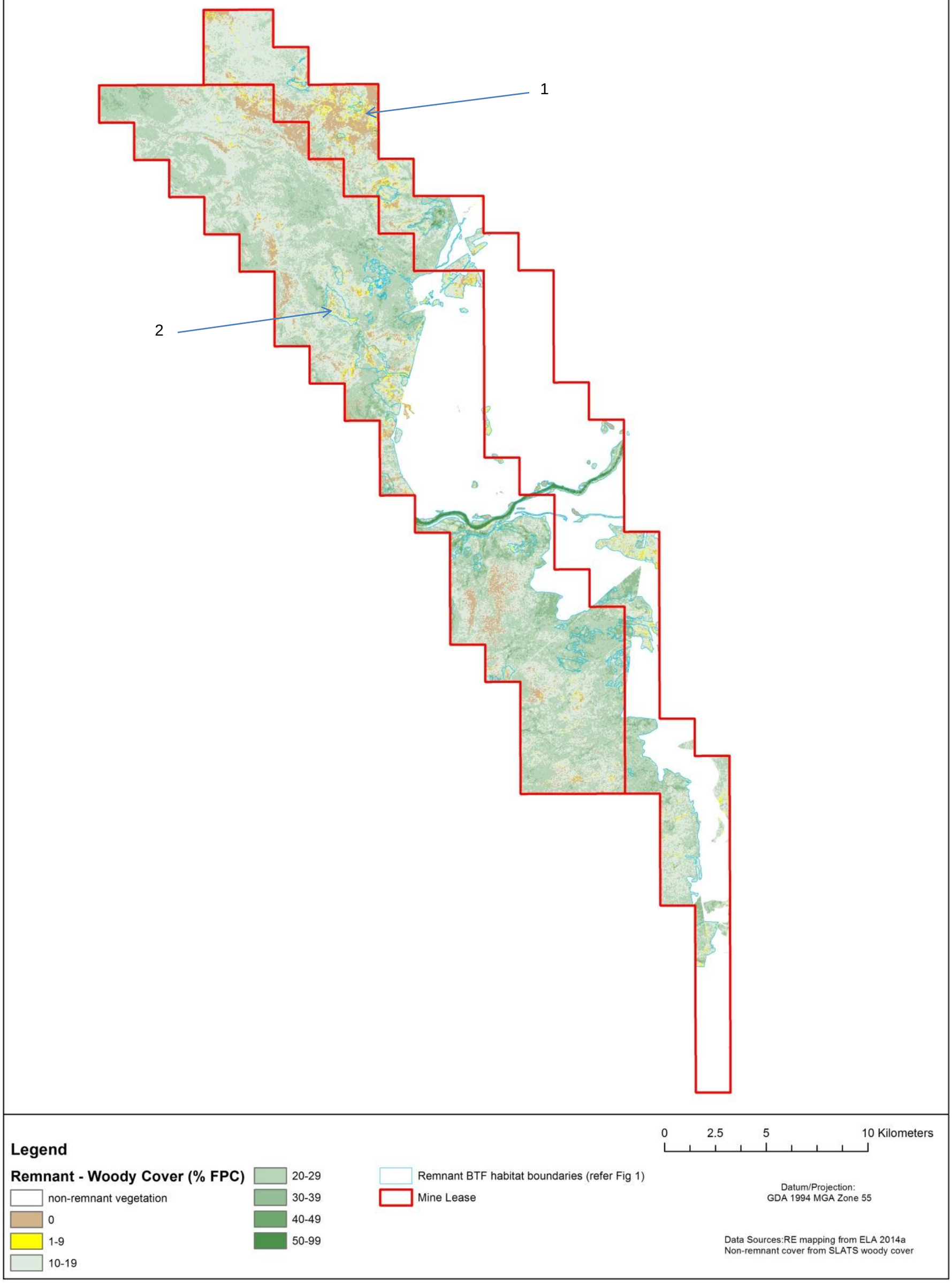
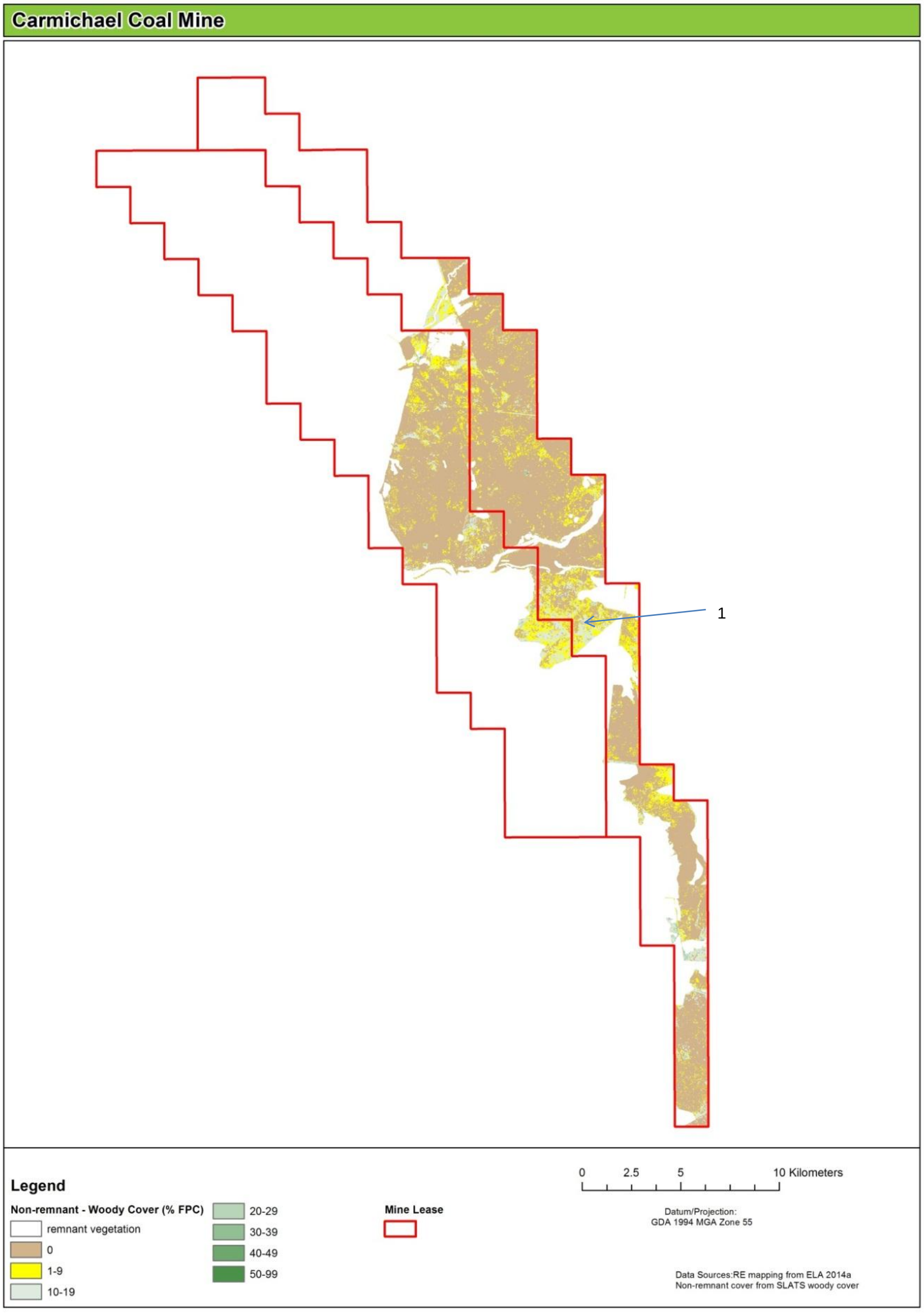


Figure 2 Woody vegetation cover across the mine lease in areas mapped as remnant on the regional ecosystem mapping.



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458 **Figure 3 Woody vegetation cover across the mine lease in areas mapped as non-remnant on the regional ecosystem mapping**

F Confirmation

In preparing this report

a) I have read and understood relevant extracts of the Land Court Rules 2010 (Qld) and the Uniform Civil Procedure Rules 1999 (Qld). I acknowledge that I have an overriding duty to assist the Court and state that I have discharged that duty.

b) I have provided within my report:

- details of my relevant qualifications;
- details of material that I relied on in arriving at my opinions; and
- other things as required by the Land Court Rules.

c) I confirm that:

- the factual matters included in the statement are, to the best of my knowledge, true;
- I have made all enquiries I consider appropriate for the purpose of preparing this statement;
- the opinions included in this statement are genuinely held by me;
- this statement contains reference to all matters I consider significant for its purpose;
- I have not received or accepted any instructions to adopt or reject a particular opinion in relation to an issue in dispute in the proceeding.
- If I become aware of any error or any data which impact significantly upon the accuracy of my report, or the evidence that I give, prior to the legal dispute being finally resolved, I shall use my best endeavours to notify those who commissioned my report or called me to give evidence.
- I shall use my best endeavours in giving evidence to ensure that my opinions and the data upon which they are based are not misunderstood or misinterpreted by the Land Court.
- I have not entered into any arrangement which makes the fees to which I am entitled dependent upon the views I express or the outcome of the case in which my report is used or in which I give evidence.

Bruce Wilson

Dated: 13 March 2015

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Appendix A Abbreviations

AU	Assessment Unit
BOS	Biodiversity Offset Strategy
BTF	Black-throated Finch (southern)
BVG	Broad Vegetation Group
CAT	Conservation Action Trust
EE	Ecological Equivalence
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Environment Protection and Conservation Protection Act 1999
JER	Joint Expert Report
OAMP	Offset Area Management Plan
SMP	Species Management Plan

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Department of Environment
and Resource Management

Ecological Equivalence Methodology Guideline

Policy for Vegetation Management Offsets

Queensland Biodiversity Offset Policy

Version 1

3 October 2011

Tomorrow's Queensland:
strong, green, smart, healthy and fair

Toward Tomorrow's Queensland

Queensland Government

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1. Summary

The Ecological Equivalence Methodology (EEM) has been developed by the Department of Environment and Resource Management (DERM) to assess the ecological equivalence between an area proposed to be cleared or impacted by development (the **clearing area**) and an area being offered in exchange for the potential clearing (the **offset area**). Ecological equivalence measures and compares ecological attributes between two sites at the site-scale and the landscape-scale. Demonstrating ecological equivalence between a clearing area and offset area is a requirement under the Policy for Vegetation Management Offsets and the Queensland Biodiversity Offset Policy.

The EEM involves assessing the clearing area and offset area against two criteria:
1) ecological condition
2) special features.

Both the ecological condition and special features of the clearing and offset areas are determined by evaluating a series of 14 indicators for each criterion. The clearing and offset areas are scored for each indicator and an overall ecological condition score and an overall special features score is calculated for the clearing area and the offset area. For the offset area and clearing area to be deemed ecologically equivalent, the offset area ecological condition and special features score must equal or exceed the clearing area ecological condition and special features score.

1.1. Ecological condition indicators

The offset area and clearing area are assessed against 14 ecological condition indicators. Where there is significant habitat variability within an offset area or clearing area, the area is to be partitioned into 'assessment units' where the condition in each assessment unit is homogenous. That is, the condition within the assessment unit must be relatively uniform. The final calculation of ecological condition involves adding the scores for individual assessment units multiplied by their area.

Assessment of the ecological condition indicators is predominantly field-based. However, some GIS desktop assessment is required. A score for each assessment unit for the 14 ecological indicators is obtained using the field or desktop information, benchmark data for each regional ecosystem and a scoring table.

Benchmark data is data describing the 'standard' or typical condition of a particular regional ecosystem. The clearing area and the offset area are compared to the 'benchmark' rather than comparing the clearing area to the offset area directly.

The sum total of the 14 ecological condition indicators for the offset area must be equal to or greater than the sum score of the clearing area for ecological equivalence to be met. In addition, two of the ecological condition indicators have minimum score requirements. If these minimum score requirements are not met on the offset area, ecological equivalence will not have been met.

1.2. Special feature indicators

The offset area and clearing area are assessed against 14 special feature indicators. Special feature indicator assessment is based on the presence or absence of a special feature on the clearing area. Where present, the assessment is characterised by the use of GIS mapping to determine the distance from the offset area to a special feature, and the percentage of native woody vegetation between the offset area and the special feature.

Where there is significant variation within an offset area or clearing area the area should be partitioned into 'assessment units' for the assessment of special features indicators.

The summed total score of the 14 special feature indicators for the offset area must be equal to or greater than the summed score of the clearing area for ecological equivalence to be met.

1.3. Ecological equivalence

For ecological equivalence to be met, the offset area must obtain all of the following:

- an overall ecological condition score equal to or greater than the overall ecological condition score for the clearing area
- an overall special features score equal to or greater than the overall special features score for the clearing area
- a minimum score for the ecological condition indicators (1) recruitment of woody perennial species and (4) tree canopy cover.

Where ecological equivalence cannot be demonstrated, the offset area will be deemed as not meeting the relevant requirement within the Policy for Vegetation Management Offsets or Queensland Biodiversity Offset Policy.

2. Background

2.1. Purpose

The Ecological Equivalence Methodology (EEM) Guideline has been developed to assist in determining ecological equivalence under the Policy for Vegetation Management Offsets, and the Queensland Biodiversity Offset Policy (Offset Policies) associated with:

- Regional Vegetation Management Codes and Concurrence Agency Policy for Material Change of Use, and Concurrence Agency Policy for Reconfiguring a Lot under the *Vegetation Management Act 1999*, or
- the *Environmental Protection Act 1994*, *Coastal Protection and Management Act 1995, Nature Conservation Act 1992*, *Sustainable Planning Act 2009, Transport Infrastructure Act 1994* or State Planning Policy Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments and where required by the Biodiversity Offset Policy.

Ecological equivalence is a requirement under both offset policies. The offset policies stipulate that an offset area must be ecologically equivalent to the clearing area that triggers an offset requirement.

Areas are considered to be ecologically equivalent when the cumulative ecological values of the areas, in terms of their ecological condition and presence of special features, are determined to be generally comparable. It measures current ecological values that can be validated by field-based assessment and the use of desktop mapping layers.

The EEM has been developed for use by DERM assessment officers, applicants, offset brokers and consultants involved with vegetation and biodiversity related offsets.

2.2. Ecological equivalence and its relationship to the offset policies

The offset policies require ecological equivalence to be demonstrated between the offset area and the clearing area where clearing is proposed to take place. Requirements for obtaining ecological equivalence are detailed in Criteria A1 of the Queensland Biodiversity Offset Policy; and Criteria 3 and Criteria 7 of the Policy for Vegetation Management Offsets.

However, the EEM is not a definitive measure as to whether an offset will be approved by DERM. An offset area must meet *all* of the requirements identified in the respective offset policies for an offset proposal to be approved. The EEM will only assist in determining whether the requirement for ecological equivalence under each of the Offset Policies has been achieved.

Use of the methodology is not a mandatory requirement under the offset policies unless it is for an ‘advanced offset’ or ‘indirect offset’ or has to meet Criteria 7 of the Policy for Vegetation Management

Offsets. However, where applicants, offset brokers or consultants have followed the methodology and ecological equivalence has been demonstrated, it will meet the relevant ecological equivalence criterion in the offset policies.

Use of the EEM to determine ecological equivalence is expected to result in:

- reduced time and resources taken to identify, assess and approve suitable offset areas, and faster approval of development applications
- reduced subjectivity in offset selection and offset assessment
- improved transparency and clarity associated with the application of ecological equivalence
- improved consistency in the quality of offsets provided across the State

2.3. An overview of how the EEM works

The EEM is a process for assessing the ecological equivalence between a clearing area and an offset area. The EEM involves determining a score for each of two ecological criteria. This provides a transparent and repeatable methodology for the comparison of the clearing area and the offset area.

The ecological criteria used in the EEM are:

> **1. Ecological condition** – a measure of the ecological condition of a patch of vegetation using a number of field-based indicators and assessed against a defined benchmark. This measure also takes into account how the patch of vegetation relates, in terms of size and connectivity, to the surrounding landscape.
>
> **2. Special features** – a measure of significant ecological features important at either a site or landscape level. These areas are generally based on expert opinion informed by a range of ecological datasets, species distribution records and regional ecosystem mapping.

The ecological criteria are comprised of a total of 28 indicators, with 14 indicators in each criterion. Table 1 identifies the individual indicators according to each criterion.

Table 1 – Ecological equivalence criteria and indicators

Criteria		
Criterion 1 – ecological condition		**Criterion 2 – special features**
#	Indicators	Indicators
1	Recruitment of woody perennial species	Centres of endemism
2	Native plant species richness	Wildlife refugia
3	Tree canopy height	Disjunct populations
4	Tree canopy cover	Taxa at limits of geographic range
5	Shrub canopy cover	High species richness
6	Native perennial grass cover	Relictual populations
7	Organic litter	Regional ecosystems with distinct variation in species associated with geomorphologic and other environmental variables
8	Large trees	Artificial water body of ecological significance
9	Coarse woody debris	High density hollow bearing trees
10	Weed cover	Breeding or roosting areas used by significant numbers of individuals
11	Size of patch (fragmented landscapes)	Ecological corridor
12	Connectivity (fragmented landscapes)	Priority species within the bioregion
13	Context (fragmented landscapes)	Significance of patch within a one kilometre buffer
14	Distance from water (intact landscapes)	Protected area estate buffer

The EEM involves assessing the clearing area and offset area by scoring each of the relevant indicators in both criteria. Within each criterion the scores are summed to produce an overall score for that criterion**.** That is, an ecological condition score and a special features score is calculated for both the clearing and offset areas. These numerical scores form the basis for demonstrating ecological equivalence between the clearing and offset areas.

Rules
The following rules apply in producing a numerical ecological equivalence score:

1. The summed score for the offset area for both ecological condition and special features must be equal to, or higher, to the summed score for each criterion on the clearing area.

2. With the exception explained below, the offset area may obtain any score for each of the indicators, irrespective of what the score was on the clearing area, as long as the same or higher summed score to that of the clearing area is achieved.

The exception to this rule is that for woodland ecosystems the ecological condition indicators, (1) recruitment of woody perennial species, and (4) tree canopy cover, must obtain a minimum score on the offset area regardless of the score on the clearing area. These two indicators are surrogates for the offset policies' requirement that an offset area must contain functioning regional ecosystems.

2.4. Ecological equivalence criterion and indicators

2.4.1. Criterion 1 – ecological condition

This criterion measures a combination of indicators for an area and the relationship of those indicators to the surrounding landscape to determine ecological condition. The ecological condition criterion and indicators have been adapted from DERM's biocondition methodology (Eyre *et al.* 2011a), which is a condition assessment framework for terrestrial biodiversity in Queensland. The biocondition methodology can be consulted for further information on the indicators used in this criterion. Where the biocondition methodology differs to the methodology outlined in this document, the EEM Guideline prevails.

Assessment of ecological condition will occur in all instances for both the clearing area and offset area. Assessment is predominately field-based (for indicators 1-10) however spatial GIS assessment is required for indicator's 11-14. Section 3.1 provides the assessment process for this criterion.

A **rapid assessment process** may be performed as an alternative to the ecological condition assessment process detailed in section 3.1. Rapid assessment entails *no field-based assessment of ecological indicator's 1-10 or desktop GIS analysis of indicator's 11-14* for the clearing area only. Adoption of this assessment process entails accepting the maximum ecological condition score for each of the indicators per ecosystem type. For example, a woodland ecosystem would score a maximum of 100 for the clearing area; this is then multiplied by the area's size (in hectares) and divided by 100. If a clearing area contains more than one ecosystem then the site needs to be assessed against the relevant ecosystems and their respective sizes. This total score must be equalled or exceeded on the offset area to achieve ecological equivalence for criterion 1 – ecological condition. For further detail about ecosystem type and weightings, see appendix B.2 Scoring ecological condition with indicators naturally absent.

Note that the rapid assessment process is only applied on the clearing area.

2.4.2. Criterion 2 – special features

The special features criterion identifies areas and values which are considered unique and ecologically significant for each of the state's bioregions. The special features indicators have been adapted from the spatial layers supporting DERM's Biodiversity Planning Assessments (BPA), which is a GIS-based biodiversity decision support tool. The BPA's have been developed using the Biodiversity Assessment and Mapping Methodology (BAMM) (EPA 2002), which is a methodology for the consistent assessment of biodiversity at the landscape scale.

Twelve of the 14 special features' indicators utilise BPA spatial data. Two indicators, (13) significance of a patch within a one kilometre buffer and (14) protected area estate buffer, have been included due to their importance at either a strategic or local level. Detailed descriptions of each of the indicators are contained in Appendix 5. Assessment of this criterion utilises desktop GIS analysis. Section 3.2 provides the assessment process for this criterion.

Special features may not occur on every clearing area. Where the clearing area does not support special features as determined using the offsets special features dataset, the offset area will not be required to address this criterion. In this instance, the offset area will only have to demonstrate ecological equivalence for ecological condition.

3. Assessment of ecological equivalence

3.1. Assessment of ecological condition

3.1.1 Steps for assessing ecological condition

Assessment of ecological condition requires a mixture of field-based and GIS-based data collection. The same method of assessment is used for both the clearing area and the offset area. Indicators 1–10 are compared to benchmark values based on the same regional ecosystems under reference conditions; and a final overall score that represents a condition state. The steps for assessing ecological condition are explained in more detail below, with an overview provided in Box 3.1.

Box 3.1 – Ecological condition assessment overview

Preparation

1. Develop a map of the area
2. Stratify area into assessment units
3. Obtain regional ecosystem benchmark data

Field-based assessment

4. Assessment of field-based indicators (skip if undertaking a rapid assessment as per page 9)

GIS desktop analysis

5. Assessment of spatial GIS indicators (skip if undertaking a rapid assessment as per page 9)

Calculate indicator and ecological equivalence scores

6. Scoring of field-based indicators against benchmark
7. Scoring of desktop/GIS indicators
8. Calculate ecological equivalence score for ecological condition

Preparation

1. Develop a map of the area

Create a map to reflect the extent and types of vegetation communities by stratifying the distribution of any mapped remnant, regrowth and non-remnant vegetation (if necessary) into assessment units noting the position of roads, watering points, fences and property boundaries. Other information that could be useful is showing the location of any transects, photo points or other spatially relevant information used in the assessment. Regional ecosystem and regrowth maps are available as downloadable hard copy maps for properties from the DERM website and as digital data. Refer to Appendix 4 for available GIS data.

2. Stratify area into assessment units

Where there is considerable variation in land type and/or condition within a clearing area and/or offset area then the area should be divided into homogenous assessment units. Assessment units should be based on the regional ecosystem or a broad condition state of the vegetation. The map produced from step 1 will assist in spatially identifying the different assessment units, however some on-ground verification may be required. Generally the minimum size for an assessment unit must be larger than 1 hectare (ha) in area. See Figure 1 for an example of assessment unit stratification. The exact number of assessment units will depend on the size of the area, the number of regional ecosystems and or the condition of the area. Assessment units are delineated based on the following rules:

1. the area is a unique regional ecosystem; or
2. the area is the same regional ecosystem but in a different condition (different disturbance levels such as weeds or significant difference in height); or
3. the area is an isolated area.

Once the area has been stratified into assessment units, the collection of data for each of the ecological condition indicators can commence. Further explanation of assessment units is provided in Eyre *et al.* 2011a.

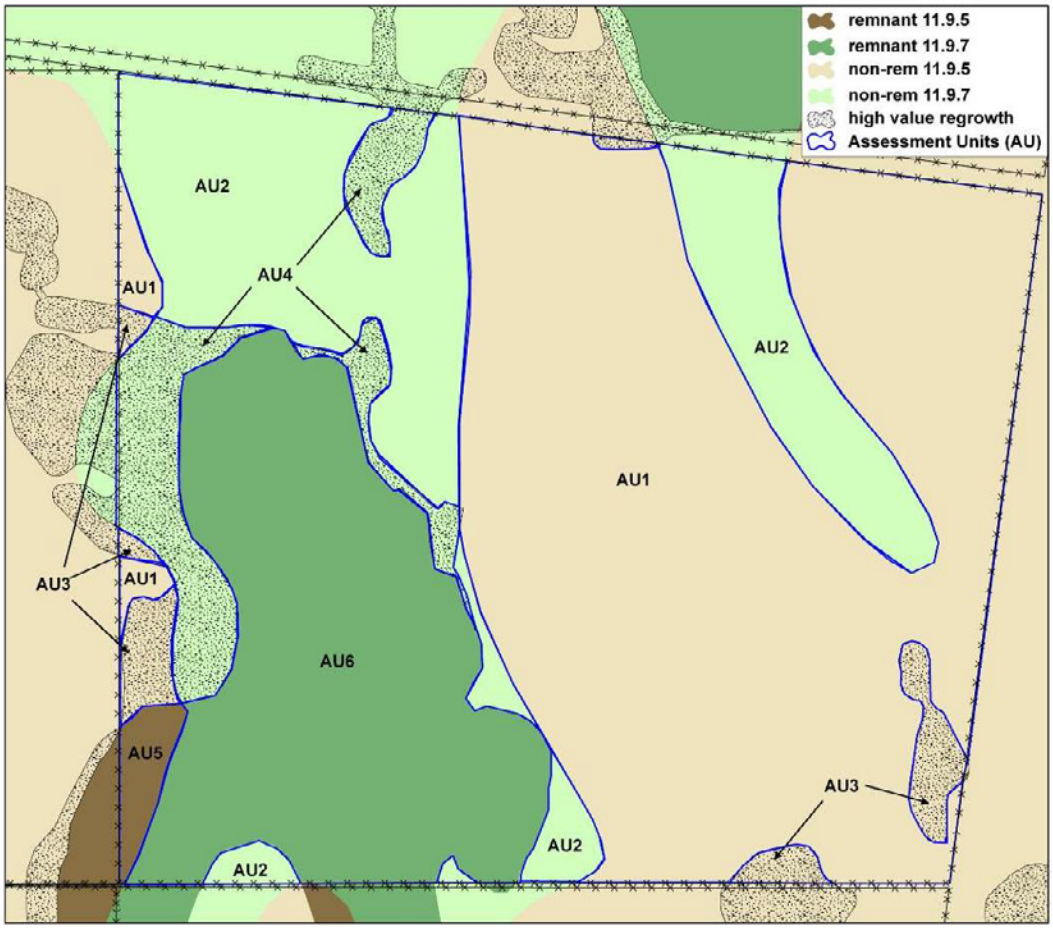


Figure 1: Stratification of the assessment unit (Eyre *et al*. 2011a)

Figure 1 shows six assessment units (AU) that have been identified for a paddock. AU1 represents an assessment unit delineated by a non-remnant area of Brigalow and Belah scrub, regional ecosystem (RE) 11.9.5 (as mapped using the pre-clearing RE mapping); AU2 is non-remnant Poplar Box woodland 11.9.7; AU3 is high value regrowth corresponding to RE 11.9.5; AU4 is high-value regrowth corresponding to RE 11.9.7; AU5 is remnant RE 11.9.5; and AU6 is remnant RE 11.9.7.

3. Obtain regional ecosystem benchmark data

A benchmark is a description of a regional ecosystem that represents the median characteristics of a mature and relatively undisturbed ecosystem of the same type (Eyre et al, 2011a). A benchmark allows for the comparative assessment of data collected for indicator's 1-10 when assessed against the same regional ecosystem. An example of benchmark data for a regional ecosystem is contained in Appendix A.

A number of benchmarked regional ecosystems are available on DERM's website. However, as not all of the regional ecosystems that occur across the State have been benchmarked, applicants may be required to establish a 'best on offer' benchmark for the regional ecosystem from the local area when a DERM benchmark for the regional ecosystem is not available. In this instance, the *Methodology for the Establishment and Survey of Reference Sites for Biocondition* (Eyre et al, 2011b) is to be followed to establish a 'best on offer' benchmark. However, for the purposes of this guideline, a streamlined sampling process may be undertaken that only requires one reference site sample (instead of the recommended three).

Field-based assessment

4. Assessment of field-based indicators

Once the assessment units have been defined sampling sites within each assessment unit need to be selected to provide representative data. As a guide it is best to aim for two to five sampling sites per assessment unit, depending on the size of the assessment unit (i.e. assessment unit < 60 hectares (ha), aim for at least two areas; assessment unit > 500 ha, aim for five areas). Where more than one set of field area data is collected within the same assessment unit, the scores are to be averaged to determine a score for that assessment unit. A reduced number of sampling sites may be possible if it can be demonstrated that different assessment units containing the same regional ecosystem are in the same condition. See Box 3.2 about streamlining field sampling sites.

Box 3.2 – Streamlining field sampling sites

Field assessment of isolated assessment units containing the same regional ecosystem can be streamlined if it can be demonstrated that the assessment unit is in the same general condition.

Evidence must include management history (where available) and recent remote sensing imagery identifying consistency between the assessment units. This must also be supported with on-ground photos and GPS points of each of the assessment units. Where consistency between assessment units can be demonstrated, a reduced number of field sampling sites can be provided.

The above does not apply to the special features criterion. When assessing special features, each assessment unit must be assessed.

Select a sampling site that is representative of the unit being assessed, that must be at least 50 m from any major disturbance, such as a road or a dam. If the clearing area has been disturbed through recent activities such as a severe fire or storm or native forestry practice, then an alternative site that is equivalent to the size of the area but not subject to the disturbance must be used to determine ecological condition indicators 1–10.

Use the ecological condition field assessment sheet in Appendix E to fill in the required information.

Note that, in addition to achieving ecological condition and special features scores equal to or greater than the clearing areas, the offset area must obtain minimum scores for ecological condition indicators (1) recruitment of woody perennial species and (4) tree canopy cover to achieve ecological equivalence. These indicators have been selected as surrogates to achieve the Offsets policy requirement that all offset areas be functioning regional ecosystems. Regeneration of woody perennial species and tree canopy height are important elements in determining whether a woodland regional ecosystem is functional. See Box 3.3 for further information on the indicators.

Box 3.3 – Minimum scores (see Table 2)

The offset area must achieve a minimum score for the following ecological condition indicators:

- Indicator 1 – Recruitment of woody perennial species. The offset area must achieve a minimum score of three (greater or equal to 20 per cent of the overstorey species present as regeneration)
- Indicator 4 – Tree canopy cover. The offset area must achieve a minimum score of two (greater or equal to 10 per cent of the benchmark)

Step 1 – Collect necessary field equipment

Prior to collecting area-based data for the ecological condition assessment, it is recommended to obtain the following field equipment:

- a 100 m transect tape
- a 50 m transect tape (optional)
- a 1 m x 1 m quadrat for measuring ground cover (or some one–metre–long sticks)
- a compass (to lay out the area)
- star pickets for the zero metre and 50 m point along the transect for relocating the area
- a diameter tape or a smaller measuring tape

- copies of the field assessment sheet and Biocondition Assessment Manual (Eyre *et al.* 2011a)
- access to the Internet in order to obtain information about the regional ecosystems that occur on the property or management area. Regional ecosystem maps (remnant, high-value regrowth and pre-clear) and regional ecosystem descriptions can also be obtained from the local DERM business centre
- benchmark documents for each of the regional ecosystems that will be assessed
- a clinometer, hypsometer or ruler for measuring tree heights
- a digital or print film camera
- clipboard, pencils and erasers
- flagging tape (not essential)
- plant identification books (not essential)
- Global Positioning System (GPS).

Step 2 – Lay out the plot

The area can be marked with a 100 m transect that follows the contour (i.e. along a slope as opposed to up or down a slope). Mark the 50 m point on the transect with a star picket or temporary marker – this point acts as the centre of the assessment area. Record the compass bearing that the transect follows from the zero point, and also record the location of the zero metre point by GPS. See Figure 2 for the layout.

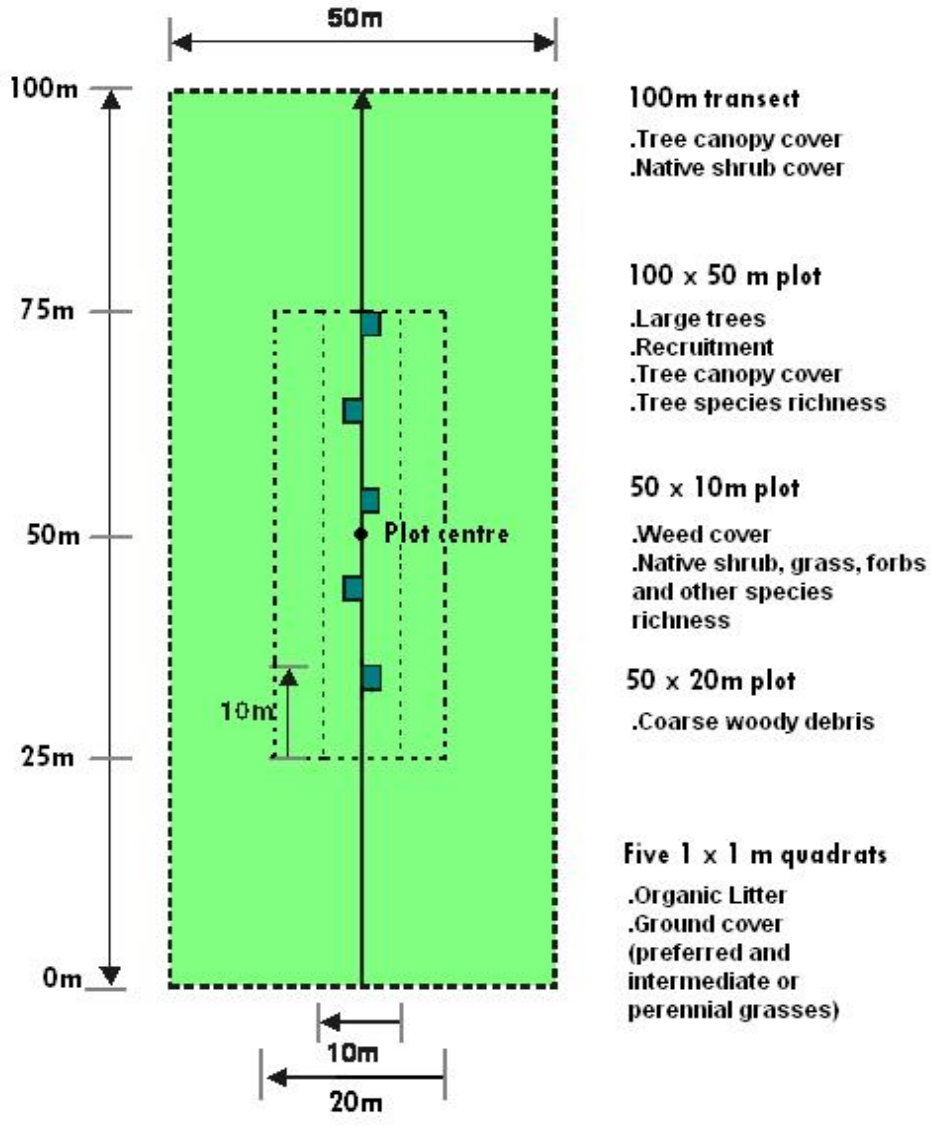


Figure 2: Plot layout (Eyre *et al*. 2011a)

Step 3 – The field assessment
Start at the centre of the plot (50 m mark on the transect), and record the area number, regional ecosystem, the date of assessment and the property or location name. Using a GPS, mark the position of the 50 m point on the transect. Take landscape photos north, south, east and west, to provide a record of the tree and shrub layers and the general condition of the area. The assessment of the ten field- based attributes is conducted within five assessment areas on the 100 m x 50 m area.

Step 4 – Area 1; 50 m x 10 m sub-plot
Incorporate 25 m to 75 m along the transect, and encompasses 5m either side of the transect.

- **Native plant species richness** is assessed by slowly walking along each side of the centre-line and tallying the number of species in each of three life-forms: shrubs, grasses and forbs/other. Note that tree species richness is assessed in the 50 m x 100 m plot.

- **Non-native plant cover** is assessed by estimating the cover of exotic species over the area. The estimate can be improved by dividing the 50m x 10 m plot into smaller areas and then averaging the cover estimate over the entire area. For example, 20 m x 5 m x 5 m (i.e. 10 plots each side of the tape).

Step 5 – Area 2; 50 m x 20 m sub-plot
Incorporate 25 m to 75 m along the transect, and encompasses 10 m either side of the transect.

- **Coarse woody debris** is assessed by measuring the length of all logs > 10 cm diameter, 0.5 m in length and within the 50 m x 20 m sub-plot. Logs are assessed if 80 per cent of the log is in contact with the ground. Measure only the portion of the log that is greater than 10 cm diameter or lies within the sub-plot, i.e. only measure the length of the log to the boundary of the sub-plot.

Step 6 – Area 3; five 1 m x 1 m sub-plots
Starting at the 35 m point, assess ground cover in 1m x 1m quadrats located 10 m apart, on alternate sides along the transect. If the quadrat location coincides with a feature such as a tree or large log it is acceptable to move the quadrat one metre up or down the transect. Assess each of the ground cover components so that the cover totals 100 per cent (see **Figure 4**). Spot photos can be taken of each quadrat to document change in ground cover over time.

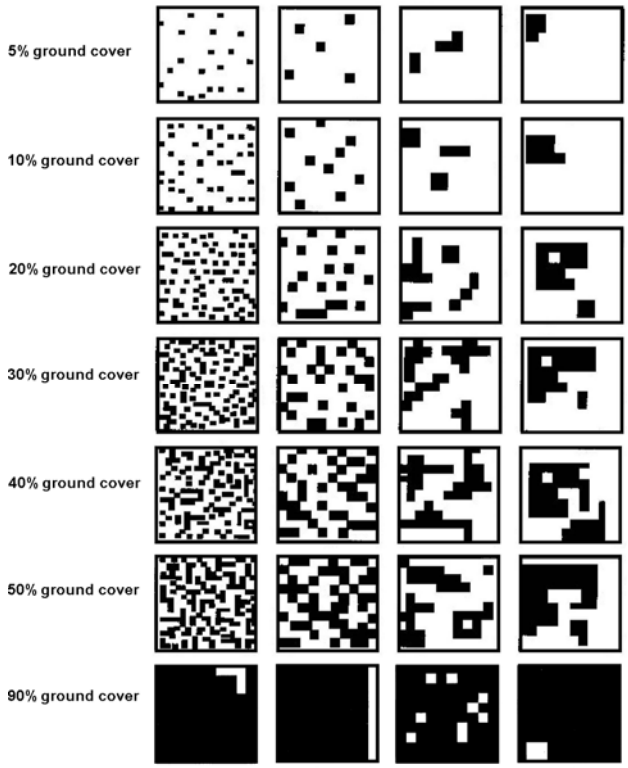


Figure 3: Examples of ground cover percentages for the 1 m x 1 m plot (Eyre *et al*. 2011a)

- **Native perennial grass cover** refers to the percentage cover of native perennial grasses, assessed within each of the five 1 m x 1 m quadrats and averaged to give a value for the area. Measure the complete coverage of all types of perennial grass cover within the quadrats.

- **Organic litter** is assessed by estimating the cover of fine and coarse organic material such as fallen leaves, twigs and branches < 10 cm diameter within the five quadrats and then averaged.

Step 7 – Area 4: 100 m x 50 m area
Visualising or marking out 25 m either side of the transect line forms the larger assessment area of 100 m x 50 m. A greater need arises for precision when assessing the numbers of large trees i.e. measuring the distance to trees that appear to be 'borderline' within the area. Refer to the benchmark document to determine if there are separate benchmarks for the canopy, emergent and/or sub-canopy layers. If more than one layer is identified in the benchmark document, then assessment of each layer is required for the recruitment, canopy height and cover attributes.

- **Number of large trees** is assessed by counting the number of trees within the 100 m x 50 m plot area over a certain size threshold, as recorded on the benchmark document for the regional ecosystem that you are assessing. If no benchmark exists for the regional ecosystem of interest, use the threshold of 30 cm diameter at breast height (DBH) for 'eucalypt' trees (genera *Eucalyptus, Corymbia, Lophostemon* and *Syncarpia*) and 20 cm DBH for 'non-eucalypts'.
- **Recruitment of woody perennial species** is assessed by observing the proportion of the ecologically dominant layer (canopy layer) species regenerating (<5 cm DBH) within the 100 m x 50 m plot area. Only one regenerating individual is required of each species. For example, if there are four dominant species of trees then four species need to occur as regeneration to get 100 per cent. **Note that when scoring this indicator for the offset area, it must achieve a minimum score of three or more for the offset area to be accepted. To score three or more, it must contain a minimum of 20 per cent of the overstorey species present as regeneration. See Table 2.**

- **Tree canopy height** (measured to the top of the highest leaves) refers to the median canopy height in metres (see Figure 4) estimated for trees in the ecologically dominant layer. If there are emergent and/or subcanopy layers identified in the benchmark document, median height of these layers needs to be assessed also. The median canopy height is the height that has 50 per cent of canopy trees larger and smaller than it. It is recommended that a clinometer or hypsometer be used if available.

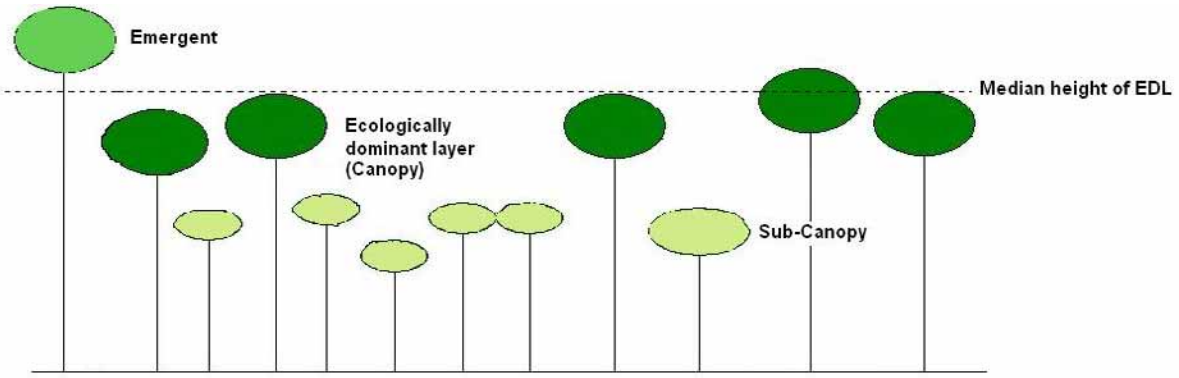


Figure 4: Example of determining the median height of the ecologically dominant layer (Eyre *et al.* 2011a)

- **Tree species richness** is the count of different tree species.

Step 8 – Area 5: 100 m transect: tree canopy and shrub canopy cover are assessed along the 100 m transect, using the line intercept method.

- **Tree canopy cover** refers to the estimation of the percentage canopy cover of the living, native tree canopy overlapping the 100 m transect. For this attribute, in the majority of cases the cover of the trees making up the canopy layer are only included. The canopy equates to the ecologically dominant layer for forests and woodlands. However, if the benchmark document lists values for more than one layer, then the heights and covers of these layers are assessed separately. Assessors work along the transect line and record the start and finish distance of tree canopies that overlap the transect line and assign them to canopy and/or subcanopy and/or emergent layers if these layers are distinguished within the benchmark document. If overlapping trees are in the same layer then they can be recorded as the one tree group. **Note that when scoring this indicator for the offset area, it must achieve a minimum score of two or more. To score two or more, it must be have a tree canopy cover of 10 per cent or greater. See Table 2.**

- **Native shrub canopy cover** uses the same method as for tree canopy cover using a vertical projection of shrub crowns downwards and above the line.

Step 9 – Compare with the benchmark data and score
Compare the field data for each assessment unit with the benchmark data where required. Use Table 2 to identity the score for each indicator. Note that the benchmark for non-native cover (weeds) is always zero.

Step 10 – Scoring sheet input
Input the scores into the ecological condition scoring sheet (Appendix 6).

Table 2 – Field-based indicator scores

Field-based indicators		
Indicator	**Description**	**Score**
1. Recruitment of woody perennial species	< 20% of overstorey species present as regeneration	**0**
	≥ 20 – 75% of overstorey species present as regeneration **Minimum score for offset area	**3**
	≥ 75% of overstorey species present as regeneration	**5**
2. Native plant species richness (trees, shrubs, grasses, forbs)	< 25% of benchmark number of species within each life-form	**0**
	≥ 25% to 90% of benchmark number of species within each life-form	**2.5**
	> 90% of benchmark number of species within each life-form	**5**
3. Tree canopy height	< 25% of benchmark height	**0**
	≥ 25% to 70% of benchmark height	**3**
	≥ 70% of benchmark height	**5**
4. Tree Canopy Cover	< 10 % of benchmark	**0**
	≥ 10% and < 50 % of benchmark ** Minimum score for offset area	**2**
	≥ 50% to ≤ 200% of benchmark	**5**
	> 200% of benchmark	**3**
5. Shrub canopy cover	< 10 % of benchmark shrub cover	**0**
	< 50% or >200% of benchmark shrub cover	**3**
	≥ 50% to ≤ 200% of benchmark shrub cover	**5**
6. Native perennial grass cover	< 10% of benchmark perennial grass cover	**0**
	≥ 10 to 50% of benchmark perennial grass cover	**1**
	> 50 to 90% of benchmark perennial grass cover	**3**
	> 90% of benchmark perennial grass cover	**5**
7. Organic litter cover	< 10 % of benchmark organic litter	**0**
	< 50% or >200% of benchmark organic litter	**3**
	≥ 50% to ≤ 200% of benchmark organic litter	**5**
8. Large trees	No large trees present	**0**
	0 to 50% of benchmark of large trees	**5**
	>50% to 100% of benchmark number of large trees	**10**
	>benchmark number of large trees	**15**
9. Coarse woody debris	< 10 % of benchmark number or total length of CWD	**0**
	< 50% or >200% of benchmark number or total length of CWD	**2**
	≥ 50% or ≤ 200% of benchmark number or total length of CWD	**5**
10. Weed cover	> 50 % weed cover	**0**
	>25 to 50% weed cover	**3**
	≥5 to 25% weed cover	**5**
	< 5 % weed cover	**10**

GIS desktop analysis

5. Assessment of spatial GIS indicators

Desktop assessment is required for four ecological condition indicators (11) size of patch, (12) connectivity, (13) context and (14) distance from permanent water. Indicators 11–13 measure the extent of site and patch –scale fragmentation. Larger patches with high connectivity and larger amounts of native vegetation retained in the landscape proximal to the site are associated with higher ecological viability and therefore receive higher scores. Indicator 14 measures the extent of grazing pressure from stock as well as feral and native herbivores that tends to radiate in intensity with distance from permanent water in the intact arid and semi-arid rangelands.

The specific indicators that are applicable depend on whether the area is within an intact (highly vegetated) or fragmented landscape, as identified in Table 3. Note that the Mulga Lands bioregion is divided into an 'intact' western and 'fragmented' eastern region. A GIS tool has been developed to assist with desktop assessment that, based on an analysis of the necessary spatial layers, will provide the scores for indicators' 11, 12 and 13. Further information on the GIS tool is provided in Appendix 4 including the spatial resources available to assist with this assessment and where they may be sourced from.

Table 3 – Intact and fragmented landscapes

Intact landscapes	Indicator	Fragmented landscapes	Indicators
Mitchell Grass Downs bioregion	14. Distance to water	Southeast Queensland bioregion	11. Size of patch 12. Connectivity 13. Context
Cape York Peninsula bioregion		Brigalow Belt bioregion	
Einasleigh Uplands bioregion		New England Tableland bioregion	
Gulf Plains bioregion		Central Queensland Coast bioregion	
Northwest Highlands bioregion		Wet Tropics bioregion	
Mulga Lands bioregion (excluding those subregions identified in Fragmented Landscapes)		Mulga Lands bioregion • West Balonne Plains subregion • Eastern Mulga Plains subregion • North Eastern Plains subregion	
Desert Uplands			
Channel Country			

Step 1 – Patch Size ***(only measured for fragmented landscapes)***

Patch size is the size of the patch being assessed and any connecting remnant vegetation or high value regrowth vegetation. Consideration of whether the area is category X or not on a property map of assessable vegetation is not required for the EEM. This indicator can be measured using GIS.

To calculate the patch size score:

1. Measure the patch of vegetation subject to the site and add on all other connecting patches of remnant vegetation and high value regrowth vegetation.
2. Determine the score for this indicator from Table 4.

Step 2 – Connectivity ***(only measured for fragmented landscapes)***

Assessment involves considering the connection of the site to adjacent remnant or high value regrowth vegetation. This indicator can be measured using GIS. An example of calculating this indicator is provided in Box 3.5.

To calculate the connectivity score:

1. Measure the length of remnant and high value regrowth that is along the boundary of the site.
2. Determine the score for this indicator from Table 4.

Step 3 – Context ***(only measured for fragmented landscapes)***
Assessment involves measuring the amount of remnant vegetation and high value regrowth vegetation within a one kilometre buffer around the site. This indicator can be measured using GIS.

To calculate the context score:
1. Create a one kilometre buffer around the edge of the site.
2. Measure the percentage of remnant and high value regrowth vegetation within the buffer zone.
3. Determine the score for this indicator from Table 4.

Step 4 – Permanent water ***(only measured for intact landscapes)***
This indicator can be measured through satellite imagery or air photo interpretation. It can also be measured by on-ground verification of the location of watering points. Permanent water points include dams, earth tanks, raised ring-tanks, troughs on pipelines and natural permanent water supplies (rivers and waterholes).

To calculate the permanent water score:
1. Measure the distance to the nearest water source from the site within a five kilometre radius.
2. Determine the score for this indicator from Table 4.

Table 4 – GIS-based ecological condition indicator scores

GIS-based ecological condition indicators		
Indicator	**Description**	**Score**
11. Size of patch *(measured only in fragmented landscapes)*	< 5 ha	**0**
	5–25 ha	**2**
	26–100 ha	**5**
	101–200 ha	**7**
	> 200 ha	**10**
12. Connectivity *(measured only in fragmented landscapes)*	The assessment unit is not connected using any of the below descriptions	**0**
	The assessment unit adjoins with adjacent remnant vegetation along ≥10 per cent to <50 per cent of its perimeter; or adjoins with adjacent remnant vegetation along <10 per cent of its perimeter AND adjoins with adjacent non-remnant native vegetation > 25 per cent of its perimeter	**2**
	The assessment unit adjoins with adjacent remnant vegetation along 50 per cent to 75 per cent of its perimeter	**4**
	The assessment unit adjoins with adjacent remnant vegetation along > 75 per cent of its perimeter; or includes > 500 ha remnant vegetation	**5**
13. Context *(measured only in fragmented landscapes)*	< 10 per cent remnant vegetation AND < 30 per cent native non-remnant vegetation (regrowth)	**0**
	≥ 10 per cent to 30 per cent remnant vegetation AND < 30 per cent high value regrowth; or < 10 per cent remnant vegetation AND ≥ 30 per cent high value regrowth	**2**
	≥ 30 per cent to 75 per cent remnant vegetation; OR ≥ 10 per cent to 30 per cent remnant vegetation AND ≥ 50 per cent high value regrowth	**4**
	> 75 per cent remnant vegetation	**5**
14. Distance from permanent water *(measured only in intact landscapes)*	0–500 m from water point	**0**
	500 m to 1 km from water point	**2**
	1–3 km from water point	**5**
	3–5 km from water point	**10**
	>5 km from water point	**20**

Step 5 – Scoring sheet input
Once all the scores have been collected for the landscape condition, input the scores into the ecological condition scoring sheet and carry out the calculations to determine the ecological equivalence score for ecological condition.

Step 6 – Repeat for multiple assessment units
Repeat the above steps for all assessment units relevant to the offset area or clearing area. See Box 6.6 for examples of scoring multiple assessment units.

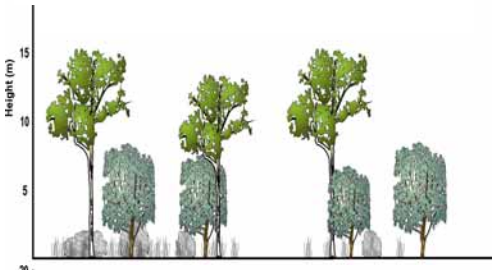
Calculate Indicator scores and overall ecological equivalence score

6. Scoring of field-based indicators against the benchmark
The field data for each indicator within the assessment unit can be compared against the relevant regional ecosystem benchmark and scored using a scoring table for that indicator. The scoring table for the field-based ecological condition indicators is provided in Table 2.

Box 3.4 provides an example of the scoring for indicator (3), tree canopy height. The tree canopy height of the clearing and offset areas are compared to the benchmark height and a score is given to each area using the scoring table. In this example the tree canopy height for the clearing area (14m) achieves a score of five, being ≥ 70 per cent of the 15 m benchmark height. The tree canopy height for the offset area (five metres) achieves a score of three as it falls between ≥ 25 per cent to 70 per cent of the 15 m benchmark.

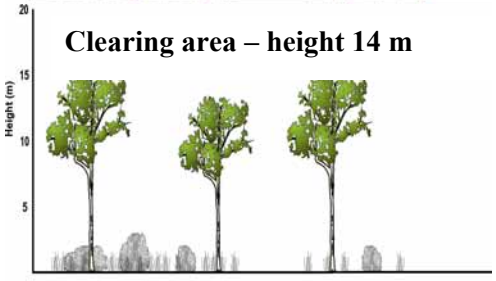
Box 3.4 – Benchmark and scoring of the indicator - tree canopy height, for regional ecosystem 11.9.6

Benchmark data – height 15 m



Tree canopy height	Score
< 25% of benchmark height	0
≥ 25% to 70% of benchmark height	3
≥ 70% of benchmark height	5

Clearing area – height 14 m



Scoring for clearing area: The tree canopy height is ≥ 70 per cent of the benchmark height. The clearing area scores **five**.

Offset area – height 5 m

Scoring for offset area: The tree canopy is ≥ 25 per cent to 70 per cent of the benchmark height. The offset area scores **three**.

7. Scoring of the desktop/GIS indicators

Once an analysis of the spatial (GIS-based) data has occurred for the ecological condition indicators, the data can be scored. The scoring table for the GIS-based ecological condition indicators are provided in Table 4**.** Unlike the field-based indicators, the GIS indicators are not assessed against a benchmark.

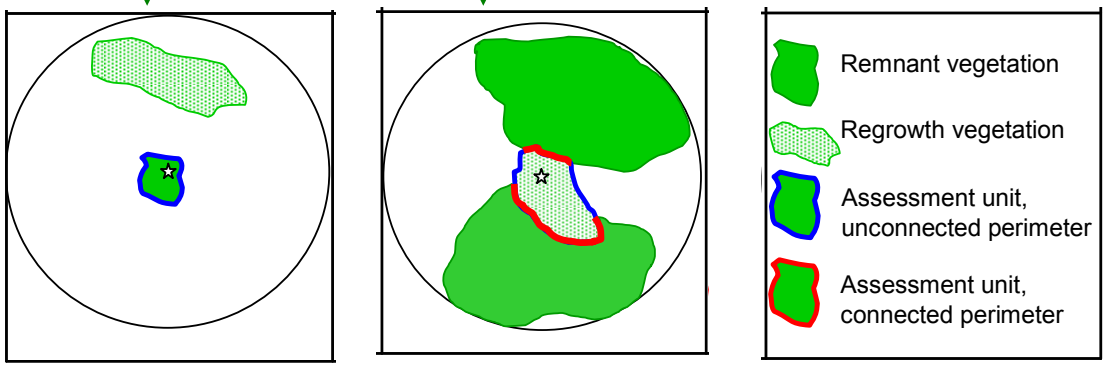
Box 3.5 provides an example of the scoring for the ecological condition indicator (12)—connectivity. In this example, the clearing area adjoins no vegetation along its perimeter and therefore receives a score of zero. The offset area adjoins remnant vegetation along 65 per cent of its perimeter and therefore scores four as it adjoins adjacent remnant vegetation along 50–75 per cent of its perimeter.

Box 3.5 – Scoring of the indicator: connectivity

Clearing area
Site is not connected to any other remnant vegetation. The area scores: **zero**

Offset area
Site adjoins remnant vegetation along 65 per cent of its perimeter. The area scores: **four**

Connectivity scoring table	Score
Site is not connected using any of the below descriptions	0
Site adjoins adjacent remnant vegetation along 50% to 75% of its perimeter	4
Site adjoins adjacent remnant vegetation along > 75% of its perimeter	5



8. Calculate ecological equivalence for ecological condition

Once the field and desktop data has been collected and scored, the ecological condition scores for each assessment unit in the clearing area and offset area can be entered into the ecological condition scoring sheet provided in Appendix 6 to calculate the ecological condition score.

Where a single assessment unit is scored, the summed score of the ecological condition indicators are multiplied by the area in hectares (ha) of the relevant clearing area or offset area, and divided by 100. This provides the ecological equivalence score for ecological condition.

Where multiple assessment units have been assessed an ecological equivalence score is calculated for each assessment unit. The scores calculated for indicator's 11–13 (or 14 for intact landscapes) are entered for all assessment units. The scores for each of the assessment units are added together to obtain a cumulative score. This cumulative score is the ecological equivalence score for ecological condition.

Box 3.6 provides an example of a completed scoring sheet for a single assessment unit, based on the information contained in Boxes 3.4 and 3.5. In this example, the ecological equivalence score obtained for ecological equivalence for the offset area is lower than the clearing area. Section 3.3 discusses how to interpret the scores and options to address the scenarios when ecological equivalence is not achieved between the clearing area and offset area.

Box 3.6 – EEM scoring sheet for ecological condition: one assessment unit

Ecological condition indicators	Clearing area	Offset area
1. Recruitment of woody perennial species	5	3
2. Native plant species richness		
- Trees	5	2.5
- Shrubs	5	0
- Grasses	5	2.5
- Forbs	5	0
3. Tree canopy height	**5**	**3**
4. Tree canopy cover	5	2
5. Shrub canopy cover	3	0
6. Native perennial grass cover	5	1
7. Organic litter	5	3
8. Large trees	15	0
9. Coarse woody debris	5	2
10. Weed cover	10	3
11. Size of patch (Fragmented)	10	2
12. Connectivity (Fragmented)	**0**	**4**
13. Context (Fragmented)	5	2
14. Distance from water (Intact)	*N/A*	*N/A*
Sum of Score	**93**	**30**
Area (ha)	**9**	**25**
Sum of scores x area / 100 = **Ecological equivalence score for ecological condition**	**(93x9/100) 8.4**	**(31x25/100) 7.5**

To fill in the ecological condition scoring sheet, input all the scores collected for each indicator for both the clearing and offset area.

Scores taken from Box 3.4.

Scores taken from Box 3.5.

In this example, these indicators are not scored because the clearing area is in a fragmented landscape.

This row includes the cumulative sum of all the scores for each criterion.

This row records the area in hectares of the clearing or offset area

These scores are the ecological equivalence scores for the clearing and offset areas

3.2. Assessment of special features

3.2.1. Steps for assessing special features

Assessment of the special feature indicators relies on desktop GIS analysis using a number of spatial datasets. Assessment is only required where the clearing area supports special features as identified by the spatial datasets. **Where no special features are identified (using the offsets special features dataset) on the clearing area, no further assessment is required for special features and ecological equivalence is demonstrated using the ecological condition criterion only.**

The assessment process for special features differs depending on which of the offsets policies is applicable. Under the Policy for Vegetation Management Offsets the clearing area will in all instances involve remnant vegetation whereas, under the Biodiversity Offset Policy, the clearing area may involve either remnant vegetation or high value regrowth vegetation.

Unlike the assessment of ecological condition, a different process is used to assess an area depending on whether it supports remnant or high value regrowth vegetation. This is a result of the special features indicator's 1–10 and 12 only being mapped over remnant vegetation. This makes the assessment of special features on areas with remnant vegetation a relatively straight forward process as it relies on the presence, or absence, of special features.

An alternative process is required to determine the presence, or absence, of special features where the vegetation is either high value regrowth or non remnant vegetation either on the clearing area or offset area.

This alternative process relies on qualifying and quantifying the adjacency of the area to nearby remnant vegetation with special features. The underlying principle is that the closer the area is to a special feature, the greater the likelihood that the area will contain, contribute to, or be influenced by the special feature.

The assessment uses an adjacency calculation based on the distance to mapped special features on remnant vegetation and the percentage of remnant or high value regrowth vegetation between the area's assessment unit and the special feature. The score reduces with increased distance between the two areas (to a maximum linear distance of two kilometres) and with reduced amounts of vegetation (e.g. due to cleared areas, paddocks and infrastructure).

The special features indicators that are not reliant on remnant vegetation mapping include (11) ecological corridors, (13) significance of patch within a one kilometre buffer, and (14) protected area estate buffer. These indicators do not require an adjacency calculation and are assessed in the same manner for both the clearing area and offset area. Indicator 13, significance of patch, measures the relative importance of small patches of native vegetation in highly fragmented landscapes. Small patches have relictual importance and can act as refugia and provide more mobile species with 'stepping stone' opportunities for dispersal across the matrix landscape. The steps for assessing special features are explained in more detail below, with an overview provided in Box 3.7 (below).

Box 3.7 – Special feature assessment overview

Preparation

1. Develop a map of the area

Desktop GIS analysis

2. Clearing area.
   Determine the presence of special features indicator's 11, 13 and 14 within the clearing area and score.
   Determine the presence of special features indicator's 1–10 and 12 within the clearing area (or adjacent to the clearing area when it consists of high value regrowth vegetation) and score.
3. Offset area.
   Determine the presence of special features indicator's 11, 13 and 14 within the offset area and score.
   Determine the special features indicators 1–10 and 12 adjacent to the offset area, carry out the adjacency calculation where applicable, and score.

Calculate ecological equivalence

4. Calculate the ecological equivalence score for special features.

Preparation

1. Develop a map of the area

Use the map created in step 1 for ecological condition to begin assessment of special features in the clearing area and offset area. The map will assist in spatially reflecting the presence and extent of the special feature on the clearing area (or adjacent to the clearing area when a biodiversity offset is triggered by high value regrowth vegetation), and the special features adjacent to the offset area and the type of vegetation between the two. This map is to reflect the stratified assessment units identified for the clearing area and offset area used in the assessment of ecological condition.

Desktop GIS analysis

2. Clearing area: determine the presence of special features within (or adjacent to*) the clearing area

*Note that special features should only be determined adjacent to the clearing area when the clearing area has been triggered for high value regrowth vegetation under the Queensland Biodiversity Offset Policy.

This step involves determining the location of special features in relation to the clearing area using the offsets special features dataset for indicator's 1–10 and 12. If none of these special features are identified on the clearing area then no further assessment is required and ecological equivalence is determined by using the Ecological Condition criterion alone. Where there is an overlap of a special feature area in to the clearing area the indicator is deemed to be present to the extent it covers the clearing area (see Appendix B, Box B.6 for an example). The scores for all special features' indicators are located in Table 7 and Table 8.

3.2.2 Indicators that do not require an adjacency calculation

Three indicators do not require the adjacency calculation - indicators (11) strategic ecological corridors, (13) significance of patch within a one kilometre buffer and (14) protected area estate buffer:

- Indicator 11 is either present or absent within any part of the clearing area.
- Indicator 13 calculates the percentage of native vegetation within a one kilometre buffer around the edge or boundary of the site for the clearing area.
- Indicator 14 is either present or absent within any part of a two kilometre buffer around the clearing area boundary.

Step 1 – Ecological corridors (Indicator 11)

1. Determine whether the site is located within a state, bioregional, regional, or sub-regional corridor (terrestrial or riparian) identified by the offsets special features spatial data layer or DERM approved map.
2. Use Table 8 to identify the score for this indicator.

Step 2 – Significance of patch within a one kilometre buffer (Indicator 13)

1. Measure a **one kilometre buffer** around the edge of the site.
2. Determine the extent of remnant and high value regrowth vegetation within the buffer.
3. Measure the percentage of this extent compared to the size of the buffer. This indicator can be measured using GIS.
4. Use Table 8 to identify the score for this indicator.

Step 3 – Protected area estate buffer (Indicator 14)

1. Determine whether the area is within a **two kilometre buffer** from the boundary of a protected area estate. The protected area estate is available on the Queensland Government Information Service (QGIS). Note that state forests may only be included if they are not used for exotic timber plantations.
2. Use Table 8 to identify the score for this indicator.

Step 4a – Presence of indicators 1–10 and 12

1. Determine whether the clearing area contains any of the indicators 1–10 and 12 from the offsets special features GIS layer. Any flora and fauna survey carried out on the clearing area may also be used to identify the presence of priority species. See Box 3.8 for further information.
2. If any indicators are present, determine the value of the indicator (medium, high and very high).
3. Where the special feature only occurs in a portion of the clearing area, measure the area that the special feature intersects.
4. Use Table 7 to identify the score relevant for that indicator.

Box 3.8 – Priority species and flora and fauna surveys

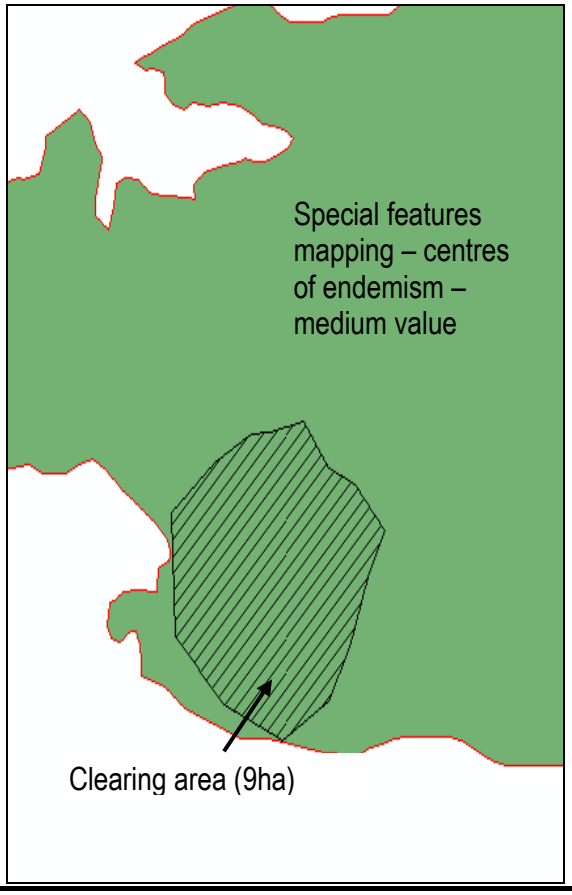
The Offsets Special Features GIS layer is available to determine the presence of priority species within the bioregion and must be used in the first instance; however priority species can also be detected through fauna and flora surveys and included in addition to the GIS layer. A list of priority species is available in Appendix 7 of the Biodiversity Assessment and Mapping Methodology (2002) from DERM to cross-check against survey results. Refer to the DERM website <www.derm.qld.gov.au>.

If flora and fauna surveys are carried out and priority species are found, this information can be scored in addition to the species found as part of the GIS layer. From the results of the survey, find the category that the priority species is in and score it accordingly against its indicator from Table 7.

If the priority species layer is disputed by the applicant, an ecological analysis of whether the area is likely to contain the presence or absence of the priority species must be provided. Information to support the analysis may include, but is not limited to:

- a flora or fauna survey targeted towards the specific species, including survey methodology and timing/frequency of survey
- advice from a suitably qualified and experienced person with expert knowledge relating to that species regarding its presence or absence.

Box 3.9 – Scoring of the indicator: centres of endemism on a clearing area with remnant vegetation



Step 1. Determine the presence of special features on the clearing area and score using the table relevant to the indicator.

Centres of endemism rating	Score
No value	0
Medium	**5**
High	17
Very high	20

The score is **five**.

Step 2. Calculate ecological equivalence for special features.
Multiply the score taken from the EEM scoring table (5) by the clearing area (9ha) and divide by 100: 5 x 9/100

The ecological equivalence score (clearing area) for special features is 0.45.

This information is entered into the special features scoring sheet for the clearing area.

The example in Box 3.9 shows the offset special features dataset layer identifying a remnant nine hectares clearing area mapped as containing special feature indicator (1) – centres of endemism with a rating of 'medium'. As a result the clearing area receives a score of five for this indicator. This score (5) is multiplied by the area (nine hectares) and divided by the maximum benchmark score for native woody vegetation (100) to have a final score for 'centres of endemism' of 0.45.

3.2.3 Indicators that require an adjacency calculation

The assessment of the special feature indicators (1–10 and 12) requires an adjacency calculation adjacent to the clearing area when the clearing area has been triggered for high value regrowth vegetation under the Biodiversity Offset Policy.

Determine the presence or absence of special features adjacent to the clearing area for each assessment unit. This requires analysis of the special feature's GIS data layers and the calculation of, within a two kilometre buffer, the number of special features' indicators present and the:

- distance from the clearing area assessment unit to the special feature
- percentage of remnant and high value regrowth vegetation between the clearing area assessment unit and the special feature.

Step 4b – Adjacency of special features indicators 1–10 and 12 around the assessment unit area

1. Create a **two kilometre buffer** around the assessment unit boundary.
2. Determine whether the area in the buffer contains any indicators 1–10 and 12 using the offsets special features GIS layer. Note that determination of priority species can also be determined through any flora and fauna surveys carried out for the area. See Box 3.8.
3. If there is a special feature, determine the value of the special features (very high, high, and medium) and what score it would receive from Table 7 for the indicator.

4. Determine the distance from the assessment unit to the special feature using the '**adjacency multiplier factor 1'**, from Table 5. If there are multiple special features, determine the distance for each indicator.

Table 5 – Distance to special feature: adjacency multiplier factor 1

Distance between site assessment unit and special feature	Adjacency multiplier factor 1
0–250 m	0.8
251–500 m	0.5
501 m–1 km	0.25
>1 km	0.1

5. Determine the proportion of remnant and high value regrowth vegetation between the assessment unit and the special feature using available GIS layers. If there is a greater amount of remnant or high value regrowth vegetation along an indirect path, re-calculate the distance accordingly to determine which path will achieve the greatest score. However, only one path can be chosen and scored.

6. Determine the percentage of native woody vegetation which measures the percentage of remnant and high value regrowth vegetation between the assessment unit and the special feature by using the '**adjacency multiplier factor 2'** in Table 6. If there are multiple special features, carry out the calculation individually for each indicator.

Table 6 – Percentage of native woody vegetation: adjacency multiplier factor 2

Percentage of remnant and high value regrowth	Adjacency multiplier factor 2
100%	1
75–99	0.75
50–74	0.5
25–49	0.25
0–24	0.1

7. Determine the adjacency multiplier. This involves the distance to special feature (adjacency multiplier factor 1) multiplied by the percentage of native woody vegetation (adjacency multiplier factor 2).
   For example:
   a. if the distance was 400 m – it would have a distance to special feature of 0.5; and
   b. if within that distance of 400 metres, the percentage of remnant or high value regrowth is 40 per cent, the factor is 0.25
   c. the adjacency multiplier is therefore 0.5 x 0.25 = 0.125.
8. Use this adjacency multiplier multiplied by the initial indicator score to determine a final indicator score. As an example, for the indicator wildlife refugia (rated 'very high'), the total score would be 20 x 0.125 = 2.5. This score (2.5) would be entered in the special features scoring sheet for the relevant area.
   Repeat this process until all special features within the buffer area have been assessed.

Step 5 – Scoring sheet input

Once all the data has been collated, input it into the relevant special features scoring sheet and carry out the calculations. Where a single assessment unit is scored, the summed score of the special feature indicators are multiplied by the area in hectares of the clearing area and divided by 100. This will provide the ecological equivalence **special features score** for the clearing area relevant to that assessment unit.

Step 6 – Repeat for multiple assessment units
Where there is more than one assessment unit, repeat the above steps for each assessment unit and fill in a separate special features scoring sheet. To determine the special features score, sum all the scores relevant to the clearing area. See Appendix 2, Box 6.5 for examples of scoring multiple assessment units for special features.

3. Offset area: determine the presence of special features within or adjacent to the offset area

3.2.4 Indicators that do not require an adjacency calculation
Three indicators do not require the adjacency calculation and are assessed in the same manner as on the clearing area: **see section 3.2.2 step's 1, 2 and 3**.

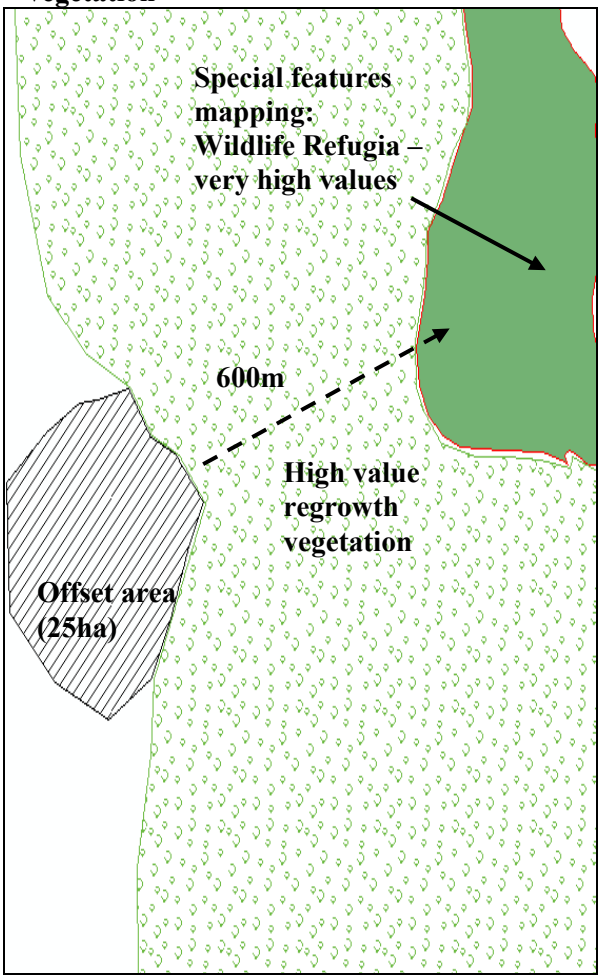
- Indicator 11 is either present or absent within any part of the offset area.
- Indicator 13 calculates the percentage of native vegetation within a 1km buffer around the edge or boundary of the offset area.
- Indicator 14 is either present or absent within any part of a 2km buffer from the boundary of a protected area estate.

3.2.5 Indicators that require an adjacency calculation
The assessment of the remaining special feature indicators (1–10 and 12) requires an adjacency calculation and are assessed in the same manner as on the clearing area: **see section 3.2.3 step 4b**.

Step 5 – Scoring sheet input
Once all the data has been collated, input it into the special features scoring sheet with the area of the offset and carry out the calculations. Where a single assessment unit is scored, the summed score of the special feature indicators are multiplied by the area in hectares (ha) of the offset area and divided by 100. This score will determine the ecological equivalence **special features score** for the offset area relevant to that assessment unit.

Step 6 – Repeat for multiple assessment units
Where there is more than one assessment unit, repeat the above steps for each one and fill in a separate special features scoring sheet. To determine the special features score, sum all the scores relevant to the offset area. See Box B.2 in Appendix B for examples of scoring multiple assessment units for special features. If there are multiple special features adjacent to the offset area, each special feature must be scored. An example of this scenario is provided in Appendix B, Box B.5. An example of calculating a score for a special feature adjacent to an offset area is provided in Box 3.10. In this example, a 25 ha offset area is located 600 m away from a wildlife refugia special feature rated as 'very high'. Between the offset area and the special feature is high value regrowth vegetation. The adjacency calculation uses multipliers to take into account the distance and type of vegetation between special features and the offset area assessment unit. Table 5 and 6 show the multipliers used. The adjacency multiplier factor 1 (for distance) equates to 0.25 (corresponding to a 0.5–1 km distance); and the adjacency multiplier factor 2 (for the percentage of native woody vegetation) equates to 1.0 (corresponding to 100 per cent regrowth). Factor 1 multiplied by Factor 2 produces a final score of 0.25. This score reflects a lower score than the maximum obtainable score due to the distance of the special feature from the offset area.

Box 3.10 – Score for indicator - wildlife refugia, on an offset area with non-remnant vegetation



Step 1. Determine presence of special feature
Identify the special features present adjacent to the offset area within a two kilometre buffer. In this example, wildlife refugia is mapped within the two kilometre buffer and rated 'very high'.

Step 2a. Obtain the indicator score
Check the special features indicator scorings in Table 7 to obtain the score. The score is **20**.

Indicator 2: **Wildlife refugia**	Score
No value	0
Medium	7
High	17
Very high	**20**

Step 2b. Calculate adjacency
Adjacency is calculated based on a) distance between the special feature and the offset area assessment unit, and b) percentage of remnant or high value regrowth vegetation. *The offset area is 600 m away from a wildlife refugia rated as 'very high' and is connected by 100 per cent high value regrowth vegetation.*

Adjacency calculations

- The distance is 600 m. This equates to an adjacency multiplier factor 1 of 0.25. Multiplier tables are described in Table 5 and Table 6.
- The percentage of vegetation between the offset area and the special feature is 100%. This equates to an adjacency multiplier factor 2 of 1.0.
  Adjacency multiplier A (0.25) x B (1.0) = 0.25

Step 3. Calculate the total special features score
Multiply initial score by adjacency multiplier: 20 x 0.25 = 5. This score is then multiplied by the offset area assessment unit (25ha is equivalent to one assessment unit in this example) and divided by 100: 5 x 25/100.
Ecological equivalence score (offset area) for special features = 1.25

Table 7 – Special features indicator scores: which require adjacency calculation (1–10 and 12)

Special feature indicator	Description	Score
1: Centres of endemism	No value	0
	Medium	5
	High	17
	Very high	20
2: Wildlife refugia	No value	0
	Medium	7
	High	17
	Very high	20
3: Areas with concentrations of disjunct populations	No value	0
	Medium	3
	High	12
	Very high	15
4: Areas with taxa at limits of geographic range	No value	0
	Medium	1
	High	4
	Very high	5
5: Areas with high species richness	No value	0
	Medium	5
	High	17
	Very High	20
6: Areas considered to be important for maintaining populations of ancient and primitive taxa	No value	0
	Medium	3
	High	12
	Very high	15
7: Areas containing regional ecosystems with distinct variation in taxa composition associated with geomorphology and other environmental variables	No value	0
	Medium	2
	High	8
	Very high	10
8: Artificially created waterbodies of ecological significance	No value	0
	Medium	1
	High	4
	Very high	5
9: Areas considered to be important because of high relative density of hollow-bearing trees	No value	0
	Medium	1
	High	4
	Very high	5
10: Breeding or roosting sites used by a significant number of individuals	No value	0
	Medium	3
	High	12
	Very high	15
12: Priority species	No value	0
	Medium	5
	High	8
	Very high	10

Table 8 – Special features indicator scores: where adjacency is not applicable (11, 13 and 14)

Special feature indicator	Description	Score
11: Ecological corridors	No value	0
	Regionally significant terrestrial or riparian corridor	17
	State significant terrestrial or riparian corridor	20
13: Significance of patch within a 1 kilometre buffer	> 50% of native vegetation remaining in buffer within 1 km of the assessment unit	0
	>30–50% of native vegetation remaining in buffer within 1 km of the assessment unit	2.5
	10–30% of native vegetation remaining in buffer within 1 km of the assessment unit	5
	< 10% of native vegetation remaining in buffer within 1 km of the assessment unit	10
14: Protected area estate buffer	Not in buffer of protected area estate	0
	Within buffer of protected area estate	5

4. Calculate special features score

To calculate the special features score, input all the scores into the special features scoring sheet provided in Appendix E. A completed scoring sheet based on the information described in Boxes 3.9 and 3.10 is provided in Box 3.11. Note that only the offset area contains calculations using the adjacency principle, and in this example there was only one special feature indicator present within the 2km buffer. The clearing area score is based on whether or not it contains a special feature. An example of where there are multiple special feature indicators adjacent to an offset area is provided in Box B.5 in Appendix B.

Section 3.3 discusses how to interpret the scores and options to address the scenarios when ecological equivalence is not achieved between the clearing area and offset area.

Box 3.11 – Ecological equivalence scoring sheet for special features

Indicators	Clearing area	Offset area				
		Indicator Score A	Distance to special feature multiplier B	% of native woody vegetation multiplier C	Adj. Multiplier (BxC)=D	Final Score A x D
Centres of Endemism	5	*NA*	*NA*	*NA*	*NA*	*NA*
Wildlife Refugia	*NA*	20	0.25	1	0.25	5
Sum of Score	5					5
Area (ha)	9					25
Sum of scores x area / 100 = **Ecological equivalence score for special features**	5x9/ 100 **0.45**					5x25/ 100 **1.25**

To fill in the special features scoring sheet, input all the data collected for the assessment unit

Score taken from Box 3.9

Scores taken from Box 3.10 for the offset area

This row includes the sum of all the scores for each scoring column

This row records the clearing or offset area in ha

This row shows the total special features score for the clearing area and offset area

3.3 Using the ecological condition and special features scores to determine ecological equivalence

For the offset area to be ecologically equivalent to the clearing area the offset area must obtain:

- an overall ecological condition score equal to or greater than the overall ecological condition score for the clearing areas
- an overall special features score equal to or greater than the overall special features score for the clearing areas
- a minimum score for the ecological condition indicators (1) recruitment of woody perennial species and (4) tree canopy cover.

If these scores are not achieved then ecological equivalence is not demonstrated and the proposed offset area does not meet the requirements of the offset policies.

Box 3.12 summarises and compares the ecological equivalence scores obtained from previous examples (Box 3.6 and 3.11). While the offset area scored higher than the clearing area for special features, it scored lower than the clearing area for ecological condition. Therefore, under the rules, the offset area is deemed not ecologically equivalent to the clearing area and would not be accepted under the offsets policies.

Box 3.12 – Scores for ecological equivalence

Criterion	Clearing area score	Offset area score
1 Ecological condition	**8.4**	7.5 ×
2 Special features	**0.45**	1.25 ✓

However, there are a number of options to address instances whereby the offset area score is not equal or greater than the clearing area for either criterion. These options can be used to increase the score of the offset area to achieve ecological equivalence:

1. If the offset area **ecological condition** score is lower than the clearing area score, either:
    a. increase the area of the offset to increase the ecological condition offset score
    b. locate an additional offset area which meets the EEM requirements to increase the score of the first offset area
    c. decrease the size of the clearing area to decrease the ecological condition clearing score.

2. If the offset area **special features** score is lower than the clearing area score, either:
    a. increase the area of the offset which is adjacent to the special feature to increase the score
    b. locate an additional offset area which is adjacent to a special feature to increase the score of the first offset area
    c. locate a different offset area which is adjacent to multiple special features which increases the score so that it is equal to or greater than the clearing area special features score
    d. decrease the size of the clearing area to decrease the special features clearing area score.

3. If the offset area does not meet the minimum score for the two ecological condition indicators where minimum scores must be obtained (1) recruitment of woody perennial species and (4) tree canopy cover:
    a. Source an alternative offset area.

4. Locate a different offset area that scores higher for one or both criteria.

4. Glossary

Assessment units – Assessment units are relatively homogenous units defined by a unique regional ecosystem and broad condition state. These condition states could be classified by whether they are remnant regional ecosystems, high value regrowth regional ecosystems or non-remnant regional ecosystems. Alternatively assessment units could be defined based on different condition states such as a different level of weed infestation.

Biocondition benchmarks –Biocondition benchmarks or regional ecosystem benchmarks are a description of a regional ecosystem that represents the median or average characteristics of a mature and relatively undisturbed ecosystem of the same type. There are numerous characteristics that make up a benchmark such as tree height, canopy cover, species richness etc. Available benchmark data can be found at the DERM website <www.derm.qld.gov.au>.

Clearing area – The area proposed to be cleared that triggers the requirements for an offset, which is provided as a way of meeting:

- Regional Vegetation Management Code's performance requirements under the *Vegetation Management Act 1999*, and the Policy for Vegetation Management Offsets; or
- the *Environmental Protection Act 1994*, *Coastal Protection and Management Act 1995*, *Sustainable Planning Act 2009, Transport Infrastructure Act 1994* or State Planning Policy Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments requirements and the Queensland Biodiversity Offset Policy.

Ecological equivalence – Ecological equivalence is the notion that two areas are similar in terms of their ecological condition and their ecological function in the landscape. The EEM uses a series of indicators to assist in determining ecological equivalence. Ecological equivalence is comprised of two ecological criteria assessed against 14 ecological equivalence indicators each. The criteria are:

1. Ecological condition – This is a measure of the ecological condition of a patch of vegetation using a number of field-based indicators and assessed against defined benchmarks. This measure is also determined by how it relates to the size, connectivity and the context of the landscape that the area sits within.

2. Special features – This includes a variety of significant ecological features important at either a site or landscape level. These areas are generally based on expert opinion informed by a range of ecological datasets, species distribution records and regional ecosystem mapping.

High value regrowth vegetation – High value regrowth vegetation is vegetation shown on a regrowth vegetation map for the State certified by the chief executive under the *Vegetation Management Act 1999* that:

a. is any of the following:
   - an endangered regional ecosystem;
   - an of concern regional ecosystem;
   - a least concern regional ecosystem; and
b. has not been cleared since 31 December 1989

Non-remnant vegetation – These are areas that are not remnant vegetation or high value regrowth vegetation. Generally, these are areas that have been cleared and contain limited amounts of native vegetation such as built up areas or pastures. However, in some circumstances it may contain some limited regrowth regional ecosystems that have been cleared after 31 December 1989.

Offset area – The area that is proposed to be conserved, enhanced, maintained, monitored and/or rehabilitated in exchange for the proposed clearing area.

Regional ecosystem – The term 'regional ecosystem' or RE refers to a vegetation community within a bioregion that is consistently associated with a particular combination of geology, landform and soil. Regional ecosystems occur in various condition states such as 'remnant' (mature, relatively undisturbed), 'high value regrowth' (20 year old regrowth) and 'non-remnant' (less than 20 year old regrowth). For more information on regional ecosystems see DERM's website at <www.derm.qld.gov.au>.

Remnant vegetation – Remnant vegetation includes areas of vegetation on a remnant map or regional ecosystem map certified by the chief executive under the *Vegetation Management Act 1999*. It includes vegetation, part of which forms the predominant canopy of the vegetation—

(a) covering more than 50 per cent of the undisturbed predominant canopy; and
(b) averaging more than 70 per cent of the vegetation's undisturbed height; and
(c) composed of species characteristic of the vegetation's undisturbed predominant canopy.

Remnant vegetation is classified into three conservation statuses – endangered, of concern and least concern.

5. References

Department of Environment and Resource Management, (2011a). *Queensland Biodiversity Offset Policy*. Department of Environment and Resource Management, Brisbane.

Department of Environment and Resource Management, (2011b). *Policy for Vegetation Management Offsets*, Department of Environment and Resource Management, Brisbane.

Environmental Protection Agency (2002). *Biodiversity Assessment and Mapping Methodology.* Biodiversity Planning Unit, Environmental Protection Agency, Brisbane.

Environmental Protection Agency, (2008). *Queensland Government Environmental Offsets Policy*. Environmental Protection Agency, Brisbane.

Eyre, T.J., Kelly, A.L., Neldner, V.J., Wilson,B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. (2011a). *Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual.* Version 2.1. Department of Environment and Resource Management (DERM), Biodiversity and Ecosystem Sciences, Brisbane.

Eyre, T.J., Kelly, A.L., and Neldner, V.J (2011b). *Method for the Establishment and Survey of Reference Sites for BioCondition*. Version 2.0. Department of Environment and Resource Management (DERM), Biodiversity and Ecosystem Sciences, Brisbane.

Appendix A – Example of benchmark data for a regional ecosystem

DERM has developed benchmarks for a number of regional ecosystems. These benchmarks are available from the DERM website. Below is the benchmark for the regional ecosystem 11.9.6.

BioCondition benchmark for regional ecosystem condition assessment

Brigalow Belt Bioregion — Regional Ecosystem: 11.9.6

Photo: Bill McDonald

Vegetation Management Act class (Nov 2009):	Endangered	**Estimated extent:**	In December 2006, <10% of the pre-clearing area remained^.
Biodiversity status:	Endangered	**Extent in reserves:**	Low
Subregion:	25, 31		

Short Description: *Acacia melvillei* +/- *A. harpophylla* open forest on fine-grained sedimentary rocks

Regional Ecosystem Description: Open-forest dominated by *Acacia melvillei* with or without *Acacia harpophylla*, and with or without *Eucalyptus populnea*. Ground cover may be sparse. Occurs on Cainozoic to Proterozoic consolidated fine-grained sediments on gently undulating landscapes on more or less horizontally bedded fine grained sedimentary rocks. It may include some areas occurring on clay plains.

Habitat:

Protected Areas: No representation

Values:

Condition: Cleared for cropping. Highly fragmented.

^Queensland Herbarium (2008) Regional Ecosystem Description Database (REDD). Version 6.0b, (November 2009) (DERM: Brisbane).

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BioCondition benchmark for regional ecosystem condition assessment

Benchmarks

1. Native plant species richness:

- Trees 3
- Shrubs 4
- Grasses 8
- Forbs 6
- Other species 4

2. Trees:

- Tree height range (m)
- Median canopy height (m): 15
- Canopy cover (%): 84
- Density (stems per hectare):
- Basal area per hectare (m^2):
- Large tree* dbh threshold (cm): 17 (Eucalypts etc.) (non-Eucalypts)
- Number of large trees* per hectare: 300 (Eucalypts etc.) (non-Eucalypts)
- Number of trees with hollows ≥10cm diameter per hectare:

Typical species:

yarran	*Acacia melvillei*
brigalow	*Acacia harpophylla*
wilga	*Geijera parviflora*
belah	*Casuarina cristata*
boonaree	*Alectryon oleifolius*

3. Shrubs:

- Median canopy height (m):
- Canopy cover (%): 14
- Density (stems per hectare):

Typical species:

4. Ground cover:

- Median canopy height (m):
- Total ground cover (%): 20.4
- Native perennial grass cover (%): 15
- Native perennial forbs and other species cover (%): 5.4
- Native annual grass, forb and other species cover (%): 0

Typical species:

5. Fallen woody material:

- Total length (m) of logs ≥ 10cm diameter per hectare:
- Number of logs ≥ 10cm diameter per hectare: 60

6. Organic litter cover (%): 74

*Eyre *et al.* (2006) Methodology for the establishment and survey of reference sites for BioCondition. (DERM: Brisbane).

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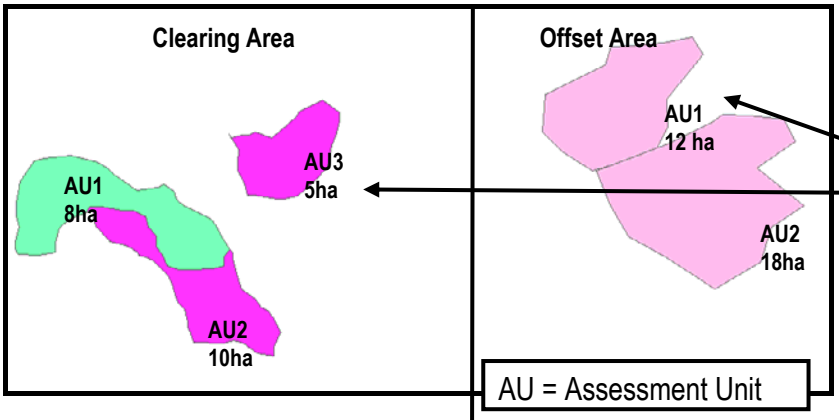
Appendix B – Common scoring scenarios

This section provides a summarised version of some common scoring scenarios.

B.1 Multiple assessment units

This scenario described in Box B.1 and B.2 demonstrates the general scoring for a clearing area and offset area that consists of a number of assessment units in each area. Each assessment unit is to be assessed in accordance with the assessment steps described in section 3. For each area the individual assessment unit scores are summed to calculate the final ecological condition score and special features score for the offset and clearing areas.

Box B.1 – Assessing ecological condition with multiple assessment units



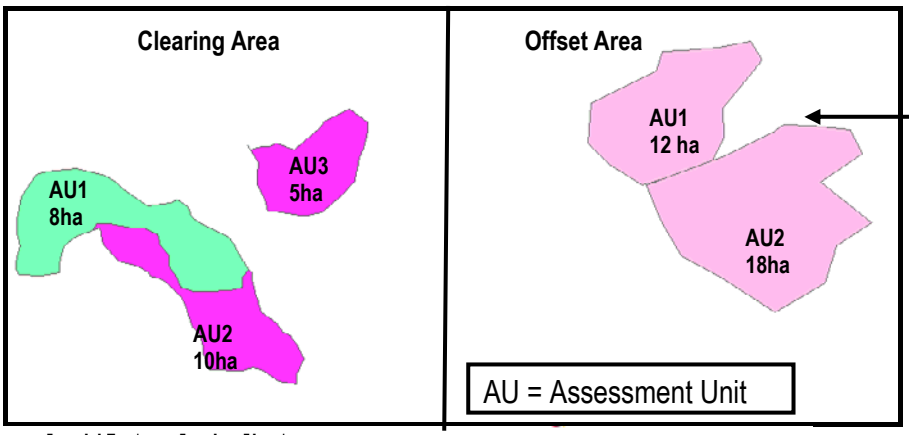
In this scenario, both the clearing and offset area have multiple assessment units. An ecological condition assessment will occur for each assessment unit.

Ecological condition Indicators	Clearing Area			Offset Area	
	AU1	AU2	AU3	AU1	AU2
1. Recruitment of woody perennial species	5	5	0	0	5
2. Native plant species richness					
- Trees	5	2.5	0	0	2.5
- Shrubs	5	5	5	2.5	0
- Grasses	2.5	2.5	2.5	2.5	5
- Forbs	5	5	2.5	5	2.5
3. Tree canopy height	5	0	5	0	0
4. Tree canopy cover	3	0	0	0	0
5. Shrub canopy cover	5	5	5	0	0
6. Native perennial grass cover	1	1	0	5	1
7. Organic litter	5	5	0	5	3
8. Large trees	10	0	10	0	0
9. Coarse woody debris	5	2	2	2	2
10. Weed cover	10	3	3	5	5
11. Size of patch (Fragmented)	10	0	10	5	5
12. Connectivity (Fragmented)	5	0	0	2	2
13. Context (Fragmented)	5	2	5	5	5
OR 14. Distance from water (Intact)	*NA*	*NA*	*NA*	*NA*	*NA*
Sum of Score	**86.5**	**38**	**50**	**39**	**38**
Area (ha)	**8**	**10**	**5**	**12**	**18**
Sum of scores x area / 100 = **Assessment Unit Ecological Condition Score**	**6.9**	**3.8**	**2.5**	**4.7**	**6.8**
Ecological Condition Score		**13.2**		**11.5**	

Where there are multiple assessment units (shown as red circles) for either the clearing or offset area, a score will be developed for each one. Carry out the standard calculations to determine the score relevant to each of the assessment units.

Each of these scores (green circles) will be summed to provide the cumulative score (pink circles). This cumulative score will be used for the ecological equivalence determination.

Box B.2 – Assessing special features with multiple assessment units



Using the same scenario in Box B.1, there is multiple assessment units in both the clearing and offset area. A special features assessment will occur for each assessment unit.

Special Features Scoring Sheet

Project title: _____ DERM reference: _____ Clearing circle
Lot plan/s: _____ Bioregion: _____ Offset circle

Special Features Indicators	Clearing Area A'ment Unit#: _____	Offset Area Assessment Unit#: _____ Indicator Score A	Distance to Special feature* B	% native woody vegetation* C	Adjacency Multiplier (BxC)=D	Overall score A x D
1. Strategic ecological corridor			*Not relevant for this indicator*			Score = A
2. Significance of patch within a 1km buffer			*Not relevant for this indicator*			Score = A
3. Protected area estate buffer			*Not relevant for this indicator*			Score = A
4. Centre of endemism						
5. Wildlife refugia						
6. Disjunct populations						
7. Taxa at limits of geographic range						
8. High species richness						
9. Relictual populations						
10. Regional ecosystems with distinct variation in species associated with geomorphologic and other environmental variables						
11. Artificial waterbody of ecological significance						
12. High density hollow bearing trees						
13. Breeding or roosting areas used by significant number of individuals						
14. Priority Species						
Extra rows for multiple special features						
Sum of Score						
Area (ha)						
Sum of scores x area / 100 = **Special features score**						

*See Appendix 2 for tables required for the adjacency calculation.

A special features scoring sheet will need to be completed for each assessment unit. Label the assessment unit specific to each special feature in the top of the column. A blank sheet is available in Appendix E.

Special Features Score Summary Table

	Clearing Area Special Feature Score	Offset Area Special Feature Score
Assessment Unit 1	3	4
Assessment Unit 2	2.5	1
Assessment Unit 3	0	N/A
Special Features Score	**5.5**	**5**

Once each of the calculations is carried out for each assessment unit, use the summary table to fill in the scores. This table is available on the scoring sheet in Appendix E.
*Add up the special features score for each assessment unit (green circles) to determine the **special features score** for the offset area or clearing area (pink circles. This score is used for ecological equivalence.*

B.2 Scoring ecological condition with indicators naturally absent

There may be situations where ecological indicators may be naturally absent from the regional ecosystems under investigation. An example may be for a shrubland or heath community, where indicators such as tree canopy cover or tree canopy height are not relevant. In the example below the five ecological condition indicators that measure tree attributes are switched off (i.e. scored as N/A – not applicable) and the calculation is adjusted accordingly, see Box B.4.

Box B.3 – Identifying vegetation communities with indicators naturally absent

To determine if a vegetation community or a regional ecosystem has indicators that are naturally absent, check the structure code of the regional ecosystem on the Regional Ecosystem Description Database (REDD). This is available from the DERM website. It prescribes the different type of structure (shrublands, woodlands, grasslands etc) for each regional ecosystem across Queensland. This can be used as a guide to identify naturally absent indicators. Eyre *et al*. (2011a; Table 4 p. 20) also provides explanation on scoring for vegetation communities with naturally absent indicators.

The assessable weightings (%) in four different ecosystems are:

- Woodland: 100
- Shrubland: 65 (tree indicators switched off)
- Grassland: 50 (tree and shrub indicators switched off)
- Mangrove: 85 (grass and litter indicators switched off).

This allows the condition of different types of vegetation communities (e.g. a woodland and a shrubland) to be compared. For further information on identifying communities with naturally absent indicators see Box B.3.

Box B.4 – Assessing ecological condition in a vegetation community with naturally absent indicators

Ecological condition indicators	Maximum score	Shrubland assessment unit
1. Recruitment of woody perennial species	5	5
2. Native plant species richness	20	
- Trees	5	*N/A*
- Shrubs	5	5
- Grasses	5	2.5
- Forbs	5	5
3. Tree canopy height	5	*N/A*
4. Tree canopy cover	5	*N/A*
5. Shrub canopy cover	5	5
6. Native perennial grass cover	5	1
7. Organic litter	5	5
8. Large trees	15	*N/A*
9. Coarse woody debris	5	*N/A*
10. Weed cover	10	10
11. Size of patch (Fragmented)	10	10
12. Connectivity (Fragmented)	5	5
13. Context (Fragmented) OR	5	5
14. Distance from water (Intact)	20	*N/A*
	Sum of score	**58.5**
	Area area (ha)	**10**
	Sum of scores x area / 65 = **Ecological condition score**	**9**

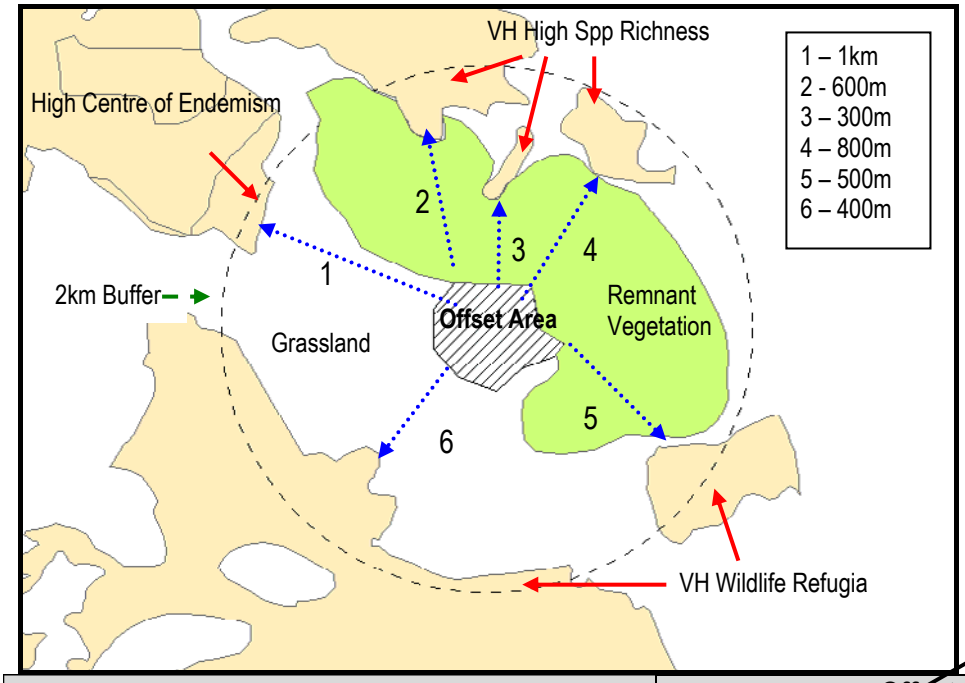
These indicators are naturally absent for a shrubland and are therefore not calculated as part of the scoring.

The final score calculation is adjusted by removing each maximum score for the indicators not measured (100-35 = 65)

B.3 Multiple special features adjacent to offset area

This scenario provides a summary of how scoring works for multiple special features adjacent to an offset area. Where there is more than one special feature adjacent to the area, the scores will need to be accumulated to provide a final special features score. This is demonstrated in the example scoring sheet and map in Box B.5.

Box B.5 – Assessing an offset area with multiple special features adjacent



In this scenario, where there is multiple special features of the one type (2 wildlife refugia etc.), input extra lines into the special features scoring sheet.

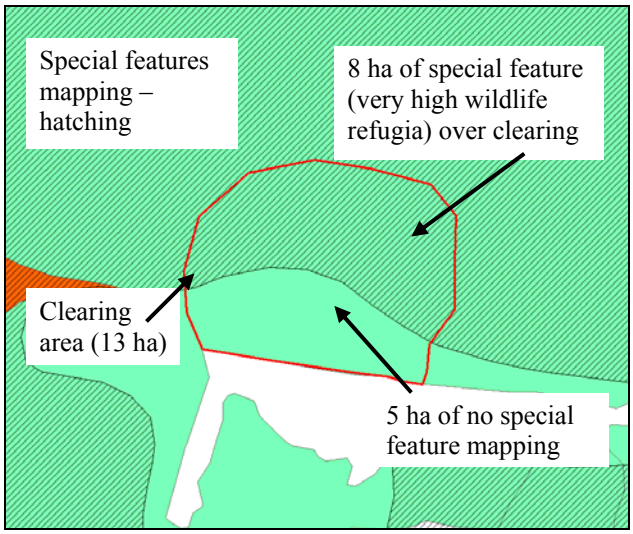
Special features Indicators		Offset Area: Indicator Score A	Distance to special feature multiplier B	% of native woody vegetation multiplier C	Adjacency Multiplier (BxC)=D	Overall score A x D
11. Strategic ecological corridor			Not relevant for this indicator			
13. Significance of patch within a 1km buffer			Not relevant for this indicator			
14. Protected area estate buffer			Not relevant for this indicator			
1. Centre of endemism (1)		20	0.1	0.1	0.01	0.2
2. Wildlife refugia (5)		20	0.5	1	0.5	10
Wildlife refugia (6)		20	0.5	1	0.5	10
3. Disjunct populations						
4. Taxa at limits of geographic range						
5. High species richness (2)		17	0.25	1	0.25	4.25
High species richness (3)		17	0.5	1	0.5	8.5
High species richness (4)		17	0.25	0.1	0.025	0.42
6. Relictual populations						
7. Regional ecosystems with distinct variation in spp. associated with geomorphologic and other env. variables						
8. Artificial waterbody of ecological significance						
9. High density hollow bearing trees						
10. Breeding or roosting areas used by significant number of individuals						
12. Priority Species						
	Sum of Score					**33.37**
	Area (ha)					**15**
	Sum of scores x area / 100 = **Special Features Score**					**5.01**

B.4 The clearing area has partial special features mapping

There may be a scenario where special features only relate to a certain part of the clearing area, even though it is the same assessment unit. In this scenario, the area subject to the special feature will be scored uniquely, as if it was its own assessment unit. This will provide a special features score unique to that area. In the below scenario, shown in Box B.6**,** the clearing area special features scoring is split based on area.

Box B.6 – Assessing special features that are only over a partial clearing area.

Special features indicators		Clearing area score
Centres of endemism		
Wildlife refugia		**20**
Disjunct populations		
Taxa at limits of geographic range		
High species richness		
Relictual populations		
Regional ecosystems with distinct variation in species associated with geomorphologic and other environmental variables		
Artificial waterbody of ecological significance		
High density hollow bearing trees		
Breeding or roosting areas used by significant numbers of individuals		
Strategic ecological corridor		
Priority Species within the bioregion		
Significance of patch		
Protected area estate buffer		
	Adjacency multiplier: 0.8 x 1.0	**0.8**
	Sum of score: 20 x 0.8	**16**
	Area (ha)	**8**
	Sum of scores (16) x area (8) / 100 = **Special features score**	**1.28**



In this scenario, although the clearing area is 13 ha, only 8 ha is used as the area calculation. This is because only 8 ha of the clearing area is affecting the wildlife refugia.

Appendix C – Analysis tools

C.1 GIS tools and data

A GIS tool has been developed for users to implement the desktop analysis and will be available on the DERM website. This tool will require access to selected GIS layers and will operate using an extension for the ArcGIS for Desktop software from ESRI. Relevant GIS layers required for assessment can be downloaded from the Queensland Government Information System (QGIS) at <http://dds.information.qld.gov.au>

Table 9 lists the resources available for assessment.

C.2 Ecological equivalence calculator

To assist with the calculation of the ecological equivalence scores for each of the criterion, a calculator is available on the DERM website. It can be used to input all the relevant indicator scores for the clearing area and offset area assessment units. It will automatically generate the final scores allowing for comparison of ecological equivalence between sites. The calculator is particularly useful for areas with multiple assessment units.

Table 9 – Resources for assessment

Indicators	Layers/information required	Data source
Map creation and stratification of assessment units	Regional ecosystem layers - Remnant regional ecosystem layer - High value regrowth layer - Property map of assessable vegetation layer - Pre-clear vegetation layer	QGIS
	Remote sensing imagery (air photo/satellite image)	DERM office Internet
Criterion 1 – Ecological condition		
Indicator 11. Size of patch (Fragmented)	Regional ecosystem layers - Remnant regional ecosystem layer - High value regrowth layer - Property map of assessable vegetation layer - Pre-clear vegetation layer	QGIS
Indicator 12. Connectivity (Fragmented)		
Indicator 13. Context (Fragmented)		
Indicator 14. Distance from water (Intact)	Satellite imagery or air photo highlighting artificial water points. Alternative on ground field inspection can occur	Google Earth or other remote sensing website. DERM website
Benchmark data	Benchmark data for each regional ecosystem	DERM website
Criterion 2 – Special features		
Indicator 1. Centres of endemism	Offsets special features spatial dataset	QGIS
Indicator 2. Wildlife refugia		
Indicator 3. Disjunct populations		
Indicator 4. Taxa at limits of geographic range		
Indicator 5. High species richness		
Indicator 6. Relictual populations		
Indicator 7. Distinct variation in species associated with geomorphologic or environmental variables		
Indicator 8. Artificial waterbody of ecological significance		
Indicator 9. High density hollow bearing trees		
Indicator 10. Breeding or roosting areas used by significant numbers of individuals		
Indicator 11. Ecological corridors		
Indicator 12. Priority species within the bioregion		
Indicator 13. Significance of patch within 1km buffer	Regional ecosystem layers - Remnant regional ecosystem layer - High value regrowth layer - Pre-clear vegetation layer	QGIS
Indicator 14. Protected area estate buffer	Protected areas of Queensland	QGIS

Appendix D – Description of special features indicators

Table 10 provides a description of the special features adapted from Criterion H, I and J in the Biodiversity Assessment and Mapping Methodology (EPA, 2002), and the additional special features included within the special features criterion. Detailed descriptions of the indicators contained within the offsets special features spatial dataset are described in the 'Offsets Special Features Description' metadata.

Table 10 – Description of special features

Indicator	Description
Centres of endemism	A taxon is considered an endemic if most of its distribution falls within a discrete geographical area such as a biogeographic region. Endemic taxa that are confined to a single site or just a few sites within the region are often called narrow endemics. The presence of endemic taxa at a site reflects evolutionary processes. Fluctuation in climate, in particular, has had a profound influence on species distributions across Australia during the Quaternary geological period (past 1.8 million years) leading to contraction and expansion of populations. Endemic taxa often co-occur. The identification of centres of endemism, places with a high number of endemic taxa in relative terms, can be undertaken at a range of scales. Clusters of endemic taxa can occur within quite small geographical areas, and centres of endemism can also be assessed and mapped at bioregional and sub-regional scales. This has been undertaken within Biodiversity Planning Assessments based primarily upon expert opinion supported by information in DERM's WILDNET database. Analyses to determine centres of endemism have been facilitated by availability of large state and continental scale datasets and GIS.
Wildlife refugia	Wildlife refugia can be defined as: • Habitats that enable taxa to survive during extreme events such as drought, fire (e.g. places where water and food resources are present for a longer period of time than in surrounding areas), and in a geological time scale, climate change; Habitats that support taxa that are uncommon, are known to be in decline due to factors such as habitat loss and predators or do not occur in surrounding areas.
Areas with concentrations of disjunct populations	Disjunct distributions refer to populations of species that are geographically isolated from closest populations by large distances e.g. 100 to 1000 km. They include: • Instances where populations have become geographically and genetically isolated through time as a consequence of changes in environmental factors such as climate and geomorphology. All species have an evolutionary origin and existence in terms of time and space. They also have a period (or many periods) of range expansion, followed by fragmentation, reduction and eventual extinction. Disjunct species include those that have been subject to long (in geological time) intervals of fragmentation and reduction that has spatially isolated populations and in extreme cases contemporary survival is restricted to one or a few highly localised sites. Disjunct populations can be genetically distinct which is an important consideration in conservation planning and management. • Where long distance dispersal of propagules has occurred across large areas of unsuitable habitat e.g. some aquatic species that have germinated from seed carried by migratory birds. Species disjunctions are dealt with in a broad manner due to limited information available on species' distributions generally. The identification of areas with concentrations of disjunct taxa is undertaken through a combination of analysis of species records and consultation with ecologists with expertise in the relevant bioregions.

Indicator	Description
Areas with taxa at limits of geographic range	Limits of range of widespread species include most northerly or southerly records in the bioregion and most easterly or westerly records. Peripheral populations of widespread species can be genetically distinct from central populations. The edges of species' geographic ranges can reflect limiting environmental factors such as rainfall and temperature or the effects of competition from other species. Species may be contracting or expanding and as a consequence are sensitive to human-induced pressures from clearing and habitat modification. Such places could also be significant in the context of predicted changes in temperature and rainfall associated with climate change. This special feature focuses on widespread species for which limits of range can generally be gauged from publicly available data and literature. Local expert opinion can be very useful in identifying specific locations that are relevant to this special feature.
Areas with high species richness	Species richness is a useful criterion in the assessment of conservation values as it provides a highly discriminating tool in meeting the objective of ensuring that as many species as possible are subject to beneficial management and protection within each bioregion. Areas of high species also tend to have other features of interest, for example high levels of endemic species. Centres of high species richness are identified using GIS analysis (density mapping), utilising bioregional species records from DERM databases that meets prescribed data standards.
Areas considered to be important for maintaining populations of ancient and primitive taxa	Some flora and fauna taxa have been linked with important stages in the earth's evolutionary history. One of the outstanding biological features of the Wet Tropics bioregion is that it contains numerous plant taxa representing long, distinct lineages and as such, preserves a high degree of evolutionary heritage. Species that exhibit ancient or primitive traits or are the only representatives of a lineage that may date from prehistory are also eligible for consideration for this feature.
Areas containing Regional Ecosystems with distinct variation in taxa composition associated with geomorphology and other environmental variables	Regional ecosystems are used as a surrogate for biodiversity as they can be characterised by a suite of plant taxa responding to distinct patterns of landform, geology, soils and climate that have a high probability of occurring at any given area. The faunal assemblages present may also be determined by these factors directly, as well as the resultant vegetation and historical events, for example, fire regimes. Regional ecosystems are often found across a range of physical environments and their flora and fauna species composition can vary accordingly. The dataset is created and addressed through expert knowledge, augmented by data such as species records.
Artificially created waterbodies of ecological significance	With the decline in the quantity and quality of natural wetlands in the landscape, some value should be placed on any artificial or manipulated waterbody where it can be demonstrated to be of ecological significance. Such significance may be in the habitat it provides for wetland dependent species or for its role in natural processes, for example filtration, that enhances the value of other areas away from the wetland. These areas have been identified via expert opinion.
Areas considered to be important because of high relative density of hollow-bearing trees	Some long-lived tree species develop hollows that are occupied by a range of hollow-dependent fauna. Clearing, selective logging and silvicultural treatment have reduced the density and quality of hollow trees. As tree hollows take considerable time to develop, they are often a limited resource in the landscape and thus of substantial value. The objective assessment of this feature is limited by the availability of suitable extensive species lists of potential hollow-bearing trees in various vegetation types for all bioregions. This feature has been evaluated through expert opinion.
Breeding or roosting sites used by significant number of individuals	Certain fauna species may forage widely when active, but when breeding or resting congregate at specific locations, for example, heronries, flying-fox camps, maternity/roost caves for microchiropteran bats. Any disturbance of these areas can have a considerable impact on the species. Consequently, some value should be assigned to locations used by a significant number of individuals. For the regions where BPAs have not yet been undertaken, breeding or roosting sites are limited to important bird and bat areas identified through sources such as: species records, Birds Australia and Important Bird Areas.

Indicator	Description
Priority species	Priority species are those species which are not endangered, vulnerable, near threatened species listed under the NCA or EPBC Act and are: • taxa at risk or of management concern • locally significant populations • highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular Regional Ecosystem • taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits,) • taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators) For the bioregions where a BPA has been undertaken, priority habitat is based on the species lists derived by each bioregional flora and fauna expert panel. For the 4 bioregions where a BPA has not yet been undertaken, the priority species list is based on work undertaken by DERM's Back on Track program. Species that have a Back on Track ranking of Critical, High or Medium were included.
Ecological corridors	Areas identified by the State and located within a state, bioregional, regional, or sub-regional corridor (terrestrial or riparian). Terrestrial and riparian bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by: • maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time • maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change • maintaining large scale seasonal/migratory species processes and movement of fauna • maximising connectivity between large tracts/patches of remnant vegetation • identifying key areas for rehabilitation and offsets.
Significance of patch within a one kilometre buffer	Significance of patch within a 1km buffer recognises the greater value of patches of vegetation remaining in more highly fragmented landscapes. The extent of clearing in the landscape is measured by the proportion of vegetation remaining within a one kilometre buffer around the area.
Protected area estate buffer	Protected area estate buffer recognises the value that surrounding vegetation plays to the values within the protected area estate, including the mitigation of edge effects, and improving long term viability. The protected area estate includes national parks, conservation parks, forest reserves and state forests. It does not include nature refuges or state forests where the state forest contains exotic pine plantations.

Appendix E – Checklist, field collection sheet and scoring sheets

The following items should be used, where relevant, for assessing ecological equivalence under the offsets policies and included as part of any offset proposal. Users should regularly refer to the DERM website for updates and the latest versions of these documents.

The following items are included and available for download.

- Ecological equivalence checklist
- Ecological condition field assessment sheet (two pages)
- EEM (ecological condition) scoring sheet
- EEM (special features) scoring sheet 1
- EEM (special features) scoring sheet 2
- EEM total score sheet

Ecological equivalence checklist

For assessment of ecological equivalence under the Biodiversity Offset Policy and the Policy for Vegetation Management Offsets. Version 1.0, 2011

Project title: _____ DERM reference: _____
Lot plan/s: _____ Bioregion: _____
Other information provided:
_____
_____
_____

Ecological equivalence checklist **Information to be provided to the Department of Environment and Resource Management**		
Information requirements	**Description**	**Information provided**
Maps for the clearing area and offset area	Provide a spatial map of the areas showing: • each assessment unit • location of field area transects • location of special features • adjacency calculation path	
Field data for the clearing area and offset area	Provide: • benchmark data relevant to each assessment unit in the area • Biocondition Reference Data Sheet where a local benchmark was generated • assessment sheets used in the collection of the field data for each assessment unit	
Desktop data for clearing area and offset area	Provide: • results from GIS analysis or GIS tools including input shape files • data used for offset area (and clearing area in some circumstances) special features adjacency calculations (distance and percentage of native woody vegetation) • for intact landscapes, imagery or locations of water points	
Scoring sheets	Provide: • ecological condition scoring sheet • special features scoring sheet • summary scoring sheet	
Ecological equivalence summary	Provide: • overview of the clearing area and offset area, including area and values based on the ecological equivalence criteria • ecological equivalence scores for ecological condition and special features	
Extra information	Other information to support the ecological equivalence assessment may include, but is not limited to: • fauna and flora survey for the clearing area and offset area • photo points of the area including GPS information • other ecological survey data	

Ecological condition field assessment sheet

For assessment of ecological equivalence under the Queensland Biodiversity Offset Policy and the Policy for Vegetation Management Offsets. Version 1.0, 2011. Page 1 of 2.

Project title: _____ DERM reference: _____
Lot plan/s: _____ Bioregion: _____

Area:	**RE/land type/assessment unit:**	**Bioregion:**	**Property:**
Date:	**Photos** (optional) **N:**	**S:**	**E:** **W:**
Landscape photo(s):		**Spot photo (s):**	
Datum: WGS84 or GDA94 Zone:	**0 m mark AMGE:**	**AMGN:**	
	50 m mark AMGE:	**AMGN:**	
Transect bearing:			
General description:			

100 x 50 m area: * Ecologically dominant layer (EDL); ecological condition indicator (ECI)

Eucalypt large tree DBH (from benchmark doc.): Number of large eucalypt trees:	Non-Eucalypt large tree DBH (**from benchmark doc.):** Number of large non-eucalypt trees:
Total large trees (ECI 8):	
Tree canopy (EDL) height (ECI 3):	
Subcanopy and/or emergent height **(where relevant)**: S:	E:
Proportion of dominant canopy (EDL) species with evidence of recruitment (ECI 1):	
Total tree species richness (ECI 2a) includes all tree (i.e. single stemmed > 2 m height) species in the 100x50m, not just EDL species:	

50 x 10 m area: *list species if known or count if unknown

Shrub species richness (ECI 2b) (defined as single stemmed below 2 m or multi-stemmed from base or below 20 cm) ***:**
Grass species richness (ECI 2c)**:**
Forbs and others (non-grass ground) species richness (ECI 2d)**:**
Non-native plant (weed) cover (ECI 10)**:**

50 x 20 m area: Coarse woody debris (ECI 9) CWD; >10 cm, >0.5 m, measured to the plot boundary:

CWD length:		CWD length:		CWD length:		CWD length:		CWD length:		CWD length:	
1		8		15		22		29		36	
2		9		16		23		30		37	
3		10		17		24		31		38	
4		11		18		25		32		39	
5		12		19		26		33		40	
6		13		20		27		34		41	
7		14		21		28		35		Total:	

Five 1x1 m plots * attributes used in scoring

Ground cover:	1	2	3	4	5	Mean
Native perennial grass cover (ECI 6)*						
Organic litter cover (ECI 7) *						
Forbs and other						
Total	**=100%**	**=100%**	**=100%**	**=100%**	**=100%**	

100 m transect

Tree canopy cover (ECI 4)**:** Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that these layers should be present; otherwise Canopy (C) *trees in the same layer and continuous along the transect can be grouped

Tree or group* (C or S or E)	Distance (m)	Total	Tree or group* (C or S or E)	Distance (m)	Total	Tree or group* (C or S or E)	Distance (m)	Total	Tree or group* (C or S or E)	Distance (m)	Total
										Total C: Total S: Total E:	

Shrub canopy cover (ECI 5)**:** *denote as native or exotic. Only native shrub cover used in scoring

Shrubs*	Distance (m)	Total	Shrubs	Distance (m)	Total	Shrubs	Distance (m)	Total	Shrubs	Distance (m)	Total	Shrubs	Distance (m)	Total
												Total native:		
												Total exotic:		

Ecological Equivalence Methodology (ecological condition) scoring sheet

For assessment of ecological equivalence under the Biodiversity Offset Policy and the Policy for Vegetation Management Offsets. Version 1.0 2011

Project title: _____ DERM reference: _____
Lot plan/s: _____ Bioregion: _____

Ecological condition	Clearing area			Offset area		
	Assessment unit 1	**Assessment unit 2**	**Assessment unit 3**	**Assessment unit 1**	**Assessment unit 2**	**Assessment unit 3**
	---	---	---	---	---	---
1. Recruitment of woody perennial species						
2. Native plant species richness						
- Trees						
- Shrubs						
- Grasses						
- Forbs						
3. Tree canopy height						
4. Tree canopy cover						
5. Shrub canopy cover						
6. Native perennial grass cover						
7. Organic litter						
8. Large trees						
9. Coarse woody debris						
10. Weed cover						
11. Size of patch (fragmented)						
12. Connectivity (fragmented)						
13. Context (fragmented)						
14. Distance from water (intact)						
Sum of score						
Area (ha)						
Assessment unit ecological condition score = Sum of scores x area / 100						
Overall ecological condition score	Sum of assessment unit scores ☐			Sum of assessment unit scores ☐		

*Woodland: 100; Shrubland: 65; Grassland: 50; Mangrove: 85.

Ecological Equivalence Methodology special features scoring sheet 1

(Adjacency calculation for clearing area **not required**: for high-value regrowth vegetation – use special features scoring sheet 2)

Project title: _____ DERM reference: _____
Lot plan/s: _____ Bioregion: _____

Special features indicators	**Clearing area** AU No: ---------- ----------	**Offset area** Assessment unit (AU) No#: Indicator score A	Distance to special feature multiplier* B	% native woody vegetation multiplier* C	Adjacency multiplier (BxC)=D	Overall score A x D
1. Centres of endemism						
2. Wildlife refugia						
3. Disjunct populations						
4. Taxa at limits of geographic range						
5. High species richness						
6. Relictual populations						
7. Regional ecosystems with distinct variation in species associated with geomorphologic and other environmental variables						
8. Artificial waterbody of ecological significance						
9. High density hollow bearing trees						
10. Breeding or roosting areas used by significant numbers of individuals						
11. Strategic ecological corridor			*Not relevant for this indicator*			Score = A
12. Priority species within the bioregion						
13. Significance of patch within a 1km buffer			*Not relevant for this indicator*			Score = A
14. Protected area estate buffer			*Not relevant for this indicator*			Score = A
Extra rows for multiple special features						
Sum of score						
Area (ha)						
Special features score = Sum of scores x area / 100						

* See **Table 5 and 6** for determining the adjacency calculation.

This scoring sheet will be used for each assessment unit. Where there is more than one assessment unit, fill in a new scoring sheet to determine the score for each assessment unit and fill in the below summary to calculate the cumulative score. This cumulative score will be the **special features score**.

Special features score summary table (when there is more than one assessment unit)

	Clearing area special feature score	**Offset area special feature score**
Assessment unit 1		
Assessment unit 2		
Assessment unit 3		
Special features score		

Ecological Equivalence Methodology special features scoring sheet 2

(Where adjacency calculation for the clearing area is required due to high-value regrowth vegetation on the clearing area)

Project title: _____ DERM reference: _____
Lot plan/s: _____ Bioregion: _____

Special features indicators	Clearing area Assessment unit (AU) No#:					Offset area Assessment unit (AU) No#: _____				
	SFI score A	Distance to special features multiplier *B	% native woody vegetation multiplier *C	Adj. multiplier (BxC)=D	Score A x D	SFI score A	Distance to special features multiplier *B	% native woody vegetation multiplier *C	Adj. multiplier (BxC)=D	Score A x D
1. Endemism										
2. Refugia										
3. Disjunct pops										
4. Taxa limits										
5. Sp. richness										
6. Relictual pops										
7. Geomorphology										
8. Waterbody										
9. Hollow trees										
10. Breeding areas										
11. Corridors		*Not relevant for this indicator*			Score = A		*Not relevant for this indicator*			Score = A
12. Priority sp.										
13. Patch sign.		*Not relevant for this indicator*			Score = A		*Not relevant for this indicator*			Score = A
14. Estate buffer		*Not relevant for this indicator*			Score = A		*Not relevant for this indicator*			Score = A
Extra rows for multiple special features										
Sum of score										
Area (ha)										
Special features score = Sum of scores x area / 100										

* See **Table 5 and 6** for determining the adjacency calculation. SFI: special feature indicator.

This scoring sheet will be used for each assessment unit. Where there is more than one assessment unit, fill in a new scoring sheet to determine the score for each assessment unit and fill in the below summary to calculate the cumulative score. This cumulative score will be the **special features score**.

Special features score summary table (when there is more than one assessment unit)

	Clearing area special feature score	Offset area special feature score
Assessment Unit 1		
Assessment Unit 2		
Assessment Unit 3		
Special features score		

Ecological Equivalence Methodology summary scoring sheet

For assessment of ecological equivalence under the Queensland Biodiversity Offset Policy and the Policy for Vegetation Management Offsets. Version 1.0, 2011

Project title: _____ DERM reference: _____
Lot plan/s: _____ Bioregion: _____

Summary score table

Assessment unit	Clearing area score	Offset area score		Assessment unit	Clearing area score	Offset area score
AU 1 – Ecological condition				AU 11 – Ecological condition		
AU 1 – Special features				AU 11 – Special features		
AU 2 - Ecological condition				AU 12 – Ecological condition		
AU 2 - Special features				AU 12 – Special features		
AU 3 – Ecological condition				AU 13 – Ecological condition		
AU 3 – Special features				AU 13 – Special features		
AU 4 – Ecological condition				AU 14 – Ecological condition		
AU 4 – Special features				AU 14 – Special features		
AU 5 – Ecological condition				AU 15 – Ecological condition		
AU 5 – Special features				AU 15 – Special features		
AU 6 – Ecological condition				AU 16 – Ecological condition		
AU 6 – Special features				AU 16 – Special features		
AU 7 – Ecological condition				AU 17 – Ecological condition		
AU 7 – Special features				AU 17 – Special features		
AU 8 – Ecological condition				AU 18 – Ecological condition		
AU 8 – Special features				AU 18 – Special features		
AU 9 - Ecological condition				AU 19 – Ecological condition		
AU 9 - Special features				AU 19 – Special features		
AU 10 – Ecological condition				AU 20 – Ecological condition		
AU 10 – Special features				AU 20 – Special features		

Criterion	Clearing area total score	Offset area total score
1. Ecological condition		
2. Special features		

Partner Peter Stokes
Writer Claire Meiklejohn
Direct line 07 3233 8760
Email cmeiklejohn@mccullough.com.au
Our reference CEM:PWS:159359-00022

Lawyers | McCullough Robertson

12 March 2015

Mr B Wilson
Senior Ecologist - Technical
Eco Logical Australia Pty Ltd

Email brucew@ecoaus.com.au

Dear Bruce

Adani Mining Pty Ltd v Land Services of Coast & Country Inc. & Anor
Land Court of Queensland Proceedings no. MRA428-14, EPA429-14, MRA430-14, EPA431-14, MRA432-14 and EPA433-01
Black-throated finch habitat

We refer to:

1 Mining Lease Applications (**MLAs**) 70441, 70505 and 70506 made by Adani Mining Pty Ltd (**Adani**);

2 the associated environmental authority application, as re-made on 14 April 2014;

3 the Environmental Impact Statement (**EIS**), Supplementary EIS (**SEIS**) and Additional Information to the EIS (**AEIS**) prepared for Adani and made publicly available under the *State Development and Public Works Organisation Act 1971* (Qld);

4 the draft Environmental Authority (**EA**) issued by the Statutory Party on 28 August 2011;

5 the Objection of Land Services of Coast and Country Inc. (**LSCCI**) to the MLAs dated 16 June 2014;

6 the Objection of LSCCI to the EA made 10 September 2014;

7 the submission (dated 17 June 2014) and objection (dated 25 September 2014) about the EA made by Debi Goenka of the Conservation Action Trust (**CAT**);

8 the Preliminary List of Issues for the LSCCI dated 2 December 2014;

9 your joint report, with Lindsay Agnew, Adrian Caneris and Mike Olsen dated 15 January 2015, in relation to the black-throated finch (**BTF**) (**First BTF JER**); and

10 your further joint report, with Lindsay Agnew, Adrian Caneris and Mike Olsen dated 27 February 2015, also in relation to BTF (**Second BTF JER**).

Instructions

11 We require you to provide a further statement of evidence under the *Land Court Rules 2000* (Qld) (**Rules**).

12 In accordance with orders made by the Court, your further statement of evidence is required by **Friday, 13 March 2015**.

Format of report

13 When preparing the further statement of evidence, and responding to the questions dealt with in section E below, please deal with the following:

SECTION A - Qualifications and Curriculum Vitae

14 Please attach your curriculum vitae to the report.

SECTION B - Material relied on in preparing the statement

15 Lists are sufficient for the statement, it would be useful to ensure that you (and we) have a copy of all the listed material when finalising your report. In particular, you should list:

(a) all material facts, written or oral, on which the statement of evidence is based; and

(b) reference to any literature or other material relied on by you to prepare the statement.

16 You do not need to list material you have **not** relied on.

17 Any inspection, examination or experiment conducted, initiated or relied on by you to prepare the statement must also be described. This can be done by reference to the calculation methodology as set out in your joint report, with any further explanation or clarification if necessary.

SECTION C – Background to Report

18 Please set out the extent of your previous involvement with the Carmichael Coal Mine Project (**Mine**). Specifically, we would like you to:

(a) indicate whether you were involved in the preparation of any material in support of the proposed Mine and, if so, provide details of that work;

(b) confirm that you have since been engaged by McCullough Robertson, on behalf of Adani, to provide an expert report in the Land Court proceedings;

(c) confirm that you have read this letter of instruction (and attach a copy of this letter of instruction to your report), and confirm that you understand your duties to the Land Court as an expert witness;

(d) confirm that, notwithstanding your previous relationship with the Mine (if any), you consider you are able to provide an informed, independent opinion about the matters contained within your Report.

SECTION D – Opinion on objections

19 Please review the objections and respond to any issues within your field of expertise which concern the MLAs and EAs.

20 In particular, we draw your attention to the grounds of each objection, which are set out below for convenience.

MLAs objection

The application for the mining leases under the Mineral Resources Act 1989 (Qld) (MRA) for the Carmichael Coal Mine (the mine) should be refused on the basis of the considerations stated in section 269(4)(c), (f), (i), (j), (k), (l) and (m) of the MRA:

1. *If the mine proceeds, there will be severe and permanent adverse impacts caused by the operations carried out under the authority of the proposed mining leases.*

2. *If the mine proceeds, the public right and interest will be prejudiced.*

3. *Good reason has been shown for a refusal to grant the mining leases due to the risk of severe environmental impacts and the lack of scientific certainty regarding those impacts.*

4. *Taking into consideration the current and prospective uses of the land, the proposed mining operation is not an appropriate land use.*

5. *There is an unacceptable risk that will there will not be an acceptable level of development and utilisation of the mineral resources within the area applied for because the mine, if it proceeds at all, is likely to cease to be economically viable within the term of the lease, resulting in some or all of the environmental impacts without realising the full economic benefits predicted.*

6. *The Applicant does not have the necessary financial capabilities to carry on mining operations under the proposed mining leases.*

7. *If the mine proceeds, the operations to be carried on under the authority of the proposed mining leases will not conform with sound land use management.*

8. *In the alternative to grounds 1-7 above, if the applications are not refused, conditions should be imposed to address the matters raised in grounds 1-7.*

EA application objection

The application for the environmental authority for the Carmichael Coal Mine (the mine) should be refused under the Environmental Protection Act 1994 (Qld) (EPA) on the basis of the considerations stated in ss 3, 5, 171 and 191 of the EPA and other relevant considerations having regard to the subject-matter, scope and purpose of the EPA:

1. *Approval of the mine is contrary to the object of the EPA stated in s 3 because approval and construction of the mine will not protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).*

2. *Approval of the mine would be contrary to the requirement in s 5 of the EPA for the administering authority and the Land Court to perform a function or exercise its power under the Act in a way that best achieves the object of the Act.*

3. *Approval and construction of the mine would be contrary to the precautionary principle, which is a principle of environmental policy as set out in the Intergovernmental Agreement on the Environment and, therefore, part of the standard criteria for the decision.*

4. *Approval and construction of the mine would be contrary to intergenerational equity, which is a principle of environmental policy as set out in the Intergovernmental Agreement on the Environment and, therefore, part of the standard criteria for the decision.*

5. *Approval and construction of the mine would be contrary to the conservation of biological diversity and ecological integrity, which is a principle of environmental policy as set out in the Intergovernmental Agreement on the Environment and, therefore, part of the standard criteria for the decision.*

6. *Approval and construction of the mine will cause environmental harm to the character, resilience and value of the receiving environment.*

7. *Approval and construction of the mine would be contrary to the public interest.*

8. *Approval and construction of the mine will cause material and serious environmental harm.*

9. *In the alternative to grounds 1-8 above, if the application is not refused, conditions should be imposed to address the matters raised in grounds 1-8 above.*

21 We also ask you to again review and consider those 'Facts and Circumstances' relied on in support of each objection that are relevant to your field of expertise pertaining to the BTF, namely:

(a) paragraphs 19 to 24 and 34 of the Facts and Circumstances in the MLAs objection; and

(b) paragraphs 18 to 24 and 29 of the Facts and Circumstances in the EA objection.

22 Please note that, pursuant to the Rules, your further statement may not:

(a) contradict, depart from or qualify an opinion in relation to an issue the subject of agreement in the joint reports; or

(b) raise a new matter not already mentioned in the joint reports.

Specific questions

23 We also ask that you also address the following specific questions:

(a) At:

(i) paragraph 6.7.5 of the First BTF JER; and

(ii) paragraph 6.19 of the Second BTF JER,

Mike Olsen states that the precautionary principle must be invoked in relation to this project. Please explain your understanding of the precautionary principle and its application, and discuss whether your understanding aligns with Mr Olsen's comments.

(b) At paragraph 6.7.7 of the First BTF JER, Lindsay Agnew acknowledges that little is known about BTF dietary patterns in the local area but that '*there is a larger body of information available in regard to BTF foraging habits in other parts of its distribution*'. He also refers to his response to issue 31, where (at paragraph 6.18.5) Lindsay Agnew states that he is 'aware' of 22 genera which provide known feeding resources. In relation to these claims:

(i) are you aware of the large body of work dealing with BTF foraging habits;

(ii) do you know the source of Lindsay Agnew's awareness of 22 genera which provide feeding resources for the BTF;

(iii) has Lindsay provided any reference material in this regard; and

(iv) do you know why Lindsay states at paragraph 6.6.1 of the Second BTF JER that there is evidence of BTF feeding on 23 different grass species (in contrast to his first statement).

(c) At paragraph 6.8.4 of the First BTF JER, Lindsay Agnew quotes from the Coordinator-General's report in saying that further work is required in order to 'fully understand' a number of matters about the BTF in the project area. In your experience, is this full understanding required to be obtained before primary approvals can be granted for the project? And if not why not.

(d) At paragraph 6.10.2.3 of the First BTF JER, Lindsay Agnew asserts that the revision of the habitat values assessment will likely indicate that previous impact calculations have underestimated offset liability for the BTF. Please provide your opinion in respect of this.

(e) At paragraph 6.10.4 of the First BTF JER, Lindsay Agnew states that it is not clear how the standard EEM might have been augmented to provide specific attention to the assessment of BTF requirements. Please respond to this, including stating whether or not it is appropriate or common place for the EEM to be augmented for a document such as the one in question. You might consider attaching the EEM to your report if it assists the discussion.

(f) Please outline in your report the specifications you refer to in paragraph 6.10.8, and highlight any specific areas in which you say the ELA assessments depart from the specifications.

(g) Please explain specifically how the ELA sampling effort conforms or does not conform with the guidelines (see paragraph 6.10.12 of the First BTF JER). Is the survey effort reasonable for the Project and location being considered?

(h) At paragraph 6.13 of the Second BTF JER, Mike Olsen states that it would be 'cavalier' to remove the known habitat from the proposed Mine site without a deeper understanding of why BTF are feeding there based on spatial or autecological data. In your understanding, does the draft EA allow for or require this to occur?

(i) Based on your understanding, would the addition of further grass species as contended for by Lindsay Agnew and Mike Olsen be likely to alter the results or ranking in the ELA documents?

24 In your further statement of evidence, the Rules also require that where:

(a) there is a range of opinion on matters dealt with, a summary of the range of opinion and the reasons why you have adopted a particular opinion be provided; and

(b) access to any **readily ascertainable** additional facts would assist you in reaching a more reliable conclusion, a statement to that effect be included.

25 In dealing with the points of disagreement in each joint report, and responding to the relevant Facts and Circumstances and grounds of the objections, please also specifically identify any relevant conditions of the draft EA and express your opinion as to the appropriateness of the draft condition or its relevance to the grounds of the objections.

26 Please also address the CAT submission and objection to the extent they are relevant to your field of expertise.

SECTION E – Summary of conclusions

27 The Rules require your further statement to provide a summary of the conclusions you have reached. In our view, this is often best presented in a separate, concluding section (or at the start of the statement).

SECTION F – Expert's confirmation

28 It is important that the report you prepare be an independent report prepared bearing in mind an expert witness' overriding duty to the court. The overriding duty encompasses the following points:

(a) You have an overriding duty to assist the Court on matters relevant to your area of expertise;

(b) You are not an advocate for a party, even when giving testimony that is necessarily evaluative rather than inferential; and

(c) Your paramount duty is to the Court and not to the person retaining you.

29 An example of the type of thing that might be said in this section is as follows:

(a) *I have read and understood relevant extracts of the Land Court Rules 2010 (Qld) and the Uniform Civil Procedure Rules 1999 (Qld). I acknowledge that I have an overriding duty to assist the Court and state that I have discharged that duty.*

(b) *I have provided within my report:*

(i) *details of my relevant qualifications;*

(ii) *details of material that I relied on in arriving at my opinions; and*

(iii) *other things as required by the Land Court Rules.*

(c) *I confirm that:*

(i) *the factual matters included in the statement are, to the best of my knowledge, true;*

(ii) *I have made all enquiries I consider appropriate for the purpose of preparing this statement;*

(iii) *the opinions included in this statement are genuinely held by me;*

(iv) *this statement contains reference to all matters I consider significant for its purpose;*

(v) *I have not received or accepted any instructions to adopt or reject a particular opinion in relation to an issue in dispute in the proceeding.*

(d) *If I become aware of any error or any data which impact significantly upon the accuracy of my report, or the evidence that I give, prior to the legal dispute being finally resolved, I shall use my best endeavours to notify those who commissioned my report or called me to give evidence.*

(e) *I shall use my best endeavours in giving evidence to ensure that my opinions and the data upon which they are based are not misunderstood or misinterpreted by the Land Court.*

(f) *I have not entered into any arrangement which makes the fees to which I am entitled dependent upon the views I express or the outcome of the case in which my report is used or in which I give evidence.*

Confidentiality

30 Any report generated by you should remain in draft until such time as we are in a position to discuss the contents of the report with you. We ask that the report be kept strictly confidential as it is to be used for the purpose of obtaining legal advice or for use in legal proceedings. You are not authorised to provide these instructions or your report to any other person or party.

If you would like any further material, or have any questions, please contact us.

Yours sincerely

Peter Stokes
Partner

attachment