Guide to determining terrestrial habitat quality

A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy

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Great state. Great opportunity.

Queensland Government

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Contents

1 Purpose and application of this guide

This guide has been developed by the Department of Environment and Heritage Protection (EHP) to assist proponents measuring the habitat quality of a land based offset under the Queensland Environmental Offset Policy (QEOP). The guide is based on the methodology set out in the BioCondition Assessment Manual and BioCondition benchmarks, as developed by the Queensland Herbarium. 'Habitat quality' is the currency for measuring these values based on three key indicators, site condition, site context and species habitat index. This approach aligns with the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA) Environmental Offsets Policy measure of 'habitat quality' and is intended to provide a consistent framework for environmental offsets in Queensland.

The purpose of this guideline is to provide a methodology for proponents for determining the habitat quality of sites under the Queensland Environmental Offsets framework. The guideline is used as a step-by-step methodology explaining how to measure habitat quality for land-based offsets for the following items under Schedule 2 of the Environmental Offsets Regulation 2014:

- Regulated Vegetation (Schedule 2 Section 2)
- Protected Wildlife Habitat (Schedule 2 Section 6(4))
- Advanced offsets for Regulated Vegetation and Protected Wildlife Habitat.

For impacts on bushland koala habitat, high value rehabilitation koala habitat and medium value rehabilitation koala habitat in South East Queensland (Schedule 2 Section 6(3) of the Environmental Offsets Regulation 2014), the only required analysis is the number of non-juvenile koala habitat trees present.

A land-based offset involves securing and managing a parcel of land in order to provide a conservation outcome for impacted prescribed environmental matters. Habitat quality is an essential part of the assessment of a land-based offset. Habitat quality is assessed to ensure that an offset site is of a suitable quality and can achieve a gain in habitat quality sufficient to compensate for a significant residual impact at the impact site.

Use of this guideline is mandatory unless an alternative approach is approved by EHP. Note any alternative methodology will have to demonstrate that it can achieve measurable comparative habitat quality score that can be replicated, and can demonstrate capacity to meet the rules for a conservation outcome in this guideline (see sections 3 and 4).

2 Habitat quality assessment

Habitat quality is assessed through a strategic combination of indicators that measure the overall viability of the site and its capacity to support a prescribed environmental matter. The process for assessing habitat quality is designed in a simple and repeatable way. The process includes mapping, field measurements and simple calculations to score the indicators. The assessment must measure habitat quality at the impact site and the offset site in order to quantify and compare scores. Each of the three indicators are scored, then summed and translated to a final score out of 10. This process is undertaken using either the rapid or standard assessment process in sections 3 and 4 respectively.

The key indicators for determining habitat quality of a land based impact site or an offset site are:

- site condition: a general condition assessment of vegetation compared to a benchmark
- site context: an analysis of the site in relation to the surrounding environment
- species habitat index: the ability of the site to support a species.

The variance in structure, function and quality of habitat on an impact or offset site is accounted for by delineating sites into 'assessment units' based on broad condition state and distinct1 regional ecosystems. Once the habitat quality of an offset site has been determined it is then assessed based on its ability to improve and provide a conservation outcome for the impacted matter.

2.1 Habitat quality scoring

A land-based offset site must be considered an equivalent replacement of the habitat values lost at the impact site. The habitat scoring system involves scores out of 10, whereby a maximum score of 10 represents a fully intact system, scores of 4, 5 and 6 may indicate good quality regrowth or medium value habitat, and a minimum score of 1 would indicate a totally cleared area.

2.2 Types of habitat quality assessments

In order to measure habitat quality, three indicators—site condition, site context and species habitat index—are combined. Site condition and site context are measured for all sites, while species habitat index is only included when impacted matters include Protected Wildlife Habitat. Each indicator is scored and the sum of the scores determines the final habitat quality score for any given site. The following formula is used:

Site condition + Site context + Species habitat index
= Habitat quality score (measured)

For the impact site, a proponent may choose to assess habitat quality using one of two methods:

- the rapid assessment process, or
- the standard assessment process.

The standard assessment process requires both field-based and desktop type assessment, whilst the rapid assessment process requires only a desktop assessment.

For the offset site, a proponent must assess habitat quality using the standard assessment process.

1 A 'distinct' regional ecosystem refers to one regional ecosystem type.

3 Rapid assessment process (impact site only)

The Rapid assessment process assumes an impact site habitat quality score of 7.

This score represents an average score of a generic remnant regional ecosystem in Queensland. It is derived from Queensland Herbarium expert analysis and from Broad Vegetation Group (BVG) data obtained from the EHP offsets financial calculator.

It is important to note that conducting a rapid assessment process is only applicable to the impact site and cannot be used to predict the values at the offset site. The offset site must be assessed using the standard assessment process. The rapid assessment process is particularly useful where time and resources are limited and/or the impact site is not a degraded site.

In order to achieve a conservation outcome, the following rules[2] must be followed in delivering a land-based offset:

1. After 20 years, the offset site habitat quality score must be at least 1 point greater than the impact site habitat quality score (at the time of impact)[3]; and
2. After 20 years, the offset site habitat quality score must have achieved an overall habitat quality score gain of 2 points.

4 Standard assessment process

The standard assessment process is identical for both the impact and offset sites. After calculating the habitat quality score of the impact site, this score can be input into the Land-based Offsets Multiplier Calculator to determine an offset size multiplier based on the applicable BVG or Species Functional Group. This multiplier can be used to determine the appropriate size of the offset site relative to the size of the impact. Note that the Land-based Offsets Multiplier Calculator uses fixed assumptions based upon the Commonwealth offset assessment guide, and on data provided by the Queensland Herbarium. These include assumptions about confidence in result and the predicted future quality with and without an offset. Offset applications that propose a conservation outcome at a lower multiplier than that calculated by the Land-based Offsets Multiplier Calculator will be considered on a case-by-case basis.

In order to achieve a conservation outcome, the rules as outlined in Section 3 above must be followed.

The following information and equipment are recommended prior to undertaking the field-based component of the standard assessment process.

[2] Note that an offset delivery plan which proposes a habitat quality condition gain of more than 2 points is likely to incur greater costs than standard management actions would normally require and include higher levels of uncertainty in regards to successful delivery. Plans that propose to achieve a habitat quality score of 9 or 10 will need to clearly demonstrate the actions to achieve this and the subsequent assessment of the plan will include appropriate scrutiny given the difficulty and uncertainty of achieving the proposed condition.

[3] In instances where this would require an offset site to achieve a habitat quality score of higher than 10 after 20 years, then a score of 10 must be achieved.

Recommended field equipment

- 100m transect tape
- 1m x 1m quadrat for measuring ground cover (or one–metre–long sticks)
- compass (to lay out the area)
- star pickets for the zero metre and 50m point along the transect for relocating the area
- flagging tape
- a diameter tape or a smaller measuring tape
- benchmark documents for each of the regional ecosystems assessed (these can be found on the EHP website at http://www.ehp.qld.gov.au/) (a reference site should be used where there is no available benchmark; see Appendix 11.4)
- a clinometer, hypsometer or ruler for measuring tree heights
- a camera
- clipboard, pencils and erasers
- Global Positioning System (GPS) receiver unit
- copies of the field assessment sheet
- Regional Ecosystem technical descriptions which can be found on the EHP website, RE descriptions also available from an EHP business centre.
- 50m transect tape (optional)
- flagging tape (optional)
- plant identification books (optional).

4.1 Assessor variation

Significant variation can occur between persons undertaking field assessment regardless of expertise or experience (Kelly et al, 2011). A minimum of two assessors is recommended to compare results. Where there is variation amongst assessors, it is best to average the results. However, if there is significant variation amongst assessors, it is recommended that assessors compare and review their methods to identify and correct any differences or deficiencies in the approach. In the event of further variation in results, guidance should be sought from an experienced assessor.

The habitat quality assessment provides a methodology which should yield consistent scoring across sites even when different assessors are involved. However, consistency is best when the same assessor(s) carries out the habitat quality assessments at both the impact site and offset site.

4.2 Desktop assessment

Prior to undertaking any field based assessment, it is recommended that a standard desktop assessment of the impact and or offset site is undertaken. This desktop assessment should quantify the full range and extent of ecosystems and threatened species records present both on site and in the surrounding landscape. A desktop assessment can save time and money by ensuring proper preparation before commencing the field assessment. A desktop assessment can include a review of mapping material to identify assessment units, but can also assist to identify logistics of travel and any potential safety risks. Maps and tables produced through this assessment are crucial in planning the extent of field work required to meet the requirements of the habitat quality guide.

4.3 Prepare a map to define the assessment units

Units of assessment are mapped to determine where the sample sites will be and how many are required to adequately assess the site's condition. Assessment units are relatively homogenous, defined by a distinct regional ecosystem (RE) and isolation from other patches of vegetation. The steps in this process are:

1. Create a digital map that reflects the vegetation communities on the ground and their extent. Also include important landmarks such as roads, fences, watering points and property boundaries.

2. Divide the map into assessment units (the minimum assessment unit size should be 1 hectare (ha)) taking note of the following to assist in defining boundaries:

- ensure the area is a distinct RE or species habitat; or

- whether the RE or species habitat is isolated from other patches of vegetation.

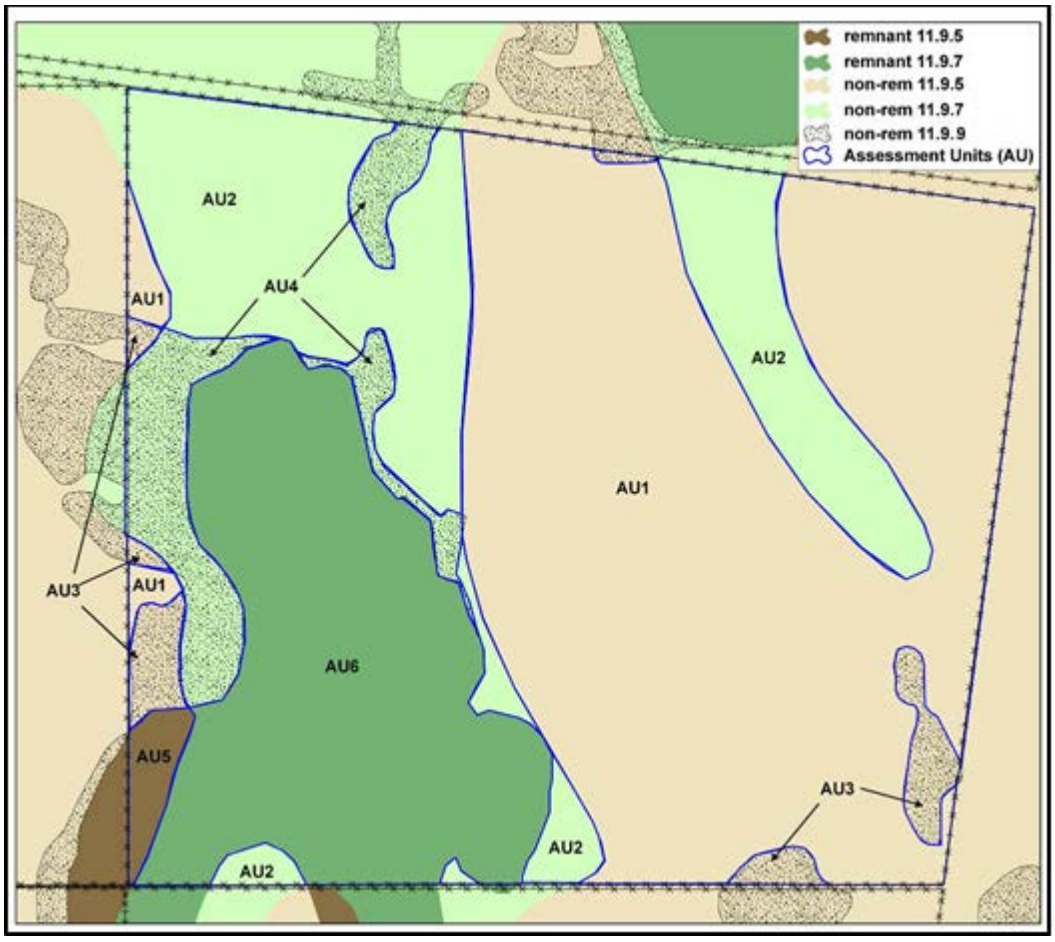


Figure 1: An impact area divided into assessment units (Eyre et al. 2011a)

4.4 Assessing field-based attributes

Once the assessment units have been defined, sampling sites within each assessment unit need to be selected. These sampling sites should be placed within the assessment unit in a way that represents the typical structure and function of the habitat or ecosystem. As a guide it is best to aim for two to five randomly selected sampling sites per assessment unit, depending on the size of the unit. A random sampling site selection methodology may be to generate a coordinate for the 50m point i.e. the centre of the plot to be used in the site condition analysis. The bearing for the 100m axis should then follow the contour, or topographic position (e.g. gully, midslope, ridge).

Table 1: Guide to number of sampling sites relative to assessment unit size

Assessment unit size	Suggested number of sampling sites
0–50 hectares (ha)	At least two
50–100ha	Three
100–500ha	Four
500–1000ha	Five
More than 1000ha	Six

It may be possible to reduce the number of sampling sites if it can be demonstrated that different assessment units containing the same RE are in the same condition. See Box 1 and Figure 2 about streamlining field sampling sites.

Box 1 – Streamlining field sampling sites

Field assessment across a single assessment unit containing discrete polygons can be streamlined if it can be demonstrated that each polygon is uniform or in the same general condition. Evidence to be supplied to the decision maker may include recent remote sensing or aerial imagery and must be supported by sufficient photographic evidence and the GPS location of the sites.

Once the evidence has been recorded, the individual site measurements are no longer necessary and the total number of sampling sites can be reduced. For example, an impact site within an intact landscape may have an assessment unit in six separate areas (consisting of the same remnant RE) over a 2000ha extent. This could be reduced by half by sampling just three representative sites where photographic evidence and aerial imagery demonstrates the uniformity and consistency in site condition across the impact area.

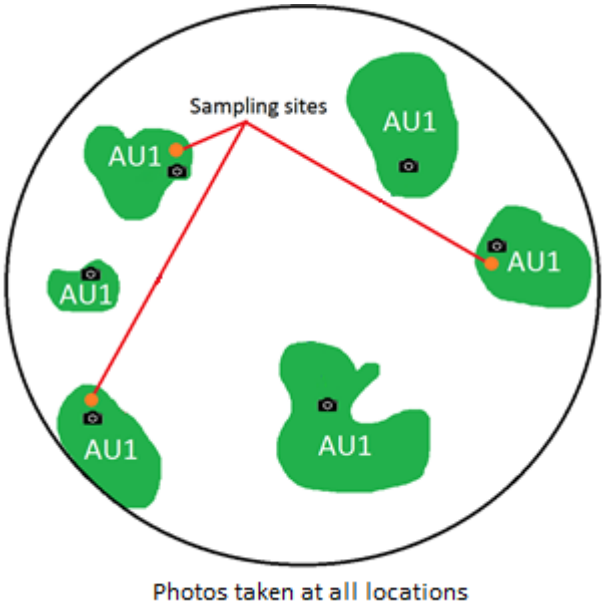


Figure 2: Diagram explaining field streamlining as outlined in Box 1

Sampling sites should be located in areas typical of the assessment unit. For example, sampling sites should not be located in weedy, disturbed roadside areas where the rest of the assessment unit is relatively undisturbed.

When undertaking a field assessment it is best practice to take photographic evidence at each assessment unit facing north, south, east and west. This evidence will support the findings of each site and should be supplied to the decision maker.

5 Site condition assessment

Bird nest fern in a tall rainforest tree, Kuranda National Park, Far North Queensland

Wait-a-while vine covering rainforest trees, Kuranda National Park, Far North Queensland

Pumpkin Gum (*Eucalyptus pachycalyx*) – a rare gum tree near Irvinebank, Far North Queensland

Photographs by G. Mogridge.

5.1 Introduction

An integral step in determining whether an offset site is suitable is to establish its capacity to support the prescribed environmental matters requiring an offset. The on-site condition is a key element of habitat quality and has a direct influence on the biodiversity it supports. Site condition is assessed using a suite of attributes to describe the structure and function of the vegetation community, compared to the expected range for a relatively undisturbed community.

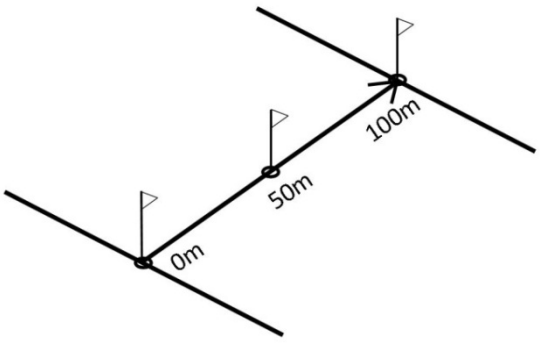
5.1.1 How to measure field based attributes

After completing the desktop component of the site condition assessment, it is assumed that verification and ground-truthing of the desktop information will occur. As part of the verification and ground-truthing process, it may be necessary to refine the assessment unit mapping to reflect any on-ground variation. It will also be useful for assessors to have an understanding of the historical use of the site/s prior to undertaking field-based assessment.

Please note that the following steps can be undertaken in any order (except Step 1 which must be completed first) and attributes can be measured in combination, if the assessor believes this will improve efficiency. However, to complete this assessment, each attribute must be measured accurately. There are six steps and 13 attributes to measure. The 13 attributes are scored using Table 2—Guide for site condition scoring sheet.

Step 1: Lay out the plot

- Lay a 100m transect line following the contour of the land (i.e. along a slope as opposed to up or down a slope).
- Mark the 50m point on the transect line with a star picket or temporary marker—this point acts as the centre of the plot.
- From the 50m point:
  - Record the area number, on-ground regional ecosystem, date of assessment and the property or location name, and GPS location.
  - Take landscape photos[4] along and perpendicular to the transect line, to provide a record of the tree and shrub layers and the general condition of the area.



[4] The standard camera lens length is 50mm.

From the zero (0m) point, use a compass to record the direction (compass bearing) the transect follows and record the location of this point using GPS.

Step 2: Tree species richness, tree canopy height, recruitment of woody perennial species and number of large trees

For steps 2-6 a copy of the benchmark document should be available. In the absence of an available benchmark, a reference site should be used (see Appendix 11.4 for details).

- Measure and mark out 25m either side of the transect line to create a large 100m x 50m plot. Four attributes are measured within this plot area.
- Refer to the benchmark document to determine if there are separate benchmarks for the canopy, emergent and/or sub-canopy layers (see Figure 3 for visual illustration of these layers). If more than one layer is identified in the benchmark document, then assessment of each layer is required for the canopy height and cover attributes.

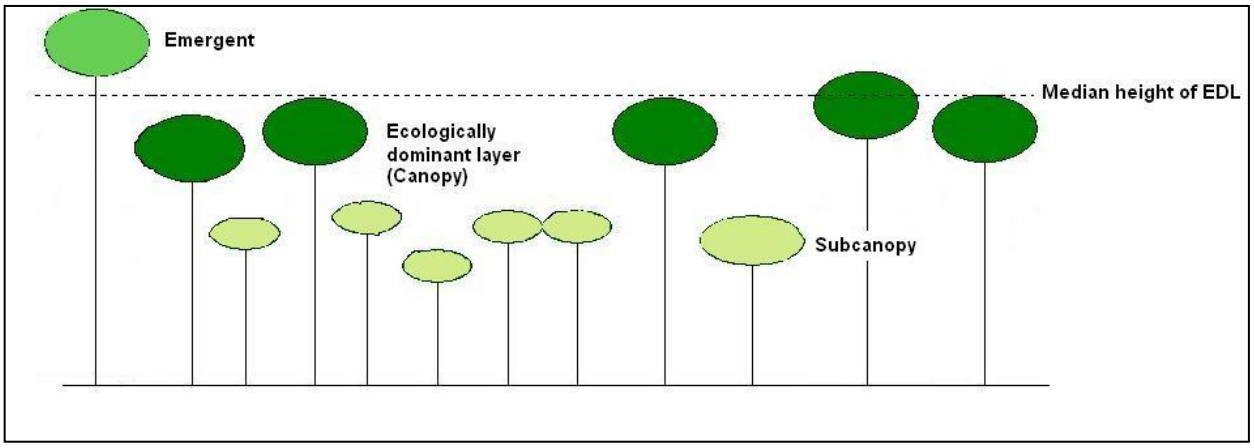
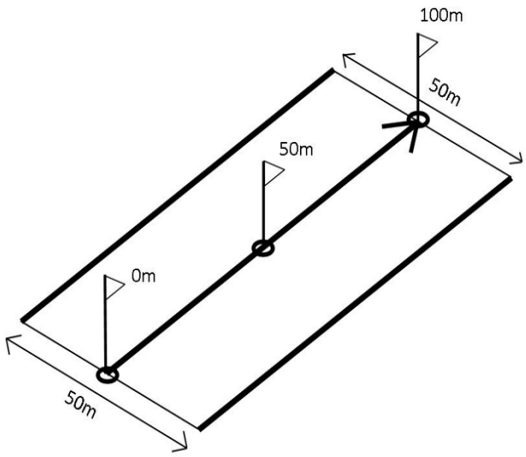


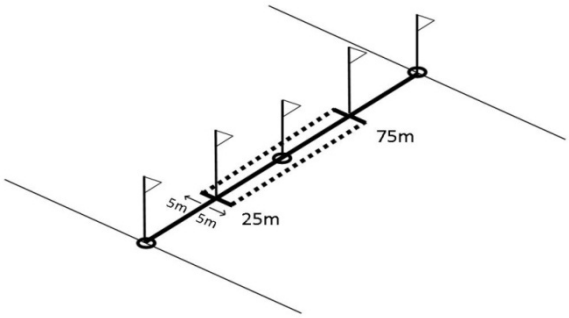
Figure 3: Example of determining the median height of the ecologically dominant layer (Eyre et al. 2011a)

- Assess the 'number of large native trees' by counting the number of trees over a certain size threshold, as recorded on the benchmark document for the regional ecosystem being assessed. If no benchmark exists for the regional ecosystem of interest, use the threshold of 30cm diameter at breast height (DBH) for 'eucalypt' trees (genera Eucalyptus, Corymbia, Lophostemon and Syncarpia) and 20cm DBH for 'non-eucalypts'. A consistent approach should be applied to determine if trees fall into these classifications. For a species of tree that typically occurs in multi stemmed form, branching below 1.3m, within the particular regional ecosystem that is measured, at least one of the stems must meet a threshold of 20cm DBH, where no benchmark exists.
- Assess 'recruitment of woody perennial species' by observing the proportion of the ecologically dominant layer species regenerating (<5cm DBH). One individual is required for each species to be counted as considered present. For example, if there are four dominant species of trees recorded in the benchmark then four species need to occur as regeneration to make up 100%.
- Assess native 'tree canopy height' by using a clinometer or hypsometer. Measure the height of trees in the ecologically dominant layer at the highest leaf in metres and determine the median canopy height. The median canopy height is the height that has 50% of canopy trees larger and 50% smaller than it.



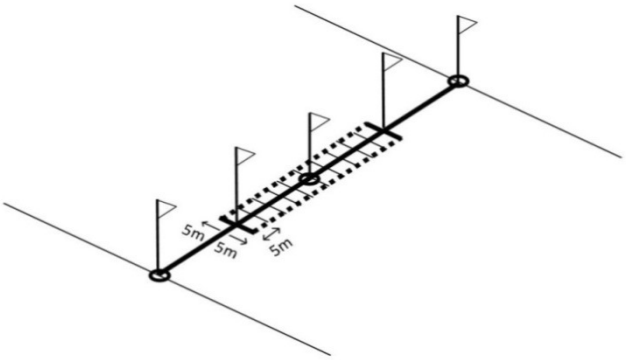
- Where the data is available in the benchmark for emergent and sub-canopy, assess 'tree canopy height' for these layers as well. In this instance, when determining the score for 'tree canopy height' this will be based on the average score from all tree canopy layers, for example, the median height for the emergent, sub-canopy and canopy layers.
- Assess native 'tree species richness' by counting the number of different native tree species present.

Step 3: Native species richness and non-native plant cover



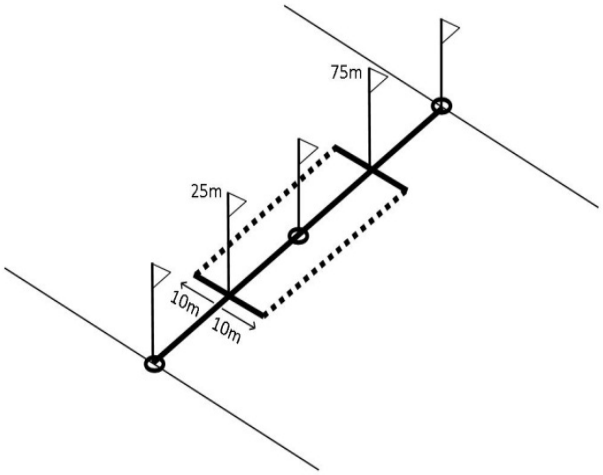
- Mark out the 25m and 75m points along the transect, for example with a star picket or flagging tape.
- Measure 5m either side of the transect at this point to create a 50m x 10m plot.
- Assess 'native plant species richness' by slowly walking along the plot, looking each side of the centre-line and tallying the number of species in each of the three life-forms: shrubs[5], grasses and forbs/other.

(This step does not include 'tree species richness' which is assessed in another step).



- Assess all 'non-native plant cover' by estimating the cover of exotic species over the 50m x 10m plot. The estimate can be improved by dividing this plot into 20 smaller 5m x 5m sub-plots (10 each side of the transect line) and then determining the average across all 20.

Step 4: Coarse woody debris



- At the 25m and 75m points along the transect line, measure 10m either side of the centre line to create a 50m x 20m sub-plot.
- 'Coarse woody debris' is assessed by measuring the total length of all logs within the sub plot that are:

o > 10cm diameter (only measure that component of the log that is > 10cm and within the sub plot); and

o > 0.5m in total length; and

o > 80% per cent in contact with the ground.

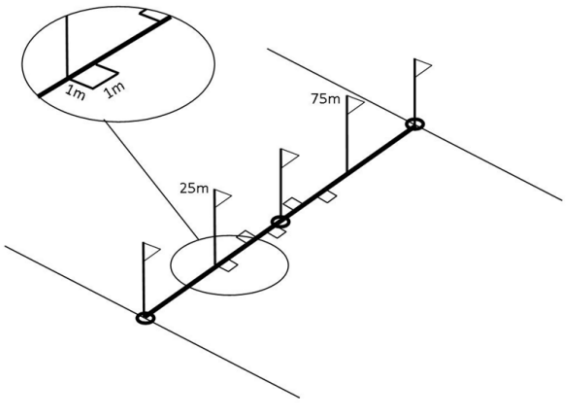
Additionally:

o only record the length of the log measured to the boundary line of the subplot.

o Note that the total measured value is multiplied by 10 for comparison with the benchmark (which is a metre per hectare value)

[5]Shrubs take their definition from the published benchmark document. Where a benchmark document does not exist and the proponent is relying on a reference site, then shrub will take its ordinary or common meaning. Where there is subjectivity in this meaning, for example, Mulga can exist as both a shrub and a small tree, it can be circumvented by applying the same definition to both the impact and offset site.

Step 5: Native perennial grass cover, organic litter



- Starting at the 25m point, mark out and measure five 1m x 1m squares located 10m apart on alternate sides—along the transect line until the 65m point.
- It may be acceptable to move the squares one metre up or down the transect line where an obstacle such as a tree or large log is present.
- 'Native perennial grass cover' refers to the percentage cover of native perennial grasses, assessed within each of the five 1m x 1m square and averaged to give a value for the area. Measure the complete coverage of all types of native perennial grass cover within the squares.

- 'Organic litter' is assessed by estimating the cover of fine and coarse organic material such as fallen leaves, twigs and branches <10cm diameter within the five squares. The organic litter score is the average of the five squares.
- Take spot photos at each square to document change in ground cover over time.
- Figure 4 below provides a visual guide to determining the percentage of cover.

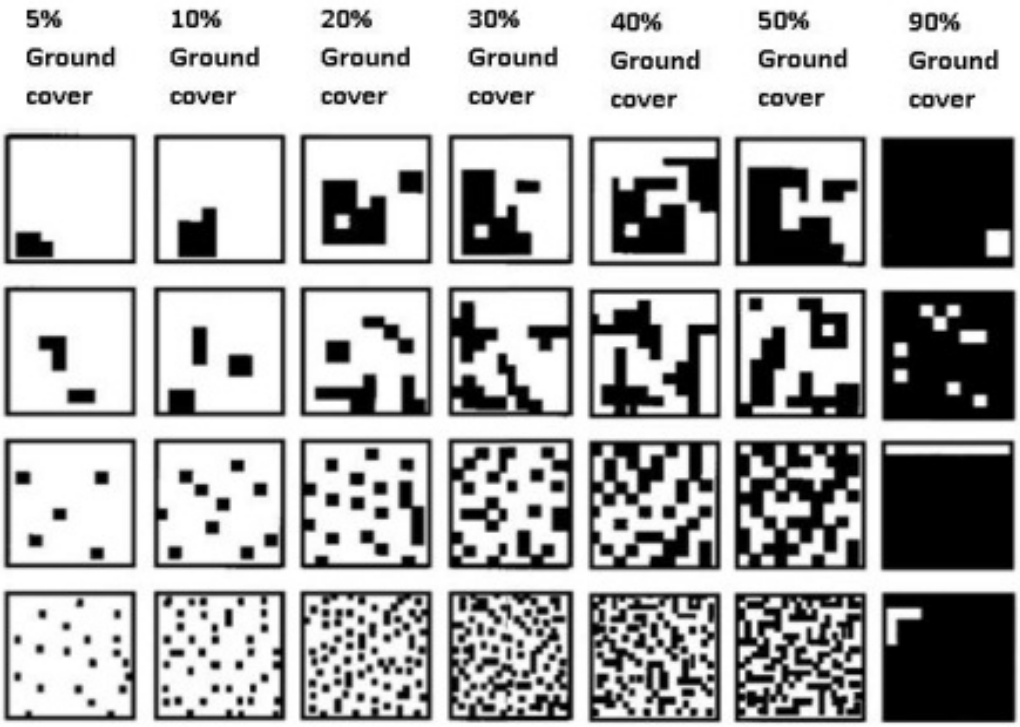
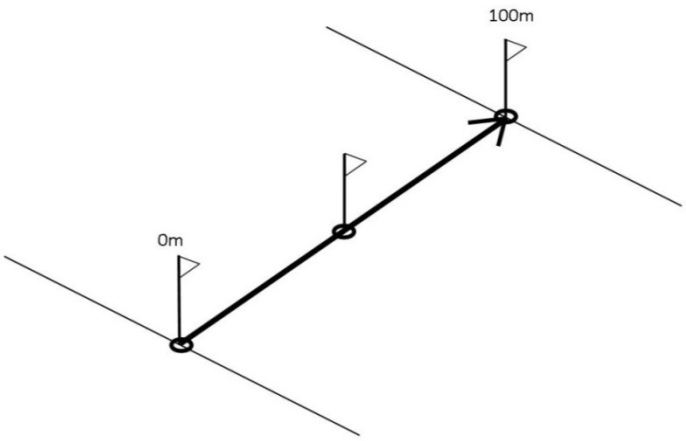


Figure 4: Examples of ground cover percentage in 1m x 1m plot (adapted from Eyre et al. 2011a)

Step 6: Tree canopy cover and shrub canopy cover



- Estimate 'tree canopy cover' as the percentage of living, native trees within the ecologically dominant layer with a canopy that overlaps the 100m transect line.
- Walk along the transect line looking upwards and record the start and finish distance of the tree canopy to determine the percentage of cover over the 100m transect line (line intercept method as shown in figure 5). Where the canopies of multiple trees overlap each other this is identified as continuous unbroken cover. For sparsely canopied trees the cover is counted as continuous for the one tree.

- Record canopy cover of the emergent and sub-canopy layers if present in the benchmark. When measuring the score for 'tree canopy cover' this will be the average score for each tree canopy cover layer. For example, the scores obtained for the emergent, sub-canopy and canopy layers.
- Where multiple layers exist, care must be taken to measure the cover relevant to that layer being measured.
- Assess 'native shrub canopy cover' using the same line intercept method. Shrub canopy cover can be assessed from above the canopy if it is below eye level.

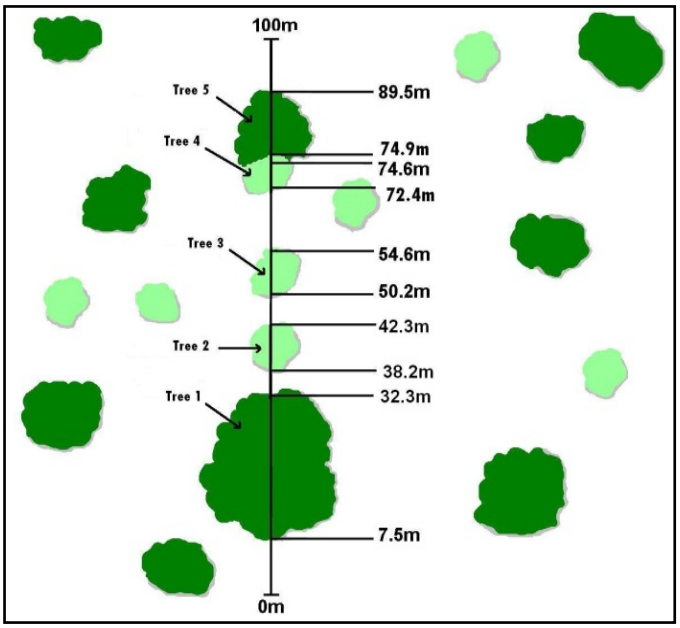


Figure 5: Line intercept method for measuring canopy cover—note that sparsely crowned individuals should also be counted as continuous cover (Eyre et al. 2011a).

Step 7: Compare the benchmark data and score

- Compare the values recorded at the site against the relevant 13 attributes for the benchmarked regional ecosystem.
- Use Table 2—Guide for Site Condition scoring sheet to determine what class range the value falls within.
- This percentage of the benchmark corresponds to a certain score. Enter the score into the assessment scoring sheet.
- For example, as depicted in Figure 6, the benchmark for the attribute 'tree canopy height' for a particular regional ecosystem is 16m. The measured value for this attribute from step 2 of the field assessment is 10m. This value falls within the class range [>25–70%] of the benchmark for attribute 6 of Table 2. The score associated with this class range is 3 and it is entered into either the Habitat Quality Scoring Template, (which automatically calculates the score), or the habitat quality assessment scoring sheet in Appendix 11.1 and 11.2, (where calculations must be done manually). If undertaking manual calculations, continue onto Step 8 below. Note, in the absence of benchmark data, a reference site is required (see Appendix 11.4 for details).

Tree canopy height (Table 2)	**Score**	**0**	**3**	**5**
	Benchmark is 16m	<25%	>25–70%	>70%

Tree canopy height (site assessment)	**Score**	**0**	**3**	**5**
	Recorded value is 10m	<4m	≥4 – ≤12m	>12m

Figure 6: Example of scoring an attribute against a benchmark

Step 8: Scoring sheet input

Compare the values observed for each attribute during the field assessment against the relevant benchmark class ranges from Table 2. Input the scores into the relevant site condition assessment sheet provided in Appendix 11.1 and 11.2. Summing these scores will determine the overall score for site condition for the assessment unit.

Table 2 - Guide for site condition scoring sheet

1 Recruitment of woody perennial species in EDL*	**Score**	**0**	**3**	**5**
	Benchmark	<20%	>20–75%	>75%
2 Native plant species richness—trees	Score	2.5	3	5
	Benchmark	<25%	>25–90%	>90%
3 Native plant species richness—shrubs	Score	2.5	3	5
	Benchmark	<25%	>25–90%	>90%
4 Native plant species richness—grasses	Score	2.5	3	5
	Benchmark	<25%	>25–90%	>90%

5 Native plant species richness - forbs	Score	2.5	3		5
	Benchmark	<25%	>25–90%		>90%
6 Tree canopy Height	Score	0	3		5
	Benchmark	<25%	>25–70%		>70%
7 Tree canopy cover	Score	0	2	3	5
	Benchmark	<10%	>10%–<50%	>200%	>50%–<200%
8 Shrub canopy cover	Score	0	3		5
	Benchmark	<10%	≥10%–<50% or >200%		>50%–<200%
9 Native perennial grass cover	Score	0	1	3	5
	Benchmark	<10%	>10–50%	>50–90%	>90%
10 Organic litter	Score	0	3		5
	Benchmark	<10%	≥10%–<50% or >200%		>50%–<200%
11 Large trees	Score	0	5	10	15
	Benchmark	0%	0–50%	>50–100%	>100%
12 Coarse woody debris	Score	0	2		5
	Benchmark	<10%	<50% or >200%		>50% or <200%
13 Non-native plant cover[6]	Score	0	3	5	10
	% of weed cover	>50%	>25–50%	>5–25%	<5%

*Ecologically dominant layer

[6] For non-native plant cover scoring: the percentages do not represent a score against a benchmark; rather, this should be assessed as a percentage of the cover of exotic species within the plot. This is because the benchmark for non-native plant cover for any ecosystem type is zero.

6 Site context assessment

Farmland and scenery near Warwick, Southern Downs, Queensland

Scenery in Almaden, Far North Queensland

Photo taken from the top of the 'Green Ladder', looking north over Cairns Airport, Far North Queensland

6.1 Introduction

The surrounding landscape and adjacent land uses can directly influence the quality and security of habitat through edge effects, environmental buffering, or threatening processes (Jurskis et al 2005). An offset site with limited threats and a complementary environmental setting (such as highly vegetated surroundings) will have greater potential for success in achieving the desired management outcomes. Site context is measured using a suite of attributes to describe the location of the habitat within the surrounding landscape and the influence of its associated threats. This assessment also considers the influence of adjacent vegetated areas and ecological corridors.

6.2 Undertaking a site context assessment

There are 7 steps. When assessment requires referral to Geographic Information Systems (GIS) mapping, relevant spatial data can be downloaded from the Queensland Government Information Service (QGIS) website at www.information.qld.gov.au and click on 'Queensland Government information service'. Alternatively, contact Regional EHP offices with details available on the EHP website www.ehp.qld.gov.au (search for 'business centres').

Step 1: Assessment of GIS attributes for site context

Site context attributes are measured via desktop assessment using GIS mapping and spatial analysis. The first step is to determine whether the site is located within a fragmented or intact subregion in Queensland. Fragmented subregions are defined as containing 30–95% non-remnant vegetation, while intact subregions are defined as containing less than 30% non-remnant vegetation. A map of fragmented and intact subregions is provided in figure 7 (below), and a complete listing of subregions is provided in Appendix 11.6.

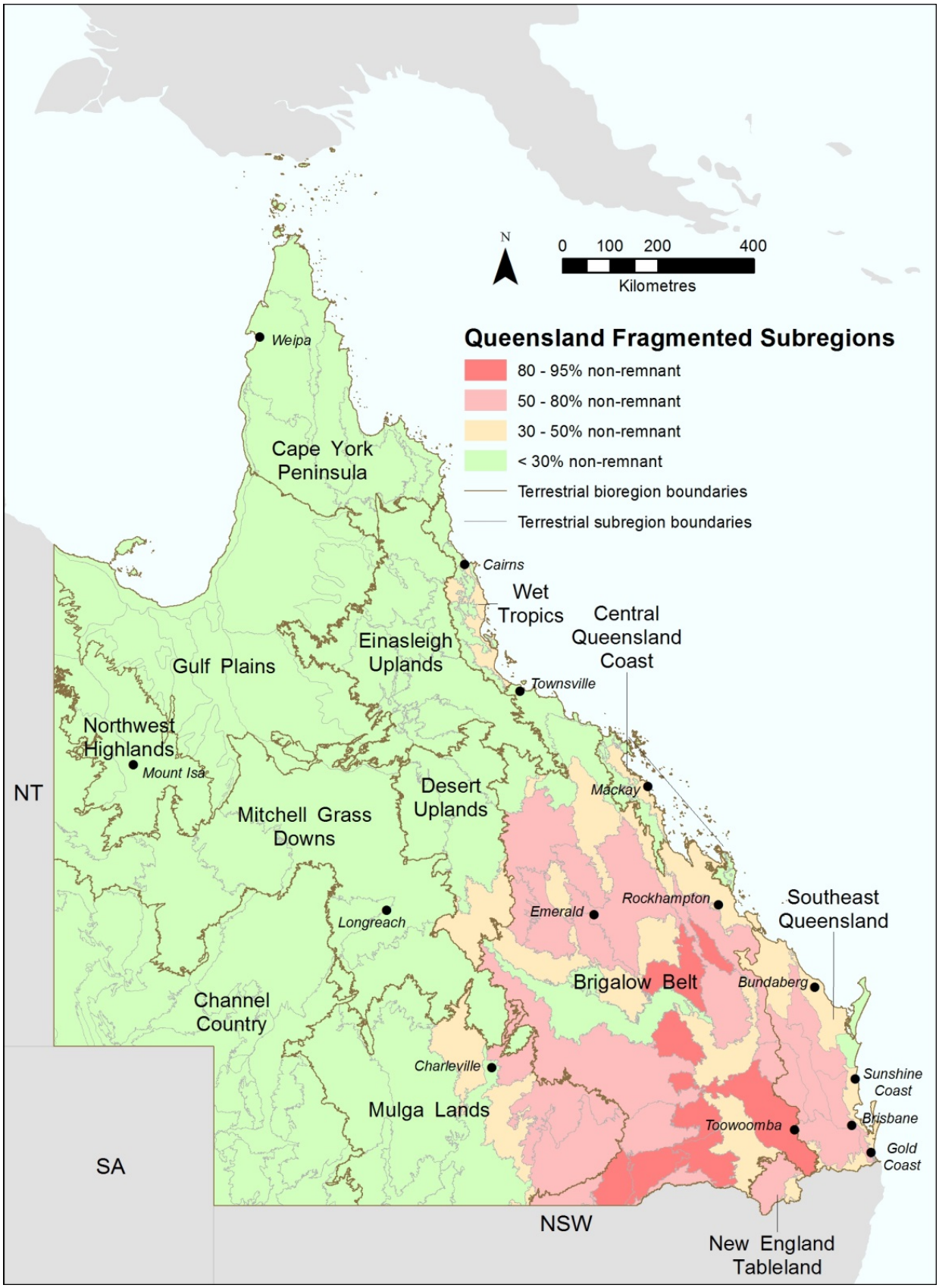

N
0 100 200 400
Kilometres
Queensland Fragmented Subregions
80 - 95% non-remnant
50 - 80% non-remnant
30 - 50% non-remnant
< 30% non-remnant
Terrestrial bioregion boundaries
Terrestrial subregion boundaries
Weipa
Cape York Peninsula
Cairns
Wet Tropics
Central Queensland Coast
Einasleigh Uplands
Gulf Plains
Townsville
Northwest Highlands
Mount Isa
NT
Desert Uplands
Mackay
Mitchell Grass Downs
Rockhampton
Emerald
Southeast Queensland
Longreach
Brigalow Belt
Bundaberg
Channel Country
Charleville
Sunshine Coast
Mulga Lands
Brisbane
Toowoomba
Gold Coast
SA
NSW
New England Tableland

Figure 7 - Intact (<30% non-remnant) and Fragmented (30–95% non-remnant) Subregions of Queensland

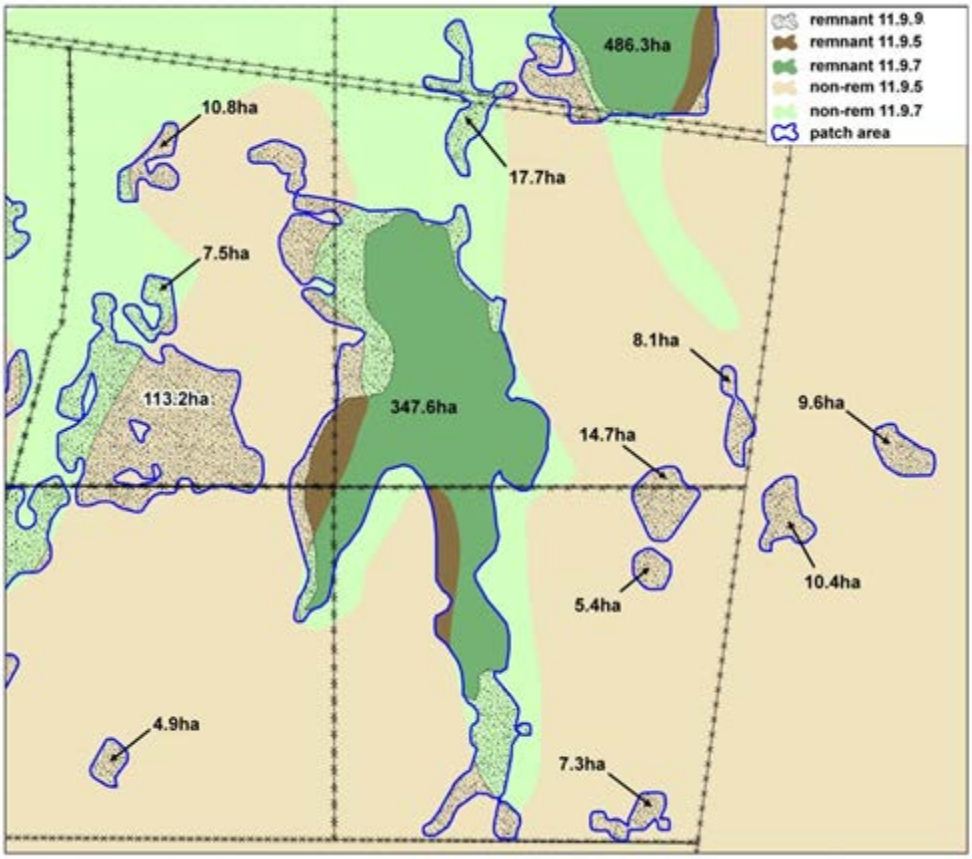


Figure 8 - Calculating patch size

Step 2: Patch size

This attribute is only scored for fragmented landscapes. Patch size is the size of the patch being assessed and any directly connecting remnant vegetation. This indicator can be measured using GIS.

To calculate the patch size score:

1. Measure the area of vegetation in which the assessment unit is contained, and add on all other directly connecting areas of mapped remnant vegetation.
2. Determine the score for this attribute by matching with the class ranges in Table 3.

Step 3: Connectedness

This attribute is only scored for sites within the fragmented subregions listed in Appendix 11.6. The assessment involves measuring the proportion of the site's boundary which is connected to remnant vegetation. This attribute can be measured using GIS. An example of calculating this attribute is provided in Figure 9.

To calculate the connectedness score:

1. Measure the length of remnant vegetation that is along the boundary of the site.
2. Determine the score for this attribute by matching with the class ranges in Table 3.

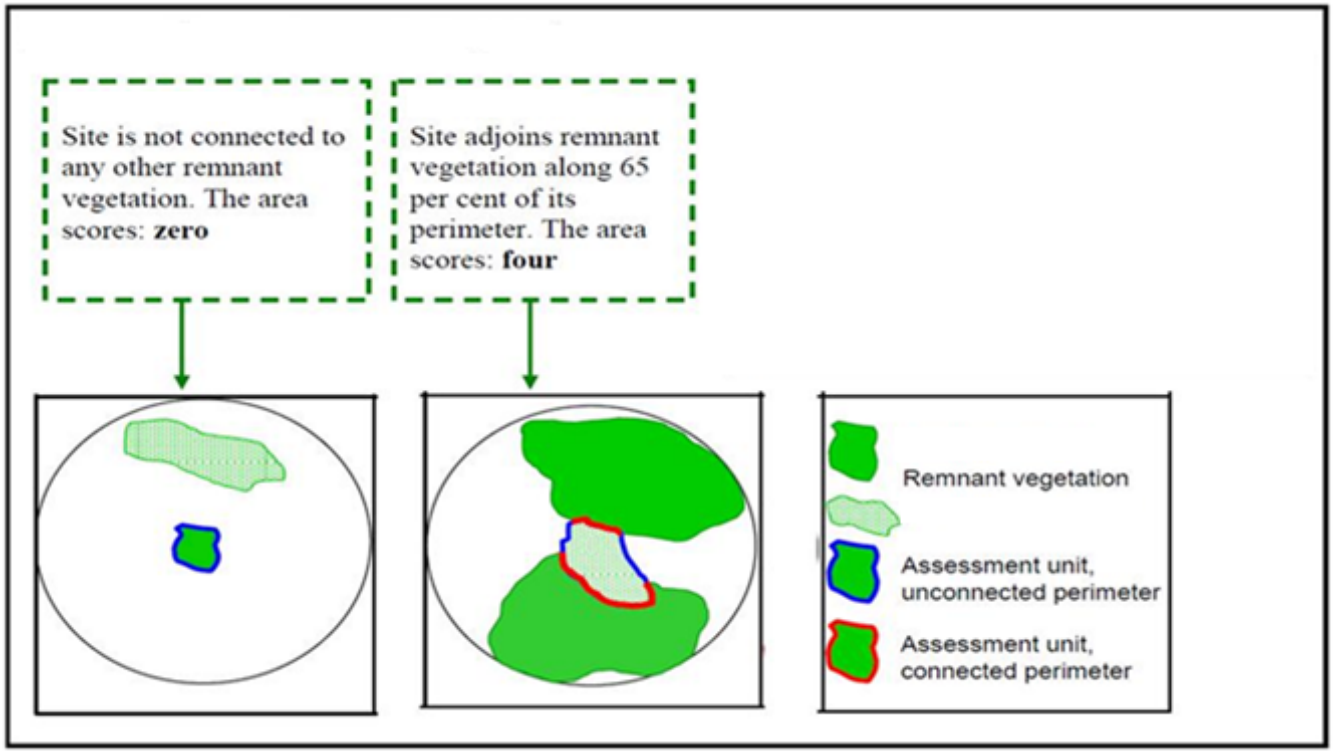


Figure 9: Scoring connectedness (adapted from Eyre et al. 2011a)

Step 4: Context

This attribute is only scored for fragmented landscapes. Assessment involves measuring the percentage of remnant 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 vegetation within the buffer zone.

3. Determine the score for this attribute by matching with the thresholds in Table 3.

Step 5: Distance to permanent watering point

This attribute is only scored for intact landscapes. This attribute 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).

Where there is a discrepancy in the permanency of waterholes, local knowledge will prevail.

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 attribute by matching with the thresholds in Table 3.

(Due to the pattern of increased grazing pressure on land closer to water (known as a piosphere), sites closer to watering points will achieve a lower score).

Step 6: Ecological corridors

This attribute is scored for both fragmented and intact landscapes. To calculate the ecological corridor score:

1. Determine the proximity of the site to state, bioregional, regional or sub-regional corridors[7] (terrestrial or riparian).

2. Determine the score from Table 3 based on whether the site is located within (wholly or partly); shares a common boundary with; or is not within a corridor.

Step 7: Scoring sheet input

Once all of the scores have been collected for site context compare the scores with the assessment scoring sheet and carry out the calculations to determine the habitat quality score. This can be done using the Habitat Quality Scoring Template (which calculates the score automatically, as per for Site Condition), or manually.

A site context scoring guide is provided in Table 3.

Table 3 - Site Context scoring sheet guide

1 Size of Patch*	**Score**	**0**	**2**	**5**	**7**	**10**
	Description	<5ha	5–25ha	26–100ha	101–200ha	>200ha
2 Connectedness*	Score	0	2	4		5
	Description	0–10%	>10%–<50%	50–75%		>75% or >500ha
3 Context*	Score	0	2	4		5
	Description	<10% remnant	>10–30% remnant	>30–75% remnant		>75% remnant
4 Distance to permanent watering point †	Score	0	2	5	10	20
	Description	0-500m	>500m–1km	>1–3km	>3–5km	>5km
5 Ecological corridors	Score	0	4		6	
	Description	Not within	Sharing a common boundary		Within (whole or part)	

*measured for fragmented bioregions only

†measured for intact bioregions only

[7] An ‘ecological corridor’ is represented as any ‘Riparian’ or ‘Terrestrial’ feature within the ‘CORR_TYPE’ attribute table of the ‘Queensland biodiversity and vegetation offsets special features’ map.

7 Fauna species habitat assessment

A Barn Owl in a hollow tree, Barron Gorge National Park, Far North Queensland

A number of birds' nests in the branches of a Poplar Gum (*Eucalyptus platyphylla*), Kuranda National Park, Far North Queensland

Koala (*Phascolarctos cinereus*)

Photographs on left and centre by G. Mogridge. Photograph on right from Queensland Government.

7.1 Species habitat index (included for fauna species offsets only)

A suitable offset must demonstrate that the species definitely occurs in the area and the site can support the reproduction and continued existence of species. Species habitat index measures the capacity of a site to support a species and requires field survey data, available modelling and current species records. The index represents an analysis of the quality and availability of habitat for the species, and the likelihood of continued existence of the species at the site.

Information is available from the EHP website to guide this process. In addition a copy of the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland is also available on the EHP website www.qld.gov.au and search for 'fauna survey guidelines'.

7.2 Undertaking a species habitat index assessment

Species Habitat Index assessment requires undertaking a targeted field survey for each offsetable species. Co-location of offsetable matters on one offset site is allowed. Consideration can be given to species with the same habitat requirements who commonly occupy the same area and are identified as belonging to the one 'species functional group[8]', as developed by EHP in conjunction with the Queensland Herbarium. In cases where species can be grouped based on shared habitat requirements, surveys can be targeted to consider the entire functional group and do not require surveys for individual species.

A site is not suitable as a species habitat offset unless it can be shown that the habitat requirements for the species occur at the site. Further evidence to show that a site is a suitable offset may be that the species is either identified at the site, adjacent to the site or within the expected home range of the site.

[8] ***Species Functional Group*** is a group of species that have similar attributes and habitats and therefore can be co-located for the purpose of offset calculation. The threatened animals data table contained in Appendix 4 of the *Queensland Environmental Offsets Policy* identifies the species functional group for each protected animal species.

Step 1: Undertake a desktop review

Undertake a desktop review of the available published and unpublished literature and information from relevant databases (including, but not limited to species mapping and modelling, recent surveys, recorded sightings and the essential habitat database). This review should also include an assessment of the known and potential threats to the species, and the habitat requirements for the species in terms of foraging, shelter and mobility requirements. Consider any essential habitat factors for the individual species or species functional group, if known, as a majority of these factors are required for the site to be considered a viable offset. Threats may include, but are not limited to, feral animal invasion and predation, encroachment of infrastructure and roads, habitat fragmentation and pollution.

Step 2: Undertake a survey of the species and its habitat

Using the same assessment units as defined within the site condition survey, undertake a targeted survey of the species and its habitat. Survey methods outlined in the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland are the best available source of information and can provide guidance on the most suitable survey for the particular species under consideration. Ensure essential information about the species is measured including, but not limited to, foraging, mobility and shelter requirements. The number of surveys to be undertaken can be reduced by re-using raw data as obtained in the site condition survey. For example, in considering shelter requirements for reptiles, the data collected when assessing 'organic litter' as part of the site condition assessment could be used to assign a score in relation to the specific reptile's shelter or foraging requirement.

In addition to fauna sightings and definitive indications of species occurrence and habitat, take note of the extent and severity of threatening processes which may have an adverse impact on the viability of the species at the site.

Step 3: Scoring sheet input

There are five attributes that are required to be assessed and scored using Table 4—Species habitat index scoring guide. This can be done using the Habitat Quality Scoring Template (which calculates the score automatically, as per for Site Condition), or manually. Please note that where multiple species in the same functional group are assessed within an assessment unit, the score of the highest scoring species should be used for that assessment unit. Note when assessing the offset site, only assess those species which are present at the impact site.

Threats to species:

This should be based on the number and severity of threatening processes observed at or adjacent to the site.

Examples include:

- clearing associated with development
- creating a barrier to movement within or between habitat critical to the survival of the species
- the introduction or spread of disease or pathogens to an area (where this is known)
- increasing the risk of high-intensity fires
- degradation of habitat from hydrological change
- introducing or increasing mortality to a species due to vehicle strike or dog attacks.

Appendix 11.5 provides examples of how the level of threat can be measured for three species.

Quality and availability of food an

d foraging habitat:

Consider these parameters relative to the essential habitat requirements for the species. These attributes should realistically reflect how much of a sustainable population of a species could be supported. For example, a site with no or very few food and foraging opportunities would score 1. A site with abundant food and foraging opportunities, with the ability to support a viable population of the species, would score a 9 or 10.

Quality and availability of shelter habitat:

An assessment of a species' shelter requirements must take into account the relative abundance and condition of habitat features that could be used within a site. The site's shelter habitat is necessarily species specific and includes, but is not limited to an assessment of: hollows, logs, cracking clays, large trees, leaf litter, caves, rocky outcrops, slopes or other microhabitat requirements.

Species mobility capacity:

This attribute should be measured in consideration of the presence and severity of factors that would contribute to a reduction in the mobility of the species. For example, when a barrier to movement is created within or between habitats that is likely to result in a long-term reduction in genetic fitness or access to important resources.

Role of site to overall population in the state:

This score should be based on the observed role of the site in relation to the overall population of the species in Queensland. This should take into account the species' use of the site – such as whether it is used for feeding and/or nesting and the effect that damage to or removal of the site would have to the likelihood of the species' overall population survival.

Table 4 - Species habitat index scoring guide

1 Threats to species	**Score**	**1**		**7**	**15**
	Description	High threat level (i.e. likely to result in death, irreversible damage)		Moderate threat level	Low threat level (i.e. likely to survive)
2 Quality and availability of food and foraging habitat	Score	1		5	10
	Description	Poor		Moderate	High
3 Quality and availability of shelter	Score	1		5	10
	Description	Poor		Moderate	High
4 Species mobility capacity	Score	1	4	7	10
	Description	Severely restricted (76–100% reduction)	Highly restricted (51–75% reduction)	Moderately restricted (26–50% reduction)	Minor restriction (0–25% reduction)
5 Role of site location to species overall population in the state	Score	1		4	5
	Description	Not or unlikely to be critical to species' survival		Likely to be critical to species' survival	Critical to species survival

8 Determine the final habitat quality score

At this stage of the assessment, the assessor will have collected the raw data, and derived a score based on a comparison with the benchmark or reference site. The following steps are outlined to assist in deriving the final habitat quality score for the impact site and/or offset site.

Step 1:

For each assessment unit: calculate the scores for 'site condition', 'site context' and 'species habitat index' (if applicable) and add these scores together to determine the Habitat Quality Score (measured).

Site condition + site context + species habitat index
= Habitat quality score (measured)

Step 2:

For each measured attribute, find the highest possible score. For example, the highest possible score for tree canopy height in site condition is '5'. Add all the highest possible scores for each measured attribute to find the Habitat quality score (max). See Table 5 below which shows the highest possible scores for each attribute.

Table 5—Attribute highest possible scores

Site condition		**Site context**		**Species habitat index**	
1. Recruitment of woody perennial species in EDL	5	1. Size of patch	10	1. Threats to species	15
2. Native plant species richness—trees	5	2. Connectedness	5	2. Quality and availability of food and foraging habitat	10
3. Native plant species richness—shrubs	5	3. Context	5	3. Quality and availability of shelter	10
4. Native plant species richness—grasses	5	4. Distance to permanent watering point [intact only]	20*	4. Species mobility capacity	10
5. Native plant species richness—forbs	5	5. Ecological corridors	6	5. Role of site location to overall population	5
6. Tree canopy height	5	Subtotal	26	Subtotal	50
7. Tree canopy cover	5				
8. Shrub canopy cover	5				
9. Native perennial grass cover	5				
10. Organic litter	5				
11. Large trees	15				
12. Coarse woody debris	5				
13. Non-native plant cover	10				
Subtotal	80				

* Only scored for intact landscapes

Step 3:

The score for each assessment unit is then converted to a score out of 10 using the following equation:

(Habitat quality score $^{(measured)}$ / Habitat quality score $^{(max)}$) x 10 =
= Assessment unit habitat quality score $^{(out\ of\ 10)}$

Round the Habitat quality score to the nearest whole number (integer), out of 10, using standard rounding conventions where 0.5 is rounded up to 1. Only use two decimal places.

Step 4:

For each assessment unit, divide the assessment unit area (in hectares) by the total impact or offset site area (in hectares) to find the size weighting for that assessment unit.

Assessment unit area (ha) / Total site area
= Size weighting

Step 5:

Multiply each Assessment unit habitat quality score by its Size weighting.

Assessment unit habitat quality score x Size weighting
= Weighted assessment unit habitat quality score

Step 6:

Once each Weighted assessment unit habitat quality score has been determined, add these scores to find the final Habitat Quality Score for the entire site (this should be rounded to the nearest whole number).

Example calculation:

An impact site consisting of three assessment units located in a fragmented bioregion is measured. Assessment unit 1 provided the following scores:

- 65 for site condition, out of a total possible score of 80 for this section;
- 19 for site context, out of a total possible score of 26 for this section; and
- 22 for species habitat index, out of a total possible score of 50 for this section.

Step 1: 65 + 19 + 22 = 106 is the Habitat quality score (measured)

Step 2: 80 + 26 + 50 = 156 is the Habitat quality score (max)

Step 3: (106 / 156) x 10 = 7 is the Assessment unit habitat quality score (out of 10)

The Habitat quality score of the assessment unit is 7 (6.79 rounded using standard conventions). This process would be repeated for each assessment unit.

Step 4: Finding the Size weightings

For the purposes of this example, assessment unit 2 achieved a score of 5, and assessment unit 3 achieved a score of 6.

- Assessment unit 1: 7ha
- Assessment unit 2: 10ha
- Assessment unit 3: 5ha
- Total site size: 22ha

Assessment unit 1: 7 / 22 = 0.32

Assessment unit 2: 10 / 22 = 0.45

Assessment unit 3: 5 / 22 = 0.23

Step 5: Finding the Weighted assessment unit habitat quality scores

- Assessment unit 1:
  7 x 0.32 = 2.24
- Assessment unit 2:
  5 x 0.45 = 2.25
- Assessment unit 3:
  6 x 0.23 = 1.38

Step 6: Finding the final Habitat quality score for the site:

2.24 + 2.25 + 1.38 = 6 (5.87 rounded). The final Habitat quality score for the site is 6.

9 Glossary

Assessment units—relatively homogenous units defined by a distinct 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.

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 EHP website www.ehp.qld.gov.au

Broad Vegetation Group (BVG)—broad vegetation groups represent a combination of regional ecosystems grouped by similar vegetation communities.

Ecologically Dominant Layer (EDL)—layer or species making the greatest contribution to the overall biomass of the site and the vegetation community.

Impact site—area proposed to be cleared that has resulted in the requirement for an offset.

Non-remnant vegetation—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 site—area that is proposed to be conserved, enhanced, maintained, monitored and/or rehabilitated to counterbalance the proposed impact area.

Regional ecosystem (RE)—refers to a vegetation community within a bioregion that is consistently associated with a particular combination of geology, landform and soil. REs 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 REs see EHP website www.ehp.qld.gov.au.

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 % of the undisturbed predominant canopy; and

(b) averaging more than 70 % 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.

Species Functional Group (SFG)—group of species that has similar attributes and habitats. Threatened species within the same SFG are considered more likely to occupy similar environments, respond positively to the same types of land management and be successfully co-located at a single offset site. The threatened animals data table included in Appendix 4 of the *Queensland Environmental Offsets Policy* identifies the species functional group for each protected animal species.

10 References

Department of Environment and Heritage Protection, (2013). Queensland Environmental Offsets Policy Department of Environment and Heritage Protection, Brisbane.

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

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Fensham, R., McAlpine, C., SeaBrook, L., (2007). Spatial and temporal analysis of vegetation change in agricultural landscapes: A case study of two brigalow (Acacia harpophylla) landscapes in Queensland, Australia, Agriculture Ecosystems and Environment 120 (211-228).

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11 Appendices

11.1 Impact site assessment sheet

Habitat Quality attributes	Impact site - assessment unit number									
	1	2	3	4	5	6	7	8	9	10
Recruitment of woody perennial species										
2. Native plant species richness										
Trees—species richness										
Shrubs—species richness										
Grasses—species richness										
Forbs—species richness										
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. Connectedness (fragmented)										
13. Context (fragmented)										
14. Distance from water (intact)										
15. Ecological corridors										
16. Threats to species										
17. Quality and availability of food and foraging habitat										
18. Quality and availability of										
19. Species mobility capacity										

20. Role of site location to overall population										

Habitat quality score(measured)										
Habitat quality score(max)										
Area (ha)										

Administrative Information

Name of assessment officer		Date			
Organisation/Company name					
Project name					
Phone number		Email			
Signature					

11.2 Offset site assessment sheet

Habitat quality attributes	Offset site—assessment unit number									
	1	2	3	4	5	6	7	8	9	10
1. Recruitment of woody perennial species										
2. Trees—species richness										
3. Shrubs—species richness										
4. Grasses—species richness										
5. Forbs—species richness										
6. Tree canopy height										
7. Tree canopy cover										
8. Shrub canopy cover										
9. Native perennial grass cover										
10. Organic litter										
11. Large trees										
12. Coarse woody debris										
13. Weed cover										
14. Size of patch (fragmented)										
15. Connectedness (fragmented)										
16. Context (fragmented)										

17. Distance from water (intact)										
18. Ecological corridors										
19. Threats to species										
20. Quality and availability of food and foraging habitat										
21. Quality and availability of shelter										
22. Species mobility capacity										
23. Role of site location to overall population										

Habitat quality score(measured)										
Habitat quality score(max)										
Area (ha)										

Administrative information

Name of assessment officer		Date			
Organisation/Company name					
Project name					
Phone number		Email			
Signature					

11.3 Checklist

Habitat quality assessment checklist
Site condition assessment complete…… ☐ Site context assessment complete…… ☐ Species habitat index assessment complete…… ☐ All forms checked and complete…….....☐ Additional supporting information attached where applicable…… ☐

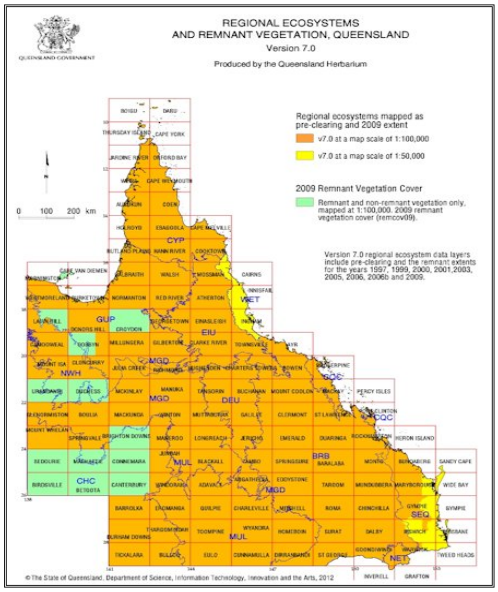
Administrative information

Name of assessment officer		Date			
Organisation/Company name					
Project name					
Phone number		Email			
Signature					

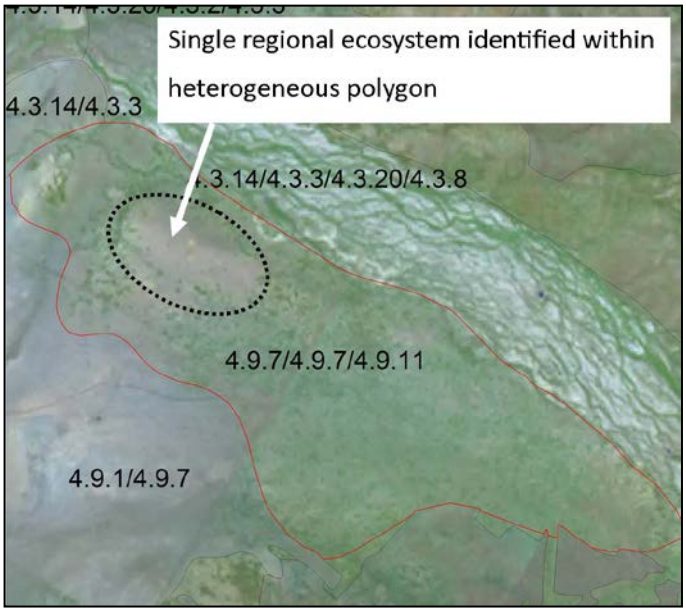
11.4 Additional information

Queensland regional ecosystem mapping framework

Regional ecosystem mapping exists for the majority of the state which can be used to determine the vegetation community on the ground, its conservation status and general clearing history including areas that have previously been cleared (non-remnant) have regenerated (regrowth) or may have never been cleared (remnant). Each regional ecosystem has been provided a unique identification number which describes the bioregion in which it occurs, the land zone type, and the species composition. Regional ecosystem mapping can be downloaded by visiting the EHP website www.ehp.qld.gov.au.



Heterogeneous polygons containing multiple regional ecosystems



Queensland's regional ecosystem framework includes polygons which are mapped as either single 'homogenous' polygons containing one regional ecosystem, or mixed 'heterogonous' polygons consisting of a number of regional ecosystems in various quantities. Where a polygon contains multiple regional ecosystems the exact location of this regional ecosystem compared with the remaining regional ecosystems will need to be defined.

The regional ecosystem mapping does provide an estimate of the percentage of each regional ecosystem within the polygon in the format %/%/%. For example, an area may contain 95% of RE 4.3.3 and 5% of RE 4.3.20 and 5% RE 4.3.8 represented as 95/5/5. In all cases the on ground presence of the regional ecosystem requiring assessment must be identified to determine its spatial area and location within the nominated impact or offset area.

Where a single regional ecosystem within a heterogeneous polygon is identified as species habitat and contains the habitat factors for a protected animal under the *Nature Conservation Act 1992*, the entire area relevant to the

species (in any stage of its life cycle) must be reasonably identified. The species habitat should not be limited to the boundaries of the single regional ecosystem mapped within a heterogeneous polygon. On the other hand if a percentage of the regional ecosystem contained within a heterogeneous polygon is sub-dominant and surrounded by unsuitable habitat, it is unlikely to support the threatened species and would not be considered species habitat.

Bio-condition benchmarks for regional ecosystems

Bio-condition benchmarks have been developed by the ecological sciences department of the Queensland Herbarium to describe an undisturbed regional ecosystem with most of its natural values intact (Eyre et al, 2011a). A comparison of the environmental values present at an offset site and impact site against the values obtained from an intact site (Bio-condition benchmark) provides an indication of the level of degradation and relative level of 'pristineness'. Bio-condition benchmarks can be downloaded by visiting the EHP website www.ehp.qld.gov.au.

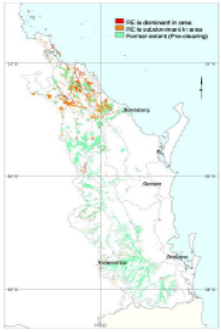
An example Bio-condition benchmark is provided to the right.

This guide was largely informed by the existing Bio-condition assessment manual (Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland, Assessment Manual, Version 2.1), and is used to assess attributes of site condition and site context. The Biocondition assessment methodology can be consulted for further information.

BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland **Regional ecosystem: 12.3.3**

Eucalyptus tereticornis woodland on Quaternary alluvium



BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	5
		Shrub:	4
		Grass:	11
		Forbs and other:	24
Trees:	Tree canopy	Tree canopy median height (m):	27
		Tree canopy cover (%):	53
	Tree sub-canopy	Tree sub-canopy median height (m):	12
		Tree sub-canopy cover (%):	9
	Large trees	Large eucalypt tree dbh threshold (cm):	47
		Number of large eucalypt trees per hectare:	24
		Large non-eucalypt tree dbh threshold (cm):	na
		Number of large non-eucalypt trees per hectare:	na
	Typical tree species: Eucalyptus tereticornis (blue gum), Angophora subvelutina (broad-leaved apple), Lophostemon suaveolens (swamp box), Allocasuarina torulosa (forest oak)		
Shrubs:		Native shrub cover (%):	1
	Typical shrub species: Acacia disparrima subsp. disparrima (southern salwood), Acacia maidenii (Maiden's wattle)		
Ground cover (%):		Native perennial grass cover (%):	47
		Organic litter cover (%):	34
	Typical ground cover species: Themeda triandra (kangaroo grass), Heteropogon contortus (black speargrass), Pteridium esculentum (common bracken), Imperata cylindrica (blady grass), Cymbopogon refractus (barbed-wire grass)		
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			445
Non-native plant cover			0
	Typical non-native species: Opuntia stricta^ (smooth pest pear), Lantana camara^, Cyanthillium cinereum (vernonia)		

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Users should refer to the regional ecosystem description database (REDD) and/or the technical description for more complete lists of characteristic species. Only the most frequently used common name is given. Other common names may be used in other regions. Declared pest species in Queensland are designated (^).

30/11/2012

Reference sites

Queensland regional ecosystem mapping has identified, mapped and provided descriptions for over 1300 regional ecosystems. Bio-condition benchmarks have been developed for a proportion of the regional ecosystems in the state representing a number of bioregions however they have not been comprehensively developed for each regional ecosystem. Where a benchmark has not yet been developed proponents may be required to obtain a reference site or 'best on offer' site from a parcel of land within the bioregion which best represents that particular regional ecosystem in its undisturbed form. The 'Method for the Establishment and survey of Reference Sites for Bio-Condition' (Eyre, T.J. et al, 2011b) describes the process for obtaining this data however for the purposes of habitat quality assessment the required number of sampling sites can be reduced to one. This method can also be downloaded by visiting the EHP website located at www.ehp.qld.gov.au.

11.5 Measuring species threat examples

Species	An example threat measurement
Koala	The main threats to koalas are habitat loss and fragmentation, car strike, dog attacks, and disease. The threat level scoring should take into account the home range of individual koalas in the relevant bioregion. An offset site may have a low threat level if it is located more than approximately 1500m from roads, or if there is a koala exclusion fence between the site and the road to prevent koala death and injury. The highest level of threat may be scored if the site is isolated from other koala habitat, or if major roads without exclusion measures, or residential encroachment is within 1500m of the site boundary, causing increased risk of contact with cars and dogs.
Black-throated finch	Aggressive noisy miners (Manorina melanocephala), fragmentation and degradation of habitat are the major threats to the Black-throated finch. A low threat level may be scored if the riparian area of the site (a main habitat of the species) is undisturbed and there is very little or no evidence of grazing. Moderate to high threat levels may be scored if noisy miners are present at the site, higher particularly if there is evidence that the noisy miners have permanent established habitat (i.e. for breeding) at the site. The highest levels of threat may be scored in instances where the risk of predation is intensified by the lack of available habitat—for example, when noisy miners are present in high numbers, as well as a disturbed riparian area.
Wallum froglet	The Wallum froglet is threatened by habitat loss, fragmentation and modification, predation of eggs and larvae by introduced fish, and deterioration of water quality. A low threat level could be scored if the site has no or very little human visitation, with a low risk of trampling on reed beds which are a main habitat feature of the species. The level of risk increases with proximity to urban areas, as nutrient-laden run-off can render habitat unsuitable for the species by inhibiting larval growth and reducing survivorship. Moderate to high levels of risk may be scored if the site contains water bodies that receive runoff from nearby urban areas. High threat levels may be scored if the site is directly adjacent to a golf course or urban area, or predatory fish are present in the froglet habitat.

11.6 Intact and fragmented subregions of Queensland

Subregions are considered fragmented when they are more than 30% non-remnant vegetation. Intact subregions are less than 30% non-remnant vegetation.

Intact landscapes	Fragmented landscapes
Northwest Highlands (NWH)	
- Mount Isa Inlier - Southwestern Plateaus and Floodouts - McArthur - Thorntonia	
Gulf Plains (GUP)	
- Donors Plateau - Claraville Plains - Holroyd Plain - Red Plateau - Gilberton Plateau - Woondoola Plains - Armraynald Plains - Mitchell - Gilbert Fans - Doomadgee Plains - Karumba Plains - Wellesley Islands	
Cape York Peninsula (CYP)	
- Starke Coastal Lowlands - Weipa Plateau - Laura Lowlands - Cape York - Torres Strait - Jardine - Pascoe Sandstones - Coen - Yambo Inlier - Battle Camp Sandstones - Northern Holroyd Plain - Coastal Plains	
Mitchell Grass Downs (MGD)	
- Southern Wooded Downs - Flinders - Central Downs - Kynuna Plateau - Georgina Limestone - Southwestern Downs	

- Barkly Tableland	
Channel Country (CHC)	
- Goneaway Tablelands - Cooper - Diamantina Plains - Noccundra Slopes - Sturt Stony Desert - Bulloo - Toko Plains - Lake Pure - Bulloo Dunefields - Georgina - Eyre Plains - Coongie - Dieri - Simpson Desert - Strzelecki Desert	
Mulga Lands (MUL)	
- Warrego Plains - West Warrego - Northern Uplands - Cuttaburra - Paroo - Urisino Sandplains - West Bulloo	- West Balonne Plains - Eastern Mulga Plains - North Eastern Plains - Langlo Plains - Nebine Plains
Wet Tropics (WET)	
- Macalister - Bellenden Ker - Lamb - Daintree - Bloomfield - Kirrama - Hinchinbrook - Paluma - Seaview	- Atherton - Innisfail - Tully - Herbert
Central Queensland Coast (CQC)	
- Debella - Clarke - Connors Ranges - Manifold - Byfield - Whitsunday	- Proserpine - Sarina Lowlands
Einasleigh Uplands (EIU)	
- Hodgkinson Basin - Herberton - Wairuna	

- Broken River - Undara - Toomba Basalts - Kidston - Georgetown - Croydon	
Desert Uplands (DEU)	
- Cape - Campaspe Plains - Prairie - Torrens Creeks Alluvials - Alice Tableland	- Jericho
Brigalow Belt (BRB)	
- Townsville Plains - Bogie River Hills - Carnarvon Ranges - Cape River Hills - Wyarra Hills - Buckland Basalts	- Tara Downs - Taroom Downs - Callide Creek Downs - Dawson River Downs - Moonie - Barwon Interfluve - Eastern Darling Downs - Moonie R. - Commoron Creek Floodout - Dulacca Downs - Warrambool - Moonie - Macintyre - Weir Fan - Isaac - Comet Downs - Upper Belyando Floodout - Weribone High - Belyando Downs - Southern Downs - Mount Morgan Ranges - Banana - Auburn Ranges - Culgoa - Bokhara - Narrandool - Basalt Downs - South Drummond Basin - Boomer Range - Arcadia - Claude River Downs - Barakula - Inglewood Sandstones - Northern Bowen Basin - Marlborough Plains - Nebo - Connors Ranges - Beucazon Hills

	- Woorabinda - Anakie Inlier
South East Queensland (SEQ)	
- Great Sandy - Southern Great Barrier Reef	- Brisbane - Barambah Volcanics - Gympie Block - Woodenbong - Burringbar - Conondale Ranges - Burnett - Curtis Coastal Lowlands - Sunshine Coast - Gold Coast Lowlands - Scenic Rim - Burnett - Curtis Hills and Ranges
New England Tableland (NET)	
	- Nandewar Northern Complex - Stanthorpe Plateau - Tenterfield Plateau