Biodiversity Assessment and Mapping Methodology

Version 2.2

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Version	Release date	Changes in this version compared to previous version
1.0	July 2001	
2.0	January 2002	
2.1	July 2002	
2.2	December 2014	• EVR to EVNT • Removal of species tables and specific calculations (e.g. Criterion C) • Essential habitat applicable to both EVNT and priority taxa in definition • Updated priority species definition although implementation has not changed • Clarified date cut off for species records • Other Essential Criteria renamed to Expert Panel Criteria • Minor editing changes • Minor updates to methodology

1 Introduction

The Biodiversity Assessment and Mapping Methodology (BAMM) has been prepared to provide a consistent approach for assessing biodiversity values at the landscape scale in Queensland using vegetation mapping data generated or approved by the Queensland Herbarium as a fundamental basis. It is being used by the Department of Environment and Heritage Protection (EHP) to generate Biodiversity Planning Assessments (BPAs) for bioregions in eastern Queensland under most development pressure. The BPAs can be used by departmental staff, other government departments, local governments or members of the community to advise a range of planning or decision-making processes. As such, the BAMM and resultant BPAs constitute EHP policy.

In preparing this document, due credit is given to a similar method upon which it is substantially based (Chenoweth EPLA 2000a). The Chenoweth EPLA (2000a) method has subsequently been amended (Chenoweth EPLA 2001) to reflect many of the methodological improvements in the BAMM. That method was the product of several years of consultation between local governments in southeast Queensland, in particular Western Subregional Organisation of Councils, the Brisbane Regional Environment Council and EHP, with Chenoweth Environmental Planning and Landscape Architecture Ltd as consultants. While some changes have been necessary to ensure consistency with agency departmental policy and state legislation, the spirit of the original method remains intact and the assessment outcomes using the methodology are largely unchanged.

The methodology has application for identifying areas with various levels of significance for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. However, natural resource values such as dryland salinity and soil erosion potential are not dealt with explicitly, nor are cultural heritage, scenic amenity or wilderness values. For this reason, the method is described as a biodiversity assessment tool, not a conservation assessment tool in its broadest sense.

One objective of the methodology is its spatial application. Assessments are compiled and integrated for mapping using databases and geographic information systems (GIS). This approach allows the known biodiversity values in an area to be presented in a clear and transparent manner for use by decision-makers. Automated procedures for information management ensure that each BPA can be readily updated with new base information from revised herbarium mapping, flora/fauna inventory or enhancements to the methodology.

Many factors contribute to the assessment of biodiversity values. The methodology focuses on a number of consistent and reliable criteria that are transparent, objective and scientifically defensible (Table 1). The criteria are in two groups, which are applied one after the other. The first group is based on existing data, which are relatively uniform and reliable across a bioregion. These criteria are diagnostic in that they are used to filter available data and provide a 'first-cut' or initial determination of significance. This initial assessment is then refined using a second group of expert panel criteria. These criteria may rely more upon expert opinion than on quantitative data, which in many cases are not available uniformly across the bioregion.

The seven diagnostic criteria in Table 1 use reliable and uniformly available information that is usually accessible in database format, and which can be queried to automatically generate significance classes using consistent rules of combination. While species data are included in the diagnostic criteria, it is acknowledged that fauna and flora surveys are far from complete in Queensland and that existing data therefore do not provide a uniform coverage across any bioregion. A 'filtering' process is used to assess remnant units by these criteria A to G (see Table 17). It can also be used as a series of questions applied to a particular site in the absence of a completed BPA. Although the various data layers are integrated in a BPA, each layer can be interrogated to ensure transparency and allow for any combination of criteria to be used in isolation from others in decision making.

Table 1. Biodiversity significance criteria

Diagnostic criteria	Expert panel criteria
For analysis of uniformly available data	Assessed by expert panel using non-uniform data
A: Habitat for EVNT taxa **B**: Ecosystem value: at three scales: B1: State B2: Regional B3: Local **C**: Tract size **D**: Relative size of regional ecosystem: at three scales: D1: State D2: Regional D3: Local **E**: Condition **F**: Ecosystem diversity **G**: Context and connection (relationship to water, endangered ecosystems and physical connection between contiguous Remnant Units)	**H**: Habitat for priority taxa **I**: Special biodiversity values **J**: Corridors **K**: Threatening process (condition)

2 Definitions

Biodiversity – The National Strategy for the Conservation of Australia's Biological Diversity defines biodiversity as “the variety of all life forms—the different plants, animals and microorganisms, the genes they contain, and the ecosystems of which they form a part. It is not static, but constantly changing; it is increased by genetic change and evolutionary processes and reduced by processes such as habitat degradation, population decline, and extinction”.

Biodiversity Planning Assessment (BPA) – is the implementation of the Biodiversity Assessment and Mapping Methodology that results in a map and database information product maintained by the EHP. The digital coverage results from a process of information collation, integration, analysis, interpretation, spatial data development and mapping.

Biodiversity significance – is the ranked significance of an area according to specified biodiversity values to account for ecological concepts such as rarity, diversity, fragmentation, habitat condition, resilience, threats, and ecosystem processes. Biodiversity Planning Assessments identify three levels of biodiversity significance—– State, Regional and Local based on a number of data queries that simultaneously integrate an array of information for a bioregion. They may also indicate areas that have not been assigned a biodiversity significance because they have not met the criteria for State, Regional or Local significance based on current information.

Biodiversity status – is the EHP classification of regional ecosystems as 'endangered', 'of concern' or 'not of concern' using the rules described on its website (Queensland Government 2014) which is based on a blend of the definitions in Sattler and Williams (1999) and the *Vegetation Management Act 1999*.

Coastal area – The State Policy for Vegetation Management on Freehold Land (2000) lists the following bioregions and provinces: Central Queensland Coast Bioregion, South East Queensland Bioregion, Wet Tropics Bioregion, The Hodgkinson Basin Province of the Einasleigh Uplands Bioregion, The Townsville Plain Province and Bogie River Hills Province of the Brigalow Belt Bioregion.

Coastal wetlands – tidal wetlands, estuaries, salt marshes, melaleuca swamps (and other coastal swamps), mangrove areas, marshes, lakes or minor coastal streams regardless of whether they are of a saline, freshwater or brackish nature (s10 *Coastal Protection and Management Act 1995*).

Core habitat – areas defined by experts and/or a recognised modelling process, where EHP is sufficiently confident that the identified areas are important for the taxon concerned, whether or not the taxon has actually been recorded there.

Critical habitat – as declared under the *Nature Conservation Act 1992*. 'Critical habitat' is habitat that is essential for the conservation of a viable population of protected wildlife or community of native wildlife, whether or not special management considerations and protection are required. A 'critical habitat' may include an area of land that is considered essential for the conservation of protected wildlife, even though the area is not presently occupied by the wildlife. This category is not exclusive of the essential and general habitat categories, below.

Diagnostic criteria – the set of criteria that are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a 'first-cut' or initial determination of biodiversity significance. This initial assessment is then refined through peer review and a second group of expert panel criteria.

Endemic – taxon that has at least 75% of its known range within a bioregion or which has a total range of 100,000 square km or less (Commonwealth of Australia 1995).

Essential habitat – is an area or location with essential resources for the maintenance of populations of EVNT or priority taxa. Essential habitat may be defined from known records or considered potential according to expert knowledge of habitat relationships. Essential habitat is considered known where the taxon is present (based on accurate records) and there are indications of reproduction, or where a significant number of individuals are present, or important resources (such as nest sites, roost caves, major food sources) are present, or where important movement corridors for breeding and/or non-breeding (including migratory) individuals have been identified. Alternatively, essential habitat is considered possible where there exists suitable habitat of a size capable of supporting one or more breeding units, and important resources (such as nest sites, roost caves, major food sources) are present, or the area is proximal to populations, or may act as a potentially important corridor.

EVNT – taxon currently listed as ‘endangered’, ‘vulnerable’, ‘near threatened’ or ‘extinct’ under the *Nature Conservation Act 1992* and amendments (e.g. Anon 2000) or the *Environmental Protection and Biodiversity Conservation Act 1999* (if there is a difference, the higher threat category is used, unless

an expert panel recommends a lower threat category).

General habitat – is an area or location that has been used by transient individuals of an EVNT or priority taxon, or where the taxon has been recorded but there is insufficient information to assess the area as essential. General habitat may be defined from known records or considered potential according to expert knowledge of habitat relationships, and may include areas of sub-optimal habitat for an EVNT or priority taxon.

Habitat value – categories of relative significance of an area for EVNT or priority taxa. Habitat value may be defined by expert opinion or by some combination of spatial analysis and expert opinion.

Heterogeneous remnant unit – a remnant unit which contains more than one code for a regional ecosystem as mapped by the Queensland Herbarium (Neldner et al. 1999). The heterogeneous remnant unit indicates that a number of vegetation types are present, but these cannot be discriminated at the scale of mapping used (see Figure 1).

Important wetland – An important wetland is an area of perennial, seasonal or intermittent inundation or water-logging, which when wet displays natural hydrological or morphological processes and / or provides a valuable function or habitat for native wildlife or wildlife processes at a taxa, community or ecosystem level. Wetland size is less important than the functional role or naturalness of the wetland. The value of a wetland is enhanced by connection with terrestrial habitats that show high levels of naturalness and low levels of disturbance. This enhancement increases cumulatively with the area of natural landscape upstream although it may be severely diminished by a single point source disturbance such as a sewage treatment plant.

Poorly conserved regional ecosystems – where less than 10% of their pre-clearing extent is represented in protected areas (including nature refuges).

Priority taxon – flora or fauna taxa currently listed as in various action plans as being of concern (for example, Garnett & Crowley 2000), most transcontinental migrants listed under international agreements (for example, CAMBA and JAMBA), as well as taxa at risk or of management concern within specific bioregions based on the written opinion of experts (e.g. McFarland 1997; Lee & Smyth 1998; McFarland et al. 1998; Rounsevell et al. 1998; NET Expert Panel 2001), or taxa of scientific interest as relictual, endemic or locally significant populations (such as a flying fox camp or heronry) based on the written opinion of experts.

Protected area – areas that have been protected under the *Nature Conservation Act 1992*.

Regional ecosystem – a vegetation community in a bioregion that is consistently associated with a particular combination of geology, landform and soil (after Sattler and Williams 1999).

Remnant unit – planning unit for assessing biodiversity significance equivalent to an area of remnant vegetation as mapped or approved by the Queensland Herbarium. Remnant units contain one or more regional ecosystems (see Figure 1).

State significance – includes areas that are also assessed as being of national or international significance.

Stream order – Stream order (Whittow 1984) is "A morphometric classification of a drainage system according to a hierarchy of orders of magnitude of the channel segments. Within a single drainage basin the unbranched channel segments which terminate at the stream head are designated as first order. Where two first-order (waterway) segments meet, a channel of the second order (creek) is produced, extending down to meet another second-order channel to create a third-order (river) channel and so forth." It should be noted that where a main channel joins lower order segments that there is no change in the order of the main channel. The delineation of stream order is scale dependent.

Expert panel criteria – the set of criteria that are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a 'second-cut' determination of biodiversity significance, which is used to refine the 'first-cut' determination.

Tract – a discrete area of remnant vegetation composed of one or more remnant units surrounded by non-remnant vegetation (see Figure 1). Non-remnant vegetation includes cleared land, regrowth, open water and bare ground, among others.

3 Diagnostic criteria

3.1 Remnant units

The remnant unit is the basic planning unit for assessing biodiversity significance. It is equivalent to a single polygon on a map approved by the Queensland Herbarium. Remnant units may contain one or more regional ecosystems (Figure 1).

Each BPA assesses regional ecosystems belonging to that bioregion. At the boundaries of bioregions, and because of scale differences between the vegetation mapping and the bioregional mapping datasets, regional ecosystems from one bioregion may become 'mixed' with regional ecosystems from a neighbouring bioregion resulting in a 'fuzzy' boundary. As a result, some regional ecosystems may lie outside the bioregion to which they belong. These are referred to as outliers and are assessed along with the other regional ecosystems belonging to the bioregion; ignoring bioregional boundaries. Conversely, there may be regional ecosystems that are inliers within a bioregion. These inliers are excluded from the analysis for the bioregion in which they are found.

As each of the outliers depends on the context of its neighbours, the remnant unit coverage is extended approximately 20–50km beyond the most distant outlier from its bioregion. For example the most distant outlier belonging to the South East Queensland bioregion is 40km from the actual bioregion boundary, so the analysis extends up to 90km from the boundary. New bioregional boundaries being developed by EHP derive from the 1:100,000 regional ecosystem boundaries and will take up some of these outliers.

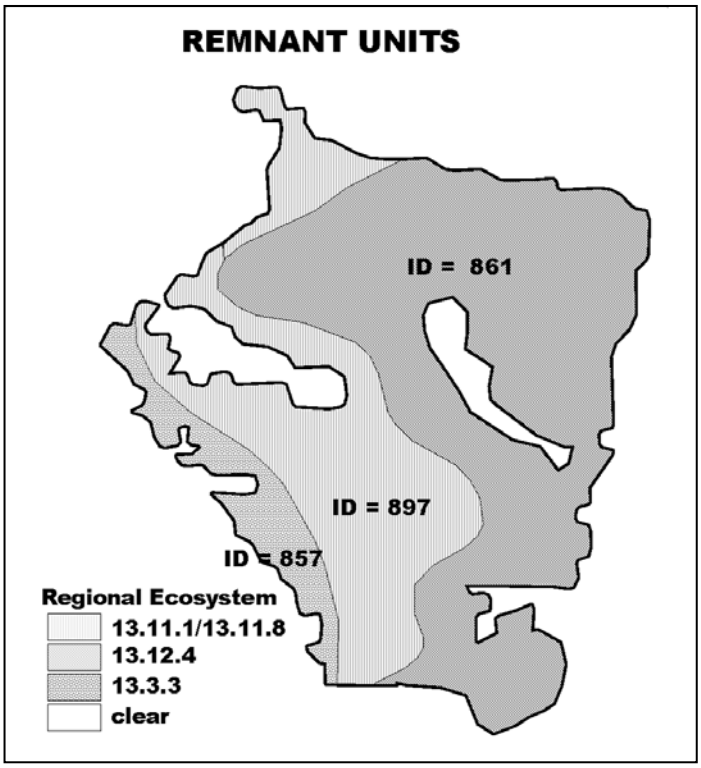

Figure 1. Example of several remnant units in a tract

The tract depicts an area of remnant vegetation mapped by the Queensland Herbarium. It is surrounded by non-remnant vegetation which may be cleared country, regrowth or a mixture of both. A non-remnant area is also contained within the remnant. According to the mapping, four regional ecosystems are present within three different remnant units. For example, the polygon with ID = 861 contains regional ecosystem 13.12.4; ID = 897 contains a mixture of 13.11.1 and 13.11.8; and ID = 857 contains 13.3.3.

3.2 A: Habitat for EVNT taxa

This criterion classifies areas according to their significance based on the presence of endangered, vulnerable and/or near threatened (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the *Environmental Protection and Biodiversity Conservation Act 1999*.

It is intended that the information from flora and fauna records will be progressively refined in subsequent iterations by incorporating advice from expert panels and the output of habitat models.

The criterion uses records based upon georeferencing precision of ≤2000m and which are collected ≥1950 (flora) or 1975 (fauna). A precision threshold of 500m is used to assign levels of higher significance because it usually represents records which have been generated through the use of a GPS or with reference to 1:100,000 (or larger) topographic mapping. Relatively imprecise records (precision between 500 and 2000m) are assigned lower levels of significance (Table 2). The data are also screened to remove any records for which the taxa identification or georeferencing appear to be inaccurate. Data that are filtered on these grounds can be referred to experts for review and refinement. The above filtering rules can be varied by expert panels for individual bioregions. Changes to the rules along with reasons for such changes are provided in the BPA expert panel reports.

The criterion excludes highly mobile fauna taxa which are instead considered in Criterion H, because such taxa usually have large home ranges (greater than 100ha per reproductive unit). Consequently, a buffered record could be misleading if it refers to an individual passing through the area. The exception to this rule is where the record is of high precision (less than or equal to 500m) and pertains to a breeding site (for example a nest tree or maternity cave) or significant roosting site (for example a cave regularly used in the non-breeding season). For some taxa, definable habitat may be limited to that known to be needed for breeding populations and expert advice is sought regarding the appropriate threshold criteria. Highly mobile taxa are listed in the fauna expert panel reports produced as part of each BPA.

Records that pass through the above filters are included in the analysis of habitat for EVNT taxa. A buffer is created around each record according to its precision. The buffer radius is twice the precision of the record with a minimum of 300m. The area formed by the buffer may contain parts of more than one remnant unit. Overlapping buffers from many adjacent records are coalesced in two groups based on those with precision less than or equal to 500m or those greater than 500m (up to 2000m). The number of taxa by their EVNT status is tallied within the buffer areas. The coalesced buffer area provides an interim definition of EVNT species habitat until more reliable information can be incorporated into the analysis. For example, where core habitat has been ascribed according to methods such as those outlined in Appendix 1 (p. 25), then these replace the buffer areas around records for the respective EVNT taxa in Table 2. Consequently, the buffer areas may be successively replaced by more refined spatial information in future iterations of a BPA. This could mean either an expansion or reduction in area, depending on the habitat requirements of individual taxa.

A remnant unit intersecting a buffered area is flagged in the database by assigning a medium value and cartographically identified as potentially supporting EVNT taxa (for example by light stippling). Figure 2 illustrates some of the above mapping scenarios. Where the precision of a record is between 500 and 2000m, a buffer with radius twice the precision distance to a maximum of 2000m is also assigned a medium value and cartographically flagged (for example by light stippling).

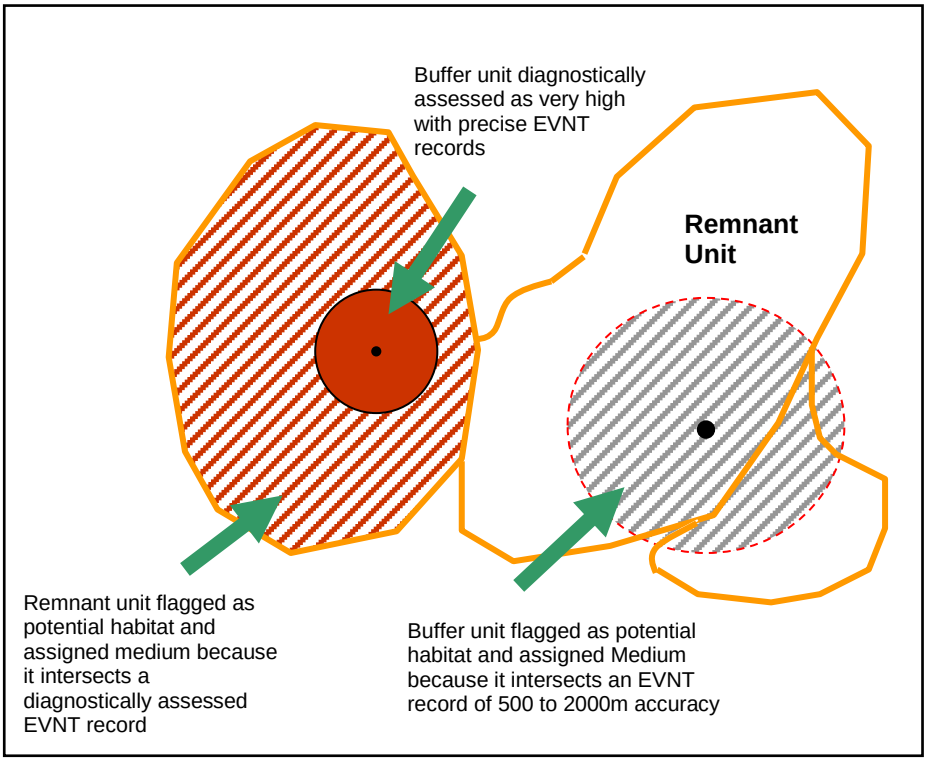

Figure 2. Mapping scenarios for Criterion A

Table 2. Indicators and ratings for Criterion A: Habitat for EVNT taxa

Rating:	Low	Medium	High	Very high
Indicator:	The remnant unit* has no confirmed records or otherwise defined areas of habitat for EVNT taxa	The buffer area within the remnant unit* has relatively imprecise record(s) (precision 500 to 2000m) for one or more EVNT taxa OR The area within the remnant unit* falls outside the buffer area for precise record/s for EVNT taxa OR The area within the remnant unit* represents non-core habitat for an EVNT taxon	The area within the remnant unit* has precise record/s or core habitat for one vulnerable taxon or one near threatened taxon	The area within the remnant unit* has precise record/s (precision ≤500m) or core habitat for one or more endangered taxa or two or more vulnerable or near threatened taxa

* Only remnant vegetation is identified in the first instance in this criterion on the grounds that neighbouring areas (for example, cultivated fields) may have lost all of their native vegetation. In the future, other native vegetation (modified) may be identified as having significant value for EVNT taxa.

3.3 B: Ecosystem value

This criterion primarily classifies remnant units according to the biodiversity status of regional ecosystems, and their extent in protected areas (whether they are poorly conserved). Ecosystem value also takes into account the significance of other ecological communities, such as wetlands and intertidal zones. Under the *Fisheries Act 1994*, intertidal vegetation is given a high level of protection and permission is required before it can be harmed in any way.

Ecosystem value is applied to REs at a hierarchy of scales designated as State, Regional or Local. In each case, RE biodiversity status is defined using similar threshold criteria. For example, State ecosystem value is based on the extent and condition of remnant REs within bioregions, Regional ecosystem value is based on the extent of remnant REs within subregions, and Local ecosystem value is based on the extent of remnant REs within local government areas (LGA).

In cases of heterogeneous remnant units containing a threatened ecosystem, the higher biodiversity status is used to describe the status of the entire remnant unit, providing the RE with the higher status represents more than 30% of the remnant unit. Remnant units in which the RE with the higher status represents less than 30%, or remnant units in which all REs are less than 30%, are assigned a medium value and cartographically identified as containing areas of endangered or of concern REs (within bioregions), or ‘very high conservation value’ or ‘high conservation value’ REs (within subregions or LGAs). When assigning ‘poorly conserved’ to remnant units, only those REs that make up at least 30% of the remnant unit are considered.

At subregional and local government area scales, the categories ‘very high conservation value’, ‘high conservation value’, ‘moderate conservation value’ and ‘limited conservation value’ refer to REs reduced to less than 10%, 10 to 30%, 30 to 50% and greater than 50% of their pre-clearing extent within a subregion or local government area, respectively. In addition, REs with a pre-clearing extent of less than 300ha within subregions and LGAs are used to distinguish levels of ecosystem value.

Where regional and local assessments of significant ecological communities, such as wetlands, have been published and accepted by the agency, these are used in assessment criteria for determining ecosystem value. For example, Blackman (2001) lists the nationally significant wetlands for Queensland in the Directory of Important Wetlands in Australia.

B1: State ecosystem value

State ecosystem value (Table 3) is based on the biodiversity status of each RE, or the presence of intertidal or 'nationally important wetlands' (listed in Blackman 2001), or wetlands of 'high' significance defined in approved coastal management plans, or the presence of REs that are poorly conserved in protected areas declared under the *Nature Conservation Act 1992*.

Table 3. Indicators and ratings for Criterion B1: State ecosystem value

Rating:	Low	Medium	High	Very high
Indicator:	'No concern at present' RE with >50% of the original extent remaining in the bioregion	'No concern at present' RE with 30–50% of the original extent remaining OR 'Poorly conserved' RE within the bioregion OR Contains subdominant (< 30%) 'endangered' or 'of concern' REs	'Of concern' RE OR A wetland designated as being of 'regional significance' in an approved coastal management plan OR A significant wetland in SEQ designated as 'regional'/'major habitat' in Chenoweth EPLA (2000b) and Dowling and Stephens (1998)	'Endangered' RE OR 'Nationally important wetland'* OR Any intertidal wetland vegetation* unless significance has been down-graded in an approved coastal management plan OR A wetland identified as being of 'state significance' in an approved coastal management plan OR Ramsar-listed wetland OR World Heritage Area declared primarily for its biodiversity values (i.e. not areas such as Riversleigh)

* Where mapped at an appropriate scale. In cases where a "Nationally Important Wetland" is also a Ramsar-listed wetland, the Ramsar-listed wetland is used.

B2: Regional ecosystem value

Biodiversity status of mapped REs (Table 4) as determined for the particular subregion, or the presence of regionally important wetlands (for example, from regional coastal management plans), or the presence of REs that are poorly conserved in protected areas within the subregion, or where pre-clearing extents are critically low (less than 300ha or less than 10%) within the subregion.

Table 4. Indicators and ratings for Criterion B2: Regional ecosystem value

Rating:	Low	Medium	High	Very high
Indicator:	'Limited conservation value' RE (>50% of the pre-clearing extent remains in the subregion)	'Moderate conservation value' RE (30–50% of the pre-clearing extent remains in the subregion) OR 'Poorly conserved" RE within the subregion OR Contains subdominant (< 30%) 'High conservation value' or 'very high conservation value" RE	'High conservation value' RE (10–30% of the pre-clearing extent remains in the subregion) OR A significant wetland in SEQ designated as 'valuable habitat' in Chenoweth EPLA (2000b; after Dowling and Stephens 1998)	'Very high conservation value' RE (with a pre-clearing extent <300ha or <10% of the pre-clearing extent remains in the subregion)

B3: Local ecosystem value

Biodiversity status of mapped REs as determined for the particular Local Government Area (Table 5), or the presence of minor wetlands (for example, from Regional Coastal Management Plans or other wetland assessments), or the presence of REs that are poorly conserved within the Local Government Area, or where pre-clearing extents are critically low (less than 300ha or less than 10%) within the Local Government Area. This criteria is not calculated as part of the BPAs, but can be calculated for Local Government Areas when required.

Table 5. Indicators and ratings for Criterion B3: Local ecosystem value

Rating:	Low	Medium	High	Very high
Indicator:	'Limited conservation value' RE (>50% of the pre-clearing extent remains in the LGA)	'Moderate conservation value' RE (30-50% of the pre-clearing extent remains in the LGA) OR RE 'poorly conserved' in the LGA	'High conservation value' RE (10–30% of the pre-clearing extent remains in the LGA) OR A wetland in SEQ designated as being of 'local significance' in Chenoweth EPLA (2000b; after Dowling and Stephens 1998)	'Very high conservation value' RE (with a pre-clearing extent <300ha, or <10% of pre-clearing extent remains in the LGA)

3.4 C: Tract size

This criterion is a measure of the relative size of a tract. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Fragmentation patterns vary vastly between different bioregions in Queensland, ranging from uncleared landscapes in the Cape York Peninsula through to highly fragmented landscapes in the New England Tableland. This variability can be factored into considerations of the relative importance of tracts of the same size within different bioregions. That is, a small tract in a depleted landscape is assumed to have comparable importance to a larger tract in a less depleted landscape.

While fragmentation is relevant in cleared or heavily degraded areas, it has less relevance in relatively intact and pristine areas. Subregions are classified according to the proportion of vegetation cleared (see Table 6, after McIntyre and Hobbs 2000). To ensure that tract size does not unduly influence the assessment of biodiversity significance, a very high value for tract size is only attainable where there is less than 60% of the native vegetation remaining. Whole tracts are assigned to the higher fragmentation class if at least 30% of its extent occurs within one or more subregions of this type.

Table 6. Classes of landscape pattern used in assessment criteria for tract size (after McIntyre and Hobbs 2000)

Landscape patterns	% Vegetation remaining
Relictual	<10
Fragmented	10–60
Variegated	60–90
Intact	>90

Threshold calculations for tract size are determined for each bioregion according to the size distribution of tracts, including their extent into neighbouring bioregions (Appendix 2, p. 2828). The area thresholds used for the tract size ratings are recorded in the summary reports produced for each current BPA.

3.5 D: Relative size of regional ecosystem

The relative size (expressed as a percentile) of the RE occurring within the remnant unit compared with all other occurrences of the same RE within other remnant units. Large examples of an RE are more significant than smaller examples of the same RE because they are:

- more representative of the biodiversity values particular to the RE,
- more resilient to the effects of disturbance, and
- constitute a significant proportion of the total area of the RE.

Size thresholds vary according to scale of application (State, Regional and Local). Absolute size thresholds are specific to each RE. Remnant units that overlap subregional boundaries are assigned to the subregion in which its extent is greatest.

In cases of heterogeneous remnant units, the higher relative size is used to describe the status of the entire remnant unit, providing the RE with the higher relative size represents more than 30% of the remnant unit. Remnant units in which the RE with the higher relative size represents less than 30%, or remnant units in which all REs are less than 30%, are assigned a medium value and cartographically identified as potentially important indicators of relative ecosystem size (for example by light stippling).

D1: State relative ecosystem size

State relative ecosystem size is defined according to the analysis of regional ecosystems within a bioregion (Table 7).

Table 7. Indicators and ratings for Criterion D1: State relative ecosystem size

Rating:	Low (ha)	Medium (ha)	High (ha)	Very high (ha)
Indicator:	The RE within the remnant unit is <25% the size of the largest example* of that RE in the bioregion.	The RE within the remnant unit is 25% to 50% the size of the largest example* of that RE in the bioregion OR The remnant unit contains a subdominant (< 30%) RE that is > 50% the size of the largest example* of that RE in the bioregion OR The remnant unit is heterogeneous in which no RE is >30%	The RE within the remnant unit is 50% to 75% the size of the largest example* of that RE in the bioregion.	The RE within the remnant unit is >75% the size of the largest example* of that RE in the bioregion.

* The 'largest example' is calculated as the average of the largest three occurrences of that RE within the bioregion.

D2: Regional relative ecosystem size

Regional relative ecosystem size value is defined according to the analysis of regional ecosystems within subregions (Table 8).

Table 8. Indicators and ratings for Criterion D2: Regional relative ecosystem size

Rating:	Low (ha)	Medium (ha)	High (ha)	Very high (ha)
Indicator:	The RE within the remnant unit is <25% the size of the largest example* of that RE in the subregion.	The RE within the remnant unit is 25% to 50% the size of the largest example* of that RE in the subregion OR The remnant unit contains a subdominant (<30%) RE that is >50% the size of the largest example* of that RE the subregion OR The remnant unit is heterogeneous in which no RE is >30%.	The RE within the remnant unit is 50% to 75% the size of the largest example* of that RE in the subregion.	The RE within the remnant unit is >75% the size of the largest example* of that RE in the subregion.

* The 'largest example' is calculated as the average of the largest three occurrences of that RE within the subregion.

D3: Local relative ecosystem size

Local relative ecosystem size value is defined according to the analysis of regional ecosystems within LGAs (Table 9). This criteria is not calculated as part of the BPAs, but can be calculated for LGAs when required.

Tale 9. Indicators and ratings for Criterion D3: Local relative ecosystem size

Rating:	Low (ha)	Medium (ha)	High (ha)	Very high (ha)
Indicator:	The RE within the remnant unit is >25% the size of the largest example* of that RE in the LGA	The RE within the remnant unit is 25% to 50% the size of the largest example* of that RE in the LGA	The RE within the remnant unit is 50% to 75% the size of the largest example* of that RE in the LGA	The RE within the remnant unit is > 75% the size of the largest example* of that RE in the LGA

* The 'largest example' is calculated as the average of the largest 3 occurrences of that RE within the local government area.

3.6 E: Condition

The quality of remnant units is judged by the extent to which each resembles its natural condition, as indicated by the degree of anthropogenic disturbance. In the absence of a consistent assessment of vegetation condition across a bioregion, the remnant vegetation mapping by the Queensland Herbarium is taken to represent areas of vegetation in their natural state (Table 10). Vegetation is mapped as remnant where the predominant canopy represents more than 50% of the undisturbed cover, averaging more than 70% of the undisturbed height and composed of species characteristic of the vegetation's undisturbed predominant canopy (*Vegetation Management Act* 1999).

Table 10. Indicators and ratings for Criterion E: Condition.

Rating:	Low	Medium	High	Very high
Default Indicator: Queensland Herbarium Mapping	Not mapped by the Queensland Herbarium	NA	NA	Mapped by Queensland Herbarium
Other Indicator/s	Alternative indicator(s) yet to be developed for entire bioregions	Alternative indicator(s) yet to be developed for entire bioregions	Alternative indicator(s) yet to be developed for entire bioregions	Alternative indicator(s) yet to be developed for entire bioregions

3.7 F: Ecosystem diversity

The number and size of ecosystems and wetlands present in an area is an indication of habitat complexity. Ecosystem diversity reflects the degree to which regional ecosystems are 'packed' within an area, that is, an area with high ecosystem diversity will have relatively many regional ecosystems and ecotones.

Ecosystem diversity is commonly classified using concepts of 'richness' and 'evenness'. Richness refers to the number of different ecosystems, while evenness refers to their relative abundance. Simpson's Diversity Index is a commonly used measure that incorporates both richness and evenness. The index calculates a probability between 0 and 1, with high scores representing areas of high densities of regional ecosystems and ecotones.

To classify ecosystem diversity a buffer is placed around the focus remnant unit reflecting its shape. The width of the buffer is derived using the modal (most frequently occurring) area of all remnant units within the bioregion (rounded to the nearest 50m). An ecosystem diversity value for the focus remnant unit is calculated within the total buffered area. Refer to Appendix 3 (p. 29) for a worked example of how this criterion is applied. The buffer distance used for each BPA is recorded in the summary report.

As each bioregion has a different range of Simpson's Diversity Index values, the indicators are defined according to the range within the bioregion. The quarter-percentiles and respective thresholds for the range of Simpson's Diversity Index values within a bioregion are used to define the ratings for ecosystem diversity (Table 11).

Table 11. Indicators and ratings for Criterion F: Ecosystem diversity

Rating:	Low	Medium	High	Very high
Indicator:	The remnant unit has a Simpson's Diversity Index that is <25% of the maximum value for the bioregion	The remnant unit has a Simpson's Diversity Index that is 25% to 50% of the maximum value for the bioregion	The remnant unit has a Simpson's Diversity Index that is 50% to 75% of the maximum value for the bioregion	The remnant unit has a Simpson's Diversity Index that is >75% of the maximum value for the bioregion

3.8 G: Context and connection

The extent to which the remnant unit incorporates borders or buffers the areas is indicated below (Table 12).

Water

The presence or inclusion of a wetland or waterway within or adjacent to remnant vegetation increases the vegetation's significance for contributing to ecological processes and protecting aquatic biodiversity. For the time being, this variable cannot be used in BPAs until a large-scale consistent coverage of wetlands and watercourses has been generated and integrated with the RE coverage. This criterion applies where waterways and wetlands have been mapped at an appropriate scale (currently, 1:250,000 for creeks, rivers and waterways and 1:100,000 or better for wetlands) and integrated with the RE coverage. Buffers for waterways and wetlands follow state policies for vegetation management on freehold and state lands (Queensland Government 2000a, 2000b) and the State Coastal Management Plan (Environmental Protection Agency 2001). Where a remnant unit buffers a waterway or important wetland, the area of the remnant unit outside the buffer is flagged in the database by assigning a medium value and cartographically identified as a potentially important buffer area (for example by light stippling).

Endangered ecosystems

Remnant units bordering endangered REs have additional importance as buffers. Buffers are only applied to heterogeneous remnant units where the endangered RE represents more than 30% of the remnant unit. Where a remnant unit buffers an endangered RE, the area of the remnant unit outside the 200m buffer is flagged in the database by assigning a medium value and cartographically identified (for example by light stippling) as a potentially important buffer area.

Physical connection

The degree to which a remnant unit is connected to other vegetation. Connected remnant units are more representative of biodiversity, contribute more to a habitat network and have greater resilience to the effects of disturbance than small isolated remnant units.

Table 12. Indicators and ratings for Criterion G: Context and connection

Rating:	Low	Medium	High	Very high
Indicator:	The remnant unit: is not physically connected to another remnant unit. *	The remnant unit: adjoins another remnant unit along <50% of its perimeter OR is adjacent to an endangered RE (only the part of the remnant unit outside the 200m buffer is attributed as medium) OR is adjacent to a waterway or important wetland ** (only the part of the remnant unit outside the buffer*** is attributed as medium).	The remnant unit: adjoins another remnant unit along 50% to 75% of its perimeter.	The remnant unit: adjoins another remnant unit along >75% of its perimeter OR borders/includes another remnant unit with an endangered RE (a buffer is extended 200m into the remnant unit and attributed as very high) OR borders/includes another remnant unit with a waterway or important wetland ** (a buffer*** is extended into the remnant unit and attributed as very high).

* Gaps of varying widths between adjacent remnant units are assessed as possible 'corridors' under Expert Panel Criterion “J”.

** This criterion is used in Biodiversity Planning Assessments where waterways and wetlands are mapped at an appropriate scale (currently, 1:250,000 or better for creeks, rivers, waterways and wetlands).

*** Buffer widths for wetlands or waterways are listed below. These adopt buffers under state policies for vegetation management for freehold and state lands (Queensland Government 2000a, 2000b) and the State Coastal Management Plan (Environmental Protection Agency 2001).

For coastal areas:

- 100m of a coastal wetland
- 50m of each high bank of a river (stream order >5)
- 25m of each bank of a creek (stream order 3–4) or waterway (stream order 1–2)

For non-coastal areas:

- 50m for important wetlands
- 200m of each high bank of a river
- 100m of each bank of a creek
- 50m of each bank of a waterway.

4 Filtering combinations

In order to combine the above seven diagnostic criteria to determine a 'first cut' analysis of relative biodiversity significance, a number of data queries are required (Table 13). These queries have been designed to interrogate a GIS database to efficiently filter large volumes of data for an entire bioregion. The process simultaneously integrates an array of information for a bioregion to identify remnant units that are of biodiversity significance at State, Regional and Local scales. A descriptive interpretation of the triggers for each of the three levels of significance are given in Appendix 4 (p. 31), listed in order by query number.

Table 13. Filtering combinations to identify 'first-cut' biodiversity significance based on diagnostic criteria

Biodiversity significance of remnant units	Query No.	A: Essential habitat for EVNT spp.		B: Ecosystem value		C: Tract size		D: Relative size of ecosystem		E: Condition		F: Ecosystem diversity		G: Context and connection
S: State	1	A: VERY HIGH	OR	B1: VERY HIGH		N/R		N/R		N/R		N/R		N/R
OR	2	N/R		B1: HIGH		N/R	&	D1: VERY HIGH		N/R		N/R		N/R
OR	3	N/R		B1: HIGH	&	C: HIGH	&	D1: HIGH	&	E: VERY HIGH1	OR	F: VERY HIGH1	OR	G: VERY HIGH1
OR	4	N/R		N/R		C: VERY HIGH	&	D1: VERY HIGH	&	E: VERY HIGH		N/R		N/R
OR	5	N/R		N/R		N/R		D1: VERY HIGH	&	E: VERY HIGH1	OR	F: VERY HIGH1	OR	G: VERY HIGH1
R: Regional	6	A: HIGH	OR	B1: HIGH		N/R		N/R		N/R		N/R		N/R
OR	7	N/R		B2:VERY HIGH		N/R		N/R		N/R		N/R		N/R
OR	8	N/R		B2: HIGH	&	C: VERY HIGH	OR	D2: VERY HIGH		N/R		N/R		N/R
OR	9	N/R		N/R		C: VERY HIGH	&	D2: VERY HIGH	&	E: VERY HIGH		N/R		N/R
OR	10	N/R		N/R		C: VERY HIGH		N/R	&	E: VERY HIGH	&	F: VERY HIGH	OR	G: VERY HIGH
OR	11	N/R		B2: HIGH	&	C: HIGH	&	D2: HIGH2	OR	E: VH or HIGH2	OR	F: VH or HIGH2	OR	G: VH or HIGH2
OR	12	N/R		N/R		N/R		D2: VERY HIGH	&	E: VH or HIGH2	OR	F: VH or HIGH2	OR	G: VH or HIGH2
L: Local	13	N/R		B2: HIGH		N/R		N/R		N/R		N/R		N/R
OR	14	N/R		B3:VERY HIGH		N/R		N/R		N/R		N/R		N/R
OR	15	N/R		B3: HIGH	&	C: VERY HIGH	OR	D3: VERY HIGH		N/R		N/R		N/R
OR	16	N/R		N/R		C: VERY HIGH	&	D3: VERY HIGH	&	E: VERY HIGH		N/R		N/R
OR	17	N/R		N/R		C: VERY HIGH		N/R	&	E: VH or HIGH2	OR	F: VH or HIGH2	OR	G: VH or HIGH2

Biodiversity significance of remnant units	**Query No.**	**A: Essential habitat for EVNT spp.**		**B: Ecosystem value**		**C: Tract size**		**D: Relative size of ecosystem**		**E: Condition**		**F: Ecosystem diversity**		**G: Context and connection**
OR	18	A: MEDIUM	OR	B3: HIGH	OR	C: HIGH	&	D3: HIGH2	OR	E: VH or HIGH2	OR	F: VH or HIGH2	OR	G: VH or HIGH2
OR	19	N/R		N/R		N/R		D3: VERY HIGH	&	E: VH or HIGH2	OR	F: VH or HIGH2	OR	G: VH or HIGH2

Notes:

The assessment is progressive i.e. a query is 'triggered' only if the preceding set has not been satisfied.

Criteria B & D vary according to the scale (State, Regional, Local) – all other criteria are independent of scale.

N/R = Not relevant.

VERY HIGH1: A single 'very high' score is not sufficient—at least two of the criteria marked as VERY HIGH1 must be rated as 'very high' to qualify as significant.

HIGH2 : A single 'high' score is not sufficient—at least two of the criteria marked as HIGH2 must be rated as 'high' to qualify as significant.

'OR' = Options which apply only to the query immediately preceding the 'OR'. (i.e. A & B OR C OR D means A+B or A+C or A+D; A OR B & C means A+C or B+C; A OR B & C OR D means A+C or A+D or B+C or B+D).

5 Expert panel criteria

5.1 Expert panels

An expert panel or panels must be convened to review and refine the 'first-cut' results of data queries based on the diagnostic criteria. The panel(s) should use the following criteria to amend the biodiversity significance of each remnant unit, if necessary. The panel(s) should include people familiar with the region's biodiversity, and must undertake the assessment in a structured, consistent and transparent manner (see Appendix 5, p. 39).

Any amendment to the 'first-cut' analysis must be recorded for future reference.

The expert panel(s) can include non-mapped areas in their review. Some areas mapped by the Queensland Herbarium as non-remnant (for example regrowth) may have significant biodiversity values.

The application of these criteria can either upgrade the 'first-cut' significance of a remnant unit on the basis of additional information, or downgrade its significance if data is inaccurate or does not adequately take condition into account, for example.

The expert panel(s) should consider whether the 'first-cut' of conservation significance should be upgraded, taking into account the potential for enhancement and maintenance through appropriate planning and management.

5.2 H: Core habitat for priority taxa

This criterion can be used to identify essential and general habitat for EVNT and other priority taxa additional to that derived under Diagnostic Criterion A. Information sources include expert and local knowledge, technical reports and papers, and modelled maps of essential and general habitat (Appendix 1, p. 25).

The criterion also addresses the significance of vegetated areas for other priority taxa deemed to be of importance by the expert panels. Priority taxa, other than EVNTs, are identified for each bioregion on the basis of one or more special values and the written opinion of experts. These values may include taxa at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), 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, highly disjunct populations), or taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators). Priority flora and fauna taxa are listed in the relevant expert panel reports produced for each BPA.

Expert panels will be responsible for screening this information and indicating any caveats associated with its use.

Core habitat defined by expert panels is treated as if the area had a spatially accurate, confirmed record for the taxon. Core habitat replaces areas identified from point records and associated buffers in criteria A and H.

5.3 I: Special biodiversity values

Areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. It is desirable for expert panels to access information derived from key databases including Herbrecs, Corveg, WildNet, and Queensland Museum records as well as informal sources and to use this information in a systematic and transparent way to support the identification of special biodiversity values. Other significant areas such as Land for Wildlife, Bushcare sites, and transport corridors 'significant environmental area' should be used as a prompt for assessing biodiversity values.

Expert panels can be provided with GIS-derived data sets for individual values such as endemic taxa, disjunct taxa and species richness, as well as the location of data gaps based upon definitions presented in Appendix 6. Environmental modelling and ecological analyses should also be undertaken to assist the panel in evaluating data gaps and locating features such as topographic isolates and gradients that have a strong local influence on biodiversity.

Areas with special biodiversity values (refer Appendix 6) can include the following:

Centres of endemism – areas where concentrations of taxa are endemic to a bioregion or subregion are found.

Wildlife refugia (Morton et al 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability (refer also to Appendix 6, p. 40).

a. Areas with concentrations of disjunct populations.
b. Areas with concentrations of taxa at the limits of their geographic ranges.
c. Areas with high species richness.
d. Areas with concentrations of relictual populations (ancient and primitive taxa).
e. Areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
f. An artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
g. Areas with a high density of hollow-bearing trees that provide habitat for animals.
h. Breeding or roosting sites used by a significant number of individuals.

5.4 J: Corridors

The expert panel(s) should consider corridor links because an automated process alone is unable to identify such areas. Areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity including regrowth, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and 'stepping stones'.

Note that physical connection between contiguous remnant units is addressed in Diagnostic Criterion G (Context and connection).

5.5 K: Threatening process (condition)

Expert panels should consider the condition or habitat quality of regrowth and remnant vegetation because a consistent assessment of condition for whole bioregions is not yet possible through the diagnostic criteria. Areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the 'first-cut' analysis.

The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change. Available data sets and information about these and related processes should be compiled to assist experts in evaluating vegetation condition.

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Appendix 1 Expert panel criterion A. Core and non-core habitat for EVNT and priority taxa

Mapping the distribution and value of habitat of EVNT and priority flora and fauna

Habitat mapping is an attempt to determine the known and possible extent and importance of core and non-core habitat for EVNT and priority flora and fauna. This shifts the conservation focus away from specific points (sites of taxa presence based on historic records) in the landscape to areas used or likely to be used by each taxon. The confidence of a prediction should be attached to the remnant unit either as a quantitative measure or, alternatively, as a qualitative 'expert' judgment. The mapping is primarily derived from expert opinion under the consultative process outlined in expert panel criteria. Where data quality and quantity are sufficient to support more sophisticated analyses, such as statistical and environmental modelling, these will be used in conjunction with expert opinion.

Habitat mapping is used in two ways. It can be used either to (a) ascribe a particular remnant unit with the presence of a particular taxon where confidence is high, thereby potentially affecting the overall biodiversity significance of the remnant unit, or (b) where confidence is low, to flag the potential presence of a taxon so that further survey work can be conducted as part of impact assessments or other resource planning exercises. In the latter case, the overall biodiversity significance of the remnant unit is unaffected.

Values are generally ascribed to remnant units, but can be ascribed to other spatial features based on expert advice. For example, the habitat for a particular taxon might be defined by catchment boundaries, or perhaps by placing an arbitrary buffer around an identified population of plants or animals in the absence of a better description of habitat requirements.

The habitat evaluation must be consistent, repeatable and transparent, documenting all the reasons for a particular level of assessment. It is conducted irrespective of tenure and the significance of the areas for other conservation reasons (for example, the biodiversity status of REs, wetlands or the presence of other threatened taxa).

The experts assess the habitat value of all known locations (including historical records known to them but absent from available databases) and potential locations, selecting remnant units that depict those areas important for the taxon. Habitat value categories are described below along with some examples of what characteristics the experts may consider in defining each category as it pertains to the individual taxon being examined. The experts recommend core and non-core habitat based on their knowledge of the taxon’s ecology and behaviour and the rule-set outlined below, or assign these habitat values to any results of a spatial analysis. Depending on the information available and the expert’s confidence in assigning habitat value not all the categories may be used in all assessments.

Habitat value categories

The following criteria represent the primary set of decision rules to be used as a guide by experts in determining habitat value categories for priority flora and fauna.

Essential habitat – known (EHK):

Flora – remnant units or sites known to contain the taxon because there is:

- a significant number* of individuals present that are self-maintaining by sexual or vegetative means, or
- a significant number* of individuals known to be present at a certain stage of the growth cycle of the vegetation in which the taxon grows (for example, some obligate seeders in coastal heath regenerate from soil seed banks after disturbance such as fire and through time may die out vegetatively at the site but remain present as propagules).

Fauna – remnant units or sites known to contain the taxon because there is:

- recorded breeding activity, or
- a significant number* of individuals present and likely to be breeding in the area, or
- essential resources, for example, nest sites, roost caves, major food sources, or
- important regular movement corridors for breeding and/or non-breeding (including migratory and dispersal behaviour) individuals. Does not include sites where vagrants have been recorded (see below).

* 'significant number' is relative depending on the taxon. It could represent, for example, a breeding pair of raptors, less than 10 individuals for some large tree taxa, or thousands of individuals for small plant taxa such as grasses and herbs.

Essential habitat – possible (EHP):

Flora – remnant units or sites that are likely to contain the taxon because there is:

- habitat containing essential resources of a size capable of supporting a significant number of individuals that are self-maintaining by sexual or vegetative means, or
- habitat which is proximate to and buffering a known occurrence of a population (as defined above for EHK), or
- habitat which is potentially important, but due to a lack of search effort individuals have not been recorded (for example, some obligate seeders in coastal heath regenerate from soil seed banks after disturbance such as fire and through time may die out vegetatively at the site but remain present as propagules).

Fauna – remnant units or sites that are likely to contain the taxon because there is:

- habitat containing essential resources either of a size capable of supporting at least one breeding unit or likely to be used as an important resource by the taxon, or
- habitat which is proximate to and buffering a known occurrence of a population (as defined above for EHK), or
- habitat which is potentially important corridors for regular movements, but individuals have not been recorded (other than vagrants).

General habitat – known (GHK):

Flora – remnant units or sites known to contain the taxon but:

- relatively few individuals have been recorded (for example, due to infrequent dispersal events from nearby or distant populations), or
- the habitat is known to be sub-optimal, or
- there is insufficient information to determine whether the habitat is essential.

Fauna – remnant units or sites known to contain the taxon but:

- where only vagrant individuals have been recorded, or
- the habitat is known to be sub-optimal, or
- there is insufficient information to determine whether the habitat is essential.

General habitat – possible (GHP):

Flora – remnant units or sites that are unlikely to contain the taxon because the habitat is sub-optimal habitat and there have been no reported sightings of individuals that are self-maintaining.

Fauna – remnant units or sites that are unlikely to contain the taxon because the sites are sub-optimal habitat and there are no records of the taxon being present.

Absence – known (AK) or absence – suspected (AS):

The absence of the taxon is known or suspected because:

- absences are consistently recorded based on intensive targeted survey, or
- it is locally extinct and never likely to recolonise the location, or
- the area is unlikely to be suitable as a reintroduction or translocation site, or
- the area has been cleared since the latest release of vegetation mapping by the Queensland Herbarium.

Index of confidence:

In addition to describing habitat for a taxon, the experts are encouraged to assign an index of confidence to their appraisal of individual areas. A three-level rating is suggested—high, medium and low.

To assist experts in choosing a rating the following could be used:

- High – personal observations or records from other reputable sources (for example, 90% certainty).
- Medium – information from sources of reasonable/mixed reliability (location accuracy/taxa identification) (for example, 70% certainty).
- Low – information from sources of unknown reliability (for example, 50% certainty).

Once the habitat suitability map has been developed as far as possible, the experts are then asked to apply the broad confidence ratings listed above to reflect their overall assessment of the map, and their overall assessment of the areas identified as core habitat. The assessment is twofold: to what extent is the map indicative of a) where the taxon's habitat occurs (species distribution), and b) the value attached to various parts of the taxon's distribution (species habitat value interpretation).

Appendix 2. Threshold calculations for tract size

Tract size distributions in fragmented landscapes are characterised by exponential area distributions (that is, a very large number of small tracts and a very small number of very large tracts). Setting percentile thresholds for classifying tract size is difficult because of the extremes in size characteristics for tracts in fragmented landscapes. The approach taken is to transform the data from an exponential distribution to a normal distribution and then apply percentiles to the normal distribution of transformed areas (as shown in Figure I below). The steps below set out the method for doing this.

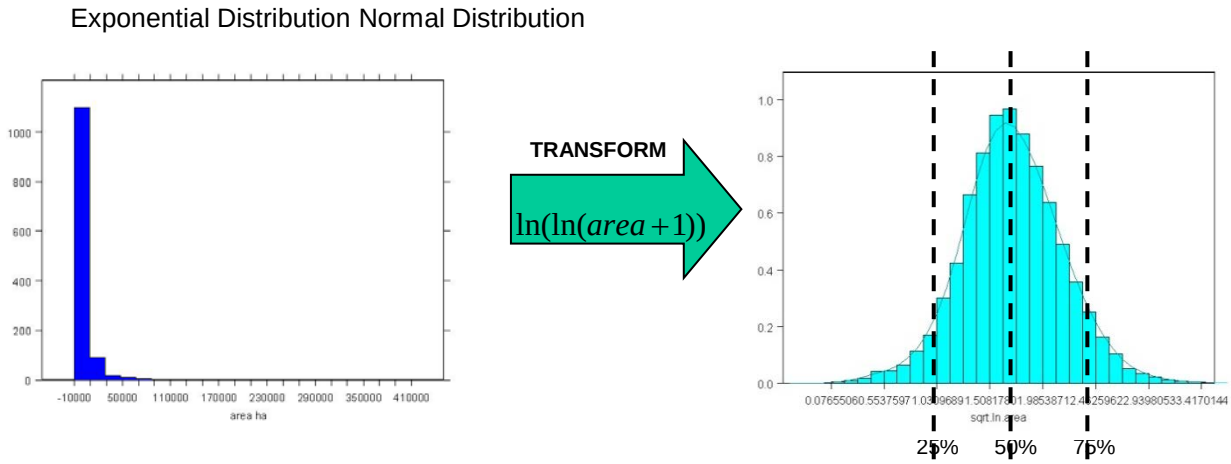

Figure I. Example transformation of an exponential distribution to a normal distribution and the application of percentiles to the normal distribution; based on tract size data for the South East Queensland Remnant Units

Step 1

Transform the exponentially distributed tract size data to a normal distribution. To do this, apply a natural log-log transform, ln(ln(*area*+ 1)) to individual tracts in the coverage.

Step 2

Calculate the area value for a given percentile of the transformed data using the mean and the standard deviation of the transformed data:

Transformed area (for percentile, P) =

average of transformed tract area + K * standard deviation of transformed tract area

where K is the number of standard deviations on either side of the mean that contains the specified percentile, P, of the data. K is calculated as $\sqrt{1/(1-P/100)}$ (Freund 1988). P values and associated area thresholds determined for bioregions in Queensland are listed in Table 1.

Step 3

Back transform the transformed area value calculated in Step 2 to get the actual area value, as follows:

area (for percentile, P) = exp[exp[(transformed area)]]-1

The result of the back transformation is a tract area threshold for a specified percentile P.

For the assessment criteria for tract size, quartiles are used to define the area thresholds in Criterion C and these are calculated for each iteration of a BPA. Quartile area thresholds are then rounded using the following rules:

Area threshold less than 500ha are rounded to the nearest 50ha.

Area thresholds greater than or equal to 500ha are rounded to the nearest 100ha.

Appendix 3. Simpson's Diversity Index

The example below demonstrates how to calculate Simpson's Diversity Index using regional ecosystems. Figure 1 shows four remnant units captured in a polygon buffer around the 'focus' remnant unit 2612 (that is, the unit for which Simpson's Diversity Index is being calculated). There are four REs involved and listed in Table 1 along with their respective heterogeneous percentages.

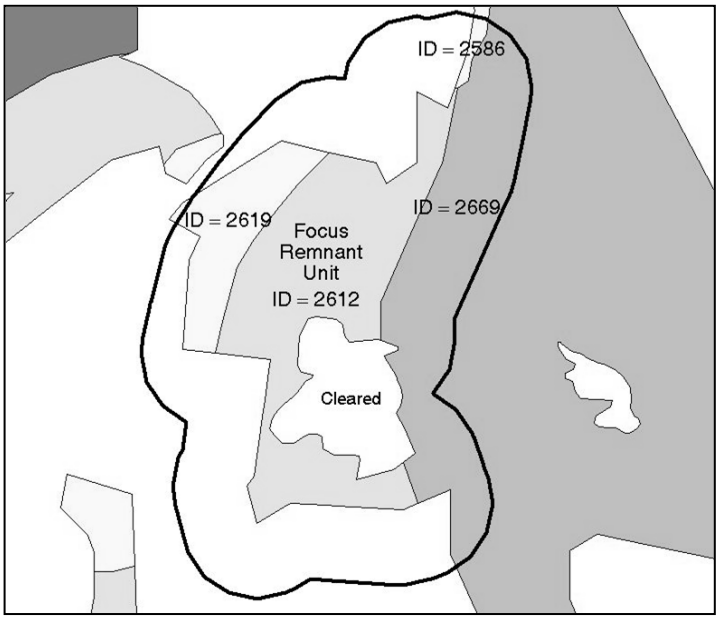

Figure 1. Example calculation of Simpson's Diversity Index

Simpson's Diversity Index is defined as:

$$SDI = 1 - \sum_{i=1}^{m} P_i^2$$

Where

$$P_i = \frac{\text{Area of remnant unit i}}{\text{Total area}}$$

m = number of REs

Table 1. Regional ecosystems and percentage area

Remnant unit ID	RE	RE percentage area
2669	13.11.3/13.11.8	90/10
2619	13.3.4/13.3.5	50/50
2612	13.11.8/13.11.3	70/30
2586	13.3.4/13.3.5	50/50

To calculate Simpson's Diversity Index you need the number of REs (m) in the buffered region, the total area of each RE within the buffered region, and the squared proportional area (P_i^2) of each RE. For the example shown in Figure 1, the data required to calculate Simpson's Diversity Index are shown in Table 2.

Table 2. Example application of Simpson's Diversity Index

RE	RE% (total)	RE area (ha)	P_i^2
13.11.3	49%	30.99	0.244
13.11.8	36%	22.36	0.127
13.3.4	8%	4.73	0.006
13.3.5	8%	4.73	0.006
Total		**62.8**	**0.383**

Simpson's Diversity Index can then be calculated using the above equation. For the example in Figure A, Simpson's Diversity Index has a value of 0.62.

Buffer size for Simpson's Diversity Index

To determine a buffer size, obtain the modal size for the remnant units over the whole bioregion. Assume the mode is a circle and use the radius of the average or mode as the buffer distance.

Appendix 4. Descriptive interpretation of filtering combinations

Section 1 of this appendix is a descriptive interpretation of the filtering combinations presented in Table 15. Diagnostic criteria which carry a flag for potential biodiversity significance at State or Regional levels are described in Section 2.

Section 1 – Filtering combinations

The following descriptions are based on the filtering combinations for State, Regional and Local significance presented in Table 13. The triggers for each of the three levels of significance are listed in order by query number. The assessment is progressive. That is, a query is 'triggered' only if the preceding set has not been satisfied. The expanded queries from Table 13 are given in Table 1, below.

Superscripts

† in heterogeneous remnant units where REs comprise at least 30% of the remnant unit area

* only the portion of the remnant unit with the core habitat, buffered record, wetland or World Heritage Area is identified as being of state significance

‡ excluding condition rated as 'high' which currently has no indicator (alternative indicator(s) yet to be developed for entire bioregions)

State significance

A remnant unit or portion* of a remnant unit is assessed as being of State significance if:

Query 1

- it contains core habitat* or confirmed records* (buffered by twice precision ≤500m) for at least one endangered taxon OR two or more of either vulnerable or near threatened taxa (excluding highly mobile taxa), **OR**
- it contains at least one endangered RE†, **OR**
- it contains a 'nationally important wetland'* **OR** a Ramsar-listed wetland* **OR** a wetland* identified as being of 'State significance' in an approved coastal management plan, **OR**
- it contains an intertidal wetland* (unless significance has been downgraded in an approved coastal management plan),; **OR**
- it contains a World Heritage Area* (that was declared primarily for its biodiversity values), **OR**

Query 2

- it contains a very large example of an RE† rated as very high with an of concern status, **OR**
- it contains a very large example of an RE† rated as very high with a wetland* designated as being of 'Regional significance' (in an approved coastal management plan) or a coastal wetland* in SEQ designated as 'regional'/'major habitat' significance in Chenoweth EPLA (2000b after Dowling and Stephens 1998), **OR**

Query 3

- it contains an of concern RE† **OR** a wetland* identified as being of 'Regional significance' in an approved coastal management plan **OR** a coastal wetland* in SEQ designated as 'regional'/'major habitat' in Chenoweth EPLA (2000b after Dowling and Stephens 1998);

AND

- it is part of a moderately large tract rated as high

AND

- it contains a moderately large example of an RE† rated as high

AND

- it has **TWO** of the following three sets of criteria:
  - it contains remnant vegetation mapped by the Queensland Herbarium; **AND/OR**
  - it has an Index of ecosystem diversity rated as very high; **AND/OR**
  - it adjoins another remnant unit along more than 75% of its perimeter **OR** forms part of a 200m buffer for an endangered RE† **OR** forms part of a buffer for a waterway or important wetland, **OR**

Query 4

- it is part of a very large tract rated as very high **AND** it contains a very large example of an RE† rated as very high **AND** it contains remnant vegetation mapped by the Queensland Herbarium, **OR**

Query 5

- it contains a very large example of an RE† rated as very high,

AND

- it has **TWO** of the following three sets of criteria:
  - it contains remnant vegetation mapped by the Queensland Herbarium; **AND/OR**
  - it has an Index of Ecosystem Diversity rated as very high; **AND/OR**
  - it adjoins another remnant unit along more than 75% of its perimeter **OR** forms part of a 200m buffer for an endangered RE† **OR** forms part of a buffer for a waterway or important wetland, **OR**

Regional significance

A remnant unit or portion* of a remnant unit is assessed as being of Regional significance if:

Query 6

- it contains core habitat* or confirmed records* (buffered by twice precision ≤500m) for one vulnerable or one near threatened taxon (excluding highly mobile taxa), **OR**
- it contains at least one of concern RE†; **OR**
- it contains a wetland* identified as being of 'Regional significance' in an approved coastal management plan **OR** a coastal wetland* in SEQ designated as 'regional'/'major habitat' in Chenoweth EPLA (2000b after Dowling and Stephens 1998), **OR**

Query 7

- it contains at least one RE† with less than 10% of its pre-clearing extent remaining in the subregion **OR** with a pre-clearing extent of less than 300ha in the subregion, **OR**

Query 8

- it contains at least one RE† with 10–30% of its pre-clearing extent remaining in the subregion **OR** a coastal wetland* in SEQ designated as 'valuable habitat' in Chenoweth EPLA (2000b after Dowling and Stephens 1998);

AND

- it is part of a very large tract rated as very high **OR** it contains a very large example of an RE† rated as very high in the subregion, **OR**

Query 9

- it is part of a very large tract rated as very high **AND** it contains a very large example of an RE† rated as very high in the subregion **AND** it contains remnant vegetation mapped by the Queensland Herbarium, **OR**

Query 10

- it is part of a very large tract rated as very high **AND** it contains remnant vegetation mapped by the Queensland Herbarium,

AND

- it has an Index of Ecosystem Diversity rated as very high **OR** it adjoins another remnant unit along more than 75% of its perimeter **OR** it forms part of a 200m buffer for an endangered regional ecosystem **OR** it forms part of a buffer for a waterway or important wetland, **OR**

Query 11

- it contains at least one RE† with 10–30% of its pre-clearing extent remaining in the subregion **OR** it contains a coastal wetland* in SEQ designated as 'valuable habitat' in Chenoweth EPLA (2000b after Dowling and Stephens 1998);

AND

- it is part of a moderately large tract rated as high,

AND

- it has at least **TWO** of the following three‡ sets of criteria:
    1. it contains a large example of a regional ecosystem that is rated as high in the subregion; **AND/OR**
    2. it has an Index of Ecosystem Diversity that is rated as high; **AND/OR**
    3. it adjoins another remnant unit along 50–75% of its perimeter, **OR**
- it has at least **ONE** of the following three sets of criteria:
    1. it contains remnant vegetation mapped by the Queensland Herbarium; **OR**
    2. it has an Index of Ecosystem Diversity rated as Very High; **OR**
    3. it adjoins another Remnant Unit along more than 75% of its perimeter **OR** forms part of a 200m buffer for an Endangered RE† **OR** forms part of a buffer for a Waterway or Important Wetland, **OR**

Query 12

- it contains a very large example of an RE† rated as very high in the subregion;

AND

- it has an Index of Ecosystem Diversity rated as high **AND**‡ it adjoins another remnant unit along 50–75% of its perimeter, **OR**
- it has at least **ONE** of the following three sets of criteria:

1. it contains remnant vegetation mapped by the Queensland Herbarium, **OR**
2. it has an Index of Ecosystem Diversity rated as very high, **OR**
3. it adjoins another remnant unit along more than 75% of its perimeter **OR** forms part of a 200m buffer for an endangered RE† **OR** forms part of a buffer for a waterway or important wetland, **OR**

Local significance

A remnant unit or portion* of a remnant unit is assessed as being of Local significance if:

Query 13

- it contains at least one RE† with 10–30% of its pre-clearing extent remaining in the subregion **OR** it contains a coastal wetland* in SEQ designated as 'valuable habitat' in Chenoweth EPLA (2000b after Dowling and Stephens 1998), **OR**

Query14

- it contains at least one RE† with less than 10% of its pre-clearing extent remaining in the local government area **OR** it has a preclearing extent of less than 300ha in the local government area, **OR**

Query 15

- it contains at least one RE† with 10–30% of its pre-clearing extent remaining in the local government area **OR** it contains a coastal wetland* in SEQ designated as of 'local significance' in Chenoweth EPLA (2000b after Dowling and Stephens 1998),

AND

- it is part of a very large tract rated as very high **OR** it contains a very large example of an RE† rated as very high in the local government area, **OR**

Query 16

- it is part of a very large tract rated as very high **AND** it contains a very large example of an RE† rated as very high in the local government area **AND** it contains remnant vegetation mapped by the Queensland Herbarium, **OR**

Query 17

- it is part of a very large tract rated as very high,

AND

- it has an Index of Ecosystem Diversity rated as high **AND**‡ it adjoins another remnant unit along 50–75% of its perimeter, **OR**
- it has at least **ONE** of the following three sets of criteria:
    1. it contains remnant vegetation mapped by the Queensland Herbarium; **OR**
    2. it has an Index of Ecosystem Diversity rated as very high; **OR**
    3. it adjoins another remnant unit along more than 75% of its perimeter **OR** forms part of a 200m buffer for an endangered RE **OR** forms part of a buffer for a waterway or important wetland, **OR**

Query 18

- it has at least **ONE** of the following three sets of criteria:
    1. it contains less precise confirmed records* (buffered by twice precision of 500–2000m) for one or more EVNT taxa (excluding highly mobile taxa) **OR**
    2. the area within the remnant unit falls outside the buffer for precise records (≤500m) of a EVNT taxa (excluding highly mobile taxa) **OR**
    3. it represents essential or general habitat* for a EVNT taxa that is not assessed as core habitat, **OR**
- it contains at least one RE† with 10–30% of its pre-clearing extent remaining in the local government area **OR** it contains a coastal wetland* in SEQ designated as of 'local significance' in Chenoweth EPLA (2000b after Dowling and Stephens 1998), **OR**
- it is part of a moderately large tract rated as high,

AND

- it has at least **TWO** of the following three‡ sets of criteria:
    1. it contains a large example of a regional ecosystem rated as high in the local government area; **AND/OR**
    2. it has an Index of Ecosystem Diversity rated as high; **AND/OR**
    3. it adjoins another remnant unit along 50–75% of its perimeter, **OR**
- it has at least **ONE** of the following three sets of criteria:
    1. it contains remnant vegetation mapped by the Queensland Herbarium; **OR**
    2. it has an Index of Ecosystem Diversity rated as very high; **OR**
    3. it adjoins another remnant unit along more than 75% of its perimeter **OR** forms part of a 200m buffer for an endangered RE **OR** forms part of a buffer for a waterway or important wetland, **OR**

Query 19

- It contains a very large example of an RE† rated as very high in the local government area,

AND

- it has an Index of Ecosystem Diversity rated as high **AND**‡ it adjoins another remnant unit along 50–75% of its perimeter, **OR**
- it has at least **ONE** of the following three sets of criteria:
    1. it contains remnant vegetation mapped by the Queensland Herbarium; **OR**
    2. it has an Index of Ecosystem Diversity rated as very high; **OR**
    3. it adjoins another remnant unit along more than 75% of its perimeter **OR** forms part of a 200m buffer for an endangered RE **OR** forms part of a buffer for a waterway or important wetland**.**

Table 1. Filtering combinations to identify 'first-cut' biodiversity significance based on diagnostic criteria (expanded queries from Table 17). Technical definitions for criteria and ratings are given below. Query numbers are given in the columns. A query may comprise one or more combinations of criteria (denoted by = ……; OR).

	State significance		Regional significance		Local significance
1	**A:VH**; OR **B1:VH**	6	**A:H**; OR **B1:H**	13	**B2:H**
2	**B1:H** & **D1:VH**	7	**B2:VH**	14	**B3:VH**
3	**B1:H** & **C:H** & **D1:H** & **E:VH** & **F:VH**; OR **B1:H** & **C:H** & **D1:H** & **E:VH** & **G:VH**; OR **B1:H** & **C:H** & **D1:H** & **F:VH** & **G:VH**	8	**B2:H** & **C:VH**; OR **B2:H** & **D2:VH**	15	**B3:H** & **C:VH**; OR **B3:H** & **D3:VH**
4	**C:VH** & **D1:VH** & **E:VH**	9	**C:VH** & **D2:VH** & **E:VH**	16	**C:VH** & **D3:VH** & **E:VH**
5	**D1:VH** & **E:VH** & **F:VH**; OR **D1:VH** & **E:VH** & **G:VH**; OR **D1:VH** & **F:VH** & **G:VH**	10	**C:VH** & **E:VH** & **F:VH**; OR **C:VH** & **E:VH** & **G:VH**	17	**C:VH** & **E:H** & **F:H;** OR **C:VH** & **E:H** & **G:H**; OR **C:VH** & **F:H** & **G:H**; OR **C:VH** & **E:VH**; OR **C:VH** & **F:VH**; OR **C:VH** & **G:VH**
		11	**B2:H** & **C:H** & **D2:H** & **E:H**; OR **B2:H** & **C:H** & **D2:H** & **F:H**; OR **B2:H** & **C:H** & **D2:H** & **G:H**; OR **B2:H** & **C:H** & **E:H** & **F:H**; OR **B2:H** & **C:H** & **E:H** & **G:H**; OR **B2:H** & **C:H** & **F:H** & **G:H**; OR **B2:H** & **C:H** & **E:VH**; OR **B2:H** & **C:H** & **F:VH**; OR **B2:H** & **C:H** & **G:VH**	18	**A:M** & **D3:H** & **E:H**; OR **A:M** & **D3:H** & **F:H**; OR **A:M** & **D3:H** & **G:H**; OR **A:M** & **E:H** & **F:H**; OR **A:M** & **E:H** & **G:H**; OR **A:M** & **F:H** & **G:H**; OR **A:M** & **E:VH**; OR **A:M** & **F:VH**; OR **A:M** & **G:VH**; OR **B3:H** & **D3:H** & **E:H**; OR **B3:H** & **D3:H** & **F:H**; OR **B3:H** & **D3:H** & **G:H**; OR **B3:H** & **E:H** & **F:H**; OR **B3:H** & **E:H** & **G:H**; OR **B3:H** & **F:H** & **G:H**; OR **B3:H** & **E:VH**; OR **B3:H** & **F:VH**; OR **B3:H** & **G:VH**; OR **C:H** & **D3:H** & **E:H**; OR **C:H** & **D3:H** & **F:H**; OR **C:H** & **D3:H** & **G:H**; OR **C:H** & **E:H** & **F:H**; OR **C:H** & **E:H** & **F:H**; OR **C:H** & **F:H** & **G:H**; OR **C:H** & **E:VH**; OR **C:H** & **F:VH**; OR

	State significance		Regional significance		Local significance
					C:H & **G:VH**
		12	**D2:VH** & **E:H** & **F:H**; OR **D2:VH** & **E:H** & **G:H**; OR **D2:VH** & **F:H** & **G:H**; OR **D2:VH** & **E:VH**; OR **D2:VH** & **F:VH**; OR **D2:VH** & **G:VH**	19	**D3:VH** & **E:H** & **F:H**; OR **D3:VH** & **E:H** & **G:H**; OR **D3:VH** & **F:H** & **G:H**; OR **D3:VH** & **E:VH**; OR **D3:VH** & **F:VH**; OR **D3:VH** & **G:VH**

Definitions (for Table 1)

A Remnant unit or portion of a remnant unit is assessed as being of biodiversity significance if:

A:VH
It contains core habitat or confirmed records (buffered by twice precision ≤500m) for at least one endangered taxon OR two or more of either vulnerable or near threatened taxa, though excluding highly mobile taxa other than breeding or significant roosting sites.

A:H
It contains core habitat or confirmed records (buffered by twice precision ≤500m) for at least one vulnerable taxon or one near threatened taxon, though excluding highly mobile taxa other than breeding or significant roosting sites.

A remnant unit or portion of a remnant unit is assessed as being of biodiversity significance if:

B1:VH
It contains at least one endangered regional ecosystem comprising at least 30% of the remnant unit area OR a 'nationally important wetland' that is not listed as a Ramsar wetland OR a Ramsar-listed wetland OR a wetland identified as being of 'state significance' in an approved coastal management plan OR an intertidal wetland (unless significance has been down-graded in an approved coastal management plan) OR a World Heritage Area that was declared primarily for its biodiversity values.

B1:H
It contains an of concern regional ecosystem comprising at least 30% of the remnant unit area OR a wetland designated as being of 'regional significance' in an approved coastal management plan OR (in SEQ bioregion) a significant wetland designated as 'regional' or 'major habitat' in Chenoweth EPLA (2000b, after Dowling and Stephens 1998).

B2:VH
It contains at least one regional ecosystem comprising at least 30% of the remnant unit area with less than 10% of its pre-clearing extent remaining in the subregion OR it has a pre-clearing extent of less than 300ha in the subregion.

B2:H
It contains at least one regional ecosystem comprising at least 30% of the remnant unit area and with 10-30% of its pre-clearing extent remaining in the subregion OR (in SEQ) a significant coastal wetland designated as 'valuable habitat' in Chenoweth EPLA (2000b, after Dowling and Stephens 1998).

B3:VH
It contains at least one regional ecosystem comprising at least 30% of the remnant unit area with less than 10% of its pre-clearing extent remaining in the local government area OR it has a pre-clearing extent of less than 300ha in the local government area.

B3:H
It contains at least one regional ecosystem comprising at least 30% of the remnant unit area and with 10–30% of its pre-clearing extent remaining in the local government area OR (in SEQ) a significant coastal wetland designated as of 'local significance' in Chenoweth EPLA (2000b, after Dowling and Stephens 1998).

C:VH
It occurs within a tract belonging to relictual subregions that fall within the third or fourth quartile of the normalised size distribution for tracts belonging to the bioregion OR it occurs within a tract belonging to fragmented subregions that fall within the fourth quartile of the normalised size distribution for tracts belonging to the bioregion.

C:H
It occurs within a tract belonging to relictual subregions that falls within the second quartile of the normalised size distribution for tracts belonging to the bioregion OR it occurs within a tract belonging to fragmented subregions that falls within the third quartile of the normalised size distribution for tracts belonging to the bioregion OR it occurs within a tract belonging to variegated or intact subregions that falls within the third or fourth quartile of the normalised size distribution for tracts belonging to the bioregion.

D1:VH
It contains a very large example of a regional ecosystem that is greater than 75% the size of the average of the three largest examples of its type in the bioregion.

D1:H
It contains a large example of a regional ecosystem that is 50–75% the size of the average of the three largest examples of its type in the bioregion.

D2:VH
It contains a very large example of a regional ecosystem that is greater than 75% the size of the average of the three largest examples of its type in the subregion.

D2:H
It contains a large example of a regional ecosystem that is 50–75% the size of the average of the three largest examples of its type in the

subregion.

D3:VH
It contains a very large example of a regional ecosystem that is greater than 75% the size of the average of the three largest examples of its type in the local government area.

A Remnant Unit or portion of a remnant unit is assessed as being of biodiversity significance if:

D3:H
It contains a large example of a regional ecosystem that is 50–75% the size of the average of the three largest examples of its type in the local government area.

E:VH
It contains vegetation in its natural condition with more than 50% of the undisturbed cover, averaging more than 70% of the undisturbed height and composed of species characteristic of its undisturbed type (regional ecosystems as mapped by the Queensland Herbarium).

E:H
Not applicable (alternative indicator(s) yet to be developed for entire bioregions).

F:VH
It has an Index (Simpson's) of Ecosystem Diversity that is greater than 75% the maximum value for the bioregion.

F:H
It has an Index (Simpson's) of Ecosystem Diversity that is between 50% and 75% of the maximum value for the bioregion.

G:VH
It adjoins another remnant unit along more than 75% of its perimeter OR forms part of a 200m buffer for an endangered regional ecosystem OR forms part of a buffer for a waterway or important wetland (where buffer widths follow state policies for vegetation management for freehold and state lands and state coastal management plans).

G:H
It adjoins another remnant unit along 50% to 75% of its perimeter.

Section 2 – Biodiversity significance flags

Some diagnostic criteria with medium ratings are important indicators of potential biodiversity significance at state or regional levels. These criteria are flagged in the final Biodiversity Planning Assessment Database for the purpose of assigning cartographic elements (for example, light stippling).

A:M (Flag)
The part of the remnant unit outside an intersecting buffered area for a precise record of an EVNT taxon (precision ≤500m) OR the buffer area for a less precise record of an EVNT taxon (precision 500–2000m).

B1:M (Flag)
The remnant unit contains a subdominant endangered or of concern regional ecosystem OR is a highly heterogeneous remnant unit in which no regional ecosystem is greater than 30%.

B2:M (Flag)
The remnant unit contains a subdominant (<30%) regional ecosystem defined as 'high conservation value' or 'very high conservation value' within the subregion OR is a highly heterogeneous remnant unit in which no regional ecosystem is greater than 30%.

D1:M (Flag)
The remnant unit contains a subdominant regional ecosystem that is greater than 50% the size of the largest example of its type in the bioregion OR is a highly heterogeneous remnant unit in which no regional ecosystem is greater than 30%.

D2:M (Flag)
The remnant unit contains a subdominant regional ecosystem that is greater than 50% of the size of the largest example of its type in the subregion OR a highly heterogeneous remnant unit in which no regional ecosystem is greater than 30%.

G:M (Flag)
The part of the remnant unit outside the 200m buffer for an endangered regional ecosystem OR outside the buffer for a waterway or important wetland.

Appendix 5. Expert panels

The following guiding principles are suggested in developing Terms of Reference for Expert Panels (see Expert panel criteria).

Purpose

Initial expert panels are convened to ensure the data is as up-to-date as possible, and to elicit responses to expert panel criteria. Experts are requested to consider species identified as endangered, vulnerable or near threatened (‘at risk‘) under state or Commonwealth legislation, declining species (as identified by the panel), species endemic to a bioregion, and the distribution of species diversity across the landscape (for example, ’hotspots‘).

Once sufficient data has been collated, expert panels are convened to review and refine the ’first cut‘ of the Biodiversity Planning Assessment. That is, while they need to understand each of the individual criteria, panel members are asked to focus their attention on the integrated BPA, and the underlying information arising from the initial expert panels.

Initially, the expert panels should check the diagnostic outputs and provide feedback on whether the results accurately reflect what they know of the areas. Panel members are encouraged to make available any relevant information that may affect the significance of a locality.

The expert panels can include non-mapped areas in their review if, in their opinion, non-remnant areas (for example, regrowth) have significant biodiversity values.

The expert panels can identify priority areas for local enhancement of significant biodiversity values, through:

- enhanced management (for example, weed control and fire management)
- retention of regrowth
- re-establishment of corridors of native vegetation.

Composition of panel

The panel should include people familiar with the region’s biodiversity within the context of the bioregion. Flora and fauna panel members should have expertise in the conservation and management of flora and/or fauna species, particularly species listed as endangered, vulnerable or near threatened under the Nature Conservation Act. The combined expertise of the panel should encompass, as far as possible, the relevant taxonomic diversity for the bioregion in question. Panel members should include government and non-government experts. If considered appropriate, stakeholders or members of community groups (for example, catchment management, conservation, local government), or other agency staff may be invited as observers.

Principles

The outputs of the expert panel should:

- be justifiable and transparent
- be captured digitally and mapped
- be a result consensus within the panel
- be ratified by the Manager, Biodiversity Assessment, EHP and/or Director.

Supporting information

The expert panel should be provided with GIS-derived data sets and maps for individual values such as endemic taxa, disjunct taxa and species richness. Environmental modelling analyses can also be undertaken to assist the panel with evaluating data gaps and the location of features such as topographic isolates and environmental gradients that have a strong local influence on biodiversity.

Appendix 6 Expert panel criterion I – special biodiversity values

Ia) Identification of centres of endemism

Endemic species are defined as those taxa which have at least 75% of their geographical range within one bioregion or which have a total range of 100,000sq.km or less (Commonwealth of Australia 1995, Queensland CRA/RFA Steering Committee 1998).

Endemic taxa can be identified through the analysis of flora and fauna records stored in WildNet using GIS. GIS can also be used to analyse the distribution of all endemic taxa defined for a bioregion and rank areas on the basis of the relative number of endemic taxa they contain. This approach needs to acknowledge data gaps that need to be addressed through expert review.

As a short-term alternative to the automated approach, which is resource-intensive, expert knowledge can be used to define an interim set of endemic taxa for a bioregion and to identify areas considered to contain high numbers of endemic taxa.

Ib) Wildlife refugia

Wildlife refugia encompass:

- habitats that support taxa that are uncommon or do not occur elsewhere
- habitats that enable taxa to survive during extreme events such as drought, fire and in the longer term, climate change
- remnants that have and will survive clearing and fragmentation. This may include large areas not suitable for broadscale clearing because of land suitability/capability. In using this criterion, there should be a reasonable expectation that the refuge areas will remain protected from broadscale clearing indefinitely. For example, areas identified as being unsuitable for clearing in a vegetation management plan developed and accepted through a community consultation process. Identified areas may also include national parks or other protected areas or state forests which have a high level of protection from clearing
- habitats used by migratory taxa for short periods of time.

The identification of wildlife refugia will sometimes rely upon studies of specific habitats such as mound springs and caves, as well as expert knowledge. Some computer-based analysis may be useful in informing expert knowledge, for example bioclimatic analysis to define topographic isolates (Nix 1993).

Ic) Identification of centres with concentrations of disjunct populations of taxa

Species disjunctions are defined as continuous populations broken by climatic, topographic or edaphic barriers bridged by long distance dispersal of propagules; or as insurmountable barriers to dispersal requiring an historical rather than ecological explanation for their presence (after Groves 1981).

The assessment of disjunct taxa needs to take into account data from neighbouring bioregions. Striking examples of disjunctions such as taxa shared by southeast Queensland and the Wet Tropics tend to be documented in ecological literature.

The assessment of taxa disjunctions is restricted by the paucity of information about species distributions generally, with the exception of eucalyptus/corymbia and rainforest flora and fauna. Consequently the identification of areas with concentrations of disjunct taxa will require a combination of GIS analysis and mapping and expert opinion.

Id) Areas with concentrations of taxa at the limits of their geographical ranges

Limits of range includes most northerly or southerly record in the bioregion and most easterly or westerly record.

For plants, distributional limits can be identified by querying broad distributions indicated on a pastoral district basis in the census of Queensland's vascular plants (Henderson 1997). All taxa identified in this initial screening can then be checked against point locations provided in WildNet to identify the limits of range. Spatial concentrations can then be determined using GIS.

Ie) Centres of high species richness

Centres of high species richness can be identified using GIS analysis, for example a grid-based enquiry, using bioregional data derived from WildNet that meets prescribed data standards. Gaps in data need to be documented and addressed through expert review.

If) 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. For example a number of primitive angiosperm families are represented in Queensland (e.g. Lauraceae, Annonaceae) and the Queensland lungfish is considered a Gondwanan relict while the dasyurids (for example Antechinus and Dasyurus spp.) are probably closest to the original marsupials present during the extensive radiation of 40 million years ago.

Ig) 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 site. 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. Given animals are mobile; their presence can also be influenced by the size and distribution of REs in the landscape. REs are often found across a range of physical environments and their flora and fauna species composition can vary accordingly. Subregions (provinces) are used to help address species variation in REs across environmental gradients in the application of Diagnostic Criteria B and D. Other more localised variation in species composition within an RE can be addressed through expert knowledge, augmented by data such as Corveg sampling sites.

Ih) Artificially-created waterbodies

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.

Ii) Areas considered to be important because of the 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. Examples of hollow-forming species include forest red gum or Queensland blue gum (*Eucalyptus tereticornis*) in alluvial situations, a number of dry and wet sclerophyll forest trees such as grey gum (*E. major*) and Sydney blue gum (*E. saligna*) and some rainforest trees (for example, *Vitex lignum-vitae* and strangler figs).

Ij) Breeding and roosting sites

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 sites can have a considerable impact on the species. Consequently, some value should be assigned to locations used by a significant number of individuals. Determination of a significant number would be based on the perceived overall abundance of the species or number of such breeding/roosting sites in the bioregion.