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Biodiversity Assessment Method 2020 Operational Manual – Stage 1

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Shortened forms

Abbreviation	Description
AOBV	Area of Outstanding Biodiversity Value
BAR	Biodiversity Assessment Report
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BCAR	Biodiversity Certification Assessment Report
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BOS	Biodiversity Offsets Scheme
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically endangered ecological community
cm	Centimetre
BAM-C	Biodiversity Assessment Method Calculator
DBH	Diameter at breast height over bark
the department	NSW Department of Planning and Environment
DIWA	Directory of Important Wetlands in Australia
EEC	Endangered ecological community
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (C'th)
Fisheries NSW Policy and Guidelines	*Fisheries NSW Policy and guidelines for fish habitat conservation and management*
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia, Version 7
LLS	NSW Local Land Services
LLS Act	*Local Land Services Act 2013* (NSW)
the Manual	Biodiversity Assessment Method 2020 Operational Manual
m	Metre
PCT	Plant community type
SEPP	State Environmental Planning Policy
SEED	Sharing and Enabling Environmental Data
the Standard	Native Vegetation Interim Type Standard (Sivertsen 2009)
TBDC	Threatened Biodiversity Data Collection
TEC	Collective term for threatened ecological communities (VECs, EECs, CEECs)
VEC	Vulnerable ecological community
VI	Vegetation integrity

Introduction

The NSW *Biodiversity Conservation Act 2016* (BC Act), and Biodiversity Conservation Regulation 2017 (BC Regulation) outline the framework for addressing impacts on biodiversity from development and clearing. The framework requires a proponent to avoid, minimise and offset impacts on biodiversity from these actions using the Biodiversity Offsets Scheme (BOS).

The BOS establishes biodiversity stewardship agreements (BSAs), which are voluntary in-perpetuity agreements entered into by landholders. BSAs are the mechanism used to secure offset sites where the improvement in biodiversity values is used to offset the loss incurred by development and clearing of native vegetation elsewhere in NSW.

The BOS includes the Biodiversity Assessment Method 2020 (BAM), which is enabled by section 6.7 of the BC Act. The BAM provides:

- a transparent, consistent, and scientifically-based approach for the assessment of biodiversity values on a proposed development, clearing or biodiversity stewardship site
- guidance on how a proponent can avoid and minimise potential biodiversity impacts
- a method for calculating the number and class of biodiversity credits that need to be offset to meet the standard of 'no net loss' of biodiversity.

At a proposed biodiversity stewardship site, the BAM is used to assess the biodiversity values on the site, identify the types of management actions and activities that must be undertaken as part of the management plan, and determine the number and class of biodiversity credits that can be created based on those management actions.

The types of development and clearing proposals that are assessed using the BAM include:

- applications for development consent under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), other than an application for state significant development or for a complying development certificate (see section 7.13(1) of the BC Act), and the modification of such consents
- applications for development consent for state significant development or for approval for state significant infrastructure under the EP&A Act (see section 7.14(1) of the BC Act), and the modification of such consents
- Part 5 activity under the EP&A Act, where the proponent has elected to obtain a biodiversity development assessment report (BDAR), under Division 2 of the BC Act (see section 7.15(1) of the BC Act), and the modifications of such approvals
- biodiversity certification of land (see sections 8.2 and 8.7(1) of the BC Act)
- applications to clear native vegetation on rural land under Division 6 of Part 5A of the NSW *Local Land Services Act 2013* (LLS Act) that do not meet the requirements of allowable activities or the Land Management (Native Vegetation) Code 2018
- clearing of native vegetation in urban areas and environmental conservation zones under the State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 (the Vegetation SEPP) (i.e. clearing that does not need development consent under the EP&A Act), that exceeds the offset thresholds.

Applying the BAM does not preclude the obligation to separately consider the requirements of other related legislation. Proponents will need to comply with the requirements of the BOS as well as other legislation or statutory instruments where applicable (e.g. State Environmental Planning Policies). Whether offset requirements under the BOS will satisfy the requirements of other legislation will be a matter for the decision-maker to decide, and will depend on the context, characteristics and impacts of the specific proposal.

Biodiversity Assessment Method – Operational Manual

Purpose of this Manual

The BAM Operational Manual (the Manual) provides operational guidance to assist applicants and accredited assessors in the application of the BAM. The Manual is a companion document to the BAM. In general, the Manual does not seek to repeat text in the BAM and therefore the 2 documents should be read together. Any updates to administrative structures, position titles and data sources since the BAM was last gazetted may also be reflected in the Manual.

Structure of the Manual

The Manual is structured to reflect the 3 stages of the BAM. Each stage is presented as a separate document to enable easy access to relevant information when implementing the BAM.

Stage 1: Biodiversity assessment identifies the types of biodiversity values on land, such as:

- land proposed as a development site, including for a Part 5 activity
- land subject to a vegetation clearing proposal which is required to be assessed by BAM under the LLS Act
- land proposed to be biodiversity certified
- land proposed as a biodiversity stewardship site under a biodiversity stewardship agreement.

In general Stage 1 focuses on the assessment of the landscape context, the vegetation integrity (VI) of native vegetation[1], and habitat suitability for threatened species.

Stage 1 is the focus of this document.

Stage 2: Impact assessment (biodiversity values and prescribed impacts) applies the avoid, minimise and offset hierarchy and assesses direct, indirect and prescribed impacts associated with the development or clearing proposal. It is used to determine the offset requirements for all residual impacts on biodiversity values at a proposed site. In general, these are measured as ecosystem credits and species credits. Stage 2 determines the number, class and offset trading group of biodiversity credits.

Stage 3: Improving biodiversity values is used to assess the anticipated improvement (or gain) in the VI of native vegetation and habitat suitability for threatened species, the management actions, and preparation of a management plan at a proposed stewardship site. The stage is also used to determine the number of biodiversity credits created at the site from the anticipated improvement in biodiversity values.

Streamlined assessment modules are set out in Appendices B, C and D of the BAM and may be used where the proposal impacts on scattered trees, a small area or planted native vegetation. A document is being developed to support the implementation of the streamlined assessment modules and will be published on the BAM webpage (see Appendix A).

[1] Native vegetation is defined under s. 60B of the *Local Land Services Act 2013* as plants native to NSW (trees, under-storey plants, ground cover, plants occurring in a wetland), established in NSW before European settlement.

Stage 1: Biodiversity assessment

Introduction to Stage 1

The purpose of Stage 1 is to identify biodiversity values present within the land proposed for development, activity, clearing, biodiversity certification or biodiversity stewardship (in all cases referred to as the subject land). These assessments must be undertaken by a specialist ecological consultant who has accreditation to apply the BAM (provided for under section 6.10 of the BC Act). This accredited person is referred to as an assessor. Stage 1 of the Manual is divided into the following parts:

- Chapter 1. Documenting Stage 1 outcomes
- Chapter 2. Establishing the site context (BAM Chapter 3)
- Chapter 3. Assessing native vegetation cover, threatened ecological communities (TECs) and VI (BAM Chapter 4)
- Chapter 4. Assessing the habitat suitability for threatened species (BAM Chapter 5)
- Chapter 5. Identifying prescribed additional biodiversity impacts (BAM Chapter 6)
- Appendix A – Websites and online resources referred to in this Manual
- Appendix B – Sample field data sheet for vegetation survey
- Appendix C – Assessing habitat suitability for threatened species.

The Manual differs from the BAM in that the information is presented as a sequence of steps, which if applied, will identify biodiversity values on the subject land in accordance with the requirements of the BAM. It does not include comprehensive descriptions of the method or any processes that are completed automatically by the BAM Calculator (BAM-C). For this information refer to the relevant sections of the BAM.

Resources

A range of online resources are available to assist assessors. Further information is available in Appendix A. Key resources include:

Biodiversity Offsets and Agreement Management System (BOAMS)

- The case management system used to administer the BOS.
- Assessors must use the BAM-C in BOAMS to apply the BAM. BOAMS is also used to submit BAM related applications, generate a credit obligation or apply to sell or retire credits.
- Assessors may also use BOAMS to submit an expression of interest for a biodiversity stewardship agreement on behalf of a landholder or submit a credit wanted listing on behalf of a development proponent.
- Important habitat area maps are also available, for those species for which the habitat constraint in the Threatened Biodiversity Data Collection (TBDC) refers to a mapped important area.
- For more information about how to use the BOAMS, the user guide can be accessed from the Frequently Asked Questions module after logging in to BOAMS.

Biodiversity Assessment Method Calculator (BAM-C)

- The tool that operationalises the BAM. The BAM-C stores much of the survey information recorded by the assessor and it calculates the number and type of credits required to offset the impacts of development on, or credits generated from improvements in, biodiversity values.

- Two versions of the BAM-C exist:
  - a public stand-alone version (open to all but will not save data or print reports)
  - a password protected version accessed through the BOAMS for the use of assessors and decision-makers when preparing or reviewing BAM related proposals (see above).
- The case in the BAM-C for the proposed development, activity, clearing, biodiversity certification or stewardship site must have a status of finalised before it can be submitted to the decision-maker.
- Updates to the biodiversity data referenced by the BAM-C, including to the underlying species and native vegetation data held in BioNet, occurs periodically. All registered users of the BAM-C will be notified accordingly.
- Refer to the BAM-C user guide for information on how to use the application.

Biodiversity Conservation Trust (BCT) guidance

- The 'Resources' page on the BCT website includes a range of resources to support private land conservation.

BioNet Atlas

- A publicly accessible online database that contains biodiversity observation data for NSW.
- Ecological consultants need to request a login that gives access to full location data and the ability to submit species sightings and survey data.
- The database includes support from the NSW BioNet quick guides, information sheets, manuals and datasheets.

BioNet Threatened Biodiversity Data Collection (TBDC)

- The database contains information for listed threatened species, populations and ecological communities such as survey requirements and habitat constraints that can guide identification of species polygons.
- It houses the information and data used in the BAM-C including the biodiversity credit class of a species.

BioNet Systematic Flora Survey

- Systematic vegetation survey data (VIS data) for NSW, including full floristic survey sites, rapid sites and site vegetation condition information.

BioNet Vegetation Classification (Veg-C)

- The database contains information on plant community types (PCTs) described for NSW including general location, floristic composition and structure, condition benchmarks and percent cleared information.
- Veg-C is the primary source for defining equivalent or part equivalent associations between PCTs and TECs.

BioNet Web Services

- NSW biodiversity data held in BioNet that has been made available via an Open Application Programming Interface (API).
- It enables organisations and individuals to directly integrate biodiversity data into their software systems.

Areas of Outstanding Biodiversity Value (AOBV)

- Declared Areas of Outstanding Biodiversity Value (AOBV) can be found in the Register of Areas of Outstanding Biodiversity Values. Links to declarations of these sites are recorded within the register.

Sharing and Enabling Environmental Data (SEED)

- SEED is a shared resource for environmental data that includes public access to the Department of Planning and Environment (the department) datasets.
- Available spatial datasets include:
    - NSW (Mitchell) Landscapes – version 3.1
    - Interim Biogeographic Regionalisation for Australia (IBRA regions and sub-regions) – version 7
    - NSW soil profiles
    - hydrogeological landscapes
    - acid sulfate soils risk maps
    - digital cadastral database
    - BioNet Vegetation Map Collection (previously called the Vegetation Information System Maps).

PlantNET NSW

- An online database of the flora of NSW that contains the currently accepted taxonomy for plants found in the state, both native and exotic.
- Online keys for plant identification, as per the published *Flora of NSW* (Harden 1990–2002) and updates.
- Plant taxonomy and naming in Biodiversity Assessment Reports (BARs) must be consistent with the *Flora of NSW*, as per PlantNET.

Use of more appropriate local data

In some circumstances, assessors may use more appropriate local data rather than existing information from resources and datasets (see BAM Subsections 1.4.2 and 1.4.1); for example, using the results of recent local surveys and studies to refine the list of ecosystem or candidate threatened species in a BAM assessment or to modify existing benchmarks to better reflect local environmental conditions. Other reasons to use local benchmark data for benchmark values may be because the existing benchmarks have a low confidence level or the benchmark at the vegetation class to IBRA bioregion scale is unsuitable for the PCT.

The use of more appropriate local data must be approved (in writing) by the decision-maker[2]. It is recommended that the assessor discusses the intent to use local data with the decision-maker early in the assessment process.

[2] Decision-maker includes: consent authorities for development applications under Part 4 of the EP&A Act; the Minister for Planning and Public Spaces for activities under Part 5.1 of the EP&A Act; determining authorities for activities under Part 5 of the EP&A Act; the Native Vegetation Panel for approvals for clearing native vegetation under s.60ZF of the LLS Act and permits under clause 14 of the Vegetation SEPP; the Minister for Environment and Energy in relation to biodiversity certification under Part 8 of the BC Act and biodiversity stewardship agreements under Part 5.5 of the BC Act (BAM 2020, Glossary).

More appropriate local data cannot be used to change values in relation to the sensitivity to loss; sensitivity to potential gain; or the biodiversity risk weighting of a threatened entity or PCT (refer to Chapter 4 of this Manual). If the assessor has data or peer-reviewed/published information that indicates these values should be reviewed they can provide these to the department at bionet@environment.nsw.gov.au.

Biodiversity values excluded from Stage 1 assessment

Biodiversity values that do not form part of an assessment are outlined in BAM Section 1.5.

The BAM **does** apply to the suite of impacts identified in clause 6.1 of the BC Regulation. These are referred to as prescribed impacts, which includes impacts other than clearing of native vegetation. For example, impacts on threatened bats roosting in human-made structures, artificial drainage lines that provide habitat for threatened frogs, or non-native trees used as a roost for grey-headed flying-fox. Chapter 5 of this Manual explains requirements for identifying prescribed impacts.

1. Documenting Stage 1 outcomes

1.1 Requirements for Biodiversity Assessment Reports

The outcomes of Stage 1 are documented in all Biodiversity Assessment Reports (BARs). BARs include Biodiversity Development Assessment Reports (BDARs), Biodiversity Certification Assessment Reports (BCARs) and Biodiversity Stewardship Site Assessment Reports (BSSARs).

The minimum information required in a:

- BDAR and a BCAR is provided in BAM Appendix K, Tables 24 and 25
- BDAR and a BCAR using the streamlined assessment modules is provided in BAM Appendix L, Tables 26, 27 and 28
- BSSAR is provided in BAM Appendix M, Tables 29 and 30.

The requirements for a BAR are reiterated at the beginning of Chapters 2–5 of the Manual.

1.2 Requirements for maps

The BAR must include 2 maps of the subject land – the Site Map and the Location Map – based on digital aerial photographs, such as ADS40 or the best available imagery. The minimum standards for these maps are:

1. **Site Map** at a capture scale of 1:1,000 or finer showing:
    - property boundary
    - boundary of the subject land
    - cadastre boundaries within the subject land (including labelling of Lot and DP or section plan if relevant)
    - landscape features identified in BAM Subsection 3.1.3
2. **Location Map** at a capture scale of 1:1,000 or finer showing:
    - the boundary of the subject land
    - the assessment area, which includes the subject land and a 1,500 m buffer surrounding the outside edge of the boundary of the subject land **or** 500 m along each side of the centre line of a linear-shaped proposal (e.g. highway or major road)
    - landscape features identified in BAM Subsection 3.1.3
    - additional relevant details such as local government area boundaries and Local Land Services boundaries.

Capture scale refers to the scale of the digital dataset. BAM Appendices K, L and M require all digital datasets to be submitted with the BAR in a geographic information system (GIS) format agreed to by the decision-maker.

Printed maps can be at a different scale to the requirements above if all relevant features and text are readable. For example, if edges are defined and delineated, the map may be presented at a scale that can be displayed on an A4 page, in line with the rest of the report. Multiple maps (on A4 pages) can be used to present landscape features in detail, providing each map is the same scale for comparison. Insets should be used to show each map location relative to the subject land.

Maps in the BAR must have a clear legend for all features, categories and boundaries and should also include standard components for interpretation, such as a scale and north arrow.

1.3 Introduction to the Biodiversity Assessment Report

For proposals other than an application for a biodiversity stewardship agreement, the following information must be included in an introduction to the BAR (BAM Section 2(3.)):

- description of the proposal and any additional clearing associated with temporary/ancillary construction facilities, infrastructure or operational maintenance activities. Detailed plans will support the description of the proposal and aid the decision-maker
- map of the final proposal footprint (operational footprint) and construction footprint for any clearing associated with temporary/ancillary construction facilities and infrastructure
- identification and justification of the threshold that triggered the requirement for the proposal to be assessed under the BOS:
    - native vegetation clearing or a prescribed biodiversity impact on land mapped on the Biodiversity Values Map or
    - clearing of native vegetation that exceeds the area threshold or
    - the proposal is likely to significantly affect threatened species or ecological communities or their habitats according to the threatened species test of significance or
    - the proposed activity requires environmental assessment under Part 5 of the EP&A Act and will be carried out in a declared Area of Outstanding Biodiversity Value.

A report from the Biodiversity Values Map and Threshold tool, stating whether the BOS threshold is triggered, may be attached to the BAR. This report may also be requested by the decision-maker. This applies to the Biodiversity Values Map and area clearing triggers only. If neither of these triggers apply to the proposal and it is likely to significantly affect threatened species or ecological communities or their habitats, a report detailing the threatened species test of significance results may be attached to the BAR.

2. Establishing the site context

This chapter outlines the landscape features that must be identified on the maps of the subject land and assessment area and recorded in the BAR.

The landscape surrounding a site will strongly influence the biodiversity values of that site (Andren 1994; Fahrig 1997, 2001). The suite of landscape features assessed in the BAM are used to inform the habitat suitability of the subject land for threatened species, the potential movement of species across the landscape and the prediction of gain in biodiversity value at a biodiversity stewardship site.

Consequently, not all information documented in this chapter is directly used to calculate biodiversity credits. However, it will aid the decision-maker in forming their opinion on the proposal, and the BCT in its review of a biodiversity stewardship application.

2.1 Requirements for the Biodiversity Assessment Report

By the end of this chapter of the Manual and BAM Chapter 3 the assessor will be able to complete the following information in the BAR (see BAM Appendices K and M for minimum requirements for Stage 1 biodiversity assessments and Appendix L for streamlined assessment modules).

Table 1 Requirements for the BAR – Site context

Information	Maps, tables and data
Identification and description of the following landscape features on the subject land and within the assessment area:	**Digital GIS files must be provided for all maps and spatial data in a format agreed to by the decision-maker.** Polygons are suitable for most spatial data requirements unless points or lines are specified. **All maps must be easy to read with clear headings, keys, colour ramps and symbols.** **Data must be provided in a format that can be analysed** (e.g. MS Excel or other downloadable format).
Subject land area (ha)	**Map:** Boundary of the subject land including the cadastre
Assessment area (ha) including the subject land and a 1,500 m (or 500 m for linear proposals) buffer	**Map:** Boundary of the assessment area including digital aerial photography at 1:1,000 scale or finer and boundary of the subject land
IBRA bioregions and subregions	**Table:** List of IBRA bioregions and subregions that intersect the subject land and assessment area **Map:** IBRA bioregions and subregions that intersect the subject land and assessment area
Rivers, streams, estuaries and wetlands	**Map:** Location of rivers, streams (using Strahler stream ordering), estuaries and wetlands that intersect the subject land and assessment area
Connectivity of different areas of habitat that may serve as movement corridors for threatened species across their range including flyways for migratory species (for proposed wind turbines)	**Map:** Mapped areas of habitat connectivity on the subject land and assessment area
Areas containing karst, caves, crevices, cliffs, rocks or other geological features of significance	**Map:** Location of karst, caves, crevices, cliffs, rocks or other geological features of significance

Information	Maps, tables and data
Areas of Outstanding Biodiversity Value (AOBV)	**Table:** List of AOBVs that intersect the subject land and assessment area **Map:** AOBVs on the subject land and assessment area
Soil hazard features (for vegetation clearing proposals that require approval under Part 5A of the LLS Act, or a permit under the Vegetation SEPP)	**Map:** Location of any soil hazard features that occur on the subject land (for vegetation clearing proposals that require approval under Part 5A of the LLS Act, or a permit under the Vegetation SEPP)
NSW (Mitchell) landscapes	**Table:** List of NSW (Mitchell) landscapes that intersect the subject land and assessment area **Map:** Boundary of NSW (Mitchell) landscapes on the subject land and assessment area
Native vegetation cover including: • total area of native vegetation within the assessment area (ha) • total percentage of native vegetation estimated in the assessment area • cover class (0–10%, >10–30%, >30–70% and >70% automatically assigned by the BAM-C)	**Map:** Total area of native vegetation within the assessment area (see Figure 1)

2.2 Identify landscape features

Information on the following landscape features must be provided in the BAR and mapped on the Site and Location maps.

2.2.1 Interim Biogeographic Regionalisation for Australia bioregions and subregions

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscape into geographically distinct regions known as bioregions or IBRA regions. These IBRA regions are based on a common climate, geology landform, native vegetation and species information. They are further subdivided into subregions based on localised patterns of geomorphology within each bioregion. The IBRA mapping is updated as improved spatial mapping and information on vegetation communities and ecosystems becomes available.

The current version, released in 2015, is IBRA7. Version 7 of the IBRA identifies 17 IBRA regions and 135 IBRA subregions in NSW. The most current version of the IBRA should be used to identify the IBRA bioregions and IBRA subregions in which the subject land and assessment area is located.

If the subject land is located within more than one IBRA subregion, the IBRA subregion selected should be the one where the largest proportion of impact/area of BSA will occur, with justifications provided in the BAR.

For linear-shaped developments that cross multiple IBRA subregions, the assessor may create a separate BAM-C assessment for each IBRA subregion. If the proposal crosses an IBRA boundary separate assessments must be created for each IBRA subregion in the second IBRA region. Multiple assessments from multiple IBRA regions and subregions may be created within one BOAMS parent case. Contact bam.support@environment.nsw.gov.au to discuss proposed alternative approaches.

The BAM uses IBRA subregions to:

- filter for threatened species likely to use habitat on the subject land
- filter for PCTs that may occur on the subject land
- filter for TECs that occur on the subject land
- identify where ecosystem credits can be sourced to offset the impacts of development
- apply the variation rules under the BOS and as identified in section 6.4(1) of the BC Act.

Additionally, the BAM uses IBRA regions to identify where alternative species credits can be sourced in accordance with the variation rules under the BOS (see section 6.4 of the BC Regulation 2017).

Regional benchmarks used by the BAM-C are also established at the IBRA/vegetation class scale.

2.2.2 Rivers, streams, estuaries and wetlands

Rivers and streams on, adjacent to, and downstream of the subject land and within the assessment area must be mapped according to the Strahler stream ordering system (see BAM Appendix E). Table 14 in BAM Appendix E shows riparian buffer distances that must be measured on both sides of the stream.

Estuaries that occur on, adjacent to, and downstream of the subject land and within the assessment area must also be identified and mapped in the BAR. Information on the location and physical characteristics of NSW estuaries can be found at *Estuaries of NSW: Physical characteristics, tidal surveys and hydrographic surveys*, see Appendix A for weblink.

Wetlands, including important wetlands, on, adjacent to, and downstream of the subject land and within the assessment area must also be identified and mapped in the BAR. An important wetland is defined as a wetland that is listed in the *Directory of Important Wetlands in Australia* or a coastal wetland identified in *State Environmental Planning Policy (Coastal Management) 2018.*

The riparian buffer distances in Table 14 in BAM Appendix E must be mapped. The assessor must identify the subject land in relation to all rivers, streams, estuaries and wetlands, including buffer areas, on the Site Map. The assessor must identify all rivers, streams, estuaries and wetlands that are on, adjacent to, and downstream of the subject land and within the assessment area on the Location Map.

2.2.3 Habitat connectivity

Habitat connectivity can be identified at different scales depending on the target entities that are present or likely to be present. Habitat connectivity can include recognised biodiversity corridors identified by the Department of Planning and Environment (the department) (e.g. priority investment areas), flyways for migratory species, a riparian buffer of a stream, wetland or estuary, or a local corridor identified by a local council.

Areas of connectivity addressed elsewhere in the BAR, for example, a flyway identified in accordance with BAM Subsection 6.1.5, should be mapped and described once in Stage 1 and then referenced in subsequent sections of the BAR.

2.2.4 Karst, caves, crevices, cliffs, rocks and other geological features of significance

A site inspection will be required to accurately identify, describe and map where these features occur on the subject land. Where these features are addressed elsewhere in the BAR, for example, when identifying prescribed biodiversity impacts in accordance BAM Subsection 6.1.1, they should be mapped and described once in Stage 1 and then referenced in subsequent sections of the BAR.

2.2.5 Areas of Outstanding Biodiversity Value

Areas of Outstanding Biodiversity Value (AOBVs) are declared by the Minister for the Environment and published on the AOBV public register. Currently, critical habitat for the little penguin population at Manly, Mitchell's rainforest snail in Stotts Island Nature Reserve, Gould's petrel on Cabbage Tree Island, and the Wollemi pine are AOBVs.

Where an AOBV occurs on the subject land or assessment area, it must be mapped on the Site and Location Maps. The little penguin AOBV at Manly is included in the Biodiversity Values Map and is visible using the identify tool in the Biodiversity Values Map and Threshold tool. Currently, the other 3 AOBVs are located in protected areas managed by the NSW National Parks and Wildlife Service. Contact the department via bam.support@environment.nsw.gov.au if you require further details about these AOBVs.

2.2.6 NSW (Mitchell) landscapes

NSW (Mitchell) landscapes, formerly known as Mitchell landscapes, are mapped at a broad scale. As such, the actual NSW (Mitchell) landscape in which the subject land occurs may not always be the landscape shown on the NSW (Mitchell) landscapes maps. Where the description of an adjacent NSW (Mitchell) landscape more accurately reflects the landscape based on field observation, the adjacent NSW (Mitchell) landscape should be chosen with justification provided in the BAR. Descriptions for NSW (Mitchell) landscapes are available via SEED (see Appendix A).

If the subject land is located within more than one NSW (Mitchell) landscape, the assessor should select the NSW (Mitchell) landscape in which the largest proportion of impact or improvement will occur.

2.2.7 Soil hazard features

Soil hazard features such as dryland salinity, acidification, compaction, structural breakdown, sodicity and contamination will require onsite assessment to accurately map location and extent. Assessors can use resources such as hydrogeological mapping and acid sulfate soil risk mapping to support field observations.

2.3 Percent native vegetation cover

Percent native vegetation cover refers to the amount of native vegetation[3] (woody and non-woody) that is estimated to remain in the landscape proximal to the assessment area.

It is used:

- as a filter by the BAM-C to predict threatened species likely to occur or use habitat on the subject land (see BAM Subsection 5.2)

[3] Native vegetation includes regrowth and planted native vegetation comprised of plants native to NSW.

- to define the intrinsic rate of increase in species richness and plant cover as part of the assessment of future vegetation condition on a biodiversity stewardship site (see Equation 10 in the BAM).

The percent native vegetation cover is assessed by applying a 1,500 m buffer around the edge of the subject land and digitising all native vegetation within, using GIS editing tools and aerial photography (such as ADS40 imagery or other best available imagery for the site) (see Figure 1 in Box 1). The total area of native vegetation is calculated across the assessment area. Information that must be recorded in the BAR includes:

- whole numbers – the total assessment area, the area of native vegetation within the assessment area in hectares
- percentages – the percentage of native vegetation estimated in the assessment area (the assessor also enters this figure into the BAM-C)
- cover class – in accordance with BAM Section 3.2(3.) (cover classes range from 0–10%, >10–30%, >30–70% and >70% and are automatically assigned by the BAM-C once the percentage of native vegetation cover is entered).

Where the development is a linear shape (e.g. a major road or highway development) the 1,500 m buffer is replaced with a 500 m buffer following the centre line of the subject land (see Figure 2 in Box 1).

This requirement in the BAM is primarily a desktop assessment and the assessor is expected to use professional judgement and their knowledge of the landscape when determining native vegetation cover. Clear justifications must accompany the outcome determined by the assessor, particularly in relation to areas of vegetation that have been excluded from the assessment. For example, verification through field assessment to identify areas of non-native vegetation is a strong justification for their removal from the assessment area. These areas must be clearly indicated on the Location Map and documented in the BAR.

2.4 Field reconnaissance

The extent and condition of landscape features on the subject land are confirmed by site inspections, particularly geological features of significance (e.g. karst, caves, crevices, cliffs, rocks) or the presence of non-native vegetation that may be difficult to interpret from remote imagery. The assessor can use any ground-truthed information to adjust maps and percent native vegetation cover estimates.

Where access to private property or the size and configuration of the assessment area limits the ability to conduct a field assessment, the assessor should apply professional judgement, and record the methods used and assumptions made in the BAR.

Box 1 – Examples of assessing percent native vegetation cover

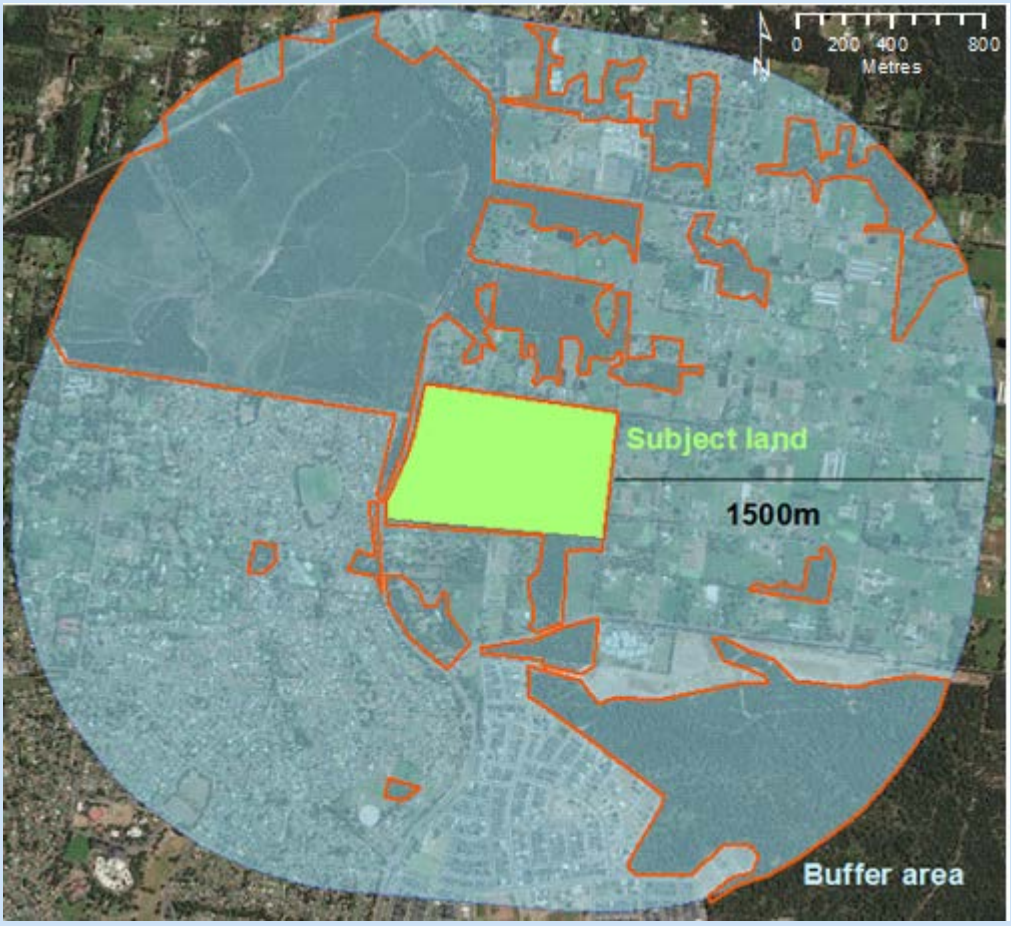

Figure 1 Example of subject land with a 1,500 m buffer

The subject land has a 1,500 m buffer measured from the boundary of the subject land. The percent of native vegetation cover is calculated within the buffer (blue) and subject land (green) areas.

In this example, the assessment area is 1,162 ha and the area of native vegetation within the assessment area (outlined in orange) is 415 ha. Therefore, the percent of native vegetation cover for this assessment proposal is estimated to be approximately 36%. The small areas of woody vegetation that are within the assessment area and not outlined in orange were assessed as non-native vegetation and therefore are not included in this map.

Box 1, continued

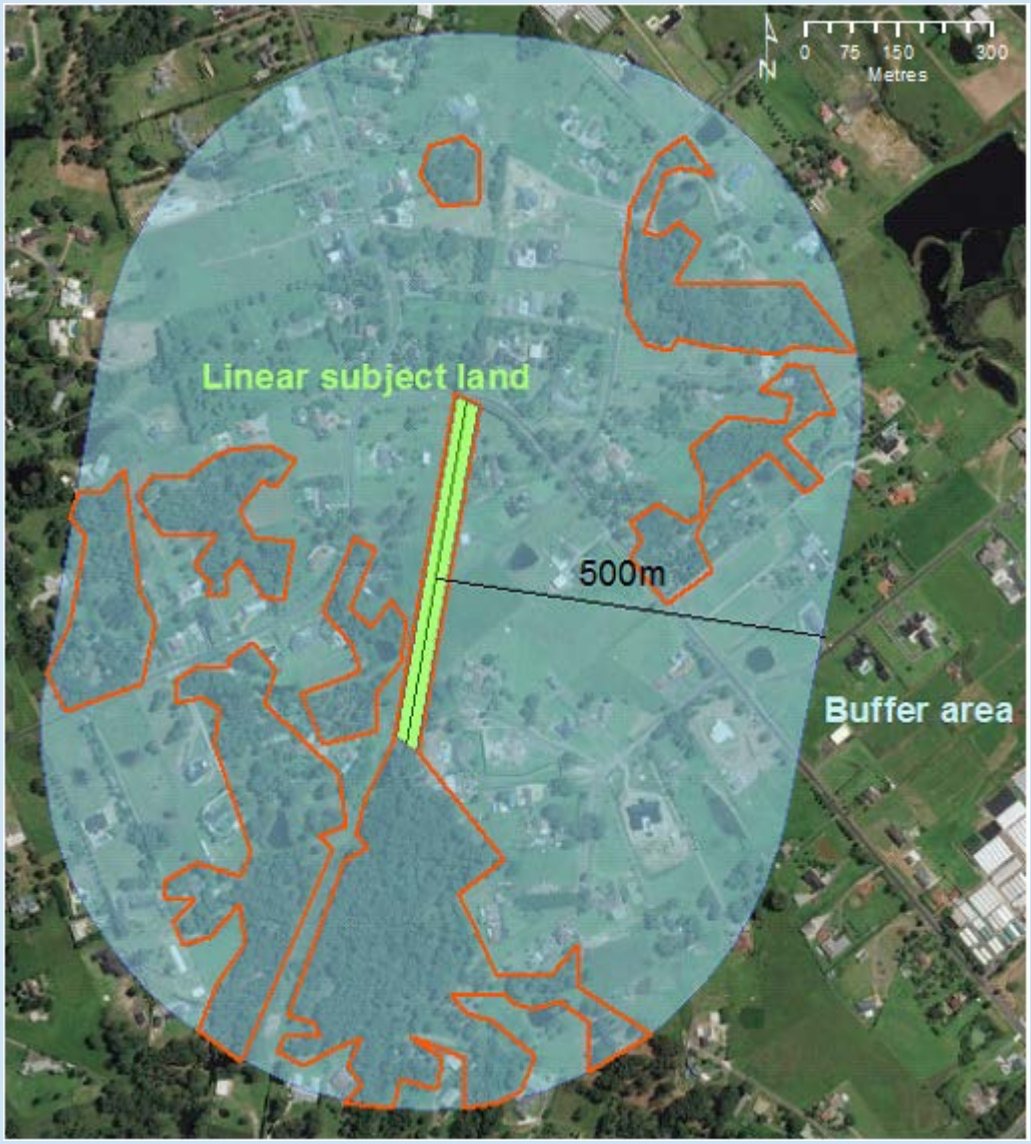

Figure 2 Example of linear development with a 500 m buffer around the subject land

Linear sites have a 500 m buffer measured from the centre line of the subject land. The percentage of native vegetation cover is calculated within the buffer (blue) and subject land (green) area.

In this example, the assessment area is 130 ha and the area of native vegetation cover (outlined in orange) is 31.5 ha. Therefore, the percentage of native vegetation cover is 24%. The small areas of woody vegetation that are within the buffer area and not outlined in orange were assessed as non-native vegetation and therefore are not included in this map.

3. Assessing native vegetation, threatened ecological communities and vegetation integrity

This chapter outlines the:

- process for mapping and identifying the native vegetation (PCTs and TECs) on the subject land
- process for stratifying native vegetation into vegetation zones, which are based on the PCT and broad vegetation condition
- role of benchmarks in the assessment
- field method used to collect data from each vegetation zone
- process to estimate vegetation condition, called the VI score.

3.1 Requirements for the Biodiversity Assessment Report

By the end of this chapter of the Manual and BAM Chapter 4 the assessor will be able to complete the following information in the BAR (see BAM Appendices K and M for minimum requirements for Stage 1 biodiversity assessments).

Table 2 Requirements for the BAR – Native vegetation, TECs and VI

Information	Maps, tables and data
Identification and description of the following native vegetation features on the subject land:	**Digital GIS files must be provided for all maps and spatial data in a format agreed to by the decision-maker.** Polygons are suitable for most spatial data requirements unless points or lines are specified. **All maps must be easy to read with clear headings, keys, colour ramps and symbols.** **Data must be provided in a format that can be analysed** (e.g. MS Excel or other downloadable format).
Native vegetation cover on the **subject land** and a description of any differences between aerial images and final mapped native vegetation cover	**Map:** Boundary of the native vegetation extent within the subject land
Areas of the subject land that do not contain native vegetation & justification	**Map:** Boundary of areas of the subject land that do not contain native vegetation
PCTs within the subject land, including: • vegetation class • vegetation type (i.e. PCT names and ID numbers) • area (ha) • species relied upon for identification of vegetation type and relative abundance • TEC status, where relevant • estimate of percent cleared value of the PCT (available in the BioNet Vegetation Classification) • evidence and justification of the decision pathway used in identification of PCTs (e.g. vegetation structure and landscape position/geomorphology)	**Map:** PCTs and TECs within the subject land **Table:** PCTs and TECs within the subject land, TEC listing and status (NSW and Commonwealth), PCT and TEC area (ha) **Map:** Plot locations relative to PCTs including GPS coordinates (Point – GDS zone, eastings, northings and bearings) and labelled according to field datasheets and consistent with the BAR) **Table:** Plot field data and sheets (scan if hardcopies) **Table:** Outcomes of any analysis undertaken to identify PCTs, could include graphs or other outputs

Information	Maps, tables and data
Vegetation integrity assessment, including: • description of vegetation zones within the subject land with justification for assigning PCTs to vegetation zones • area (ha) of each vegetation zone • patch size (ha) for each vegetation zone • survey effort (number of plots per vegetation zone) • composition, structure, function and VI scores	**Map:** Vegetation zones (labelled according to the BAM-C and consistent with the BAR) and locations of the patches used to determine patch size for each vegetation zone **Table:** Vegetation zones with area (ha), sampling effort (number of plots per vegetation zone) and patch size (area/s for each vegetation zone) **Table:** Plot field data and sheets (scan if hardcopies) **Table:** Vegetation integrity scores for each vegetation zone within the subject land
Where the use of more appropriate local data is proposed, identify: • source of information for local benchmark data • justification for use of local data in preference to database values • written agreement from the decision-maker supporting use of more appropriate local data	**Table:** More appropriate local data used

3.2 Native vegetation extent

BAM Section 4.1 requires the extent of native vegetation cover (woody and non-woody vegetation), on the **subject land** to be delineated on the Site Map. These data are not entered into the BAM-C but reported in the BAR.

Mapping requirements mirror those for percent native vegetation cover in Chapter 2 of this Manual, 'Establishing the site context', but are restricted to the subject land only.

The assessor needs to:

- access digital aerial photography (such as ADS40 imagery) or best available imagery at a scale no greater than 1:10,000
- digitise and clearly indicate:
  - the boundary of the subject land
  - all areas of native vegetation including areas that are ground cover only (e.g. grasslands)
  - all areas that do not contain native vegetation (e.g. cleared land) or other site features to be assessed for habitat suitability (in accordance with BAM Chapter 5) and/or proposed for restoration at a stewardship site (Stage 3 of the BAM)
- identify changes in native vegetation extent (i.e. due to clearing) since the remote image capture, confirm vegetation boundaries through site inspection (or fine-scale native vegetation maps if available) and amend the Site Map accordingly. Differences between the remote image and the vegetation extent shown on the Site Map must be documented in the BAR.

3.3 Stratify native vegetation

Vegetation zones are relatively homogenous units defined by a unique NSW PCT and broad condition state.

Vegetation is used as a surrogate for assessing general ecosystem biodiversity values. The BAM uses PCTs as the basis for vegetation community classification. PCTs are assigned to a vegetation class, which is in turn nested within a vegetation formation (Figure 3). Evidence-based changes to PCT profile information and changes in the total number of PCTs will occur over time. The standard operational classification hierarchy of native vegetation in NSW illustrates the 3 nested classifications as shown in Figure 3.

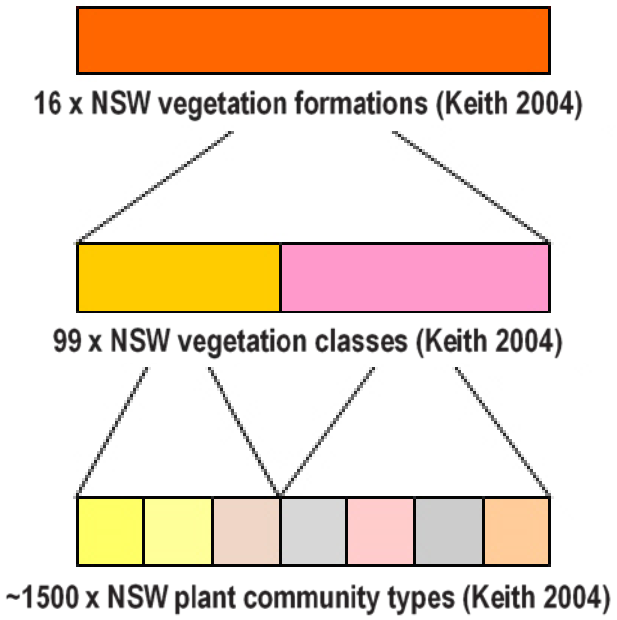

Figure 3 NSW vegetation classification hierarchy

The PCT classification represents the full geographic distribution of each plant community.

The BAM uses the term PCT when referring to an ecological community (which many ecologists term 'vegetation' in a structural sense) and the assessor should select the most likely PCT from the Veg-C application to identify vegetation on the subject land. The most likely PCT must be justified using a quantitative analysis of plot data in which the species are matched to the potential list of PCTs that could occur in that location (BAM Section 4.2). This is often prepared as an analysis that considers all PCTs at a subregional or greater scale.

Existing information for the subject land (e.g. past survey data, vegetation maps or previous reports) may also be useful in assigning a PCT. The State Vegetation Type Map (see Appendix A) available via SEED, maps the distribution of PCTs across NSW and is available for specific regions at the time of publication. Where an assessor identifies the likely PCT and this PCT is not provided in the list of potential PCTs shown by the BAM-C, the assessor can search for and add PCTs that are considered to occur outside of the IBRA.

3.3.1 Identify native plant community types and ecological communities on the subject land

The assessor must identify and map PCTs located on the subject land in accordance with BAM Sections 4.2 and 4.3. PCT classifications are described in the BioNet Vegetation Classification and include the following information, where relevant, to aid field identification:

- dominant canopy species
- main associated species
- landscape position
- characteristic mid-storey species
- characteristic ground cover species
- other diagnostic features and descriptive fields.

PCTs are identified via vegetation strata. The approach differs from that used to determine VI, which records vegetation condition within growth form groups.

To identify a PCT the assessor must:

1. Review existing information for the subject land (e.g. past survey data, vegetation maps or previous reports). Mapping products often include vegetation communities based on statistical analysis (e.g. PATN), and as such include useful fidelity tables that describe diagnostic and characteristic taxa, which may be useful in assigning a PCT. Any existing information used to identify PCTs in the subject land should be reported in the BAR.
2. Determine survey design and number of plots required to confidently identify the PCT/s on the subject land. Use the outcomes of 1 above, the level of environmental variation on the subject land, gaps in existing mapping and information, and the vegetation extent to inform this determination.
3. Undertake plot-based floristic vegetation survey in a 20 m x 20 m plot.
4. Collect the vegetation survey data listed in Table 3 below at each plot.

Table 3 Vegetation survey data requirements

Attribute	Survey requirement
Growth form	Growth form for each recorded native species
Species name	Scientific name of each species and whether it is native or exotic
Cover	Estimate the foliage cover of each native and exotic species within the boundaries of the plot including all attached plant material, alive or dead, rooted in or overhanging the plot. Cover should be recorded: • in decimals if less than 1% (e.g. 0.1, 0.2) • in whole numbers up to 5% (e.g. 1, 2, 3) • to the nearest 5% if >5% cover (e.g. 5, 10, 15, 20, 25)
Abundance rating	Count (when ≤10) or estimate (when >10) the number of individuals of each native and exotic species rooted within the plot. Record abundance as: • counts of 1, 2, 3… • estimates of 10, 20, 30… • 100, 200, 300… • 1,000, 2,000, 3,000…

5. Combine vegetation survey data with existing information in 1 above to identify PCT/s on the subject land.
6. Provide evidence in the BAR in accordance with BAM Subsection 4.2.3 to support the selection of the PCTs.
7. Finalise the mapped distribution of PCTs on the subject land.

Boundaries between PCTs are rarely distinct, and mapping the distribution of a PCT will usually involve determining a line of best fit.

Vegetation that does not strictly meet the definition of a PCT, as per the BioNet Vegetation Classification, can be allocated to the PCT to which it most closely aligns. PCT selection must be documented, with justifications, in the BAR.

The assessment of ground cover should be conducted at a time when indigenous vegetation is most abundant and is easiest to identify. Species naming and classification must be in accordance with the NSW Herbarium (refer to PlantNET NSW; see Appendix A for weblink). Specimens of species that cannot be identified during field work should be collected for identification. Genus (or Family name) can be used to record species where the appropriate fertile material for identification is unavailable.

PCTs that are classified in the vegetation class as inland saline lakes, mangrove swamps or saltmarshes under the saline wetland vegetation formation must be assessed according to the BAM. For development, clearing, activity or biodiversity certification proposals that impact on PCTs and any TECs classified under saline wetlands formation, the department also recommends assessors consult with NSW Fisheries (refer to the Fisheries NSW policy and guidelines for fish habitat conservation and management (update 2013); see Appendix A for weblink). BSA proposals may be developed for these PCTs.

In addition to identifying and mapping the PCTs on the Site Map the assessor is required to:

1. record the estimated percent cleared value of each PCT
2. identify and map the distribution of:
    - TECs that are associated with the PCTs
    - derived or secondary vegetation or planted native vegetation and the PCT to which it is allocated in accordance with Box 2.

Box 2 – Supporting information for determination of percent cleared value, TEC status, and derived, planted or secondary vegetation communities

Percent cleared value

The percent cleared value for a PCT can be obtained from the BioNet Vegetation Classification. It is also displayed in the BAM-C. Percent cleared value is the proportion of remnant PCT relative to the estimated distribution prior to 1750. The value is used to determine the offset trading group for non-threatened plant community types (see BAM Subsection 10.2.1).

Threatened ecological communities

The BioNet Vegetation Classification provides an indication of whether a PCT may be a TEC; the list is not exhaustive. The assessor must determine whether any of the vegetation meets the definition of a TEC listed under the BC Act. For example, the assessor should compare the PCT description to that of the NSW Scientific Committee Determination, which describes the community composition of a likely TEC. Up to date information on TEC listings for NSW can be found on the NSW Threatened Species webpage (see Appendix A). Case law may also be consulted to determine if vegetation meets the definition of a TEC.

Box 2, continued

Derived or secondary communities

Derived or secondary vegetation is native vegetation that has changed to an alternative stable state as a consequence of land management practices since European settlement. Derived communities can have one or more structural components of the vegetation entirely removed or severely reduced (e.g. over-storey of grassy woodland) or have developed new structural components where they were previously absent (e.g. shrubby mid-storey in an open woodland system).

Derived PCTs differ from PCTs that have been modified from their natural state in that the derived PCTs are unlikely to revert to the natural state without significant active restoration.

The BioNet Vegetation Classification does contain PCTs that are derived or secondary vegetation communities (i.e. the PCTs have been modified substantially since 1750); however, they are generic and lack values such as percent cleared estimates.

The assessor must determine the most likely original PCT for areas of derived native vegetation. In determining the most likely PCT that occupied the site prior to modification, the assessor should use nearby reference sites with similar geophysical characteristics (e.g. position, landform, aspect and lithology).

Some derived vegetation may meet the definition of a TEC. For example, a derived native grassland with a species composition similar to a box gum grassy woodland (without the over-storey of trees) may be a box gum grassy woodland TEC. The assessor should follow the steps above to stratify native vegetation when considering whether a vegetation community is a TEC.

Planted native vegetation

Planted native vegetation should be assessed in accordance with BAM Appendix D. In accordance with this appendix any planted native vegetation that occurs within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT, must be allocated to the best-fit PCT. The BAM is then applied. Some planted native vegetation may meet the definition of a TEC. The assessor should follow the steps above to stratify planted native vegetation when considering whether it is a TEC.

3.3.2 Map vegetation zones

A vegetation zone is an area of the same PCT with the same broad condition state. Vegetation zones are mapped in accordance with BAM Subsection 4.3.1.

The assessor must:

- stratify areas of each PCT that are in different broad condition states into separate vegetation zones (e.g. sections of vegetation in good condition should be separated from sections that have been significantly degraded or where strata layers are absent)
- describe each vegetation zone in the BAR to accurately reflect significant and distinct differences in condition
- calculate the area of each vegetation zone in hectares.

The assessor enters each vegetation zone into the BAM-C. The BAM-C will assign it a zone number and the relevant PCT number with space for the assessor to type a general description of the zone (this does not influence condition scores or credit calculations). The table of vegetation zones in the BDAR (and associated spatial data supplied to the approval authority) should be consistently numbered according to the BAM-C case. Additional identifiers are to be used where the project requires multiple BAM-C cases.

Vegetation zones made up of one or more discontinuous remnants (i.e. fragments of the same PCT in the same broad condition state) or multiple vegetation zones (i.e. different PCTs and/or the same PCT in different broad condition states) should be represented by separate polygons on the map.

Separate vegetation zones are required for:

- parts of the subject land where the vegetation has a current VI score of:
    - <15 for a PCT representative of a critically endangered ecological community (CEEC) or an endangered ecological community (EEC)
    - <17 for a PCT that provides habitat for threatened species or is representative of a vulnerable ecological community (VEC)
    - <20 for a PCT that is not representative of a TEC or associated with threatened species habitat

  as vegetation below these thresholds do not require an offset in the form of ecosystem credits (see BAM Subsection 9.2.1)
- derived, planted or secondary PCTs such as a derived native grassland
- scattered tree areas.

The description of the vegetation zone needs to reflect the condition of vegetation relative to benchmark to adequately inform the decision-maker.

Box 3 below provides examples for identifying and mapping vegetation zones.

While a vegetation zone is not required for cleared land or land that does not contain native vegetation on a development, activity or clearing site it should be shown on the Site Map. Cleared land can be included in a vegetation zone on a stewardship site where active restoration management actions are proposed.

Where there are PCTs with vegetation zones that are too small to fit in a survey plot (e.g. some sandstone riparian communities in the Sydney Basin) the assessor should modify traditional sampling methods to fit the site.

Mapped vegetation zones are confirmed by field reconnaissance, which may result in boundary changes or reallocation of some areas to different zones.

Box 3 – Examples for identifying and mapping vegetation zones

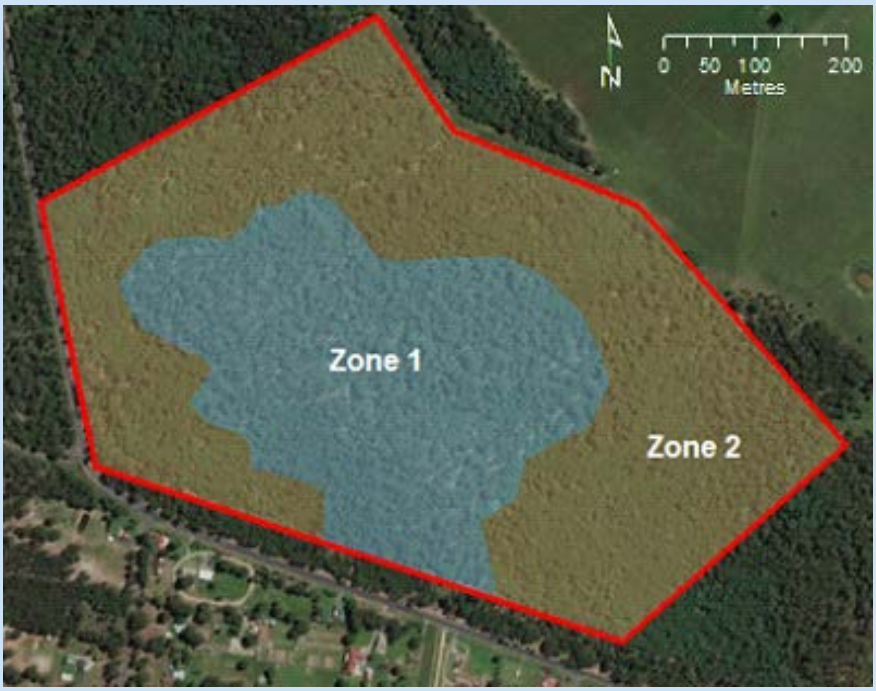

Figure 4 Contiguous vegetation zones on a stewardship site

Zone 2 - PCT 2

There are 2 PCTs that are each mapped as separate vegetation zones.

Box 3, continued

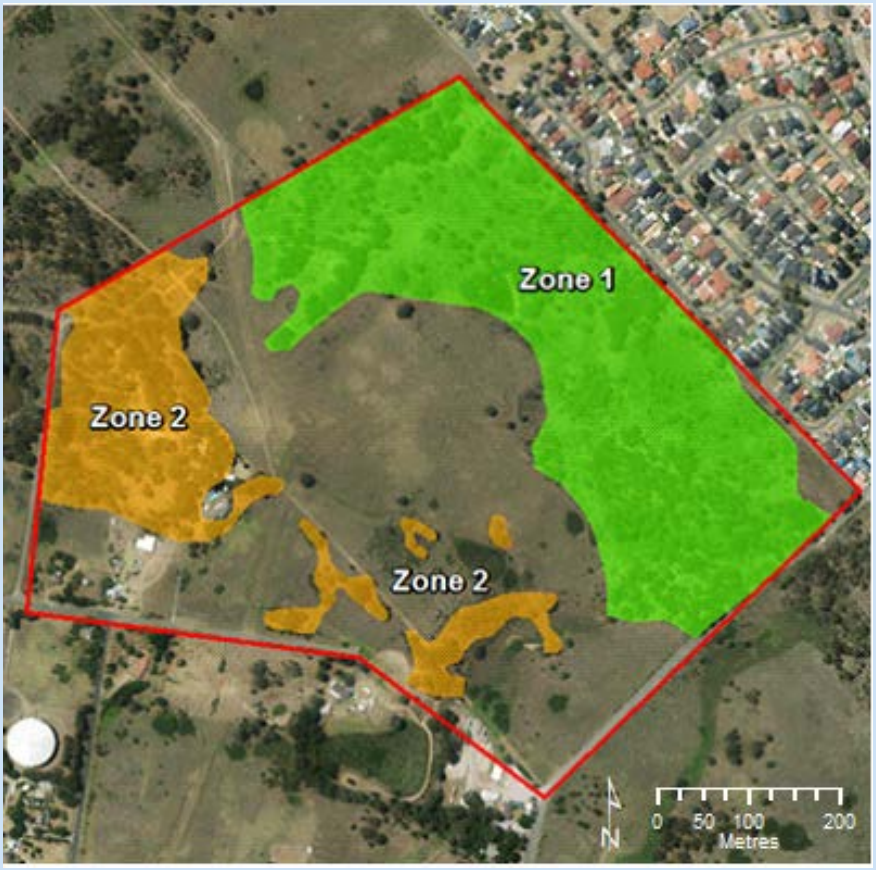

Figure 5 Continuous and discontinuous vegetation zones on a development site

Zone 2 - PCT 2 (five polygons)

There are 2 PCTs that are each mapped into a separate vegetation zone. Zone 1 is a continuous polygon. Zone 2 is discontinuous with 5 separate polygons all described as in the same broad condition state. Other vegetation on the site is exotic.

Box 3, continued

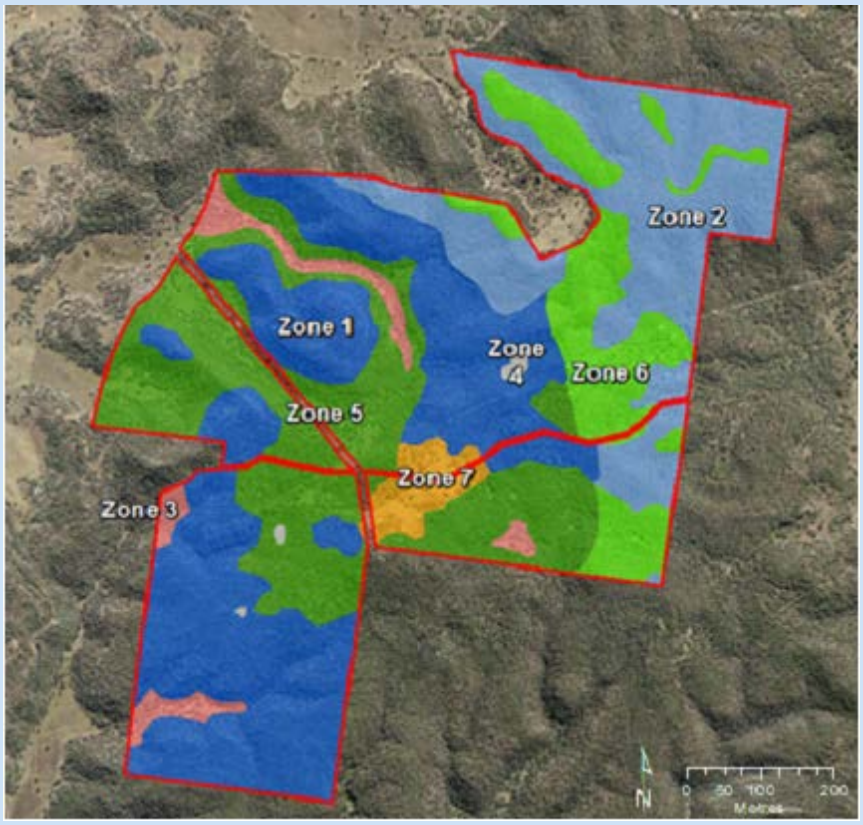

Figure 6 Discontinuous zones on a stewardship site

Zone 7 - PCT 5

The site has 5 PCTs that have been stratified into 7 vegetation zones based on condition:

- All vegetation zones are comprised of discontinuous polygons across the site (Note: Zones 5 and 7 extend across a gap in the site boundary that is an easement, which is excluded from the site).
- Zones 1 and 2 are the same PCT but have different condition states, so they were mapped as 2 separate zones.
- Zone 3 is a second PCT.
- Zone 4 is a third PCT.
- Zones 5 and 6 are the 4th PCT but with different condition states based on the density of ground cover.
- Zone 7 is a fifth PCT.

Box 3, continued

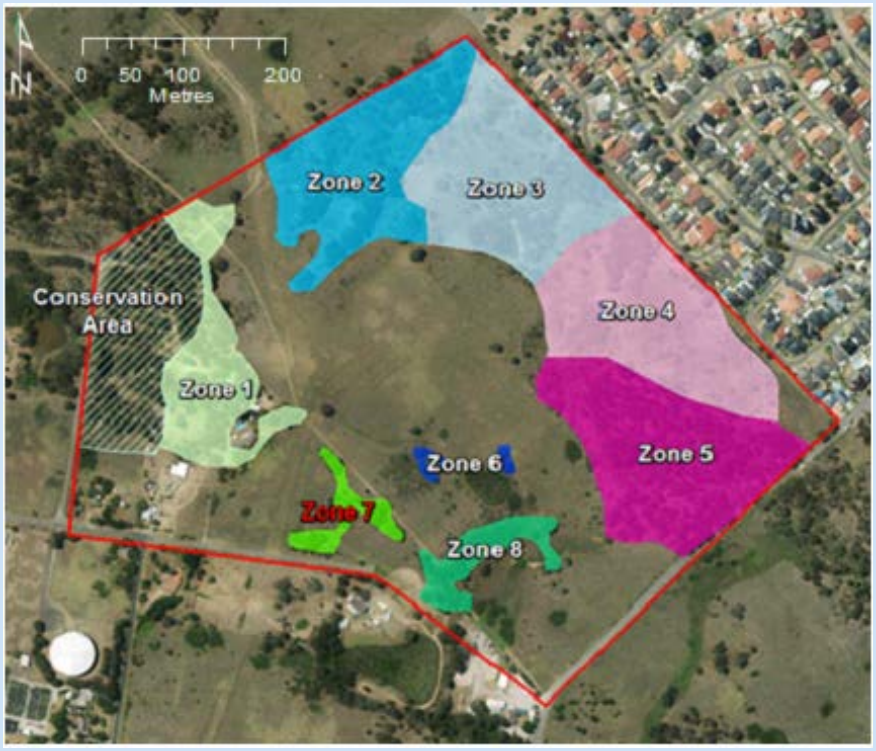

Figure 7 Vegetation zones on a major project site

Zone 8 - PCT 1 condition b

The site has 3 PCTs that have been stratified into 8 vegetation zones based on vegetation condition:

- Zones 1, 7 and 8 are the same PCT:
  - Zone 1 is missing key structural elements in the PCT (condition a)
  - Zone 7 is a derived native grassland (shown in red text) with a vegetation integrity score of <17
  - Zone 8 is described as in good condition (condition b).
- Zones 2, 3 and 6 are the same PCT, however, all are described as having different condition states (conditions c, d and e).
- Zones 4 and 5 are the same PCT but are separated based on the density of exotic weeds (conditions f and g). Other vegetation on site is non-native.

3.3.3 Assess the patch size for a vegetation zone

A patch is defined in the BAM as an area of native vegetation that occurs on the subject land and includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems). The patch may extend onto land adjoining the subject site.

The patch size for each vegetation zone located on the subject land is mapped in accordance with BAM Subsection 4.3.2 using the following steps:

1. Identify vegetation zones that will be included in the same patch (i.e. vegetation zones located within 100 m of one another for native woody vegetation and within 30 m of one another for native non-woody vegetation).
2. Identify the boundary of any adjoining native vegetation that extends beyond the limit of the subject land.
3. Digitise each patch using separate polygons where multiple patches exist.
4. Calculate the area of each patch in hectares.

The patch size should include derived communities (i.e. one or more of the structural components or strata layers is missing, modified or new) as these are likely to provide suitable habitat for at least some species. For example, for a derived grassland with no woody over-storey, vegetation zones located within 30 m of one another would be included in the same patch. For a derived shrub and grassland, vegetation zones located within 100 m of one another would be included in the same patch.

An example calculation of patch size for a proposed development site is provided in Box 4 below.

Details of the patch size for each vegetation zone must be documented in the BAR and entered into the BAM-C. If multiple vegetation zones are included in a single patch, the assessor should enter the same patch size in the BAM-C for each of these zones. Alternatively, more than one patch size class can be entered into the BAM-C for a vegetation zone if it is made up of multiple discontinuous patches of different sizes. Here separate vegetation zones are entered into the BAM-C, each with its own patch size and the same plot data.

The patch is allocated to a patch size class (<5 ha, 5–<25 ha, 25–<100 ha or ≥100 ha – see BAM Subsection 4.3.2) by the BAM-C. Patch size class is used as a filter to predict threatened species likely to occur in or use habitat on subject land (see Chapter 4 of this Manual).

Box 4 – Example of patch size calculation

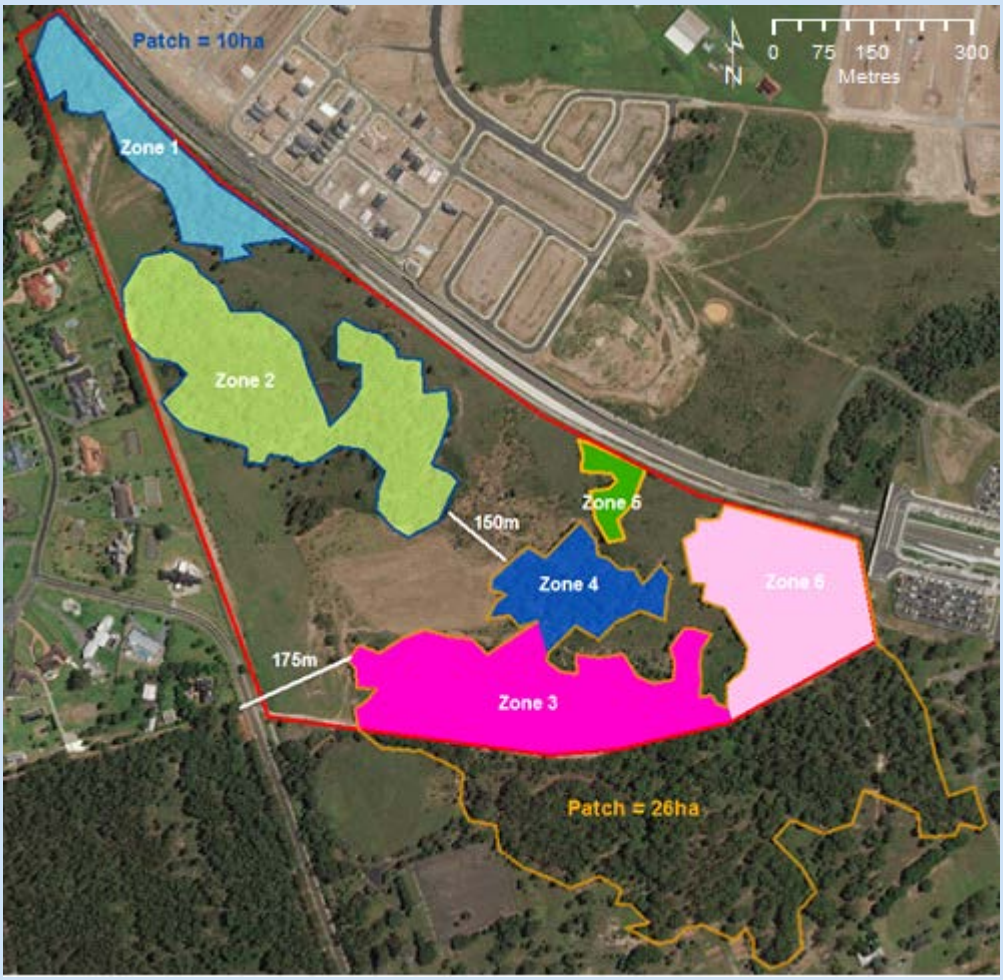

Figure 8 Mapped vegetation zones and patches on a proposed development site

Patch size for a vegetation zone must be calculated:

- Zone 1 is 4 ha and Zone 2 is 6 ha. Zones 1 and 2 (bordered in blue) form a single patch of 10 ha as they are separated by <100 m from each other but are 150 m from the next closest area of native vegetation (Zone 4). The patch size class for these 2 vegetation zones is 5–<25 ha.
- Zone 3 is 6 ha, Zone 4 is 4 ha, Zone 5 is 2 ha and Zone 6 is 6 ha. Zones 3, 4, 5 and 6 (bordered in orange) form a second patch as they are all <100 m distance from each other. Native vegetation to the south-east of the site is also included in this patch as it adjoins native vegetation on the subject land. This adjoining vegetation is 8 ha. Therefore, the total patch size is 26 ha and is allocated to the patch size class of 25–<100 ha.

The native vegetation in the bottom left-hand corner is greater than 100 m from the nearest zone (Zone 3) and does not overlap the subject land boundary, so is it excluded. Other vegetation within 100 m of the mapped zones is predominately exotic so it is also excluded.

3.4 Assess vegetation integrity (vegetation condition)

The assessor must undertake a VI assessment in accordance with BAM Subsection 4.3.3. The VI assessment:

- uses data-driven benchmarks
- uses vegetation growth forms to estimate vegetation condition
- uses dynamic attribute weights in calculations
- aggregates composition, structure and function scores using a geometric mean
- scores attribute condition using a continuous non-linear function.

The Vegetation Condition Benchmarks webpage (see Appendix A) provides further detail on the approach to assessing vegetation condition under the BAM.

Field surveys (including targeted species surveys for candidate species credits species) less than 5 years old can be used in place of onsite survey. Time limitations are imposed to ensure data used in assessments reflect the current biodiversity values on the subject land.

If a field survey has been undertaken on the subject land within 5 years of the current proposal lodgement date, and that survey meets the requirements of the BAM, including this section of the Manual, the assessor can use the results in place of an onsite survey. The use of a past survey must be documented in the BAR. Surveys undertaken more than 5 years prior to the proposal lodgement date may be used to **inform** the assessment process but **cannot** be used in place of a species survey. This is to ensure results are current with respect to site condition, structural attributes and species presence. Note, where biodiversity values have changed dramatically within 5 years (e.g. land use has changed) onsite assessment is required.

3.4.1 Vegetation integrity survey plots

The assessor must undertake plot surveys within each vegetation zone. The fundamental requirements for survey design are detailed in Section 5 of the Standard (Sivertsen 2009).

The level of survey effort across the vegetation zone must meet the **minimum number** of plots per zone in Table 4, as described in BAM Subsection 4.3.4.

Table 4 Minimum number of plots required per zone (copy of Table 3 from BAM Subsection 4.3.4)

Vegetation zone area (ha)	Minimum number of plots
<2	1 plot
>2–5	2 plots
>5–20	3 plots
>20–50	4 plots
>50–100	5 plots
>100–250	6 plots
>250–1,000	7 plots; more plots may be needed if the condition of the vegetation is variable across the zone
>1,000	8 plots; more plots may be needed if the condition of the vegetation is variable across the zone

The BAM-C automatically generates fields for the minimum number of plots required, based on the area of a vegetation zone. Additional plots may also be created within the BAM-C. Survey data from the plot-based floristic survey used to identify the PCT (see the 'Identify native plant community types and ecological communities on the subject land' section of this Manual) can contribute to the VI assessment if all relevant information is collected in line with the BAM standards.

Where field data is required to confirm and finalise boundaries of vegetation zones, it is recommended additional plots be used to address information gaps. Additional plots may also be required to provide a representative sample of highly variable vegetation. Where plot data indicates significant differences in vegetation condition across the vegetation zone, it must be split into zones of relatively homogenous condition states (see the 'Map vegetation zones' section of this Manual).

Survey plots measure **composition, structure and function attributes** if the PCT is from the following vegetation formations (see BAM Subsection 4.3.3(2.)):

- rainforests
- wet sclerophyll forests
- dry sclerophyll forests
- forested wetlands
- grassy woodlands
- semi-arid woodlands
- heathlands with trees: Wallum Sand Heaths (NSW031), Sydney Coastal Heaths (NSW032), Northern Montane Heaths (NSW033) and Sydney Montane Heaths (NSW034).

Survey plots measure **composition and structure attributes** if the PCT is from the following vegetation formations (see BAM Subsection 4.3.3(4.)):

- freshwater wetlands
- saline wetlands
- grasslands
- alpine complex
- arid shrublands
- heathlands without trees: Southern Montane Heaths (NSW035), South Coast Heaths (NSW065) and Coastal Headland Heaths (NSW070).

Where present it is best practice to collect data on function attributes, in these PCTs. Additionally, the high threat weed cover attribute will need to be assessed in survey plots for all PCTs (refer to details in 'Field survey' below).

Survey plots should sample the variation in vegetation condition across the zone. Randomly locating plots within stratified units can be achieved by:

- marking waypoints and bearings randomly in each vegetation zone on aerial imagery and establishing plots at all or some of these points in the field
- pacing a random distance into the vegetation zone and collecting survey data from that point onwards or on a randomly generated compass bearing.

Edge effects and ecotonal areas may distort the VI score. Wherever possible, plots should be located greater than 50 m from ecotones, roads, disturbed areas (including watering points and along fence lines) or the zone boundary.

Where multiple discontinuous areas of vegetation form a vegetation zone (see the 'Map vegetation zones' section of this Manual), plots must be evenly distributed across these areas if size permits. This requirement is essential for linear development proposals. If size is restrictive, as a minimum, at least one plot should be placed in each of the separate areas.

If a standard plot does not fit into a vegetation zone, a longer and narrower (e.g. 10 m x 100 m = 0.1 ha) or wider and shorter (e.g. 25 m x 40 m = 0.1 ha) plot may be used. If the vegetation zone is smaller than the standard plot size dimensions allow, the assessor may adjust the plot dimensions to fit as best as possible, providing it is representative of the vegetation zone.

Photographic records of plots including examples of hollows, leaf litter sub-plots, logs and other attributes should be retained as a visual record of vegetation condition. Additionally, photographs should be taken for each plot, along the mid-line, typically from one end, with GPS and bearing details recorded in the BAR (Figure 9).

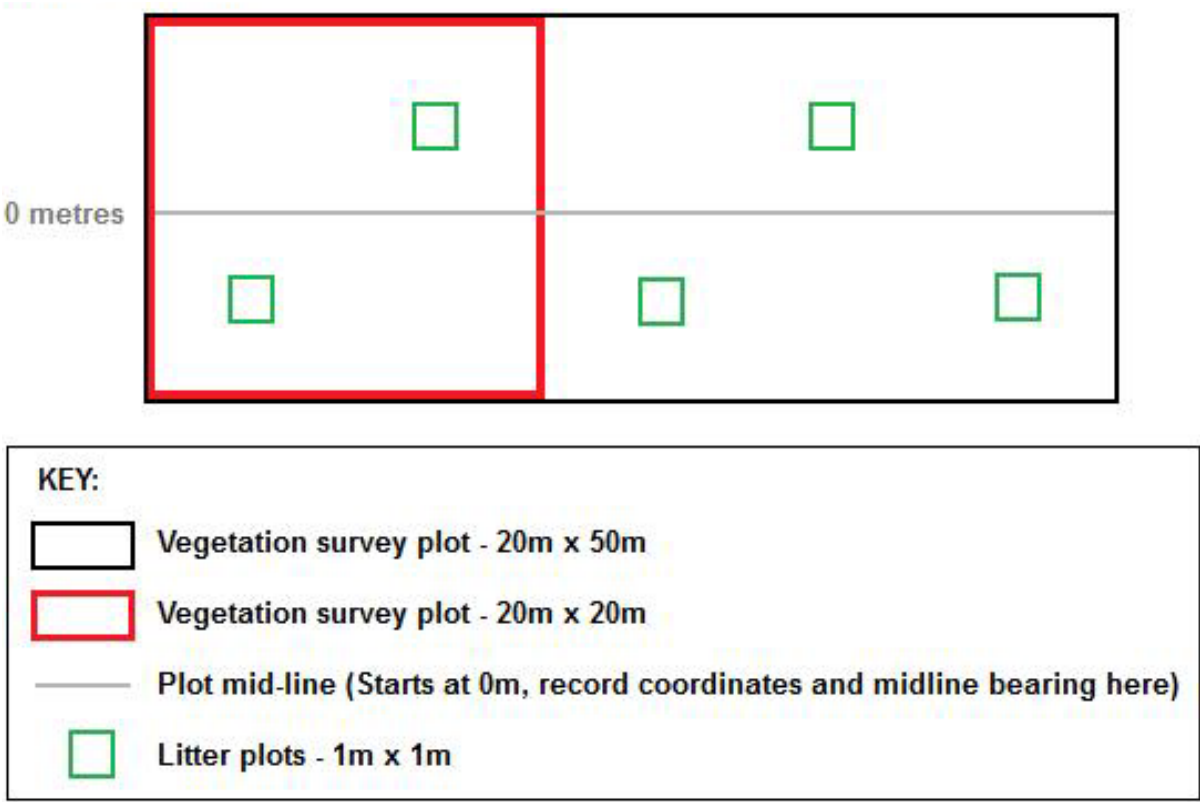

Figure 9 Standard plot layout to be used for site assessment

3.4.2 Field survey

Attributes used to measure the composition (richness), structure (foliage cover including all attached plant material) and function of each vegetation zone are shown in Table 5.

Copies of raw field data can be submitted electronically with the BAR including scanned hand-written site sheets or reports from electronic recording systems for each individual plot. Raw data allows the decision-maker to verify conditions within plots and/or provides a basis for recording and monitoring change over time in biodiversity stewardship sites.

An example field data sheet for assessment of VI is provided in Appendix B. The assessor may modify this sheet to suit their needs.

Table 5 Growth form groups and attributes used to assess the composition, structure and function components of vegetation integrity

Growth form groups used to assess composition and structure		Assessment unit
a)	Tree	20 m x 20 m plot
b)	Shrub	20 m x 20 m plot
c)	Grass and grass-like	20 m x 20 m plot
d)	Forb	20 m x 20 m plot
e)	Fern	20 m x 20 m plot
f)	Other	20 m x 20 m plot

Attributes used to assess function		Assessment unit
g)	Number of large trees	50 m x 20 m plot
h)	Tree regeneration	50 m x 20 m plot
i)	Tree stem size class	50 m x 20 m plot
j)	Total length of fallen logs	50 m x 20 m plot
k)	Litter cover	5 x 1 m^2 plots
l)	High threat weed cover	20 m x 20 m plot

1. Composition attributes

Composition attributes refers to the number of native species within each growth form group recorded within the survey plot. It is this number that is entered in the BAM-C.

The assessor assigns native plant species to a growth form group using the look-up table developed by the department, downloadable from the BAM Calculator home page (see Appendix A for weblink). Allocation of native species (including juveniles) to a growth form group was based on the most common growth form expressed by the mature plant across the extent of the species' range. If a species is not present in the table, the assessor must assign the species to a growth form group according to the definitions provided in BAM Appendix F. For more information see Oliver et al. (2019), available on the department's Vegetation Condition Benchmarks webpage.

Whilst only native species are used in the calculations for composition the assessor is also required to document non-native species and whether they are high threat weeds (see BAM Subsection 4.3.4(16.c.)).

2. Structure attributes

Structure attributes relate to the foliage cover of each native species in each growth form group within the plot.

The assessor records an estimate of foliage cover for each native and exotic species present in the 20 m x 20 m plot using the following number series: 0.1, 0.2, 0.3… 1, 2, 3… 10, 15, 20, 25… 100%. Foliage cover is the percentage of the plot covered by a vertical projection of all attached plant material, regardless of whether it appears alive or dead, of all individuals of a species. The estimate must include leaves, stems, twigs, branchlets and branches, from forb, grass and grass-like species, and any canopy overhanging the plot, even if the stem is outside the plot.

The structure of each growth form group in each 20 m x 20 m plot is calculated by adding the individual foliage cover estimates for all native plant species recorded within the growth form group. For example, if there are 2 tree species recorded in a plot, the first with an individual foliage cover estimate of 10% and the second with an estimate of 15%, then the total native foliage cover estimate for the tree growth form group is 25%. Total percentage foliage cover within a growth form group is cumulative and therefore may exceed 100% due to overlapping canopies.

The assessor enters the total native foliage cover estimate for each growth form group into the BAM-C.

Note that the 'other' column in the BAM-C under structure is for recording native species that do not fit into the standard growth form groups; for example, cycads or vines (see BAM Appendix F).

3. Function attributes

Function attributes include tree stem size classes, number of large trees, tree regeneration, length of fallen logs and leaf litter. Attributes are assessed in each 20 m x 50 m plot and should only include living trees (except for fallen logs) and the largest stem of multi-stemmed trees.

Presence or absence of each **tree stem size class** from 5 cm DBH (diameter at breast height, over bark and measured at 1.3 m above ground level) to the large tree threshold size is recorded and entered into the BAM-C. Threshold size is located in the PCT description in the BioNet Vegetation Classification; for example, when the large tree threshold size is 50 cm, tree stem size classes are 5–9, 10–19, 20–29, 30–49 cm DBH.

While only presence or absence data is required for an assessment, assessors are encouraged to record actual counts or estimates of the number of stems within each size class, as these data can be used to improve thinning thresholds and benchmark data within the BioNet Vegetation Classification.

The **number of large trees** is assessed by counting all living stems with a DBH equal to or greater than the large tree threshold DBH for the PCT or vegetation class. The number of large trees is entered into the BAM-C.

Tree regeneration is assessed as presence or absence of living trees from the tree growth form group with a maximum stem diameter of less than 5 cm regardless of height. Only presence or absence is entered into the BAM-C.

An estimate of the total length of **fallen logs** is made by adding together the lengths of all dead woody material greater than 10 cm in diameter that is entirely or partly on the ground, within the 20 m x 50 m plot. Where logs extend outside the plot only the length within the plot is recorded. The assessor enters the total length of fallen logs in metres into the BAM-C.

Percentage **litter cover** is measured in five 1 m x 1 m sub-plots located evenly along the 50 m mid-line (see Figure 9). Litter is taken as plant material detached from a plant including leaves, seeds, twigs, branchlets and branches with diameter of <10 cm. Litter not in contact with the ground is not recorded. The assessor averages the litter cover from the 5 sub-plots to generate the average percentage litter cover for the entire plot, which is entered into the BAM-C.

4. Other attributes

For a BSSAR, the assessor must also estimate the foliage cover of each high threat weed species. This is not required for a BDAR or BCAR. A list of high threat weeds in NSW is downloadable from the BAM Calculator home page (see Appendix A for weblink). The total percentage of **high threat weed cover** for each 20 m x 20 m plot is entered into the BAM-C. Although this figure is estimated during collection of composition and structure attribute data

(BAM Subsection 4.3.4(16.) and (21.)), it is entered in the zone function data section of the BAM-C. The proportion of high threat weed cover influences the estimate of gain in vegetation condition at a biodiversity stewardship site (i.e. Stage 3 of the assessment process).

The **presence of hollow bearing trees** is assessed in each plot. Hollow bearing trees include living and dead native species allocated to both the tree and shrub growth form groups and that have at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. solid wood cannot be seen beyond the entrance); and (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles.

Plant species allocated to the shrub growth form can be counted where the hollow meets the above requirements. The presence of hollow bearing trees in each plot is entered into the BAM-C.

Assessors should note that hollow bearing trees do not contribute directly to the VI score. The 'count of hollow bearing trees' attribute used in past assessment methods (e.g. the BioBanking Assessment Methodology and Framework for Biodiversity Assessment) has been replaced by the function attribute 'number of large trees'. The change is in recognition of the importance of large trees in the provision of food, habitat and other resources (in addition to hollows), and the fact that counts of trees with hollows can vary significantly between assessors; however, the **presence of hollow bearing trees**:

- forms part of the assessment of habitat suitability for threatened species reliant on hollows for breeding or roosting, particularly those with specific requirements
- is recorded on the credit profile for ecosystem credits, if impacted vegetation contains hollow bearing trees then the offset site must also contain hollow bearing trees.

3.4.3 Determine the vegetation integrity score

VI scores are used in the BAM during:

- Stage 1 (Biodiversity assessment) to describe the current condition of native vegetation on the subject land
- Stage 2 (Impact assessment) to determine the impact of development, activity, clearing or biodiversity certification (i.e. the difference between the current and future site condition), which is in turn used to calculate:
    - whether an offset is required (if VI exceeds the thresholds of ≥15 for a CEEC or EEC, ≥17 for VECs and PCTs that provide threatened species habitat or ≥20 for all other PCTs)
    - number of ecosystem credits required to offset the impacts to that vegetation zone
    - number of species credits required to offset the impacts to a species' habitat where the assessment unit for that species is based on area of habitat
- Stage 3 (Improving biodiversity values) to determine the future vegetation condition from implementing management actions and averted loss from foregoing existing land-use entitlements for a stewardship site, which is in turn used to calculate the number of ecosystem credits created for that vegetation zone or species credits for species assessed by area.

Field data entered into the BAM-C are used to compare the composition, structure and function attributes of the vegetation zone against benchmarks for the regional vegetation classes (which are an amalgamation of IBRA regions and NSW Vegetation Classes), generating scores from 0–100. The BAM-C then aggregates these 3 scores using a geometric mean to provide the final VI score for the vegetation zone. Box 5 explains how the BAM-C operationalises these metrics; they do not need to be performed by the assessor.

Box 5 – Explanation of the calculations performed by the BAM-C to determine the composition, structure and function condition scores and the vegetation integrity score

Composition condition score

To calculate the composition component of the VI score, the BAM-C averages the observed species richness within each growth form group for all plots within a zone and converts this to continuous unweighted condition scores (by comparing the average observed richness to the benchmark value richness).

Dynamic weights are then applied to the unweighted scores for each growth form group. Dynamic weights are generated from richness benchmarks based on the proportional contribution of each growth form group to the total richness (sum of benchmark richness across all growth form groups, see Table 6).

The composition condition score for the vegetation zone is the sum of the weighted composition scores for each growth form group (see Table 6 for a worked example).

Table 6 Worked example of composition condition score calculation

Growth form group	Native plant richness (observed mean)	Native plant richness (benchmark)	Unweighted score	Dynamic weight	Weighted composition score
Tree	4	3	100	3/23=0.13	13
Shrub	4	5	96	5/23=0.22	21
Grass & grass-like	4	10	56	10/23=0.43	24
Forb	2	5	56	5/23=0.22	12
Fern	0	0	0	0	0
Other	1	0	0	0	0
Total	**15**	**23**		**1.0**	**70**

Structure condition score

The calculation of the structure component of the VI score is similar to that for composition. The BAM-C averages the observed cover values within each growth form group for all plots within a zone and converts this to continuous unweighted structure scores (by comparing the average observed cover to the benchmark value cover).

Dynamic weights are then applied to the unweighted scores for each growth form group. Dynamic weights are generated from structure benchmarks based on the proportional contribution of each growth form group to the total benchmark cover score (sum of benchmark structure across all growth form groups, see Table 7).

The structure condition score for the vegetation zone is the sum of the resultant weighted structure scores for each growth form group (see Table 7 for a worked example).

Box 5, continued

Table 7 Worked example of structure condition score calculation

Growth form group	Native plant cover (observed mean)	Native plant cover (benchmark)	Unweighted score	Dynamic weight	Weighted score
Tree	3	1	100	1/16=0.06	6.3
Shrub	2	2	100	2/16=0.13	12.5
Grass & grass-like	6	9	84.3	9/16=0.56	47.4
Forbs	6	4	100	4/16=0.25	25
Ferns	0	0	0	0	0
Other	0	0	0	0	0
Total	**17**	**16**		**1**	91.2

Function condition score

For formations listed under BAM Subsection 4.3.3 unweighted condition scores are calculated for the average number of large trees, average length of fallen logs and average litter cover observed among plots within a vegetation zone.

The unweighted tree regeneration score for a plot is 100 when counts are ≥1, or zero when counts equal zero. The average unweighted score for the vegetation zone is the sum of scores divided by the number of plots.

Tree stem size diversity is based on presence of trees within stem size classes that neither qualify as large trees nor regenerating trees. Unweighted tree stem size diversity is scored according to Table 8. The average unweighted tree stem size diversity score for the zone is the sum of scores divided by the number of plots.

Table 8 Tree stem size diversity scores (copy of BAM Table 18)

Size classes present (not including large trees or regenerating trees)	Large tree benchmark size ≥80 cm DBH	Large tree benchmark size ≥50 cm DBH	Large tree benchmark size ≥30 cm DBH	Large tree benchmark size ≥20 cm DBH
None	0	0	0	0
One	9	15	28	59
Two	40	59	85	100
Three	76	92	100	N/A
Four	95	100	N/A	N/A
Five	100	N/A	N/A	N/A

Box 5, continued

The function condition score for the zone is calculated as the sum of the products of unweighted condition scores and their static weights for each attribute (see BAM Table 17).

Table 9 Worked example of function condition score calculation

Item	Benchmark	Observed mean	Weighting	Weighted score
Number of large trees	3	1.7	0.35	24.1
Litter cover	35	25	0.15	13.4
Length of logs	40	15.7	0.20	7.7
Tree stem size class	4	2.3	0.15	11
Tree regeneration	Present	0.7	0.15	12.6
High threat weed cover	–	–	–	–
Total	**82**	**45.4**	**1**	**68.8**

Vegetation integrity score

The vegetation integrity score is calculated as the geometric mean (cubed root) of the 3 scores in accordance with Equations 16 to 24 in BAM Appendix H: composition, structure and function (or the square root of composition and structure scores in non-woody vegetation). This approach reduces the problem of a low scoring attribute being compensated for by a high scoring attribute. It also provides a clear indication on whether a site is lacking compositional, structural or functional components, which is useful information for developing restoration management actions at a stewardship site.

3.4.4 Determining benchmarks

Vegetation Condition Benchmarks describe the reference state to which sites are compared to score their site-scale biodiversity values or set goals for management or restoration. The 3 primary attributes of biodiversity: composition, structure and function, are described by benchmarks. The vegetation integrity score represents the degree to which the composition, structure and function of the vegetation type at a site differs from the best-on-offer condition.

When the assessor adds a vegetation zone and selects a PCT in the BAM-C it automatically populates the relevant benchmark data from the BioNet Vegetation Classification. If the vegetation in the zone is assessed as naturally occurring (i.e. not derived), the assessor should use the pre-populated data. However, if the vegetation is assessed as being in a derived form, the assessor must select the most likely original PCT to generate the appropriate benchmark data (see Box 6 below). The assessor must provide justification of PCT selection in the BAR, including their decision pathway.

For further information on the development of vegetation condition benchmarks see the Vegetation Condition Benchmarks webpage (see Appendix A).

Box 6 – Benchmarks and determining if a PCT is derived

Derived vegetation communities are communities that have changed to an alternative stable state as a consequence of management practices following European settlement. See the BAM Glossary for a definition of 'Derived PCT' and Office of Environment and Heritage (2017) for more information. An assessor may no longer select a derived PCT under BAM 2020. Instead, the assessor must select the most likely original PCT, or a PCT from the most likely original vegetation class.

Professional judgement should be used when determining if a PCT is derived and the selection of the most likely original PCT. Benchmark data are available for each PCT in the BioNet Vegetation Classification, which also includes descriptive information and, where possible, an indication of the original vegetation type(s) for each fully or partially derived vegetation type. To assist in the determination of the most likely original PCT for a zone, the assessor may use this information in combination with consideration of:

- remaining species composition
- patterns of surrounding vegetation
- landscape attributes, including aspect, slope and position
- soil type and underlying lithology
- historical land management practices in the area.

3.4.5 Use of modified benchmarks

An assessor may consider using modified benchmarks in accordance with the Practice Note: Biodiversity Assessment Method – Use of modified benchmarks (see 'Assessor resources' in Appendix A for weblink). Modified benchmarks are also referred to as local benchmarks.

Wet and dry benchmarks, which reflect seasonal variations, may be available on the Veg-C database (see Appendix A). Wet and dry rainfall year thresholds are available for each Vegetation Class/IBRA region in the Veg-C database[4]. Where the rainfall totals for the 12 months prior to the survey date reach the threshold for a wet or dry rainfall year, the use of dynamic benchmarks, where available in the Veg-C database, should be considered before collecting local benchmark data.

Where extreme drought occurs for prolonged periods and the annual rainfall totals fall below the 10th percentile of long-term records, it is recommended that the BAM Stage 1 assessment is delayed where possible until conditions improve. This is particularly important for proposed BSA assessments, because it increases the uncertainty around the predicted ecological response of habitats and communities to management actions undertaken at a site.

[4] The wet and dry rainfall year thresholds are scheduled to be published in the BioNet Veg-C in early 2021. If you require this information prior to its publication please contact bam.support@environment.nsw.gov.au.

4. Assessing the habitat suitability for threatened species

This chapter outlines the survey and assessment requirements for threatened species. Note that the definition of threatened species includes threatened populations (see the BAM Glossary). In the BAM, species are assessed as either ecosystem credit species, species credit species or a combination of the 2 (referred to as 'dual credit species'). In general, ecosystem credit species are those where the likelihood of occurrence of the species and/or elements of its habitat can be confidently predicted by vegetation surrogates and landscape features. The likelihood of occurrence of species credit species cannot be reliably predicted by habitat surrogates. Dual credit species are those where part of the species' habitat is assessed as an ecosystem credit (e.g. foraging habitat) and part as a species credit (e.g. breeding habitat).

4.1 Requirements for the Biodiversity Assessment Report

By the end of this chapter of the Manual and BAM Chapter 5 the assessor will be able to complete the following information in the BAR (see BAM Appendices K and M for minimum requirements for Stage 1 biodiversity assessments and Appendix L for streamlined assessment modules).

Table 10 Requirements for the BAR – Habitat suitability

Information	Maps, tables and data
Identification of ecosystem and species credit species:	**Digital GIS files must be provided for all maps and spatial data in a format agreed to by the decision-maker.** Polygons are suitable for most spatial data requirements unless points or lines are specified. **All maps must be easy to read with clear headings, keys, colour ramps and symbols.** **Data must be provided in a format that can be analysed** (e.g. MS Excel or other downloadable format).
List of predicted ecosystem credit species likely to occur on the subject land (derived from the BAM-C) Justification for the addition or exclusion of any ecosystem credit species predicted above	**Table:** Predicted ecosystem credit species, their sensitivity to gain class and identifying species added to or removed from the list

Information	Maps, tables and data
Identify candidate species credit species on the subject land, including: • list of species credit species derived from the BAM-C • justification for exclusions of any species credit species based on geographic limitations, habitat constraints, microhabitats, vagrancy OR additions based on data, previous surveys, etc. • indication of presence based on targeted threatened species survey, expert report, an important habitat map or assumed (development only, see below) • details of threatened species survey including method and effort, timing, weather conditions, and surveyor/s. Justifications for the approach taken and any limitations or assumptions made should also be documented • species polygons for species determined to be present within the subject land • biodiversity risk weighting for species determined to be present within the subject land	**Table:** List of auto-generated species credit species identifying: species removed from/added to the list; presence on subject land as determined by targeted survey, expert report, assumed presence or important habitat map; and biodiversity risk weighting **Table:** For species determined to be present, a table detailing habitat constraints or microhabitats associated with the species, counts of individuals (flora)/area of suitable habitat (flora and fauna) on the subject land, BC Act listing and number of species credits required **Data:** Where threatened species survey was completed, detail survey technique, effort (dates/times), weather and results **Map:** Location of survey effort points or lines, e.g. sample points or transects, attributed with survey type **Map:** Indicating the GPS coordinates (points) of all individuals of each species recorded within the subject land and the species polygon for each species Other data requirements listed in Appendix K, L or M
Where use of more appropriate local data is proposed: • identify relevant species • identify data to be amended • identify source of information for local data • justify use of local data • provide written confirmation from the decision-maker supporting the use of local data	
Where expert reports are used in place of a species survey: • identify the relevant species • estimate the number of individuals of the species (where the unit of measure is count) if determined to be present • justify the use of an expert report • identify the expert, provide evidence of their expert credentials and departmental approval of expert status • ensure all requirements of Box 3 in the BAM have been addressed in the expert report	Expert reports and any supporting data used to inform the conclusions documented **Map:** Species polygon for each species

4.2 Threatened Biodiversity Data Collection

The Threatened Biodiversity Data Collection (TBDC) is a portal for accessing government-held information about plants and animals in NSW. It is maintained by the department and provides a detailed profile on each threatened species and ecological community in NSW including the entity's habitat, range, key threats, and data required to operate the BAM (e.g. appropriate time to survey, unit of measure, etc.). The TBDC is updated regularly to include the best available information and to add new listings under the BC Act. The BAR must reflect any changes in data made up to the date it is finalised[5].

Assessors need to register for a login to BioNet to access the TBDC. BAM Section 5.2 outlines the information an assessor needs to extract from the TBDC for threatened species likely to occur on the subject land. To download data from the TBDC, follow instructions in 'How to access the BioNet Web Service using Power Query: A BioNet Quick Guide' (see Appendix A).

If an assessor considers that the data in the TBDC does not reflect the local environmental conditions, use of local data may be proposed (in accordance with BAM Subsection 1.4.2 – see the 'Use of more appropriate local data' section of this Manual).

4.3 Class of biodiversity credit

Biodiversity credits are the units used in the BAM to assess losses and gains in biodiversity. All threatened entities in NSW have been allocated to at least one of 2 biodiversity credit classes: species credit or ecosystem credit (defined in the BAM Glossary). The BAM-C displays the credit class of each species (sourced from the TBDC).

Credit requirements are calculated for species credit species based on counts of individuals or area of suitable habitat. The BAM-C displays the unit of measure (count or area) for a species.

Table 11 Biodiversity credit classes and associated general definitions for application in the BAM

Credit class	Definition	Criteria
Species credit	The likelihood of occurrence of a species or elements of a species' habitat cannot confidently be predicted by vegetation surrogates or landscape features	Species has a low probability of occupying or using any site of apparently suitable habitat, and if present has a reasonable chance of being detected using suitable survey techniques
		Species has habitat constraints or elements that cannot be easily replaced or offset by improvements in condition in suitable habitat elsewhere, e.g. breeding caves or tree hollows for bats/birds, nest sites for raptors
Ecosystem credit	The likelihood of occurrence of a species or elements of a species' habitat can be confidently predicted by vegetation surrogates and landscape features	Habitat constraints or elements that can be replaced or offset by improvements in condition in suitable habitat elsewhere
		Species that are widely distributed, highly mobile or dispersed, and/or those that cannot be reliably detected from survey

[5] An assessor has 14 days from the finalisation date in BOAMS to submit the BAR to the decision-maker (BCARS have 28 days to submit). If not submitted within this timeframe the assessor will be required to apply any changes as a result of TBDC data updates.

Fauna species may be **'dual credit'** species where their behaviour and habitat requirements meet the criteria for both a species credit species and an ecosystem credit species; these are displayed as 'ecosystem/species' in the Biodiversity Credit Class field of the TBDC. Dual credit species are **generally** those with critical habitat, such as breeding habitat, that warrant particular consideration (e.g. cave breeding bats, birds dependent on hollows of particular dimensions/size for breeding, species with habitat on an important habitat map and mapping approaches are evidence-based). These details are recorded in the 'habitat constraints' field of the TBDC.

For the purposes of the BAM, species are allocated to the same class of biodiversity credit across their entire distribution in NSW.

Whether a species is an ecosystem credit species or species credit species influences several key elements in the Biodiversity Offsets Scheme (BOS). Firstly, it determines the level of assessment required for a species, i.e. assumed presence, threatened species survey, expert report or important habitat map. For dual credit species the species credit component may require survey. For example, where breeding habitat is the species credit, species surveys must be targeted to determine breeding (e.g. lactating females, females with young or juveniles); foraging habitat then forms the ecosystem credit component of the dual credit. Some dual credit species have important habitat maps used to identify the species credit. Assessors can access the important habitat maps via the map viewer available in BOAMS. Further species-specific information is available in the TBDC.

Secondly, different offset rules apply to ecosystem and species credits. BAM Subsection 10.2.1 outlines the shared attributes that define like-for-like offsets to meet ecosystem credit requirements for a proposal and BAM Subsection 10.2.2 outlines those for species credits. Variations to these rules are also different between ecosystem and species credits. Trading rules are outlined in the Biodiversity Conservation Regulation 2017.

4.4 Identify habitat suitability for threatened species

The flowchart in Appendix C outlines the steps involved in identifying habitat suitability for threatened species.

4.4.1 Identify threatened species for assessment (Step 1)

BAM Subsection 5.2.1 (Step 1) describes the criteria used to identify threatened species that must be assessed on the subject land. All criteria in Table 12 relevant to that species must be met for it to be considered likely to occur on or use the subject land.

The BAM-C automatically generates a list of the threatened species that meet these initial criteria. If relevant, the assessor can then determine whether the geographic limitations of a species are applicable based on the location of the proposal.

Table 12 Criteria for identifying ecosystem and species credit species at a site

Criteria	Categories
The species is classed as an ecosystem or species credit species within the TBDC	Ecosystem credit, species credit or species/ecosystem credit (Note: the TBDC labels dual credit species as 'species/ecosystem credit species').
Species distribution – distribution of the species includes the IBRA subregion in which the subject land is mostly located	No categories
Geographic limitations – further refines distribution of the species by providing limits to where the species occurs within an IBRA subregion (only applies to select species), see Box 7 below	No categories
Species associations with PCT – species is associated with any one of the PCTs occurring on the subject land	No categories
Percent native vegetation cover class – the percent native vegetation cover within the assessment area (BAM Section 3. 2) is equal to, or greater than, the minimum class required for the species (not relevant for threatened plants)	Intact (>70% native vegetation cover)
	Variegated (>30–70% native vegetation cover)
	Fragmented (from >10–30% native vegetation cover)
	Relictual (with 10% or less native vegetation cover)
Patch size class – the size of the patch as determined according to BAM Subsection 4.3.2, is equal to, or greater than, the minimum specified for the species (not relevant for threatened plants)	<5 ha
	5–<25 ha
	25–<100 ha
	≥100 ha

Box 7 – Applying geographic limitations

Geographic limitations for each species can be viewed from the online 'Threatened Species Profile' app (see Appendix A).

The assessor can search for the species, then click on the hyperlink under the 'Indicative distribution' map, and expand the pop-up window to view the IBRA subregions and any geographic limitations. Most species do not have geographic limitations.

Geographic limitations usually relate to altitude (e.g. a frog species that only occurs above an altitudinal limit), topographic features (e.g. named permanent waterbodies) or specific local government areas. Different geographic limitations can be described for different IBRA subregions across a species' distribution.

Where the subject land is not within the geographic limitation described, the assessor can select 'no' in the BAM-C and the species will be removed from the auto-generated list of threatened species.

For a BCAR or BDAR the assessor must review the list of species to ensure it is accurate and includes all species likely to occur within or use habitat on the subject land. Further species may be added to the list if, for example, the species:

- has been recently listed under the BC Act (and not yet added to the TBDC)
- has been recorded on or near the subject land but is not auto-generated by the BAM-C (e.g. based on review of ecological reports, environmental impact statements, scientific literature, presence on site during survey)
- in the assessor's professional opinion, is likely to be present in the proposed disturbance area, or the species may be affected by the proposed development.

As per BAM 2020 (Subsection 1.4.1) BioNet databases must be checked. If any past surveys of the subject land have recorded the presence of a threatened species or it has been incidentally observed on site, the species must be assessed in accordance with Steps 2–6 in BAM Subsections 5.2.2 to 5.2.6, irrespective of the criteria in Table 12. Information relating to the past survey and/or reasons for adding species to the list must be included in the BDAR or BCAR. If the assessor is uncertain about the likelihood of the presence of a species on the subject land, as a precautionary measure the species must be included on the list. These steps are optional for a biodiversity stewardship site assessment as it is up to the landholder whether they seek to generate a specific class or type of biodiversity credit.

4.4.2 Assess the habitat constraints and vagrant species (Step 2, optional)

In accordance with BAM Subsection 5.2.2 (Step 2), the assessor may opt to undertake an onsite assessment to determine the presence of habitat constraints for a threatened species considered likely to occur on the subject land (i.e. on the auto-generated BAM-C list). Undertaking this step is recommended where species have identified habitat constraints (see the TBDC) as these may be difficult to identify using digital imagery alone.

Habitat constraints relevant to ecosystem and species credit species are automatically populated in the BAM-C from the TBDC. Where all listed habitat constraints relevant to a species are absent from the subject land, the species can be removed from the list auto-generated in the BAM-C as it will not require further assessment. Documentation in the BAR should reflect the TBDC information and evidence that the features are not present, including field reconnaissance methods and supporting information. However, if the species has multiple constraints listed and a single constraint is present, the species must be assessed under the remaining steps in BAM Section 5.2.

Some species do not have any identified habitat constraints (in the TBDC), in which case this step is not required.

Similarly, if a species is considered a vagrant in the IBRA subregion it can be removed from the auto-generated list in the BAM-C and no further assessment is required. Vagrancy refers to occasional records of individuals of a species that are outside their normal distribution or habitat, including escaped animals and planted specimens. The suspect record will need to be reviewed against the species' known distribution and the assessor must confirm, with species experts that it is likely to represent a vagrant. If agreed by experts the assessor should contact the department to have the record quarantined from the BioNet Atlas (via bionet@environment.nsw.gov.au). The BAR will need to contain supporting information such as who was contacted, when, their credentials and the resultant response from the department.

Assessors should note that the absence of a BioNet record on the subject land is not adequate justification to remove a species from the list generated by the BAM-C as requiring assessment for a proposal.

All ecosystem credit species that remain on the list are considered likely to have suitable habitat on the subject land and development or management actions impacting upon them must be addressed in the BAM.

All species credit species that remain on the list are likely to have suitable habitat on the subject land. These are referred to as 'candidate species credit species' in the BAM-C and require further assessment in accordance with BAM Subsection 5.2.3 (Step 3).

4.4.3 Further assessment of candidate species credit species (Step 3)

Whilst optional for a proposed biodiversity stewardship site, Steps 3–6 of BAM Section 5.2 must be completed to create species credits. If pursued it is recommended that the species credit assessments are undertaken simultaneously with the vegetation assessment when establishing the biodiversity stewardship agreement. Adding new classes of credits after management has been initiated on a biodiversity stewardship site may incur additionality (see BAM Subsection 11.9.3).

BAM Subsection 5.2.3 (Step 3) outlines further options for removing a species credit species from the list auto-generated in the BAM-C. The BAR must include:

a. a description of microhabitats required by the species, supported by evidence such as published literature
b. details of the habitat constraints listed in the TBDC for the species (where relevant)
c. details of the field assessment conducted to determine if a. is absent, or if present, whether a. and/or b. are degraded to the point that the species is unlikely to use the subject land (or specific vegetation zones).

BAM Subsection 5.2.3 (Step 3) must not be applied to ecosystem credit species. A degraded vegetation zone is not adequate justification to remove an ecosystem credit species from the generated list.

To apply Step 3 to a candidate species credit species, evidence to support the absence or degradation of habitat features listed in a. and b. above could include reference to the attribute scores for the VI assessment to illustrate if these conform to the habitat constraint or microhabitats on the site, photographic evidence, maps, etc.

Describing a vegetation zone as degraded or low/poor condition is not adequate justification to remove a candidate species credit species from the generated list. Evidence must support a. and b. above.

A candidate species credit species that does not have suitable habitat as per BAM Subsection 5.2.3(2.a.), does not require further assessment.

Similarly, where an expert report, used in place of survey (see below), states that the species is unlikely to be present on the subject land or specific vegetation zones, no further assessment is required.

4.4.4 Determine the presence of a candidate species credit species (Step 4)

BAM Subsection 5.2.4 outlines the options for determining whether a candidate species credit species is present on the subject land or specific vegetation zone/s:

1. assume the species is present (this option must not be applied to proposed biodiversity stewardship sites) or
2. conduct a threatened species survey or
3. obtain an expert report or
4. if an important habitat map is available for the candidate species, confirm whether the subject land is within an area identified on that map.

For a small number of species, a habitat constraint may refer to an important habitat map (see BAM Subsection 5.2.4(2.d.)). Important habitat maps (previously referred to as an important mapped area) identify areas that are considered important for the species (e.g. breeding areas or sites where multiple records have been located over multiple years). The species for which these maps have been developed are usually dual credit species, where part of their habitat is assessed as an ecosystem credit (unmapped area) and part assessed as a species credit (mapped area). The important habitat map for a species is the same layer that forms part of the Biodiversity Values Map.

Assessors can access the important habitat maps via the map viewer available in BOAMS. If the subject land is identified as an important mapped area for a species, it must be assessed for species credits. Generally, no survey is required (unless otherwise indicated in the TBDC); the species is considered to be present and the area of the subject land within the important habitat map forms the species polygon used to generate species credits (in accordance with Steps 5 and 6 of BAM Section 5.2). Any remaining habitat on the subject land (e.g. foraging, unmapped areas) used by these species is assessed for ecosystem credits.

For all other candidate species credit species, if assumed to be present or the species survey or expert report confirms presence, the species must be assessed further in accordance with Steps 5 and 6 (BAM Subsections 5.2.5 and 5.2.6). No further assessment is required for a species if the species survey or expert report confirms that it is not present, or is unlikely to be present, on the subject land. The expert report must be included in the BAR.

1. Threatened species survey requirements

BAM Section 5.3 outlines requirements for threatened species surveys. The objective of the species survey is to determine, with a high level of confidence, the presence of the species on the subject land and, if present, the number of individuals or area of suitable habitat. The species survey aims to minimise ‘false negatives’ and can provide additional information on habitat use and distribution of the species across the subject land.

The assessor must undertake a targeted threatened species survey using a scientifically robust, fit-for-purpose and repeatable method. Species surveys are to be conducted in accordance with the department’s taxa-specific guidelines, available on the Assessor resources webpage (see Appendix A). Guidelines are updated periodically to include the best available information.

If the department publishes new or revised survey guides, assessors are expected to apply them to all assessments for which the survey component is yet to be completed, and to all new assessments that commence on or after the publication date. This is to ensure that BARs meet the requirements of BAM Section 5.3(2.b.). Where survey has been completed prior to the publication of a new or revised survey guide, the department expects the assessor (or surveyor) to have applied current best-practice in searching for the target species (in accordance with BAM Section 5.3(2.c.). Assessors can use information from other published, peer-reviewed sources to guide survey technique and effort, however this must be clearly documented and justified in the BAR as well as indicating how this differs from the department’s recently published guide.

If the department has not published a survey guide applicable to the species, the assessor should check the species profile in the TBDC; the ‘General Notes’ and ‘Survey Comments’ fields often provide information on appropriate survey methods and effort. Details for species with specific survey requirements are also provided on the BAM-C webpage (see Appendix A). Alternatively, a published peer-reviewed survey guide applicable to the species may be applied, such as those developed by the Department of Agriculture, Water and the Environment. The assessor must provide detail on the timing, weather conditions, the method used (including references to any survey guides) and survey effort in the BAR.

Species surveys must be conducted at the optimum time for detection. Appropriate survey months are automatically populated in the BAM-C. The assessor may adjust survey timing if, for example:

- the species is flowering/fruiting out of season and these features are required for visibility or identification
- natural disturbances or climatic events have occurred (e.g. recent fire, flood or rainfall)
- ground disturbances have occurred (e.g. for species frequently found in disturbed road verges, fire obligates).

If survey times are varied from those identified by the BAM-C, the assessor must provide justification in the BAR using appropriate published or peer-reviewed references and/or data. Adjusting survey times to accommodate a species' response to local environmental conditions does not require written permission from the decision-maker (i.e. it is not considered more appropriate local data). The department acknowledges that survey times in the BAM-C and TBDC are indicative, assuming average conditions and across the species' distribution.

Section 3.4 of this Manual provides guidance for using past surveys. If there are existing records of a species on the subject land, and the current survey does not detect the species (or the population has changed), then evidence to justify the change should be provided in the BAR.

Threatened species records must be submitted to BioNet at bionet@environment.nsw.gov.au if the assessment requires a licence under the BC Act (e.g. if it involves trapping). However, it is good practice to submit **all** records of species to BioNet to improve our collective knowledge of the species.

Flora specimens for threatened species, particularly those resulting in range extensions and/or considered to be a hybrid or an intergrade, should be collected and sent to NSW Herbarium for verification. All correspondence must be included in the BAR; see DPIE (2020b) for more details. Similarly, calls for threatened frogs should be confirmed using FrogID, a service provided by the Australian Museum; see DPIE (2020a) for more details.

If a species survey confirms that the species is present on or is likely to use habitat on the subject land, the species must be assessed further in accordance with Steps 5 and 6 (BAM Subsections 5.2.5 and 5.2.6). No further assessment is required for a species if the survey confirms it is not present, or is unlikely to be present, on the subject land. The assessor can select 'no' for presence in the BAM-C to remove the species from the list of candidate species credit species.

2. Expert report or assuming presence

An expert report may be relied upon in place of species surveys, in accordance with BAM Section 5.3(1.) and BAM Box 3. Alternatively, an assessor may choose to assume a species is present on the subject land (see BAM Subsection 5.2.4(2.), Step 4); however, this option must not be applied to a proposed biodiversity stewardship site. Assuming species' presence or using an expert report may be appropriate where:

- the target species is cryptic and therefore difficult to identify via survey
- the optimal survey time for the species has been missed (e.g. where the assessor would prefer that an expert report be prepared rather than wait for the appropriate survey season).

Where one of these options is selected a species survey cannot subsequently be used to assess presence at some time post development application lodgement or approval. For a BSA new credits types may be generated at any time but could incur additionality. It is recommended the landholder discuss these options with the BCT.

Box 3 in the BAM outlines requirements for using expert reports instead of a species survey. An expert report can only be prepared by a person who, in the opinion of the Secretary of the department or anyone authorised by the Secretary, is suitable. Expert status can be demonstrated by:

- the expert's academic qualifications such as relevant degrees, postgraduate qualifications
- their history of experience in the ecological research, habitat assessment and survey method, for the relevant species
- a resumé detailing projects pertaining to the survey of the relevant species (including the locations and dates of the work), their employer's names and periods of employment (where relevant) over the previous 10 years
- peer-reviewed publications on the species or other evidence that the person is a well-known authority on the species to which the survey relates. The assessor cannot act as a referee for the proposed expert for this purpose.

A list of approved taxa-specific experts is published on the department's website (Appendix A – Biodiversity experts). A person not on the published list may be contracted to conduct an expert report, however the proposed expert must be approved by the department before the BAR is submitted (see Box 3 in the BAM for details). Therefore, it is recommended that the assessor seek approval for such an expert early in the assessment process.

The expert must author the expert report. The information used to determine whether a species is present on or likely to use the subject land must be documented in the expert report. **The expert is also responsible for preparing the species polygon.** The full report must be included in the BAR.

If a species is assumed to be present or the expert report confirms that the species is present on or is likely to use habitat on the subject land, the species must be assessed further in accordance with Steps 5 and 6 (BAM Subsections 5.2.5 and 5.2.6) (see Subsection 4.4.5 below). No further assessment is required if the expert report confirms the species is not present on, or is unlikely to use, the subject land. The assessor can select 'no' for presence in the BAM-C to remove the species from the list of candidate species credit species.

4.4.5 Determine the area or count, and location of suitable habitat for a species credit species (a species polygon – Step 5)

BAM Subsection 5.2.5 outlines the requirements for preparing a species polygon. A species polygon must be prepared for each species credit species:

- determined to be present or likely to use suitable habitat on the subject land by a species survey, expert report or important habitat map or
- assumed to be present (not applicable to proposed biodiversity stewardship sites).

Species are assessed using one of 2 units of measure: 'count of individuals' or 'area of suitable habitat', the outcomes of which are used in credit calculations. The unit of measure appropriate for the species is automatically populated in the BAM-C from the TBDC. All fauna are assessed by area whereas some flora are assessed by area and others by count.

The approach and information used to prepare the polygon must be described in the BAR.

The species polygon must be finalised after completion of the species survey or expert report (where relevant). In accordance with Box 2 in the BAM, the species polygon must:

- use the unit of measurement identified for that species in the TBDC to show the locations of individual flora species (see BAM Subsection 5.2.5(3.)), or the area of suitable fauna/flora species habitat

- contain the habitat constraints or other suitable microhabitats associated with that species on the subject land
- take into consideration information within the TBDC for the species regarding the species polygon (usually located in the 'general notes' field)
- be established by adding a 30 m buffer around the individuals or groups of individuals for flora species assessed by count on the subject land
- use GPS to confirm the location of the species polygon on the best available ortho-rectified aerial image of the subject land.

A description of the species including any habitat constraints present on the subject land; the area of suitable habitat or number of individuals recorded; any buffers applied to define the polygon must be included in the BAR. For example, a polygon to calculate Cumberland Plain land snail (*Meridolum corneovirens*) species credits would include the PCTs associated with the species that had suitable habitat features such as soil cracks and a good cover of course woody debris (identified in the TBDC). The polygon would also include accurate GPS point locations centred on the live specimens or shells found (see Box 8).

A polygon for a plant species assessed by counts would show the point location of the individual plant, or group of plants, buffered by a minimum of 30 m (see BAM Subsection 5.2.5(3.) and DPIE (2020b)). Note that for these species the polygon is not used in credit calculations, instead it indicates the location of the individuals recorded on the subject land and can inform management zones for a biodiversity stewardship site.

Where the species is assumed to be present and the unit of measure is 'counts of individuals', the number of individuals likely to be present on the subject land will need to be estimated (e.g. based on reference sites, relevant information in the TBDC for the species, etc.). The approach to generate population estimates must be evidence-based and clearly documented in the BAR. Advice can be sought from the department via bam.support@environment.nsw.gov.au.

If any part of the subject land is identified on an important habitat map for a species, the entire area of the subject land that is within the mapped area should form the species polygon. For example, if the subject land is 10 ha in area and the entire subject land is within a mapped location for a species, the assessor should map this as the species polygon.

The species polygon may contain an area of land that is not part of a vegetation zone; for example, non-native vegetation, caves, rock outcrops, rock faces or bridges. These features are assessed in BAM Chapter 6 as prescribed biodiversity impacts for development, activity, clearing or biodiversity certification proposals.

It is important that assessors consider the taxa-specific information relating to designing the species polygon in the survey guides published by the department.

4.4.6 Determine the habitat condition within the species polygon for species assessed by area (Step 6)

For species assessed by area of suitable habitat, the BAM-C determines the habitat condition within the species polygon using the VI score. Where multiple vegetation zones occur wholly or partially within the species polygon the BAM-C will generate a habitat condition score using the VI scores for these zones.

Where the species polygon contains an area of land that is not part of a vegetation zone, the assessor must not use a VI score to determine the habitat condition of this area.

Box 8 – Example of a species polygon

Figure 10 Species polygon for Cumberland Plain land snail (*Meridolum corneovirens*)

Species surveys located 5 live Cumberland Plain land snails on the subject land. An 8.4 ha species polygon has been mapped around the extent of one PCT with suitable habitat for the species. The area of habitat in hectares should be entered into the BAM-C.

4.5 Identify the biodiversity risk weighting for the species

The biodiversity risk weighting (BAM Section 5.4) is used in the Biodiversity Offsets Scheme to address uncertainty in offsetting impacts on threatened entities. It mitigates risk by increasing the quantum of credits required to offset a proposed impact to a threatened entity.

The biodiversity risk weighting is derived from a combination of 2 components:

- sensitivity to loss – based on threat status under legislation or evidence-based information that suggests the entity is at an increased risk of extinction
- sensitivity to potential gain – based on life history characteristics and ecological information for a species indicating its ability to respond to management at an offset site.

BAM Appendix I describes the criteria used to score these components and the process to calculate the biodiversity risk weighting for ecosystem and species credits. All associated data can be viewed in the TBDC.

The biodiversity risk weighting for each species credit species on the subject land should be documented in the BAR. Species and ecological communities with a ‘very high’ biodiversity risk weighting are considered at risk of a serious and irreversible impact (SAII). Entities at risk of an SAII are flagged in the BAM-C and TBDC. The additional assessment requirements for these entities are outlined in Stage 2 of the BAM and further guidance is provided in Stage 2 of this Manual.

5. Identifying prescribed additional biodiversity impacts

Prescribed additional biodiversity impacts (prescribed impacts) are the impacts identified in clause 6.1 of the BC Regulation. These can be direct or indirect impacts and are additional to the impacts of native vegetation clearing (BAM Chapter 6). In general, prescribed impacts are habitats or features of the environment that are irreplaceable. Avoiding and minimising these impacts will likely be a consideration for the decision-maker in determining conditions of consent/approval for development proposals. Stage 1 of the BAM seeks to identify if the proposal is likely to result in any prescribed impacts that must be included in the BAR.

Identification of potential prescribed impacts under BAM Chapter 6 is primarily aimed at development, activity, clearing and biodiversity certification proposals. While this assessment is generally not required for biodiversity stewardship proposals, identification of these features may assist in habitat assessment and designing the plan of management at these sites.

5.1 Requirements for the Biodiversity Assessment Report

By the end of this chapter of the Manual and BAM Chapter 6 the assessor will be able to complete the following information in the BAR (see BAM Appendix K and M for minimum requirements for Stage 1 biodiversity assessments and Appendix L for streamlined assessment modules).

Table 13 Requirements for the BAR – Identifying prescribed impacts

Information	Maps, tables and data
Identification of potential prescribed biodiversity impacts on threatened entities:	**Digital GIS files must be provided for all maps and spatial data in a format agreed to by the decision-maker.** Polygons are suitable for most spatial data requirements unless points or lines are specified. **All maps must be easy to read with clear headings, keys, colour ramps and symbols.** **Data must be provided in a format that can be analysed** (e.g. MS Excel or other downloadable format).
List of prescribed biodiversity impact features within the subject land and assessment area including: • karst, caves, crevices, cliffs, rocks and other geological features of significance • human-made structures • non-native vegetation • habitat connectivity • waterbodies, water quality and hydrological processes	**Map:** Location of prescribed impact features
List of threatened entities that may be dependent upon or may use habitat features associated with the above	

Information	Maps, tables and data
Description of the importance of habitat features to the species including, where relevant, impacts on life cycle or movement patterns	
Where the proposal may result in vehicle strike: • list of threatened fauna or protected fauna species that are part of a TEC and at risk of vehicle strike due to the proposal	**Map:** Potential vehicle strike locations on the Site Map
Where the proposed development is for a wind farm: • list of protected animals that may use the development site as a flyway or migration route • details of targeted survey for candidate species • predicted habitual flight paths for nomadic and migratory species likely to fly over the subject land	**Map:** Habitual flight paths for nomadic and migratory species likely to fly over the site and likely habitat for resident threatened aerial and raptor species

5.2 Identify prescribed impacts

An assessor should use professional judgement when identifying prescribed impacts. Habitat features and the processes needed for the feature to continue to exist should be identified.

To prepare the list of threatened entities likely to use the habitats and feature/s identified as a prescribed impact, the assessor should consider:

- the list of threatened species auto-generated by the BAM-C for the subject land
- any BioNet records within the vicinity of the subject land; here the assessor is attempting to capture those species that may have been filtered out of the auto-generated list by the BAM-C because they are not associated with PCTs on site
- information on threatened species and TECs occurrence from previous surveys, published and unpublished literature, local government data layers and other relevant sources
- information gained from field reconnaissance and site visits
- threatened species and protected fauna species that are part of a TEC and may be at risk of vehicle strike due to the proposal
- for wind farms, any protected bird and bat species resident in, or likely to fly over, the proposed development site.

Information relating to prescribed impacts should be included on the Site Map and documented in the BAR (see Table 14 below for an example). Where information on prescribed impacts is captured elsewhere in the BAR, reference can be made to these sections to minimise repetition.

Table 14 Example of identification of prescribed impacts on site

Feature	Present	Description of feature characteristics and location	Potential impact	Threatened species or community using or dependent on feature	Section of the BAR where prescribed impact is addressed
Karst, caves, crevices, cliffs, rocks or other geological features of significance	☒Yes / ☐No	Small cave in escarpment along southern edge of site. Entrance 50 cm in width	Disturbance to habitat for cave dwelling species	Southern myotis	Section X.X Stage 2 impact assessment
Karst, caves, crevices, cliffs, rocks or other geological features of significance	☒Yes / ☐No	Large outcrop with multiple boulders over 2 m in width, 500 m from escarpment	Disturbance to habitat for rock dependent species	Brush-tailed rock wallaby	Section X.X Stage 2 impact assessment
Human-made structures	☒Yes / ☐No	Small building	Demolition of roosting site for microbats	Southern myotis	Section X.X Stage 2 impact assessment
		Stormwater facility – no native vegetation present	Removal of artificial habitat	Green and golden bell frog	Section X.X Stage 2 impact assessment
Non-native vegetation	☒Yes / ☐No	Mature planted *Pinus* spp.	Removal of roosting site	Powerful owl	Section X.X Stage 2 impact assessment
Habitat connectivity	☒Yes / ☐No	Riparian corridor along creek that flows through the site and links to the assessment area	Disturbance of spring feeding creek likely to threaten riparian corridor health	Rose-crowned fruit-dove	Section X.X Stage 2 impact assessment
Waterbodies, water quality and hydrological processes	☒Yes / ☐No	Natural spring feeding creek that flows through the site	Disturbance of spring likely to affect flow of creek	None identified	Section X.X Identifying prescribed additional biodiversity impacts
Wind farm development	☐Yes / ☒No	N/A	No wind farm proposed on site	N/A	N/A
Vehicle strikes	☐Yes / ☒No	N/A	No new roads required for proposed development	N/A	N/A

5.2.1 Wind farm development

BAM Subsection 6.1.5 applies only to proposed wind farm developments.

Prescribed impacts related to wind farm developments apply not only to threatened aerial species but also to any **protected species** including resident raptor species and nomadic or migratory species whose flight paths are likely to cross over the subject land (BAM Subsection 6.1.5(1.a.–c.)). The assessor must develop a candidate list of species that are likely to use or fly over the subject land. For each candidate species, the assessor must undertake a targeted species survey that meets the requirements under BAM Subsection 6.1.5(2.).

The BAR must include the:

- list of candidate species
- methods used to develop the list of candidate species
- methods, location of detectors, effort and timing used for species surveys for each candidate species including the details required under BAM Subsection 6.1.5(2.)
- results of species surveys.

If species surveys identify nomadic or migratory species likely to fly over the subject land, assessors must map predicted flight paths on the Location and Site Maps.

If species surveys identify resident raptors or threatened aerial species, assessors must map likely habitat on the Site Map.

References

Andren H 1994, Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: A review, *Oikos*, vol.71, no.3, pp.355–366.

Department of Planning, Industry and Environment (DPIE) 2020a, *NSW Survey Guide for Threatened Frogs: A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method*, NSW Department of Planning, Industry and Environment, Sydney.

Department of Planning, Industry and Environment (DPIE) 2020b, *Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method*, NSW Department of Planning, Industry and Environment, Sydney.

Fahrig L 1997, Relative effects of habitat loss and fragmentation on population extinction, *Journal of Wildlife Management*, vol.61, no.3, pp.603–610.

Fahrig L 2001, How much habitat is enough? *Biological Conservation*, vol.100, no.1, pp.65–74.

Harden GJ 1990–2002, *Flora of New South Wales*, *Volumes 1–4*, UNSW Press, Sydney.

Office of Environment and Heritage (OEH) 2017, *Native Vegetation Integrity Benchmarks: An information sheet*, NSW Office of Environment and Heritage, Sydney.

Oliver I, McNellie MJ, Steenbeeke G, Copeland L, Porteners MF and Wall Julian 2019, Expert allocation of primary growth form to the New South Wales flora underpins the biodiversity assessment method, *Australasian Journal of Environmental Management*, vol.26, no.2, pp.124–136.

Sivertsen D 2009, *Native Vegetation Interim Type Standard*, Department of Environment, Climate Change and Water NSW, Sydney.

Appendix A – Websites and online resources referred to in this Manual

‘Expert allocation of primary growth form to the NSW flora underpins the Biodiversity Assessment Method’
www.tandfonline.com/doi/full/10.1080/14486563.2019.1595186

‘Native Vegetation Integrity and Benchmarks – An information sheet’
www.environment.nsw.gov.au/topics/animals-and-plants/native-vegetation/vegetation-condition-benchmarks

Acid sulfate soils risk
www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/acid-sulfate-soils

Application for login access to BioNet
www.environment.nsw.gov.au/atlaspublicapp/Registration.aspx

Areas of Outstanding Biodiversity Value (AOBV)
www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value

Areas of Outstanding Biodiversity Value public register
www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register

Assessor resources
www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/accredited-assessors/assessor-resources

Australian Government Species Profile and Threats Database
www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Biodiversity Assessment Method Calculator (BAM-C)
www.lmbc.nsw.gov.au/bamcalc

Biodiversity Assessment Method Calculator User Guide
www.lmbc.nsw.gov.au/bamcalc/app/assets/BAMTools_UserGuide.pdf (PDF 3MB)

Biodiversity Assessment Method
https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-assessment-method

Biodiversity Conservation Regulation 2017
www.legislation.nsw.gov.au/view/html/inforce/current/sl-2017-0432

Biodiversity experts
www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-offsets-scheme/experts

Biodiversity Offsets and Agreement Management System (BOAMS)
www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-offsets-scheme/biodiversity-offsets-and-agreement-management-system

Biodiversity Values Map and Threshold Tool
www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap

BioNet Atlas – Species sightings search
www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx

BioNet Atlas – Species sightings
www.environment.nsw.gov.au/wildlifeatlas/about.htm

BioNet guides, information sheets, manuals and datasheets
www.bionet.nsw.gov.au/bionet-guides-manuals.htm

BioNet Systematic Flora Survey data collection
www.environment.nsw.gov.au/research/VISplot.htm

BioNet Threatened Biodiversity Data Collection (TBDC)
www.environment.nsw.gov.au/asmslightprofileapp/Account/Login

BioNet Vegetation Classification user manual
www.environment.nsw.gov.au/resources/bionet/bionet-vegetation-classification-user-manual-170340.pdf (PDF 4.1MB)

BioNet Vegetation Classification
www.environment.nsw.gov.au/research/Visclassification.htm

BioNet Vegetation maps
www.environment.nsw.gov.au/research/VISmap.htm

BioNet Web Services – How to access the BioNet Web Service using Excel and Power Query: A BioNet Quick Guide
https://data.bionet.nsw.gov.au/resources/bionet/bionet-access-excel-power-query-160403.pdf (PDF 1MB)

BioNet Web Services
https://data.bionet.nsw.gov.au/

Department Public Registers
www.environment.nsw.gov.au/policy-and-law/public-registers

Department Threatened Species Survey and Assessment Guidelines
www.environment.nsw.gov.au/surveys/BiodiversitySurveyGuidelinesDraft.htm

Directory of Important Wetlands in Australia (DIWA)
www.environment.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands

EPBC Act listed threatened species and ecological communities
www.environment.gov.au/epbc/what-is-protected/threatened-species-ecological-communities

Estuaries of NSW: Physical characteristics, tidal surveys and hydrographic surveys
www.environment.nsw.gov.au/topics/water/estuaries/estuaries-of-nsw

Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013)
www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/468927/Policy-and-guidelines-for-fish-habitat.pdf (PDF 2.4MB)

Geological sites of NSW
www.geomaps.com.au/scripts/geositeslist.php

Hydrogeological landscapes
www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/salinity/salinity-locations-and-mapping

Native Vegetation Integrity Benchmarks
www.environment.nsw.gov.au/research-and-publications/publications-search/native-vegetation-integrity-benchmarks

Native Vegetation Interim Type Standard
www.environment.nsw.gov.au/resources/nativeveg/10060nvinttypestand.pdf (PDF 1.6MB)

Native Vegetation Regulatory Map
www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap

NSW (Mitchell) Landscapes – Version 3.1
https://datasets.seed.nsw.gov.au/dataset/nsw-mitchell-landscapes-version-3-1

NSW (Mitchell) Landscapes Descriptions
www.environment.nsw.gov.au/resources/conservation/LandscapesDescriptions.pdf (PDF 1.2MB)

NSW Cadastre Web Service
https://datasets.seed.nsw.gov.au/dataset/nsw-cadastre-web-service

NSW Guide to Surveying Threatened Plants
www.environment.nsw.gov.au/research-and-publications/publications-search/surveying-threatened-plants-and-their-habitats-survey-guide-for-the-biodiversity-assessment-method

NSW Interim Biogeographic Regions of Australia (IBRA region and subregions) – Version 7
http://environment.gov.au/land/nrs/science/ibra#ibra

NSW SEED data portal (Sharing and Enabling Environmental Data)
www.seed.nsw.gov.au

NSW Soil Profiles
https://datasets.seed.nsw.gov.au/dataset/nsw-soil-profiles15bf7

NSW Survey Guide for Threatened Frogs
www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-survey-guide-for-threatened-frogs

NSW Threatened Species
www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species

PlantNET NSW
http://plantnet.rbgsyd.nsw.gov.au/

SEPP 14 Coastal Wetlands
https://data.gov.au/data/dataset/d2ec27ef-026b-4cb8-ad12-bd1d638240d0

Spatial Collaboration Portal
https://portal.spatial.nsw.gov.au/portal/apps/sites/#/homepage

State Vegetation Type Map
www.environment.nsw.gov.au/vegetation/state-vegetation-type-map.htm

Threatened species profile search
www.environment.nsw.gov.au/threatenedspeciesapp

Threatened species survey and assessment guidelines: field survey methods for fauna – amphibians
www.environment.nsw.gov.au/resources/threatenedspecies/09213amphibians.pdf (PDF 177KB)

Threatened Species Test of Significance Guidelines
www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/threatened-species-test-significance-guidelines-170634.pdf (PDF 191KB)

Vegetation Condition Benchmarks
www.environment.nsw.gov.au/topics/animals-and-plants/native-vegetation/vegetation-condition-benchmarks

Appendix B – Sample field data sheet for vegetation survey

It is not mandatory to use this field data sheet, assessors may use their own.

Numbers [1–8] on this page correlate with the numbers and explanatory notes on page iii of the data sheet

Site sheet #	1 of	**Date**	/ /	**Survey name**				**Plot identifier**			
Recorders					**IBRA region**				**Veg zone ID**		
[1]**Datum**		**Coordinate system**	□ Projected □ Geographic	**MGA zone**		[1]**X coordinate**		[1]**Y coordinate**			
Location description	descriptive notes to locate site without grid reference										
[1] **Plot dimensions**	For composition & structure (400 m²): 20 m x 20 m For function (1,000 m²): 20 m x 50 m					[1] **Orientation of midline from 0 m point**		Magnetic °	**Photo #**		

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1,000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50–79 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30–49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥30 cm, count
	Forbs (FG)			Forbs (FG)		20–29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥20 cm, count
	Ferns (EG)			Ferns (EG)		10–19 cm	Count (best practice)/tick
	Other (OG)			Other (OG)		5–9 cm	Count (best practice)/tick
						[4]Tree regeneration <5 cm	Tick
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space / Total m
						[6] Hollow bearing trees	Tick

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					**Bare ground cover (%)**					**Cryptogam cover (%)**					**Rock cover (%)**				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date _ _ / _ _ / _ _			

GF code	**Species name** Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33				
	34				
	35				

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed. **Voucher:** specimens collected for identification by a herbarium.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1,000, 2,000, 3,000 … (as integer values).

Explanatory notes to support the BAM sample field data sheet for vegetation survey

Print and laminate one copy of this page and carry it with you in the field for cross-referencing. Please do not provide a copy of this page with each field sheet submitted with a Biodiversity Assessment Report.

The number for each point below correlates with the reference numbers on the survey form.

1. Record X/Y coordinates (latitude/longitude or easting/northing) at the 0 m point on the 50 m midline and take the magnetic bearing along the midline. If applicable, such as for a permanent plot in a stewardship site, orient a star picket so that the perforated rib points along the direction of the midline. Identify dimensions (i.e. shape, e.g. 20 x 20 m) of 400 m^2 plot inside 1,000 m^2 plot. If the vegetation zone is smaller than the standard plot size dimensions allow, the assessor may adjust the plot dimensions to fit as best as possible, providing it is representative of the vegetation zone. Complete the floristics plot (400 m^2) on page 2 then the vegetation integrity (condition) plots (400 m^2 and 1,000 m^2) on page 1, or concurrently if 2 operators are assessing a plot. Some information on page 1 relies on data from the floristic survey. Refer to BAM 2020 4.2.1 (floristic plot) and 4.3.4 (vegetation integrity plot) for more details.

2. **Foliage cover** is the percentage of the plot covered by a vertical projection of all attached plant material, regardless of whether it appears alive or dead, of all individuals of a species. This includes leaves, stems, twigs, branchlets and branches, from forb, grass and grass-like species, and any canopy overhanging the plot, even if the stem is outside the plot. Refer to BAM 2020 4.2.1 and 4.3.4(18.–21.) for more details.

3. **Tree stem size class**: Identify the presence (with a tick) of living stems in each size class that is ≥5 cm DBH and less than the large tree benchmark size for that PCT. If you choose to count/estimate the number of stems within each size class, only the largest living stem of a multi-stemmed tree is included. Counting is optional but preferable unless data are to be used as more appropriate local data, i.e. to generate local benchmarks, in which case it is mandatory. Counts hold potential value for future vegetation integrity assessment attributes and benchmarks; for enhancing PCT description; and for monitoring the site condition over time for stewardship sites.

4. **Tree regeneration**: Record presence (tick) of living stems from the tree growth form group that are naturally regenerating are <5 cm diameter, regardless of height. Diversity is not recorded – it is simply a record of presence of natural regeneration.

5. Length of fallen logs: woody material ≥10 cm diameter and >50 cm in length, dead, entirely/partly on the ground within the plot, native and exotic combined.

6. Hollow bearing trees: Include plants rooted within the plot, including living and dead native species, allocated to both the tree and shrub growth form groups that contain at least one hollow. Include the presence of a stem containing hollows, not the count of hollows in that stem. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the entrance is at least 5 cm wide; (c) the hollow appears to have depth (i.e. solid wood cannot be seen beyond the entrance); and (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles (BAM 4.3.4(8.–12.)).

7. **Litter cover** is assessed as the average percentage ground cover of litter recorded from five 1 m^2 plots, located on alternate sides and 5 m from the plot midline at the locations, 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter), native and exotic species combined, that is detached from a plant and in contact with the ground surface, including litter under canopies of erect plants. Refer to BAM 2020 4.3.4(30.–31.). Within these 1 m^2 plots, assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional – the data do not currently contribute to assessment scores. They hold potential value for future vegetation integrity assessment attributes and benchmarks; for enhancing PCT description; and for monitoring the site condition over time for stewardship sites.

8. Large trees: Count all living native stems with a DBH equal to or greater than the large tree benchmark DBH (20, 30, 50 or 80 cm) for that PCT or vegetation class. For a multi-stemmed tree, at least one living stem must be equal to or greater than the large tree benchmark DBH. Refer to BAM 2020 4.3.4(25.). Only the largest living stem is included in the count (BAM 2020 4.3.4(24.).). Large tree benchmark sizes are published in the BioNet Vegetation Classification database with benchmark data.

Appendix C – Assessing habitat suitability for threatened species