Fauna Technical Note No. 2:

Assessing mature habitat availability

FPA
FOREST PRACTICES AUTHORITY

The Fauna Technical Note Series provides information for Forest Practices Officers on fauna management in production forests. These technical notes are advisory guidelines and should be read in conjunction with the requirements of the Forest Practices Code. The current technical note provides background information for practitioners using the mature habitat availability map and provides guidance on how to assess mature habitat.

The technical notes can be accessed on the Forest Practices Authority's website: www.fpa.tas.gov.au

1. Introduction

Forests are classified as mature when they are about 100 years old and begin to develop structural features typically found in older forests. These structural features can provide important habitat for a range of species, and thus mature forests need to be managed in the landscape in order to maintain biodiversity. Features important for biodiversity that are found in mature forest include large spreading crowns, tree hollows and coarse woody debris.

Strategic management of the mature forest habitat is required, particularly in production forest areas, but effective management is hampered by a lack of information on current distribution (Lindenmayer & Franklin 2002; Munks *et al.* 2009). Information on forest structure, as obtained from aerial photographs (Appendix 1), can be used to explain a significant proportion of the variability in hollow-bearing tree density (Koch & Baker 2011). Photo-interpreted data (PI-data) of mature eucalypt tree density explained half of the variability in hollow-bearing tree availability in wet forest (when two outlying sites were removed due to unusual crown structure). A similar amount of variability in hollow availability was explained in dry forest, except that approximately 8.5% was explained by stand senescence (Koch and Baker 2011). Mature hollow-bearing trees are expected to have larger crowns and contribute to the availability of coarse woody debris (rotting logs). Therefore information on mature tree density and senescence can be used to produce a mapping layer to assist conservation planning across all land tenures.

Spatial information has varying levels of accuracy, so it can be important to have on-ground methods to assess the values that spatial layers are trying to reflect. This technical note outlines the data underlying the construction of a spatial layer reflecting mature habitat availability, outlines the limitation of using this layer, and provides guidance on how to conduct on-ground surveys of mature habitat availability for finer scale and more accurate assessments.

2. Strategic planning: the mature habitat availability map

2.1 Background information and map construction

In the swift parrot interim habitat planning guideline (Fauna Strategic Planning Group 2009), the mature eucalypt crown density component of PI-type data (Appendix 1, Stone 1998), senescence codes (CoASoT 1996) and TASVEG 2.0 data were used to differentiate potential hollow availability classes. The allocation of mature eucalypt crown density categories to the different potential hollow availability classes was decided by hollow experts after informal field assessments and a round-table discussion with members of the Fauna Strategic Planning Group. These classes were used as the initial basis of the mature habitat availability map. A number of additional steps have since been added to improve the accuracy of the map (particularly on private land) and create the most recent version of the mature habitat availability map (MHA map), as outlined below.

1. **Identify areas to which the map applies: areas dominated by eucalypts prior to European colonisation**

- Eucalypts are the most prevalent family of native tree found in Tasmania, are particularly prone to forming hollows and provide important habitat for a range of species (Gibbons & Lindenmayer 2002). Therefore mapping mature forest habitat has focused only on forest types that include a eucalypt component. This was done using the statewide vegetation mapping layer TASVEG 3.0 (DPIPWE 2009) and classifying all native vegetation types that do not have a major eucalypt component as 'not applicable' (i.e. TASVEG categories: rainforest and related scrub, non-eucalypt forest and woodland, scrub, heathland and coastal complexes, highland treeless vegetation, saltmarsh and wetland, moorland sedgeland, rushland and peatland, native grassland, other environments, see Appendix 2).
- Areas on public land indicated to have a mature eucalypt component <20% but mapped as 'rainforest' in the PI-type data were also classified as 'not applicable'.
- For areas where the vegetation type has changed since European colonisation (TASVEG 3.0 category: agricultural, urban and exotic vegetation), the federal NVIS pre1750 mapping layer (DSEWPC 2012) was used to identify areas expected to historically have contained vegetation not dominated by eucalypts (and therefore classified as 'not applicable'). This historic mapping layer will have considerable inaccuracies but no other mapping layer was available that delineated vegetation types prior to European colonisation.

2. Use spatial data on mature crown density and senescence to make the initial assessment of mature habitat availability

The availability of hollow-bearing trees in wet and dry eucalypt forest in Tasmania has been related to mature eucalypt crown density and senescence (Koch and Baker 2011). Both these layers are derived from photo-interpreted data, which is when aerial photographs are examined stereoscopically in order to get a three-dimensional view of the forest canopy. Natural features or obvious changes in forest structure are used to manually delineate polygons down to 3 ha in size which are then assessed for various attributes (Stone 1998). Mature crowns are generally larger, more irregular in shape and lacking a conical form compared to regrowth crowns which are discrete, circular, and slightly conical. The statewide spatial layer of mature crown density was originally developed in the 1970s and 1980s and has been gradually updated on public land available for timber harvesting (Stone 1998), with updates focusing on areas that have been harvested. Updates on private land are less frequent and more *ad hoc*. The senescence layer assesses the presence of senescent trees, which were defined as eucalypts with shrinking crowns, bayonet branches (branches sticking out of the canopy), dead branches and missing branches (Commonwealth of Australia and State of Tasmania 1996). The senescence layer was produced in 1996 for areas of the State thought to potentially meet the federal definition for 'old growth' and has not been updated.

- The data on mature crown density and senescence were used to classify areas as high, medium, low or negligible mature habitat availability as outlined in Table 1.

Table 1. First two steps for constructing the mature habitat availability map, including identifying the relevant areas (covered by eucalypts prior to European colonisation) and an initial assessment of mature habitat availability in the remaining area.

Mature habitat availability class	Mature eucalypt crown cover	Senescence
High	>40%	Unknown or >nil
Medium	20-40%	Unknown or >nil
Low	1-20%	All categories
	OR >20%	Nil
Negligible	0%	All categories
Not Applicable	Areas that currently are or historically were (according to the NIVS layer) comprised of native vegetation types without a substantial eucalypt component.	All categories

3. Update mature habitat availability map to account for recent disturbance

Due to issues with the currency of the photo-interpreted data, particularly on private land, it is important to update areas where we know there has been or will be disturbance and mature habitat

has or will be 'lost'. Four main data sources are available for assessing disturbance and therefore potential loss of mature habitat; a local database of harvesting plans (FPP database), spatial layer on forest structure held by the forest industry (PI data), the Global Forest Change layer (Hansen *et al.* 2013) and a spatial layer on the extent of fires (DPIPWE 2014).

- The FPP database was established in 2000 by the regulator of forestry activities and provides approximate central coordinates, the type of silviculture used and the expected size of the harvested area for most planned forest operations since 2000. It includes activities such as road and quarry construction if they are associated with the timber industry, but does not include land clearance for other reasons like urban expansion or fire boundary construction.
- An overview of PI data production is provided above. These data include a number of structural attributes (Appendix 1). Some attributes are updated more regularly and rapidly after disturbance than others.
- The Global Forest Change (GFC) layer is produced by the University of Maryland and uses time-series analysis of Landsat images to characterise global forest extent and change from 2000 to 2013 over 30m cells (Hansen *et al.* 2013). The layer comprises two components, loss and gain. To assess the accuracy of the layer for updating the MHA map we took a random sample of forest harvesting plans that reflect the range of different types of operations, and examined both Google Earth imagery and the GFC layer to determine if the operation had gone ahead and, if so, whether the GFC layer captured it. The results of this process should be interpreted with caution as we only had the central coordinates and not the boundary of the operations we were assessing, and for less intensive types of silviculture we could not always be certain if the operation had actually gone ahead or not. However, we concluded that the layer was very likely to capture the more intensive types of silviculture that resulted in greater loss of trees, and captured some but not all of the operations that were less intensive. Note: we considered both loss and gain in the GFC layers because gain seemed to be associated with historic forest loss and thereby extended the period for which we could assess forest loss.
- Not all areas mapped as loss or gain in the GFC layer are associated with a known harvest operation. The majority of the 'non-harvesting loss' seems to be associated with fire. The Fire layer reflects all known fires from 1969 onwards, providing a known or approximate date for each fire. No information is available on fire intensity.

Some polygons of loss and gain in the GFC layer are not associated with recorded timber harvesting or fire. Only a small number of areas were examined but many of these were associated with forest loss outside of the timber industry (e.g. urban development). Under these circumstances forest loss did not necessarily occur over the entire pixel in the GFC layer and in some circumstances Google Earth imagery did not indicate any forest loss that we could detect.

Although there are some issues with accuracy in these spatial layers, overall we concluded that they were sufficiently accurate to adjust the base MHA map for more recent disturbance, as per the process outlined in Table 2.

Table 2. Process for updating the mature habitat availability map to account for recent disturbance. GFC indicates the Global Forest Change layer which uses satellite imagery to indicate forest loss or gain at 30m cell sizes. The FPP database is a database of timber harvesting plans, which was established in 2000. PI data is spatial information on forest structure derived and maintained by the forest industry. The Fire layer is maintained by the Tasmanian fire service and reflects fires from 1969 onward.

Layers used	Process	Intent
PI data	Areas PI typed to have had historical thinning but classified as high or medium MHA were converted to low.	The intent of this step is to capture updates in the harvesting information that may not have been translated throughout the PI-type data. Google Earth was used to examine some areas with historical thinning. The imagery suggests that in these areas mature habitat availability is likely to be low and the historical thinning may not have been reflected throughout the PI-type information. A thinning operation indicates there is likely to be some loss of mature habitat, but it is uncertain how much, so these areas were only changed to low if they were mapped as high or medium MHA.
PI data	On public land, areas where PI data (variable DISMETR) indicates recent disturbance but also mature crowns, areas of high, medium or low MHA were converted to low	The PI type variable DISMETR variable can indicate if there was recent disturbance, information which is not always updated in the mature crown density information. This step attempts to impose this update where appropriate.
FPP database and GFC layer	Around the central coordinates of all harvest plans in the database, create a circular polygon proportional to the size of the operation. Any areas of loss or gain in the GFC layer that overlap with these circular polygons and are MHA high, medium or low are converted to 'negligible'.	Most types of silviculture remove the hollow-bearing trees, if not in the first harvest then in the second. This process is trying to identify the areas of loss due to harvesting. Areas of gain in the GFC layer are typically preceded by a period of loss, so areas mapped as gain are also considered.
FPP database and GFC layer	If the centre point of the FPP falls on medium or high MHA and does not lie within an area of loss or gain in the GFC layer, then convert the circular polygon to low for most operations, or negligible if the dominant silviculture type is clearfall, advanced growth retention, overstorey removal or potential sawlog retention. Repeat the process for private land but apply the circular buffer if the central point falls on an area of low MHA.	This step is trying to capture harvest operations that are planned but not yet implemented, or recent harvesting that has not yet been captured by other spatial information. If these units were located in an area of low or negligible mature habitat availability on public land, or negligible mature habitat availability on private land, it was assumed that details of the harvested area have been incorporated into the mapping layers. The areas are converted to low not negligible for lower intensity silviculture due to uncertainty in the level of retention of mature trees or the final harvest area. Circular areas were used as an approximation of coupe location because the Forest Practices Authority does not have access to spatial data on the boundaries of harvested areas. A greater level of modification is used on private land because spatial data on private land is updated much less often and consistently than data for public land.

Layers used	Process	Intent
Fire and GFC layers	Where there is a fire indicated by the Tasfire layer for 1995 onwards, and loss or gain is indicated by the GFC layer, any areas of high or medium MHA are converted to 'low'.	Fires can affect the availability of mature trees and hollows, but the degree to which this occurs depends on fire intensity. Burnt areas appear to be reflected very patchily (ie scattered pixels of loss) in the GFC layer. Converting just those scattered pixels of loss/gain to 'low' will result in some decrease in mature habitat availability from fire, but only in isolated areas where the fire is expected to have been most intense. Only fires from 1995 onward were considered to approximately correspond to the time frame captured by the GFC layer.
GFC layer	Any areas of high or medium MHA that are GFC loss or gain more than 3 pixels in size, and also outside of the FPP buffered area and the Fire layer, are changed to 'low' MHA. Diagonally adjacent pixels were not considered to be in the same 'cluster'.	From a cursory examination of the GFC layer, most but not all of the areas of loss/gain in the GFC layer relate to forest loss. Furthermore a pixel of loss may not indicate that the entire area it covers was affected. Therefore a minimum of three pixels was used as this larger area is assumed to be more likely to reflect some loss. Areas are only changed to 'low' in case the forest loss did not cover the entire area reflected by the GFC layer.

2.2 Updates

Attempts will be made to create a 'live' version of the MHA map which will use updated spatial information as soon as it becomes available. However, while this process is being established the following measures will be taken to keep the map updated.

On public land, the mature habitat availability map will be updated annually using updated information on the location and extent of mature forest, and the location of certified FPPs. FPPs need to be taken into account because there can be a time lag between FPP certification and completion of the operation and updating of mapping layers. The process used on public land (outlined in detail above) involves applying a circular buffer around certified FPPs located in high or medium mature habitat availability. The process of updating the map using FPP data will be repeated annually for all FPPs from 2000 onwards. The reason for repeating the process for all FPPs (and not just the most recent ones) is that updates in the mapping layers may provide more accurate information on coupe boundaries than the crude estimations made using the process outlined above.

Areas of private land will be updated when information is available, which is expected to primarily be from the forest groups layer on an annual basis. However, native forest harvesting is rarely used to update mapping layers on private land. Therefore around the central coordinates of all certified FPPs located in areas of high, medium or low mature habitat availability, a circular buffer (equal in area to the specified harvesting area stated on the FPP) will be converted to low mature habitat availability. The reason that certified FPPs located in areas of low mature habitat availability are used in private land but not public land is because of the general lack of updating mapping layers for private land.

In addition to the annual updates outlined above, the mature habitat availability map will have further monthly updates on both public and private land. This will involve applying the circular buffer method, as outlined above, to all FPPs certified in that month.

A review of the MHA map will also occur opportunistically if an updated version of any of the other layers is released (e.g. GFC, TASVEG).

In addition to the updates listed above, the FPA can be notified if people using the map identify areas that are incorrectly mapped. If documentation demonstrating why the area is not mapped correctly and a shapefile of the area is provided, then the FPA can update the map accordingly.

2.3. Limitations and areas of concern

There are a number of limitations and inaccuracies associated with this map that need to be taken into account when using this map for decision-making. Some of the main limitations are listed below.

- Using remotely-sensed data to predict features at the tree-level will obviously provide a result with varying levels of accuracy. However, research on this method has shown that areas predicted to have high mature habitat availability are more likely to contain hollow-bearing trees than areas predicted to have low mature habitat availability (Koch and Baker, 2011). This does not mean that area classified as high mature habitat availability will always contain quality hollows useful for fauna, or that areas with low mature habitat availability are always hollow-poor.
- When aerial photographs are PI-typed, assessments are generally done for areas of forest at least 3ha in size (and often substantially larger), so the map is not designed to be accurate at small spatial scales (e.g within a coupe).
- The data for private land has not been systematically updated since its creation in the 1980s and is out of date. This means that some areas on private land that were harvested after the creation of the layer, either by clearfall or partial harvest methods, may still be classified as either medium or high mature habitat availability. We have used available information to minimise areas where this occurred. Inaccuracies associated with these corrections are that the area harvested is often less than the area planned for harvest, that variability in the amount of maturity retained will not be captured, and the exact location of the harvested area is unknown. Some of the areas harvested between the time when the photos were taken and 2000 could not be taken into account due to limitations in data availability, so substantial errors in mapping accuracy may occur.
- FPPs used for updating the mature habitat availability map that were entered into the database prior to the coverpage system (mid 2008) do not have the coordinates validated at all and those in the coverpage system are only validated to the map sheet selected. A significant number of older FPPs have centre coordinates which have been taken off physical map sheets and have only been estimated to the nearest 100m or 1km in some cases. A number of FPPs are likely to have incorrect coordinates entered into the database through human error. Furthermore some FPPs that were certified prior to 2008 may have been in AGD 66 coordinates rather than GDA 94, but information on mapping units is unavailable so we assume GDA 94 was used for all FPPs. Consequently, the circular buffer applied to certified FPPs may not always be located in the exact area where harvesting occurred.
- Some areas will have aged and developed mature features such as hollows since the PI-type information was gathered and so the map may under-predict mature habitat availability in some areas.
- Some areas classified as negligible mature habitat availability will actually contain trees with mature features such as hollows (e.g. paddock trees).
- The federal mapping layer ‘Estimated Pre1750 Major Vegetation Subgroups – NVIS Version 4.1’ (2012) was used to identify areas of modified land that were expected to contain non-eucalypt-dominated vegetation types prior to 1750. There will obviously be considerable errors associated with this map, but to our knowledge it is the only map that defines the boundaries of different vegetation communities expected to occur prior to 1750.
- The comparatively fine resolution of the GFC layer compared the other spatial layers means that the MHA map will have some areas that contain a scattering of small polygons of ‘high or medium’ adjacent to ‘negligible’. Ideally a ‘smoothing’ process would be applied to classify larger land areas as ‘low’ MHA instead of scattered small polygons of high/medium and negligible so the spatial resolution of the map is more consistent. At this stage this smoothing process has not been applied due to processing limitations.

2.4. Using the mature habitat availability map

The mature habitat availability map may be useful for planning mature habitat management at the landscape-scale, but potentially also as an initial assessment of the coupe-scale. At the landscape-scale it may be useful in estimating the extent and spatial arrangement of mature habitat in a forest block or within the surrounding area. At the coupe-scale it may be useful to estimate how much of the area around the coupe and within the coupe is expected to contain suitable mature habitat. However

the map is not intended to be accurate at the coupe-scale and so on-ground assessments of mature habitat within a coupe are recommended (see below).

The mature habitat context of an area can be calculated using the habitat context assessment tool, available on the FPA website (http://www.fpa.tas.gov.au/fpa_services/planning_assistance/advisory_planning_tools/habitat_context_assessment_tool). To use the tool forest planners simply enter the central coordinates of the planned forestry operation (in GDA 94), and the radius around this point that they are interested in (in kilometres). The tool then calculates how much of the specified area potentially supports mature habitat (high or medium mature habitat availability on the mature habitat availability map). The tool also calculates the proportion of the corrected area that is comprised of high or medium mature habitat availability. This corrected area excludes areas classified as 'not applicable' (non-forest and forest without a major eucalypt component, see Appendix 2).

The mature habitat availability map has been designed to help forest planners plan for the management of mature habitat and fauna dependent on mature habitat features (e.g. hollows) taking landscape-scale availability of mature habitat into account. The output from the on-line habitat context tool is:

- the version of the mature habitat availability map that was used,
- the central co-ordinates used (in GDA 94),
- the radius around the central co-ordinates that was assessed (km),
- the area estimated to contain high or medium mature habitat availability (ha),
- the percentage of the corrected area estimated to contain high or medium mature habitat.

As the mature habitat availability map is subject to a number of limitations and inaccuracies, ground-truthing is recommended wherever possible. This is particularly important in areas classified as low MHA.

3. On-ground assessments of mature habitat availability

Table 3 outlines the field-based definitions for the mature habitat availability classes. The classifications differ between wet and dry forest due to the difference in growth rates between these forest types. The likelihood of a tree containing the mature forest features likely to be targeted for management (e.g. hollows) increases with tree age and diameter. The habitat assessment definitions in Table 3 are based on tree diameter to maximise efficiency and facilitate auditing. However it is understood that in some instances tree diameter may not reflect habitat value. For example, some regrowth trees in wet forest can be over 100 cm dbh and some trees smaller than 70cm dbh in dry forest can contain hollows used by fauna. Under these circumstances evidence can be provided to the FPA (e.g. photographs as part of the biodiversity evaluation) to verify which habitat category the forest should be classified as.

With regards to tree hollows in particular, trees most likely to provide nest hollows are old, large in diameter, senescent (i.e. contain lots of or large dead branches) and have major forking in the crown. The FPA booklet 'Tree hollows in Tasmania' is available on the FPA website and provides further guidance in identifying potential hollow-bearing trees.

Assessments of mature habitat availability, or hollow-bearing tree availability, should be conducted at approximately a 1 ha scale. It is expected that these assessments be conducted during normal coupe assessments. For planners who would like a more formal assessment process, line transects can be conducted using the survey form provided in appendix 3 of this technical note. As with any habitat mapping it is understood that it can be difficult to ensure every hectare of the map is accurately assessed, but planners need to be confident with the standard they have achieved.

Table 3. Mature habitat availability categories as determined from ground-based assessment

Mature habitat availability class	Field-based assessment criteria [a]	
	Dry forest	Wet forest
High	At least 8 trees/ha are over 100 cm dbh	At least 15 trees/ha are over 100 cm dbh or 8 trees /ha over 150 cm dbh

Medium	At least 8 trees/ha are greater than 70 cm dbh	At least 8 trees/ha are greater than 100 cm dbh
Low	Trees over 70 cm dbh are present, but comprise less than 8 trees/ha	Trees over 100 cm dbh are present, but comprise less than 8 trees/ha
Negligible	There are no eucalypt trees over 70cm dbh	There are no eucalypt trees over 100 cm dbh

[a] *A size limit is used to facilitate rapid assessments of mature trees. However, it is acknowledged that in some areas regrowth trees can be ≥100 cm in diameter and some areas smaller trees can provide mature forest features such as hollows. In circumstances where the definitions provided do not meet the intent of the mature habitat availability map, documentation and explanation can be provided with the biodiversity evaluation when management of mature forest habitat is required.*

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Appendix 1. Summary of relevant PI-data derivation

Below is some information on PI-type mapping techniques and classifications used in Tasmania. PI-typing is primarily conducted by Forestry Tasmania, and the information provided here is only intended to provide readers with sufficient understanding to allow interpretation of the limitations of the mature habitat availability map. For more detailed information refer to Stone (1998).

Photo-interpretation mapping (PI-type mapping) is when high resolution aerial photographs are examined stereoscopically, providing a three-dimensional view of the forest canopy. Areas of forest are divided into polygons, primarily based on natural features or obvious changes in forest structure. Polygons are generally at least three hectares in size. Each polygon is assessed for a number of attributes, including the presence and density of mature crowns.

Maturity

Trees with discrete, circular, slightly conical crowns are defined as regrowth crowns. The rest are considered mature and are generally larger, more irregular in shape and lacking a conical form. The density of mature eucalypt crown cover is classified into one of six categories.

Process and availability

PI-type mapping in Tasmania was done by experienced photo-interpreters, primarily at Forestry Tasmania. The process is extremely costly and time consuming, so areas were re-examined only infrequently and are unlikely to have extensive review in the future. However, PI-type layers can be updated as other information becomes available, for example if harvesting or clearing is known to have occurred. Aerial photographs used in current mapping on public land range from the mid 1980s until 2015. The majority of PTPZ land is mapped from photographs taken in the last two decades. Areas of private land were photo-interpreted when managed by Forestry Tasmania, and so are primarily derived from photographs taken in the late seventies and early eighties.

Senescence mapping

Senescence mapping in Tasmania was undertaken as part of the 1996 Regional Forest Agreement process, for the purpose of mapping RFA defined old-growth (CoASoT 1996). Senescent trees were defined as eucalypts with shrinking crowns, bayonet branches (branches sticking out of the canopy), dead branches and missing branches. Using the 1996 PI-type base layer, areas that potentially contained oldgrowth forest (JANIS 1997) were assessed for the proportion of the mature crowns that were senescent, categorised into four classes. It should therefore be noted that senescence mapping is not an indication of the *abundance* of senescent trees, but rather the *proportion* of mature trees that are senescent. Senescence mapping has not been repeated since the 1996 RFA process.

DISMETR

DISMETR data provides information on harvest operations and is more up-to-date than data on mature crown density. Therefore DISMETR should override other data categories.

Appendix 2. Areas classified in the mature habitat availability map as 'negligible' or 'not applicable'

TASVEG and PI-type data were used to determine whether an area was classified as having negligible mature habitat availability, or was of a vegetation type that was not dominated by eucalypts prior to European colonisation (i.e. areas classified as 'not applicable'). TASVEG categories assumed to have negligible mature habitat availability are outlined in Box 1. Some of these areas can contain mature forest features (e.g. rainforest), but eucalypts are more prone to forming features such as hollows and so mapping of mature habitat focuses on eucalypt forests. In some cases TASVEG data can be inaccurate, so areas PI-typed as having >20% mature crown cover (i.e. a, b and c density) were included in the mature habitat mapping regardless of the TASVEG category.

Areas PI-typed as non-forest (Forest Groups layer), unstocked forest and plantation were assumed to have negligible mature habitat availability.

Box 1: TASVEG categories classified as 'negligible' or 'not applicable' mature habitat availability

NEGLIGIBLE	**NOT APPLICABLE**
Agricultural, urban and exotic*	**Moorland, sedgeland, rushland and peatland**
Agricultural land (FAG)	*Alkaline pans (MAP)*
Extra-urban miscellaneous (FUM)	*Buttongrass moorland (undifferentiated) (MBU)*
Marram grassland (FMG)	*Buttongrass moorland with emergent shrubs (MBS)*
Permanent easements (FPE)	*Eastern buttongrass moorland (MBE)*
Plantations for silviculture (FPL)	*Highland grassy sedgeland (MGH)*
Pteridium esculentum *fernland (FPF)*	*Pure buttongrass moorland (MBP)*
Regenerating cleared land (FRG)	*Restionaceae rushland (MRR)*
Spartina *marshland (FSM)*	*Sparse buttongrass moorland on slopes (MBR)*
Unverified plantation for silviculture (FPU)	*Sphagnum peatland (MSP)*
Urban areas (FUR)	*Subalpine* Diplarrena latifolia *rushland (MDS)*
Weed infestation (FWU)	*Western buttongrass moorland (MBW)*
	Western lowland sedgeland (MSW)
Non-eucalypt forest and woodland**	
Acacia dealbata *forest*	
Lowland grassland complex (GCL)	**Rainforest and related scrub**
	Athrotaxis cupressoides - Nothofagus gunnii *short rainforest (RPF)*
NOT APPLICABLE	Athrotaxis cupressoides *open woodland (RPW)*
Highland treeless vegetation	Athrotaxis cupressoides *rainforest (RPP)*
Alpine coniferous heathland (HCH)	Athrotaxis selaginoides - Nothofagus gunnii *short rainforest (RKF)*
Cushion moorland (HCM)	Athrotaxis selaginoides *rainforest (RKP)*
Eastern alpine heathland (HHE)	Athrotaxis selaginoides *subalpine scrub (RKS)*
Eastern alpine sedgeland (HSE)	*Coastal rainforest (RCO)*
Eastern alpine vegetation (undifferentiated) (HUE)	*Highland low rainforest and scrub (RSH)*
Western alpine heathland (HHW)	*Highland rainforest scrub with dead* Athrotaxis selaginoides *(RKX)*
Western alpine sedgeland/herbland (HSW)	Lagarostrobos franklinii *rainforest and scrub (RHP)*
Saltmarsh and wetland	Nothofagus – Atherosperma *rainforest (RMT)*
Freshwater aquatic herbland (AHF)	Nothofagus - Leptospermum *short rainforest (RML)*
Freshwater aquatic sedgeland and rushland (ASF)	Nothofagus – Phyllocladus *short rainforest (RML)*
Lacustrine *herbland (AHL)*	Nothofagus gunnii *rainforest and scrub (RFS)*
Saline aquatic herbland (AHS)	Nothofagus *rainforest undifferentiated (RMU)*
Saline sedgeland/rushland (ARS)	*Rainforest fernland (RFE)*
Saltmarsh (undifferentiated) (AUS)	
Succulent saline herbland (ASS)	
Wetland (undifferentiated) (AWU)	
Scrub, heathland and coastal complexes	**Non-eucalypt forest and woodland****

Acacia longifolia *coastal scrub (SAC)* Banksia marginata *wet scrub (SBM)* *Broad-leaf scrub (SBR)* *Coastal heathland (SCH)* *Coastal scrub (SSC)* *Coastal scrub on alkaline sands (SCA)* *Eastern riparian scrub (SRE)* *Eastern scrub on dolerite (SED)* *Heathland on calcareous substrates (SCL)* Kunzea ambigua *regrowth scrub (SKA)* *Leptospermum glaucescens heathland and scrub (SLG)* *Leptospermum lanigerum scrub (SLL)* *Leptospermum scoparium heathland and scrub (SLS)* *Leoptospermum scrub (deprecated) (SLW)* *Leptospermum with rainforest scrub (SRF)* Melaleuca pustulata *scrub (SMP)* Melaleuca squamea *heathland (SMM)* Melaleuca squarrosa *scrub (SMR)* *Rookery halophytic herbland (SRH)* *Scrub complex on King Island (SSK)* *Spray zone coastal complex (SSZ)* *Subalpine heathland (SHS)* *Western regrowth complex (SWR)* *Western subalpine scrub (SSW)* *Western wet scrub (SWW)* *Wet heathland (SHW)*	Acacia melanoxylon *forest on rises (NAR)* Acacia melanoxylon *swamp forest (NAF)* Allocasuarina littoralis *forest (NAL)* Allocasuarina verticillata *forest (NAV)* Banksia serrata *woodland (NBS)* Bursaria - Acacia *woodland and scrub (NBA)* Callitris rhomboidea *forest (NCR)* Leptospermum *forest (NLE)* Leptospermum lanigerum - Melaleuca squarrosa *swamp forest (NLM)* Leptospermum scoparium - Acacia mucronata *forest (NLA)* Melaleuca ericifolia *swamp forest (NME)* *Subalpine* Leptospermum nitidum *woodland (NLN)* **Native grassland** *Coastal grass and herbfield (GHC)* *Highland* Poa *grassland (GPH)* *Lowland grassy sedgeland (GSL)* *Lowland* Poa labillardierei *grassland (GPL)* *Lowland* Themeda triandra *grassland (GTL)* *Rockplate grassland (GRP)* **Other natural environments** *Lichen lithosere (ORO)* *Sand, mud (OSM)* *Water, sea (OAQ)*

** All vegetation categories in Box 1 are classified as 'non-eucalypt area for the mature habitat availability calculation (Section 5), with the exception of the 'cleared land' vegetation types which are considered separately.*

***Note:* Acacia dealbata *forest and Lowland grassland complex are classified as 'negligible' mature habitat rather than 'not applicable'.* Acacia dealbata *forest can develop after disturbance to an area of eucalypt forest, and areas subject to historic clearing are often classified as lowland grassland complex*

Appendix 3. Mature Habitat Survey Assessment Sheet

This sheet can be used when surveying an area for mature habitat, but use of this assessment sheet is optional. As an approximate guide, this sheet should be filled in for every PI type within the proposed operation and at least once for every 10 ha area.

Instructions for use:

- Establish or walk a transect. Use a hip-chain or GPS to estimate the length of the transect, and enter at (A) below.
- While walking the transect, scan the trees on either side and enter in the table below (section 2) the number of high, medium or low quality habitat trees observed.
- At the end of the transect estimate approximately how far from the transect line habitat trees could be assessed on average, enter at (B) below.
- Complete the rest of the form.

Coupe Name: …… Date of Survey: …… Surveyor: ……

PI-type: …… Survey No. …… of ……

GPS coordinates at start of survey: ……Easting ……..Northing

GPS coordinates at end of survey: ……Easting ……..Northing

Section One: Survey Area

(This section will establish the size of the plot used to assess mature habitat availability. At least half a hectare should be examined whenever practicable).

Transect length:_____ m (A)

Estimated average observation distance from transect: _____ m (B)

Total transect area (A × B × 2 / 10,000) _____ ha (C)

Section Two: Mature Habitat Survey

(This section is to be filled out during the nesting habitat survey. A tally should be kept of every potential habitat tree detected and the quality of the habitat tree should be classified according to estimated tree diameter as indicated below).

Tally of mature habitat trees		
High quality	Medium quality	Low quality
>100cm dbh dry forest, >150cm wet forest	70-100cm dbh dry forest, 100-150 cm wet forest	<70 cm dbh dry forest, <100 cm wet forest
Total: (D)	Total: (E)	Total: (F)
Density: (D / C)	Density: (E / C)	Density: (F / C)

Mature habitat category = _____

(The highest Density category that meets the definition outlined in Table 2 of the current technical note is the mature habitat category for this survey area).

Document Summary Information

Document name	**Fauna Technical Note No. 2: Mature habitat availability map**
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Owner	Biodiversity Section Staff
Author(s)	Amy Koch
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Version Control

Version	Date	Author(s)	Summary of changes
1	September 2011	Amy Koch	
1.1	January 2012	Amy Koch	Greater detail is provided on how PI-type and TASVEG vegetation categories are classified on the Mature Habitat Availability Map, and rainforest is now included as non-eucalypt forest. The name of the document has been adjusted.
1.2	March 2012	Amy Koch	Remove most references to PI-type information being used to identify areas classified as not suitable, as this information was almost entirely derived from TasVeg data.
1.3	June 2012	Amy Koch	After discussions with Rod Knight and Tim Leaman about the potential historic eucalypt component in lowland grassland complex, this forest type was no longer classified as 'not applicable'.
1.4	August 2012	Amy Koch	Provided greater clarification on plantation classification
1.5	April 2013	Chris Grove	Removed draft watermark
2.0	March 2016	Amy Koch	Major overhaul of process for constructing the map, and addition of on-ground assessments

Stages required for release outside FPA

Category of advice (A1, A2, B1, B2, B3 or C):		**B2**
Stages	**Required/not required**	**Completed (date)**
Specialist		
Line Manager	Required	
Peer/FPO/stakeholder review	Required	
CFPO	Required	
FPAC	Not required	
Board	Not required	

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