

# Interim benchmarks for the *BioMetric* Tool

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## Introduction

Benchmarks are quantitative measures that describe the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement. Benchmarks are described for specified condition variables by vegetation community (usually Keith (2004) vegetation class in *BioMetric*), at the scale of the stand, patch or zone.

Unmodified vegetation generally has minimal timber harvesting (few stumps, coppicing, cut logs), minimal firewood collection, minimal exotic weed cover, minimal grazing and trampling by introduced or over abundant native herbivores, minimal soil disturbance, minimal canopy dieback, no evidence of recent fire or flood, not subject to high frequency burning, and with natural recruitment of native species, but minimal dense recruitment of native species following high levels of anthropogenic disturbance or sudden release from high levels of anthropogenic disturbance.

Vegetation condition benchmarks are required for assessing clearing and incentive applications in *BioMetric* in the *PVP Developer*. The benchmark for the vegetation type at the assessment site or likely to have originally occurred at the site (i.e. pre-clearing, or pre-1750) must be used in the assessment process.

The vegetation type should be the original vegetation type at the site, not the derived vegetation type. Some vegetation types listed and defined in the *BioMetric* are derived or secondary communities - these can be selected only where the original vegetation type cannot be determined. A preliminary list of derived communities is available from the *BioMetric* website

[http://www.nationalparks.nsw.gov.au/npws.nsf/Content/BioMetric\\_tool](http://www.nationalparks.nsw.gov.au/npws.nsf/Content/BioMetric_tool).

## How were the benchmarks derived?

### Process

An expert panel workshop of people who have personal expertise in vegetation condition was held to develop and review benchmarks for condition variables for *BioMetric* (PVP biodiversity tool). The expert workshop on benchmarks had two specific purposes. 1. To use expert opinion to review the benchmarks that are already

**Table 1: Expert panel members who provided benchmarks for each Catchment Management Authority area, and the principal data sources they utilised. See p. 5 for definitions of foliage cover (FC), projective foliage cover (PFC) and crown cover (CC).**

<b>CMA</b>	<b>Expert panel members</b>	<b>Data sources utilised by expert panel</b>	<b>Benchmark modifications</b>
Border Rivers/ Gwydir	Alan Ede, Wendy Hawes	<ul style="list-style-type: none"> <li>• A= Surrounding CMAs (NR) for some hollows and logs benchmarks.</li> <li>• E: All expert opinion benchmarks for plant species richness and % cover variables have been field trialled.</li> </ul>	<ul style="list-style-type: none"> <li>• Cover benchmarks supplied as crown cover for all strata. Converted to ~FC (%) by multiplying by 0.5.</li> </ul>
Central West	Steve Lewer, Dominic Sivertsen, Darren Shelly	<ul style="list-style-type: none"> <li>• P = <ul style="list-style-type: none"> <li>• Based on plot data (0.04ha) - for some native plant species richness benchmarks</li> <li>• Based on Hunter data – for some cover benchmarks.</li> </ul> </li> <li>• A = Adjoining (and other) CMAs. Includes HCR, HN, N, LMD, MB, MY, SR, and W - for some plant species richness, cover, hollows and log length benchmarks.</li> </ul>	<ul style="list-style-type: none"> <li>• Cover benchmarks supplied as crown cover for all strata. Converted to ~FC (%) by multiplying by 0.5.</li> </ul>
Hawkesbury/ Nepean	Daniel Connolly, Tim Hager	<ul style="list-style-type: none"> <li>• Benchmarks for H/N CMA have been supplied by vegetation type, except for hollows and logs, which are supplied by vegetation class.</li> <li>• P = <ul style="list-style-type: none"> <li>• Based on data from Tindall <i>et al.</i> (2004) – for most native species richness and cover benchmarks;</li> <li>• Based on very limited site measurements – for some hollows and logs benchmarks.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• None (cover benchmarks supplied as PFC for all strata and hence remain unmodified).</li> </ul>
Hunter/ Central Rivers	Daniel Connolly, David Russell	<ul style="list-style-type: none"> <li>• P = <ul style="list-style-type: none"> <li>• Based on Lower Hunter site data - for some native plant species richness benchmarks;</li> <li>• Based on McRae and Cooper (1983) – for some cover benchmarks;</li> <li>• Based on Peake <i>et al.</i> (in prep.) – for some cover benchmarks;</li> <li>• Based on NSW NPWS (2000) - for some cover benchmarks.</li> </ul> </li> <li>• A = Surrounding CMAs (BRG, H/N, N, NR, SR) - for some plant species richness, cover, hollows and log length benchmarks.</li> </ul>	<ul style="list-style-type: none"> <li>• None (cover benchmarks supplied as PFC for all strata and hence remain unmodified).</li> </ul>
Lachlan	Steve Lewer, Dominic Sivertsen, Darren Shelly, Rainer Rehwinkel	<ul style="list-style-type: none"> <li>• P = <ul style="list-style-type: none"> <li>• Based on plot data (0.04ha) - for some native plant species richness benchmarks;</li> <li>• Based on limited plot data – for some cover benchmarks.</li> </ul> </li> <li>• A = Surrounding CMAs (CW, HN, SR, W) - for some plant species richness, cover, hollows and log length figures.</li> </ul>	<ul style="list-style-type: none"> <li>• Cover benchmarks supplied as crown cover for all strata. Converted to ~FC (%) by multiplying by 0.5.</li> </ul>

CMA	Expert panel members	Data sources utilised by expert panel	Benchmark modifications
Lower Murray/ Darling	Anne Kerle, Terry Mazzer, Roger Oxley, James Val	<ul style="list-style-type: none"> <li>P = <ul style="list-style-type: none"> <li>Based on Roger Oxley's data - for some native plant species richness and cover benchmarks;</li> <li>Based on James Val's data - for some native plant species richness, hollows and logs benchmarks.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Cover benchmarks supplied as crown cover for over-storey and mid-storey. Converted to ~FC (%) by multiplying by 0.5.</li> <li>Ground stratum cover benchmarks were provided as PFC and hence remain unmodified.</li> </ul>
Murray	Michael Dunn, Megan McNellie Ray Willis	<ul style="list-style-type: none"> <li>P = <ul style="list-style-type: none"> <li>Plot-generated data (10th percentile figures for good quality sites) - for some native plant species richness benchmarks;</li> <li>Based on Rainer Rehwinkel's data - for some native plant species richness, cover, hollows and logs benchmarks;</li> <li>Plot-generated data (25<sup>th</sup> and 75<sup>th</sup> percentile figures for good quality sites) - for some cover benchmarks;</li> <li>Based on benchmark data (Gibbons <i>et al.</i>, in prep.) - for some hollows and log length benchmarks;</li> <li>P = NVMP (HAY 250, 000) collected at 0.04ha and scaled up to 0.1ha - for stem density benchmarks.</li> </ul> </li> <li>A = Adjoining CMAs (SR) - for some cover, hollows and log length benchmarks.</li> </ul>	<ul style="list-style-type: none"> <li>Cover benchmarks supplied as crown cover for all strata. Converted to ~FC (%) by multiplying by 0.5 for over-storey only.</li> </ul>
Murrumbidgee	Michael Dunn, Megan McNellie Ray Willis	<ul style="list-style-type: none"> <li>P = <ul style="list-style-type: none"> <li>Plot-generated data (10th percentile figures for good quality sites) - for some native plant species richness benchmarks;</li> <li>Based on Rainer Rehwinkel's data - for some native plant species richness, cover, hollows and logs benchmarks;</li> <li>Based on quadrat data of Keith McDougall and benchmark data for similar vegetation classes - for some native plant species richness, cover, hollows and logs benchmarks.</li> <li>Plot-generated data (25<sup>th</sup> and 75<sup>th</sup> percentile figures for good quality sites) - for some cover benchmarks;</li> <li>Based on benchmark data (Gibbons <i>et al.</i>, in prep.) - for some hollows and log length benchmarks;</li> <li>P = NVMP (HAY 250, 000) collected at 0.04ha and scaled up to 0.1ha - for stem density benchmarks. ('0' = data collected, but no stems present in plots).</li> </ul> </li> <li>A = Surrounding CMAs (CW, SR, W) - for some native plant species richness, cover, hollows and logs benchmarks.</li> </ul>	<ul style="list-style-type: none"> <li>Cover benchmarks supplied as crown cover for all strata. Converted to ~FC (%) by multiplying by 0.5 for over-storey only.</li> </ul>

<b>CMA</b>	<b>Expert panel members</b>	<b>Data sources utilised by expert panel</b>	<b>Benchmark modifications</b>
Namoi	Alan Ede, Wendy Hawes	<ul style="list-style-type: none"> <li>• A = Surrounding CMAs (NR) - for some hollows and logs figures.</li> <li>• E: All expert opinion benchmarks for plant species richness and cover variables have been field trialled.</li> </ul>	<ul style="list-style-type: none"> <li>• Cover benchmarks supplied as crown cover for all strata. Converted to ~FC (%) by multiplying by 0.5.</li> </ul>
Northern Rivers	Doug Binns, Chris Nadolny, Phil Redpath	<ul style="list-style-type: none"> <li>• P = <ul style="list-style-type: none"> <li>• Based on 10<sup>th</sup> percentile figures from plot data, adjusted due to known or suspected bias or other data limitations – for some native plant species richness benchmarks.</li> <li>• Based on some data – for some hollows and logs benchmarks.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• None (cover benchmarks supplied as foliage cover for all strata and hence remain unmodified).</li> </ul>
Southern Rivers	Keith McDougall, Ken Turner	<ul style="list-style-type: none"> <li>• E, P? = Native plant species richness figures estimated based on small number of quads and personal knowledge.</li> <li>• E = Rainer Rehwinkel input for some cover figures.</li> <li>• A = Surrounding CMAs (HN, MB, MY) - for some native plant species richness, cover, hollows and logs figures.</li> </ul>	<ul style="list-style-type: none"> <li>• None (cover benchmarks supplied as PFC for all strata and hence remain unmodified).</li> </ul>
Western	Anne Kerle, Terry Mazzer, Roger Oxley	<ul style="list-style-type: none"> <li>• P = <ul style="list-style-type: none"> <li>• Based on Riverina Bioregion data - for some cover benchmarks.</li> <li>• Based on Roger Oxley's data - for some native plant species richness and cover benchmarks.</li> </ul> </li> <li>• A = Surrounding CMAs (CW, L, LMD, N) - for some native plant species richness, cover, hollows and logs benchmarks.</li> </ul>	<ul style="list-style-type: none"> <li>• Cover benchmarks supplied as crown cover for over-storey and mid-storey. Converted to ~FC (%) by multiplying by 0.5.</li> <li>• Ground stratum cover benchmarks were provided as PFC and hence remain unmodified.</li> </ul>

available; and 2. To use expert opinion to fill gaps in benchmark data, where benchmarks are not currently available. Benchmarks collated at the workshop and subsequently were derived from several sources: E = Expert opinion (often based on a range of data and information sources, though not always specified), P = Plot data (source/s specified where provided), and/or A = Adjoining (and other) CMAs. Table 1 lists the expert panel members consulted for each CMA, and the data sources utilised. The benchmark data are available on the *BioMetric* website [http://www.nationalparks.nsw.gov.au/npws.nsf/Content/BioMetric\\_tool](http://www.nationalparks.nsw.gov.au/npws.nsf/Content/BioMetric_tool).

### **Cover definitions**

Depending on the data sources utilised and/or the methodological preferences of the experts consulted, benchmark values for cover variables were provided in a diversity of forms, including crown cover, foliage cover, projective foliage cover, or a combination of these depending on the structural layer. These terms are defined below (as per Walker and Hopkins 1988:

- Crown cover (CC) is “the percentage of the sample site within the vertical projection of the periphery of crowns. In this case, crowns are treated as opaque”. To convert to percentage foliage cover (FC), crown cover (%) is multiplied by the % openness of the crown (= crown type, obtained from Figure 6, p. 71 of Walker and Hopkins 1998).
- Foliage cover (FC, *sensu* Carnahan 1977) is “the percentage of the sample site occupied by the vertical projection of foliage and branches (if woody)”. This is sometimes also termed per cent foliage cover, canopy cover or projected canopy cover.
- Projective foliage cover (PFC, *sensu* Specht *et al.* 1974) is “the percentage of the sample site occupied by the vertical projection of foliage only”.

The following modifications were consistently applied to benchmarks on the basis of their format. Benchmarks provided as foliage cover (FC) or projective foliage cover (PFC) were presented unmodified. Benchmarks provided as crown cover (CC) were converted to an approximate FC by multiplying by a nominal 50% (0.5), regardless of vegetation class or stratum, and rounding up to integer values. Table 1 shows the benchmark figures in CMAs that have been thus modified. Note that no other rounding has been undertaken.

### **Notes**

The interim benchmarks are based on the best information that was available in the time frame for their development. Benchmarks are not available for all vegetation classes in all CMAs. Very few stem density benchmark data are available (these are restricted to a small number of vegetation classes in the Murray and Murrumbidgee CMAs only). The assessor is strongly encouraged to collect plot data at reference sites in benchmark condition where data are unavailable, and to check the accuracy of the benchmarks provided (including where seasonal or climatic (e.g. drought) impacts may not be reflected in benchmarks). Reference plots can also be used to check/supplement benchmarks for individual condition variables. For example, if the benchmark range for over-storey cover for the vegetation class is considered too broad for a particular vegetation type by the assessor, three local reference plots (transects) can be used to obtain over-storey cover benchmarks for the specific vegetation type. This technique is particularly relevant for assessing whether a zone

contains vegetation in low condition, which uses the lower benchmark for over-storey cover.

Reference sites are unmodified sites with vegetation in relatively unmodified condition used to obtain benchmark information where the benchmarks are not already available for a vegetation type. Refer to Appendix 1 of the *BioMetric* Operational Manual (Gibbons *et al.* 2005) for detailed methodology. Use the Site Value – plot data sheet to record reference plot data, and forward completed data sheets to Stuart Doyle, Woodland Ecology Unit, NSW DEC (fax 02 6242 1705, or via email: [stuart.doyle@csiro.au](mailto:stuart.doyle@csiro.au)).

Definitions of vegetation strata used in *BioMetric* are in Table 2. Some benchmarks have been provided for strata that are not defined as in Table 2 (predominantly using a different definition of over-storey, and hence of mid-storey). Benchmarks defined according to different definitions of over-storey or mid-storey are highlighted in bright green in the benchmarks data spreadsheets. Assessors are requested to check highlighted benchmarks by using reference plots. Some of the data in the highlighted cells may be incorrect. In some instances the mid-storey benchmarks should be the over-storey benchmarks, with zero cover for the mid-storey benchmark. This is because if there is only one layer above 1 metre, then that layer is the over-storey, not mid-storey.

A nominal 0-10% FC was applied to the mid-storey of all woodland, forest and rainforest vegetation classes where the recommended benchmark range was 0-0%, to include regeneration of over-storey species, as well as any under-storey tree and shrub layer, in the benchmark values.

**Table 2: Definitions of vegetation strata as applied to benchmark data and condition variable used in *BioMetric*. These definitions are as per the *BioMetric* Operational Manual.**

Stratum	Definition
Native over-storey cover	Native over-storey is the tallest woody stratum present (including emergents) above 1m and includes all species native to Australia (i.e. native species not local to the area can contribute to over-storey structure). For example, in a woodland community the over-storey stratum is the tree layer, and in a shrubland community the over-storey stratum is the tallest shrub layer above 1m. Some vegetation types (e.g. grasslands) may not have an over-storey stratum.
Native mid-storey cover	The mid-storey contains all vegetation between the over-storey stratum and 1m in height (typically tall shrubs, under-storey trees and tree regeneration) and includes all species native to Australia (i.e. native species not local to the area can contribute to mid-storey structure). Some vegetation types (e.g. grasslands) may not have a mid-storey stratum.
Native ground cover (grasses)	The ground stratum contains all native vegetation below 1m in height and includes all species native to Australia (i.e. is not confined to species indigenous to the area). The ground stratum (grasses) refers to native grasses (i.e. plants belonging to the family Poaceae).
Native ground	The ground stratum contains all native vegetation below 1m in

cover (shrubs)	height and includes all species native to Australia (i.e. is not confined to species indigenous to the area). The ground stratum (shrubs) refers to native woody vegetation <1m.
Native ground cover (other)	The ground stratum contains all native vegetation below 1m in height and includes all species native to Australia (i.e. is not confined to species indigenous to the area). The ground stratum (other) refers to non-woody native vegetation (vascular plants only) <1m that is not grass (e.g. herbs, ferns).

## Review/revision of benchmarks

It is recommended: (i) that these benchmarks be reviewed at regular intervals, at least annually, for the first few years; and (ii) that an institutional process be resourced and set up to conduct the benchmark reviews. Benchmark reviews are dependent on sound curation and review of the vegetation types in *BioMetric*. This in turn will require a sound institutional process and resources.

## References

Ayers, D. *et al.* (in prep.). Benchmarks for surrogates of biodiversity in selected woodland communities in northern central New South Wales, and their use in ecosystem management.

Carnahan, J.A. (1976). Natural Vegetation. Atlas of Australian Resources. Second Series. Department of Natural Resources, Canberra.

Gibbons, P., Ayers, D., Seddon, J., Doyle, S. and Briggs, S. (2005). *BioMetric* Version 1.8. A Terrestrial Biodiversity Assessment Tool for the NSW Property Vegetation Plan Developer: Operational Manual. NSW Department of Environment and Conservation.

Gibbons, P. *et al.* (in prep.). Benchmarks for surrogates of biodiversity in selected native vegetation types in central New South Wales, and their use in ecosystem management.

Keith, D. (2004). Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation. Hurstville, NSW.

McRae, R.H.D. and Cooper, M.G. (1983). Vegetation of the Merriwa Area. *Cunninghamia*. **1**: 351-369.

NSW NPWS. (2000). Vegetation Survey Classification and Mapping Lower Hunter and Central Coast Region: A project undertaken for the Lower Hunter and Central Coast Regional Environment Management Strategy by CRA Unit Sydney Zone NPWS Version 1.2.

Peake *et al.* (in prep). The Native Vegetation of the Hunter Valley Floor. Report Produced for the Hunter Catchment Management Authority, Tocal NSW.

Specht, R.L., Roe, E.M. and Boughton, V.H. (1974). Conservation of major plant communities in Australia and Papua New Guinea. *Aust. J. Bot. Suppl.* Series No. 7.

Tindall, D., Pennay, C., Tozer, M., Turner, K. and Keith, D. (2004). Native vegetation map report series No. 4. Version 2.2. The Araluen, Batemans Bay, Braidwood, Burragorang, Goulburn, Jervis Bay, Katoomba, Kiama, Moss Vale, Penrith, Port Hacking, Sydney, Taralga, Ulladulla and Wollongong 1:100 000 mapsheets. Department of Environment and Conservation and Department of Infrastructure, Planning and Natural Resources. Sydney.



Walker, J. and Hopkins, M.S. (1998). Vegetation. Pp. 58-86 *in* Australian Soil and Land Survey Field Handbook. Second Edition. Ed by McDonald, R.C., R.F. Isbell, J.G. Speight, J. Walker, and M.S. Hopkins. Australian Collaborative Land Evaluation Program, CSIRO Land and Water, Canberra.