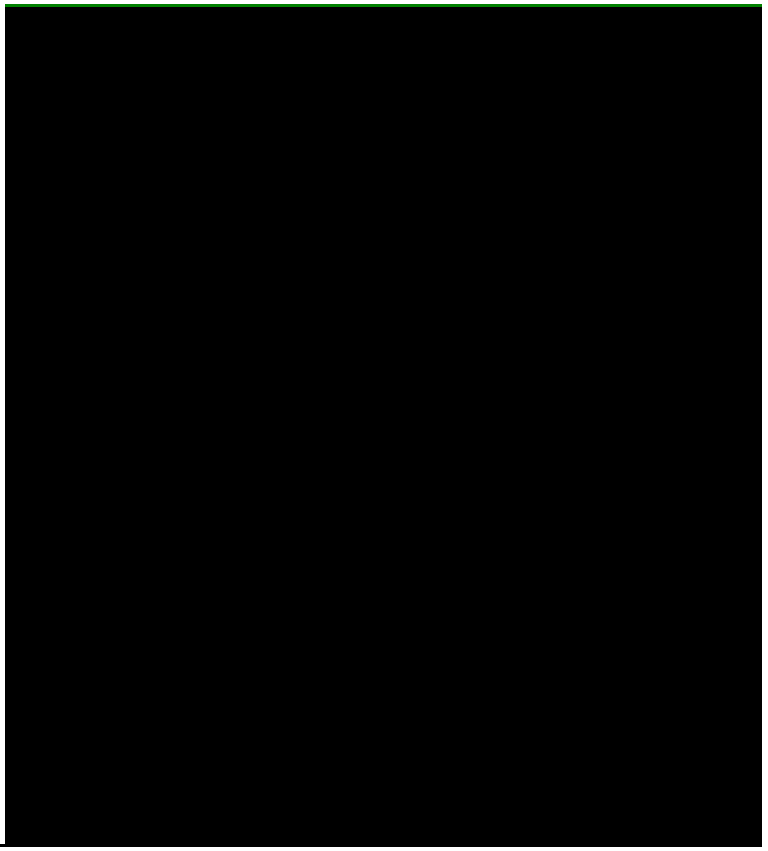
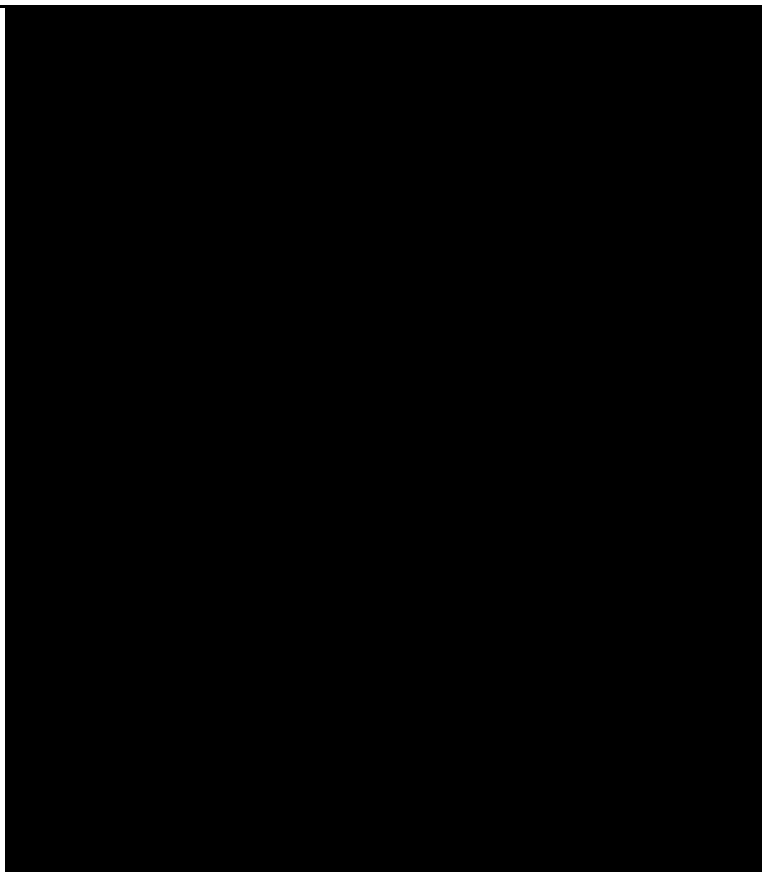


Identification, Assessment and Protection of National Estate Values in Southern NSW CRA Region

A report undertaken for the NSW Comprehensive Regional Assessments

January 2000



IDENTIFICATION, ASSESSMENT AND PROTECTION OF NATIONAL ESTATE VALUES

SOUTHERN NSW CRA REGION

ENVIRONMENT AUSTRALIA

A report undertaken for the NSW Regional Forest Agreement Steering Committee as part of the NSW Comprehensive Regional Assessments

project numbers
NA 02/EH, NA 03/EH, NA 10/EH, NA 15/EH, NA 16/EH,
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January 2000

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The projects have been jointly funded by the New South Wales and Commonwealth Governments and managed through the Resource and Conseration Division, Department of Urban Affairs and Planning, and the Forests Taskforce, Department of the Prime Minister and Cabinet.

The project has been overseen and the methodology has been developed through the Environment and Heritage Technical Committee which includes representatives from the New South Wales and Commonwealth Governments and stakeholder groups.

Disclaimer
While every reasonable effort has been made to ensure that this document is correct at the time of printing, the State of New South Wales, its agents and employees, and the Commonwealth of Australia, its agents and employees, do not assume any responsibility and shall have no liability, consequential or otherwise, of any kind, arising from the use of or reliance on any of the information contained in this document.

Erratum
Map 22 is incorrectly titled ‘Areas Above Threshold for Geoheritage’. The correct title is ‘Areas Identified as Potential Geoheritage’

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EXECUTIVE SUMMARY

This report has been prepared for the joint Commonwealth/State Senior Officials Committee which oversees the Comprehensive Regional Assessments (CRA) of forests in New South Wales. It documents the methodology and rule-sets used to identify potential areas of natural national estate significance, and summarises the findings of the projects conducted for the assessment of cultural national estate values as part of the CRA.

The national estate component of the CRA has greatly enhanced the knowledge of the occurrence of national estate values in the forests of Southern New South Wales. A broad range of natural values has been identified, including extensive natural values and localised biodiversity values. Over sixty-five sites and areas were identified as indicative national estate areas of social, aesthetic and historic value. The assessment of national estate indigenous values is ongoing in consultation with representatives of the Southern NSW Aboriginal community.

The areas identified in this report as having potential national estate value are indicative only and are not necessarily the delineated forest areas that will be listed in the Register of the National Estate. The report documents the natural and cultural values that need to be taken into account in determining national estate places, with the data in the report forming the basis of that determination by the Australian Heritage Commission (AHC). The data layers and areas identified in this report will remain indicative until they have been considered by the AHC.

The CRA provides the scientific basis on which the State and Commonwealth governments will sign Regional Forest Agreements (RFAs) for the major forests of New South Wales. These agreements will determine the future of the State's forests, providing a balance between conservation and ecologically sustainable use of forest resources.

It is expected that the RFA between the NSW and Commonwealth Governments will include specifications for a jointly agreed national estate outcome in terms of both the listing of places, including a review of places currently listed or interim-listed in the Register of the National Estate (RNE), and the long-term management of national estate values in forests.

Note: All area calculations contained in this report are based on grid analysis and therefore have a minimum resolution, in most cases 100 m (one hectare) for localised values and 500 m (25 ha) *for extensive values. Consequently, all area figures should be regarded as indicative only.*

1. INTRODUCTION

The development of the Regional Forest Agreement (RFA) between the New South Wales and Commonwealth Governments involves a number of stages. The comprehensive regional assessment (CRA) has involved both governments in a wide array of projects to provide the necessary information to identify forest associated values and determine possible approaches for an RFA. Later stages include the integration of social, economic, environment and heritage values in the region, public consultation and drafting of the RFA.

This report presents the results of the assessment of natural national estate values conducted as part of the CRA and identifies indicative areas of national estate value in the region. The work was conducted as part of the project: *JANIS Conservation Requirements and Natural National Estate Identification, Assessment and Protection for the Southern Region.* Conservation requirements will be reported on separately.

Under the National Forest Policy Statement (Commonwealth 1992), Commonwealth, State and Territory Governments agreed to the assessment of national estate values of forests. Attachment 1 of the NSW CRA/RFA Scoping Agreement requires the CRAs to 'identify, assess and document national estate values including natural and cultural heritage in NSW to satisfy Commonwealth obligations under the *Australian Heritage Commission Act 1975.*'

Key points from the Scoping Agreement include:

- identification to be undertaken jointly by the Australian Heritage Commission (the Commission) and NSW in accordance with national estate criteria for identifying places of significance;
- values identified and methodologies utilised to be jointly agreed between the Commission and NSW;
- identification, delineation and mapping of national estate values and places;
- assessment of current levels of protection of national estate values and places;
- identification of conservation principles for the protection of national estate values and places;
- documentation of agreed methodologies; and
- documentation sufficient for interim listing in the Register of the National Estate (RNE) where appropriate.

As defined in the *Australian Heritage Commission Act 1975*, the national estate comprises:

those places, being components of the natural environment of Australia, or the cultural environment of Australia, that have aesthetic, historic, scientific or social significance or other special value for future generations as well as for the present community.

The Australian Heritage Commission's responsibility is to identify the national estate and under section 30 of the Act, to advise the Commonwealth Government on the protection of national estate places and the potential impact on national estate values of Commonwealth decisions relating to those places. The Act also requires the establishment of the Register of the National Estate. The Register includes places of importance at a local, regional or national level. The identification and assessment of places for listing in the Register is guided by the national estate criteria.

This report presents the results of the assessment of natural and cultural national estate values, carried out as part of the CRA, and identifies indicative areas of national estate value in the Region. The values documented in this report will be taken into account in delineating national estate places. Areas endorsed by the Australian Heritage Commission (AHC) will be interim listed in the Register of the National Estate. The interim listing of areas will then be advertised and subject to the statutory period of three months allowed for objections and public comment. It is anticipated that interim listing of areas identified through this process will occur after the New South Wales - Commonwealth Southern RFA is signed.

The RFA process is designed to comply with a range of Commonwealth and State statutory obligations in relation to the management of forests, including the identification of and provision of advice on the protection of national estate values required under the *Australian Heritage Commission Act* 1975. A regional assessment model for identifying the National Estate was developed in 1991-92 by the AHC, in cooperation with the Western Australian Department of Conservation and Land Management (CALM), for the southern forest region of south-west Western Australia (AHC and CALM, 1992). The model was refined in 1993 for regional assessments in Victoria's East Gippsland and Central Highlands forest regions, with similar assessments later completed for Tasmania and Western Australia CRAs.

2. NATIONAL ESTATE NATURAL VALUES

This section of the report presents the results of the assessment of natural national estate values conducted as part of the CRA, and identifies indicative areas of natural national estate value in the region.

2.1 CRITERIA

Natural values in the Southern NSW CRA region were assessed against the national estate criteria. Identification and treatment of natural values follows three broad subdivisions:

- extensive natural values;
- localised biodiversity values; and
- other natural values, including those relating to geology, geomorphology and soils.

In the regional context, assessment of the national estate requires a comparative appraisal of the significance of places having one or more attributes or values. The values are derived from the significance criteria for the Register of the National Estate, which are reproduced in Appendix A.

Indicators of significance vary across natural national estate values and include:

- rarity or threat;
- distribution pattern;
- condition and integrity;
- diversity or richness;
- outstanding example; and
- representativeness.

2.2 THRESHOLDS

In order to identify areas of potential and indicative significance for natural national estate values a threshold level is set. Areas that exceed this threshold are regarded as meeting the criteria required for listing in the Register of the National Estate. Thresholds are set in relation to the significance indicators and are specific to each national estate value. The development of thresholds for national estate significance varies depending on the level of current knowledge about the nature and extent of the values and their distribution in the landscape at a local, regional or national level.

2.3 DATA

The area assessed for natural national estate included all the forested public and private lands in the Southern NSW CRA region. Values identified in the adjacent areas of northern Victoria and central and western NSW were used as contextual information, particularly where area thresholds were used in assessing criteria.

The major data sets used were:

- flora - flora data were provided by the NSW National Parks and Wildlife Service and comprises a subset of the total sum of flora data. This sub-set has had basic validation done including the removal of gross errors. For the purposes of the work conducted for national estate, the data set was assumed to have an average spatial reliability of 1 km. The use of point records was avoided wherever possible because of the problems of spatial uncertainty.
- fauna - fauna data were provided by the NSW National Parks and Wildlife Service and consisted of NSW Wildlife Atlas data with no reliability or accuracy work conducted on it. Rudimentary auditing on this data-set was conducted by Environment Australia and consisted of culling gross errors and spurious records. An additional CRA fauna data-set for priority species was also provided. These data have had reliability and accuracy auditing done on it. Data-sets were taken to have an average spatial reliability of 1 km. The use of point records was avoided because of the problems of spatial uncertainty. These data-sets were primarily used for richness analysis and context.
- forest ecosystems - the CRA forest ecosystem data-set was used, the version being that provided to the Environment and Heritage Technical Committee. This data-set is the output of forest ecosystem modelling conducted for the CRA and was used to provide forest ecosystem landscape information. . The data-set was not field validated at the time of report writing.
- old-growth forest - the CRA old-growth data-set was used. These data are derived from API, disturbance and logging history data obtained from the Southern CRAFTI and MANHIC projects. It is known to contain errors including errors relating to post 1993 disturbance and interpretation of CRAFTI senescent classes. The extent of these errors is uncertain and has not been fully field-validated.
- disturbance - disturbance was derived from the biophysical naturalness data-set (generated according to the National Wilderness Inventory methodology). The biophysical naturalness data rely heavily on aerial photo interpretation done as part of the CRA Aerial Photograph Interpretation Project 1999 (CRAFTI). Biophysical naturalness was used to generate undisturbed catchments, natural landscapes and was used to filter data in some other analyses.
- digital elevation model – a 1:25,000 scale digital elevation model (DEM) was used. The model was used to provide information on the escarpment, steep areas and general elevational information.

All mapped indicative national estate natural areas have been digitised and are held in ARC format on a Geographic Information System platform held by Environment Australia.

2.4 METHODOLOGY

The Southern NSW methodology was developed using best available data. It may not necessarily be similar to the formulation of requirements for other CRA regions in NSW. The detail of the process by which each of the national estate values was assessed is provided in Sections 3 and 4.

For extensive natural values, the methodology closely followed the approach adopted in other CRAs. Undisturbed catchments were derived from data provided by the Wild Rivers Database. Natural landscapes were derived from the biophysical naturalness layer used to generate National Wilderness Inventory (NWI) wilderness. Old-growth forest was derived from the draft old-growth forest data provided to the data warehouse. These layers were driven entirely by data.

For remnant vegetation communities, rare vegetation communities and old-growth forest, the analyses were based entirely on forest ecosystem and old-growth data. In these cases, data were used to delineate indicative areas and then checked for coverage of specific areas identified by experts.

For local national estate values (ie not extensive natural values), areas of indicative national estate significance were delineated for each criteria (see Attachment A) using the following information:

- species point locality data based on information provided by experts and literature review (Appendix H);
- landscape elements nominated by experts as being foci for the particular national estate criteria (Appendix I); and
- particular sites nominated by experts as being important for criteria (Appendix I).

Experts were consulted during the Conservation Requirements and Response to Disturbance Workshops held between June and October 1999 and were given additional time to submit information outside these forums. The outputs from these workshops were combined with CRA survey data, the result of literature reviews and the experience of previous CRAs to create two separate data-sets, based on environmental modelling and species point locality information. This was to enable an analysis that could be spread across the whole landscape and not restricted to areas where survey work had been conducted or experts had visited. The two data-sets were compared with the areas known by experts to be important for national estate values. Rule-sets were used to refine the environmental modelling. Where modelling could not validated against expert opinion and species locality data in known areas, the modelling was disregarded and the species point locality data were used to provide presence-only information.

The three data sources were compared to cross-validate the approaches used and refine and increase confidence in the outcome. The species and expert nominated areas were used to validate and refine environmental modelling.

Most species-related values were thresholded by displaying species point location data as a richness map across the landscape. Areas that had concentrations of relevant species more than two standard deviations above the average number of species in the landscape were identified as above threshold. The choice of 2 standard deviations was based on the need to delineate areas of significance that are clearly above the average level of variance in the landscape.

Principal characteristics of class and successional stages were felt by experts to be best represented through the JANIS criteria.

3. EXTENSIVE NATURAL VALUES

Extensive natural values in the Southern region were assessed against the Register of the National Estate significance criteria A.2 and B.1 (Appendix A).

Criterion A.2: Importance in maintaining existing processes or natural systems at the regional or national scale, and
Criterion B.1: Importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness.

These are inclusive values, extending broadly across the landscape rather than being confined to single vegetation types, landforms or localities. The values considered in this aspect of the Southern assessment are:

- natural landscapes;
- undisturbed catchments;
- wilderness; and
- old-growth forest.

Assessment of these values resulted in the identification of indicative places of importance for the maintenance of natural processes (such as hydrological processes) at regional and national scales, and places that are of regional importance for maintaining specific natural systems (such as remnant vegetation).

3.1 WILDERNESS

The assessment of wilderness in the Southern CRA region of New South Wales utilised the Commonwealth's National Wilderness Inventory methodology, developed by the Australian Heritage Commission, as specified under JANIS. The NSW Wilderness Act was also used in the Southern CRA Wilderness Assessment but not used for national estate.

The assessment, identification, declaration and management of wilderness in New South Wales is principally guided by the *New South Wales Wilderness Act 1987.* The criteria for identification of wilderness under the Act are consistent with the National Forest Policy Statement definition of wilderness. The National Forest Policy Statement does, however, define wilderness as being remote from the influences of European settlement whereas the Act uses recovery potential as a criterion.

3.1.1 Method

The National Wilderness Inventory methodology (Lesslie and Maslen 1995) is the adopted standard approach to the assessment of wilderness in Regional Forest Agreements throughout Australia. While a dual identification approach was undertaken in the Southern region, protection requirements in the Regional Forest Agreement process are linked solely to the National Wilderness Inventory. The nationally agreed criteria stipulates that, *Ninety percent, or more if practicable, of the area of high quality wilderness that meets minimum area requirements should be protected in reserves* (JANIS 1997, p.15).

The National Wilderness Inventory is a geographic information system algorithm, which measures remote and natural values to produce a 'Wilderness Quality' continuum. The National Wilderness Inventory Wilderness Quality is produced from four disturbance indicators, each weighted equally. Each of the indicators is individually updated with the best available data and then combined to measure the Wilderness Quality of an area. The indicators are derived from the definition of wilderness quality as the extent to which a location is remote from and undisturbed by the influence of modern technological society. The indicators are:

- Remoteness from Settlement
  remoteness from places of permanent occupation;
- Remoteness from Access
  remoteness from established access routes;
- Apparent Naturalness
  the degree to which the landscape is free from the presence of permanent structures associated with modern technological society; and
- Biophysical Naturalness
  the degree to which the natural environment is free from biophysical disturbance caused by the influence of modern technological society.

For each of the three distance-based wilderness indicators, primary data were graded according to its associated impact. The Remoteness from Access and Remoteness from Settlement indicators utilise four categories or grades of impact, whilst three grades are used in determining Apparent Naturalness. Minimum standardised distances are classified to produce consistent Remoteness from Settlement, Remoteness from Access, and Apparent Naturalness classes, with values of 0 to 5.

Biophysical naturalness

The fourth indicator, Biophysical Naturalness (BN), is based upon the assumption that the degree of change sustained by an ecosystem is directly related to the intensity and duration of interference. For the National Wilderness Inventory, land use considerations are generally restricted to the grazing of stock and the harvesting of timber. However, where more reliable data are available, information on a range of other disturbances is also included. The types of disturbance data typically used to derive the BN layer includes information on:

- timber harvesting records;
- regional information on grazing;
- air photo interpretation;
- land tenure;
- grazing leases;
- vegetation communities; and
- mining sites.

In the Biophysical Naturalness rating scheme, wildfire is considered a natural process, so that areas affected by wildfire can still be given a high BN rating (ie. 5), unless other disturbances resulted in a lower rating. The rating scheme for BN used in the National Wilderness Inventory is outlined in Table 3a. This rating system is for the 'baseline National Wilderness Inventory' and each region has its own rating system applied in consultation with stakeholders.

TABLE 3A: BIOPHYSICAL NATURALNESS RATING SCHEME

Indicator Value	National Wilderness Inventory Description for Baseline National Wilderness Inventory
5 High	Unlogged and ungrazed
4	Unlogged and ungrazed for at least 60* years; excluding clear-felled and intensively grazed areas
3	Selective single logging; irregular grazing within preceding 60* years
2	Light / Moderate grazing; repeated selective logging within preceding 60* years
1 Low	Clear-fell logging operations and / or intensive grazing
0	Agricultural, urban and developed land, pine and other exotic plantations, reservoirs.

* threshold period may vary between regions

The rating scheme adopted for upgrading the BN indicator to assess wilderness values in the Southern region is shown in Table 3b.

TABLE 3B BIOPHYSICAL NATURALNESS RATING SCHEME APPLIED TO SOUTHERN NSW

Indicator Value	NWI Description for Southern regional update
5 High	No evident disturbance from grazing or logging; natural water bodies; API code of "nil disturbance".
4	Non-intensive disturbance in Rainforest *; unmapped logging events with no API evidence of disturbance; other forest management events considered to have made minimal impact.
3	Grazing lease (SF only) with pasture grasses present; weeds present, some evidence of logging from API and associated evidence from logging records.
2	Intensive record of disturbance in Rainforest *; some multiple logging records, evidence of logging from API.
1 Low	Multiple, recent and intensive logging records with evidence of disturbance in API.
0	Agricultural, urban and developed land, pine and other exotic plantations, reservoirs.

* Re-evaluated at time of delineation.

3.1.2 Establishing the threshold

For the purposes of the Southern region CRA, the threshold for indicative national estate wilderness was considered equivalent to JANIS Wilderness (JANIS 1997, 15). That is, areas with a minimum "High Wilderness Quality" rating of 12 and above, and a minimum size of 8,000 ha (or less if the area adjoins a wilderness area outside the region) were considered to meet the national estate threshold.

3.1.3 Results

The National Wilderness Inventory upgrade revealed that 17 areas in the Southern region meet the JANIS criteria for defining high quality wilderness (minimum National Wilderness Inventory rating of 12 and a minimum size of 8,000 ha). Spatial distribution of indicative national estate wilderness is represented at Map 2. The combined extent of the 17 wilderness areas in the Southern region is 860,400 ha, as shown in Table 3c.

TABLE 3C: LAND TENURE OF SIGNIFICANT NATIONAL ESTATE WILDERNESS VALUES

Place	Total Area (ha)	Area in Reserves (NP/NR only) (ha)	Proportion in Reserves (NP/NR only) (%)
Brindabella NP	15,300	9,100	59.5
Clear Range	2,400	0	0
Deua (Deua NP)	101,000	74,000	73.3
Buckenbowra	17,600	4,500	25.6
Tantangara (Kosciuszko NP)	22,500	22,500	100
Tabletop (Kosciuszko NP)	25,300	25,100	99.2
Youngal (Kosciuszko NP)	20,300	19,900	98
Geehi (Kosciuszko NP)	31,000	31,000	100
Bimberi (Bimberi NR)	35,700	34,300	96.1
Bogong Peaks (Kosciuszko NP)	34,500	34,100	98.8
Byadbo (Kosciuszko NP)	88,300	80,400	91.1
Goobarragandra (Kosciuszko NP)	56,900	50,700	89.1
Jagungal (Kosciuszko NP)	81,600	80,200	98.3
Pilot (Kosciuszko NP)	88,000	85,600	97.3
Ettrema (Morton NP)	124,300	97,800	78.7
Budawang (Morton/Budawang NPs)	86,200	80,900	93.9
Wadbilliga (Wadbilliga NP)	29,500	20,500	69.5
Total	860,400	750,700	87.3

NB: Figures are indicative only.

3.2 NATURAL LANDSCAPES

Natural landscapes are large, relatively undisturbed areas with topographic and catchment integrity where natural processes continue largely unmodified by human intervention. Natural processes include:

- energy flows;
- nutrient cycling;
- hydrological processes;
- ecological processes such as succession; and
- evolutionary processes such as speciation and extinction.

At a national level, 'natural landscapes' are considered rare, and in those Regional Forest Agreement regions where they are found they have generally been assessed under the Register of the National Estate significance Criterion B.1 *importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness.*

3.2.1 Method

The following measures were used to identify areas of potential natural landscape value:

- naturalness (or level of disturbance indicated by the biophysical naturalness indicator);
- size; and
- integrity in the landscape.

The assessment of natural landscapes was largely based on the Biophysical Naturalness indicator of the National Wilderness Inventory (method described in section 3.1.1)

3.2.2 Establishing the threshold

Areas of high biophysical naturalness (BN equals 4 or 5) and with an area of 1,000 ha or greater were identified. Areas adjacent to the coast with high biophysical naturalness were identified if greater than 250 ha. The set threshold was chosen to be consistent with the process carried out in the other CRA regions. Biophysical Naturalness layers for areas adjacent to but outside the region were used to allow potential areas on the boundary of the region to be assessed within context. In order to rationalise the identification of areas, identified areas could contain fragmented but not significant areas of disturbance. Boundaries were permitted to include areas of disturbed forest, but not cleared land or substantially modified landscapes such as plantations.

3.2.3 Results

A large number of natural landscapes were identified in Southern NSW. Natural landscapes follow the general line of the escarpment from the northern edge of Morton National Park to Wadbilliga National Park in the South. Natural landscapes were identified around the Brindabella National Park and Kosciuszko National Park and in Woomargama State Forest. The areas delineated are above the threshold for nomination to the Register of the National Estate and use the best available data from the CRA for Southern NSW. There is a strong correlation with places already listed in the Register of the National Estate. These areas cover 1,341,017 ha. Delineated areas of natural landscapes are shown at Map 3.

About 72% of the total natural landscape area identified as having indicative national estate significance occurs in existing reserve, including national park or nature reserve, and 7% of the total area is in state forest (Table 3d).

TABLE 3D: LAND TENURE OF SIGNIFICANT NATIONAL ESTATE NATURAL LANDSCAPE VALUES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	971,000	72%
State Forest	90,700	7%
Reserved and Other Crown Land	69,200	5%
Leasehold Crown Land	21,500	2%
Other Tenures*	118,600	14%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

3.3 UNDISTURBED CATCHMENTS

'Undisturbed catchments' are catchments where natural hydrological processes remain essentially unmodified and unimpeded.

3.3.1 Method

The identification of undisturbed catchments was based on an analysis of river flow impediments and the naturalness of the area within the catchment. The assessment is derived from the River Disturbance Index Database (Stein et al 1998) held by the Wilderness and Wild Rivers Group, Environment Australia. The River Disturbance Index is a measure of river/stream quality across sub-catchment areas based on two indicators: Naturalness of Flow Regime Index and Sub-Catchment Naturalness Index.

Delineation of catchments
Sub-catchments were identified from the Wild Rivers database, compiled for the Wild Rivers assessment that formed part of the Southern region CRA. These sub-catchments were used as the basis of the national estate analysis. The database delineates a separate modelled sub-catchment for each stream segment, as defined on the AUSLIG 1:250,000 scale hydrography theme database.

Catchment Naturalness
The River Disturbance Index Database was constructed by establishing a grid across a primary database and calculating scores for sub-catchment condition (Sub-Catchment Naturalness Index) and flow regime indicators (Naturalness of Flow Regime Index). The scores for Sub-Catchment Naturalness Index were combined and adjusted for sub-catchment area to produce a Catchment Naturalness Index. The final River Disturbance Index values combine the Naturalness of Flow Regime Index and the Catchment Naturalness Index.

The primary database is derived from topographic map series and the National Wilderness Inventory database. The National Wilderness Inventory sources provide settlement and infrastructure features, the extent of non-natural land cover and an index of biophysical naturalness (Lesslie and Maslen 1995). The topographic map series provides watercourse data, built-up areas, infrastructure, reservoirs and canals.

The River Disturbance Index was created using guidelines established by an expert panel of government and non-government officials and stakeholders. Panel participants helped develop decision rules on quantifying disturbance and measuring catchment and river naturalness. From these discussions, the River Disturbance Index rates sub-catchment areas on a scale from undisturbed (0) to disturbed (1).

3.3.2 Establishing the threshold

Selection of a threshold to capture intact and undisturbed catchments was made on the basis that highly undisturbed catchments occur in the River Disturbance Index range less than or equal to 0.01.

Using a geographic information system, the data were filtered to capture all sub-catchments less than or equal to 0.01. Those places falling within these parameters were deemed to have indicative national estate value for undisturbed catchments.

Areas of high biophysical naturalness (BN equals 4 or 5) and with an area of 1,000 ha or greater were identified. The set threshold was chosen to be consistent with the process carried out in the other CRA regions.

Undisturbed catchments that were under 1,000 ha along the boundary of the RFA region were investigated to see whether such units were part of a larger undisturbed catchment that extended beyond the region. A lower area threshold of 250 ha was permitted for areas adjacent to the coast.

In order to rationalise the identification of undisturbed catchment areas, boundaries were permitted to include areas of disturbed forest, but not cleared land or substantially modified landscapes such as plantations.

3.3.3 Results

After applying the size threshold of 1,000 ha, significant indicative undisturbed catchments were identified with an area of approximately 1,026,048 ha (Table 3e, Map 4). The areas identified are above threshold level to warrant national estate listing and have been delineated using best available data from the Southern CRA.

Major areas delineated include areas along the great escarpment from Morton National Park to Wadbilliga National Park in the South, and Kosciuszko National Park. Other areas include Brindabella National Park, Tinderry Nature Reserve and Woomargama State Forest. Many of these areas have been previously listed in the Register of the National Estate, including Morton National Park, Deua National Park, Wadbilliga National Park and Kosciuszko National Park.

TABLE 3E: LAND TENURE OF INDICATIVE NATIONAL ESTATE UNDISTURBED CATCHMENT VALUES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	743,800	51%
State Forest	105,100	7%
Reserved and Other Crown Land	28,900	2%
Leasehold Crown Land	10,200	1%
Other Tenures*	138,100	39%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

3.4 OLD-GROWTH FOREST

The assessment of old-growth forest of indicative national estate value is considered under Criterion B.1 (Natural rarity) and Criterion A.2 (Continuing processes). Criterion B.1 focuses on examples of old-growth forest for particular forest communities that are rare or uncommon at a regional level, while Criterion A.2 recognises the importance of old-growth forests for the maintenance of existing natural processes (Appendix A).

The comprehensive regional assessment work is guided by the JANIS criteria which define old-growth forest as 'ecologically mature forest where the effects of disturbances are now negligible' (JANIS 1997, p. 13). Old-growth forests in Australia are considered rare at the national level. Old-growth forests have intrinsic value as the oldest growth-stage of a given vegetation class or community as well as those characteristics, associated with those oldest age class-dominated forests. For example, senescent trees are important for providing nesting and roosting sites for large forest owls and arboreal mammals.

In the Southern CRA region, comparatively large tracts of old-growth forest are to be found along the escarpment from Morton National Park to Wadbilliga National Park in the south. Additional areas also occur in Kosciuszko National Park, the Brindabella Range and Buccleuch State Forest. Most stands of old-growth occur in complex mosaics of mature and younger forest on accessible parts of the coastal ranges. Old-growth is particularly uncommon on the coastal plain.

3.4.1 Method

The old-growth forest identified according to the JANIS criteria was used as the primary data-set for identification of indicative national estate old-growth forest values in the Southern region. Detail on the processes used to delineate old-growth forest can be obtained from the Old-growth Forest Related Projects report (NSW NPWS 1999).

Areas of indicative national estate old-growth forest significant for ecological processes (under criteria A.2) are considered to be those that have high integrity and natural context (as identified by the National Wilderness Inventory biophysical naturalness index) and above a minimum size threshold to ensure the viability and quality of the forest stand.

3.4.2 Establishing the threshold

The old-growth forest layer was overlaid with the natural landscapes and undisturbed catchments layers. It was assumed that within these areas, all old-growth forest regardless of size possesses a high level of integrity. Outside areas of natural landscapes and undisturbed catchments, a minimum viable forest patch size threshold of 100 ha was applied.

3.4.3 Results

The process outlined above delineated 677,934 ha of old-growth forest in the Southern CRA region as above threshold. Approximately 61% is in existing reserves and approximately 18% is in state forest (Table 3f). Areas of indicative national estate old-growth forest, identified under Criterion A.2 are illustrated at Map 5.

TABLE 3F: LAND TENURE OF INDICATIVE NATIONAL ESTATE OLD-GROWTH FOREST

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	410,200	61%
State Forest	120,700	18%
Reserved and Other Crown Land	47,400	7%
Leasehold Crown Land	29,700	4%
Other Tenures*	69,900	10%

*Other tenures includes: Private Land, Commonwealth land, State Forest Plantations, areas under Aboriginal land claims.

4. FLORA AND FAUNA VALUES

Flora and Fauna values in the Southern region were assessed against the Register of the National Estate significance criteria A.1, A.2, A.3, B.1 and D.1 (Appendix A).

Criterion A.1: Importance in the evolution of Australian flora, fauna, landscapes or climate.

Assessment for values under this criterion involved the identification of places where the present distribution and ecology of flora and fauna of Southern NSW reflect the influence of past evolutionary, climatic and environmental processes. These included places important for:

- endemic flora and fauna;
- flora and fauna with disjunct distributions;
- flora and fauna at the limit of their range;
- flora and fauna refugia; and/or
- relictual and primitive flora and fauna.

4.1 FLORA AND FAUNA SPECIES ENDEMIC TO REGION

Endemic species provide an important insight into the process of evolution of flora and fauna (Criterion A.1). Heatwole (1987) noted two processes by which endemism could occur. The first is where a species becomes extinct over the bulk of its range except for small refugia. The second is a long period of isolation leading to the evolutionary divergence of species from a common ancestor (eg Gondwanic species in Australia). In some cases, biogeographic determinants such as the influence of terrestrial and oceanic climatic influences, soils and localised topographic variation may be the main controlling factors in the development of endemism. In other cases the role of climatic refugia in speciation during periods of climate change are important.

For the purposes of the current study, endemic species were regarded as those species with at least 75% of their distribution range confined to Southern NSW. The presence of Hawkesbury Sandstone heath associations and the complex environments of the alpine zone present unique habitats for a high level of endemism in the region. Heatwole (1987) summarised the findings of Kikkawa et al (1979) who studied the relationship of Australian heathlands with their fauna. Heath endemism was generally associated with specialised species more or less restricted to heathland because of speciation, the presence of specific habitat no longer available elsewhere or species isolated phylogenetically and geographically after heath-type habitats retreated in past ages.

4.1.1 Method

The approach taken in identifying flora and fauna data were to create a model using expert defined habitat. Environmental data from the workshops was used to generate an environmental layer derived from API, Forest Ecosystems, Old-growth, Geology and DEM. The following habitats were identified:

- rock, plateaus, bare ground, some heath;
- wetlands, mangroves, coastal associations, estuaries, some rock, heath, casuarina and paperbark;
- estuaries;
- rhyolite outcrops;
- temperate grasslands and woodlands with grass understorey;
- basalt outcrops;
- coastal volcanics;
- granite outcrops;
- Hawkesbury Sandstone inc adjacent sandstone groups;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations;
- Mount Dromedary;
- areas of Kangaroo Valley covered by natural vegetation;
- areas of Snowy River valley covered by natural vegetation;
- areas of Eurobodalla NP covered by natural vegetation; and
- areas of the Great Escarpment covered by natural vegetation.

The model was then verified by comparing it with recorded species localities. If the correlation between the two data-sets was strong then defined habitats were adopted.

Expert workshops and a literature review were used to identify endemic fauna species to compile a species list for the region. A flora list was provided by NSW NPWS and supplemented by a literature review. Expert workshops were used to identify environments likely to be significant for endemic species and to identify known areas important for endemic species.

Species data for fauna were derived from surveys conducted for the comprehensive regional assessment and from the NSW NPWS Wildlife Atlas. Species data for flora were derived from the validated flora data-set used for comprehensive regional assessments.

This information was used to validate the expert defined habitats.

4.1.2 Establishing the threshold

A satisfactory level of correlation between identified statistical centres from the richness layer and the environmental layer were used to refine and threshold the environmental layer. Extraneous environment data were modified or removed from the layer. The final layer was deemed to have a strong enough correlation with identified species statistical centres. This indicated that the final environmental layer was above threshold.

4.1.3 Results

The endemic habitats identified as areas of indicative national estate significance are shown on Map 6 (fauna) and Map 7 (flora). Each area depicted represents foci for endemic species using best available information to the Southern region CRA and all areas identified are above the threshold level warranting national estate listing.

Areas delineated for endemic fauna and flora had similar distributions across the landscape, with fauna areas concentrated along the great escarpment and Kosciuszko National Park, while endemic flora focussed on the northern end of the escarpment, Kosciuszko National Park and Mt Dromedary. The heathland areas of the Sydney Basin (including the Hawkesbury Sandstone) were significant for both fauna and flora, including Barren Grounds Nature Reserve, Jervis Bay, Colymea State Forest, Yalwal State Forest and Morton National Park. Further west, areas with outcropping granite and rhyolite and alpine environments were also significant for endemic species, including Kosciuszko National Park, Brindabella National Park, Buccleuch State Forest, Bago State Forest and Maragle State Forest. Along the coast concentrations of endemic species were found in Mt Dromedary, Conjola National Park, and Conjola State Forest. The areas that were identified include several areas that are already listed in the Register of the National Estate, including Morton National Park, Deua National Park and Kosciuszko National Park.

About 52% of the total area identified as centres of fauna endemism occurs in national park or nature reserve and 10% of the total area is in state forest (Table 4a). Approximately 50% of the total area identified as centres of floristic endemism occurs in national park or nature reserve and 10% of the total area is in state forest (Table 4b).

TABLE 4A: LAND TENURE OF INDICATIVE NATIONAL ESTATE CENTRES OF FAUNA ENDEMISM

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	628,000	52%
State Forest	125,900	10%
Reserved and Other Crown Land	75,400	6%
Leasehold Crown Land	53,800	5%
Other Tenures*	318,300	27%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4B: LAND TENURE OF INDICATIVE NATIONAL ESTATE CENTRES OF FLORA ENDEMISM

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	427,800	50%
State Forest	84,500	10%
Reserved and Other Crown Land	48,700	5%
Leasehold Crown Land	32,600	4%
Other Tenures*	263,700	31%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

4.2 FLORA AND FAUNA WITH DISJUNCT POPULATIONS

Disjunct populations are those that have become physically separated, resulting in minimal or no gene flow between them. This separation could be caused by a break in a formerly continuous distribution or by long-distance dispersal (jump dispersal) over a barrier. Heatwole (1987) summarised features that could act as barriers including climate, topography, vegetation type and intra or inter-species competition. In Southern NSW, the presence of environmental isolates such as the Australian Alps, granite and rhyolite outcrops and rainforest are all conducive to the development of disjunct populations (Covacevich 1991). Often, a disjunction takes the form of a larger parent or core population and a smaller outlier, or outliers, but in some instances, the disjunct populations are of about the same size. Species with disjunct populations can be regarded as being important elements in the evolution of Australian flora and fauna (Criterion A.1).

Disjunct species in Southern NSW were taken to be species with highly specific habitat preferences and low powers of dispersal such as invertebrates, frogs and reptiles, species with documented isolated populations within the region, and associated with fragmented habitat, primarily rocky outcrops.

4.2.1 Method

The approach taken in identifying areas important for disjunct flora species was to create a model using expert defined habitat and then verify with recorded species location analysis. Environmental data from the workshops were used to generate an environmental layer for flora derived from API, Forest Ecosystems, Old-growth, Geology and DEM. The following habitats were identified:

- wetlands, mangroves, coastal associations, estuaries, some rock, heath, casuarina and paperbark;
- Hawkesbury Sandstone including adjacent sandstone groups; and
- rainforests.

The model was then verified by comparing it with recorded species localities. If the correlation between the two data-sets was strong then defined habitats were adopted.

Expert workshops and a literature review were used to identify fauna species with disjunct distributions to compile a species list for the region. A flora list was provided by NSW NPWS and supplemented by a literature review. Expert workshops were used to identify environments likely to be significant for disjunct species and to identify known areas important for species with disjunct distributions.

Species data for flora were derived from the validated flora data-set used for comprehensive regional assessments. This information was then used to validate the expert defined flora habitats

Observed species point analysis was used to create the fauna layer. Species data for fauna were derived from surveys conducted for the comprehensive regional assessment and from the NSW NPWS Wildlife Atlas.

Point location information for all identified species was plotted respectively for fauna on a one kilometre square grid across the region. An analysis was done which then searched for records of disjunct species within a two kilometre radius around each grid cell. The resultant analysis showed concentrations of disjunct species respectively, across the landscape. This statistical distribution analysis was thresholded to only show areas more than two standard deviations above the mean number of species in the landscape.

4.2.2 Establishing the threshold

A satisfactory level of correlation between identified statistical centres from the flora richness layer and the environmental layer were used to refine and threshold the environmental layer. Extraneous environment data were modified or removed from the layer. The final flora layer was deemed to have a strong enough correlation with identified species statistical centres. This indicated that the final environmental layer was above threshold. Note that disjunct fauna was the only layer which was not deemed to have a strong enough correlation, hence statistical distribution was adopted.

4.2.3 Results

The areas identified as having indicative national estate significance for species with disjunct populations are delineated on Map 8 (fauna) and Map 9 (flora). Areas shown represent habitat of species with disjunct ranges (except for disjunct fauna where concentrations of more than two standard deviations above the mean were used) using relevant best available information to the Southern region CRA. All areas identified are significant concerning Australia's evolutionary history and are above the threshold warranted for national estate listing.

Some of the major areas delineated for species with disjunct populations were associated with major ecological divisions, such as the break in alpine environments between the Kosciuszko and Brindabella ranges or discontinuous environments such as heath, outcropping rhyolite and granite and rainforest. Such areas are typified by Kosciuszko National Park and the Hawkesbury Sandstone area, including Nowra State Forest, Colymea State Forest, Yalwal State Forest and Morton National Park. In the coastal sub-region further areas delineated included Benandarah State Forest, Kioloa State Forest, Yerriyong State Forest, Dampier State Forest, and Badja State Forest. In the tablelands sub-region, further areas included Tumut State Forest and Woomargama State Forest.

A total of 167,281 ha were identified as above threshold for fauna with disjunct ranges. Approximately 56% of this was on existing reserves and 20% in state forest. 305,929 ha were identified above threshold for flora with disjunct ranges (Table 4c). Nearly 45% of this was on existing reserves and 18% in state forest (Table 4d). Places already listed in the Register of the National Estate were strongly associated with the areas delineated as having values associated with species that have disjunct distributions.

TABLE 4C: LAND TENURE OF INDICATIVE NATIONAL ESTATE FAUNA SPECIES WITH DISJUNCT RANGES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	93,400	56%
State Forest	33,300	20%
Reserved and Other Crown Land	10,200	6%
Leasehold Crown Land	3,600	2%
Other Tenures*	26,800	16%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4D: LAND TENURE OF INDICATIVE NATIONAL ESTATE FLORA SPECIES WITH DISJUNCT RANGES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	138,000	45%
State Forest	54,500	18%
Reserved and Other Crown Land	27,600	9%
Leasehold Crown Land	3,600	1%
Other Tenures*	82,100	27%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

4.3 FLORA AND FAUNA AT THE END OF THEIR DISTRIBUTION RANGE

Flora and fauna species at the end of their range are those species whose known distribution range terminates within or near the RFA region. The value can reflect broad biogeographic boundaries or past species population movements. Within the context of southern NSW, species at the limit of their range tend to be those species from northern NSW or Victoria who reached their southern or northern distribution limits in the region. There were also a number of woodland species that reached their eastern distribution limit within the region. Distributions and range limits can yield important information relating to past population movements and evolutionary history and species at the end of their range are importance in the evolution of Australian fauna and flora (Criterion A.1).

4.3.1 Method

The approach taken in identifying areas important for flora and fauna species at the end of their range was to create a model using expert defined habitat. Environmental data from the workshops were used to generate an environmental layer derived from API, Forest Ecosystems, Old-growth, Geology and DEM. The following habitats were identified for fauna:

- rock, plateaus, bare ground, some heath;
- wetlands, mangroves, coastal associations, estuaries, some rock, heath, casuarina and paperbark;
- temperate grasslands and woodlands with grass understorey;
- granite outcrops;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations; and
- areas of Kangaroo Valley covered by natural vegetation.

The following habitats were identified for flora:

- wetlands, mangroves, coastal associations, estuaries, some rock, heath, casuarina and paperbark;
- granite outcrops;
- Hawkesbury Sandstone including adjacent sandstone groups;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations; and
- Mount Dromedary.

The model was then verified by comparing it with recorded species localities. If the correlation between the two data-sets was strong then defined habitats were adopted.

Expert workshops and a literature review were used to identify fauna species at the limit of their range. A flora list was provided by NSW NPWS and supplemented by a literature review. Expert workshops were used to identify environments likely to be significant for species at the end of their distribution and to identify known areas important for species at the end of their distribution

Species data for fauna were derived from surveys conducted for the comprehensive regional assessment and from the NSW NPWS Wildlife Atlas. Species data for flora were derived from the validated flora data-set used for comprehensive regional assessments.

This information was used to validate the expert defined habitats.

4.3.2 Establishing the threshold

A satisfactory level of correlation between identified statistical centres from the richness layer and the environmental layer were used to refine and threshold the environmental layer. Extraneous environment data were modified or removed from the layer. The final layer was deemed to have a strong enough correlation with identified species statistical centres. This indicated that the final environmental layer was above threshold.

4.3.3 Results

The areas identified as having indicative national estate significance for species at the limit of their range are delineated on Map 10 (fauna) and Map 11 (flora). Areas shown represent habitats of species at the end of their range using best information available to the Southern region CRA. All areas identified are significant concerning Australia's evolutionary history and are above the threshold warranted for national estate listing.

Areas delineated for species at the end of their range reflect the complex biogeographic patterns occurring in the Southern region. Some of the major areas delineated were the great escarpment from the northern edge of Morton National Park to Wadbilliga National Park to the south, reflecting the gradation of species associated with the Sydney Basin and the North Coast with species from the far South Coast and Victoria. Particularly significant areas included Nowra State Forest, Barren Grounds Nature Reserve, Mt Dromedary, Colymea State Forest and Yalwal State Forest. In the western parts of the region, natural areas with environments such as box-ironbark woodlands and temperate grasslands represent important habitats for inland species reaching the eastern edge of their distribution in areas such as Kosciuszko National Park, Tallaganda State Forest, Bago State Forest, Maragle State Forest, Buccleuch State Forest, and Ellerslie and Woomargama State Forest.

A total of 1,100,640 ha were identified as above threshold for fauna at the limit of their range. 46% of this was on existing reserves and 17% in state forest (Table 4e). 773,463 ha were identified above threshold for flora at the end of their range. 48% of this was on existing reserves and 10% in state forest (Table 4f). Places already listed in the Register of the National Estate were strongly associated with the areas delineated as having values associated with species at the limit of their range.

TABLE 4E: LAND TENURE OF INDICATIVE NATIONAL ESTATE FAUNA SPECIES AT THE LIMIT OF THEIR RANGE

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	499,700	46%
State Forest	189,400	17%
Reserved and Other Crown Land	56,800	5%
Leasehold Crown Land	44,700	4%
Other Tenures*	310,000	28%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4F: LAND TENURE OF INDICATIVE NATIONAL ESTATE FLORA SPECIES AT THE LIMIT OF THEIR RANGE

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	370,900	48%
State Forest	80,700	10%
Reserved and Other Crown Land	47,000	6%
Leasehold Crown Land	30,500	4%
Other Tenures*	244,400	32%

*Other tenures includes: Private Land, ACT, Commonwealth land, State Forest Plantations, areas under Aboriginal land claims.

4.4 FLORA AND FAUNA REFUGES

The high altitude environments, extensive swamps, heaths and wetlands and deeply incised sandstone gorges of Southern NSW provide a diverse array of potential refugia. The Geehi rainforest remnants on the western flanks of Kosciuszko National Park are a significant example of relictual rainforest species occurring in small refugia in an otherwise xeric environment in Southern NSW. Heatwole (1987) noted the cyclic nature of climate in Australian geological history causing a series of long term wetter and drier periods that result in mesic and xeric species respectively radiating and contracting in the landscape. At the extremes of these cycles, species are restricted to small, favourable microhabitats in the landscape (refugia). Refugia are areas where physical and biological attributes combine to provide an environment that is more resilient to climatic variation, severe fire events and drought, than surrounding areas, and are important centres for the conservation of environmentally sensitive species. Consequently, refugia also constitute important sources of genetic variation and are regarded as important centres for species radiation when conditions become more favourable.

Refugia can be identified both as short term refuges from current perturbations such as fire, and long term evolutionary refuges. In the later case, the size of the refugia becomes significant. For example, it has been suggested that landscapes in which rainforests are extensive enough for core areas to have remained comparatively stable during adverse climatic periods are highly likely to have primitive species or concentrations of narrow range endemic species that have disappeared from smaller rainforest areas in the landscape that shrink or disappear all together (Covacevich 1991).

Nix (1982) identified a number of areas along the east coast with high growth indices for species with thermal optimums in the range of 10-12^{o}C and threshold temperatures around 0^{o}C, including the edge of the escarpment in Southern NSW. These disjunct areas support cool temperate rainforests, are similar to South West Tasmania and high altitudes in New Guinea, and can be regarded as potential refugia (Nix 1982, Commonwealth 1992). A range of other environments has already been discussed under endemic species and will be discussed under primitive and relictual species.

In summary, refugia are important for maintaining flexibility and adaptability in times of climatic change, as well as providing an insight into the vegetation of a past period, and the biogeographic and evolutionary processes which have shaped the present biota. These areas are generally also important for many species now uncommon elsewhere (Criteria B.1, A.1, A.2 and D.1).

4.4.1 Method

The approach taken in identifying areas important for flora and fauna refugia was to create a model using expert defined habitat and then verify with recorded species location analysis. Environmental data from the workshops were used to generate an environmental layer derived from API, Forest Ecosystems, Old-growth, Geology and DEM. The following habitats were identified:

- temperate grasslands and woodlands with grass understorey;
- granite outcrops;
- Hawkesbury Sandstone inc adjacent sandstone groups;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations;
- forest red gum associations;
- wet sclerophyll forest with high proportion of senescent trees;
- rainforests;
- box/ ironbark woodlands (in some layers, only includes public land remnants);
- areas of Kangaroo Valley covered by natural vegetation;
- areas of Shoalhaven River Valley covered by natural vegetation;
- areas of steep slope and gorge; and
- areas of Buccleuch SF covered by natural vegetation.

Expert workshops and a literature review were used to identify refugia. Expert workshops were used to identify environments likely to be significant for refugia, and to identify known areas important for refugia. These areas were then validated against the areas identified as important for primitive and relictual species.

4.4.2 Establishing the threshold

Based on expert opinion, all refugia at any scale were important and were considered to be above threshold for listing in the Register of the National Estate.

4.4.3 Results

Areas delineated as refugia are shown on maps 12 and 13. The areas shown represent habitats nominated by experts as refugia, which were validated by comparison with the distribution of primitive and relictual species using best information available to the Southern CRA. All areas identified are significant concerning Australia's evolutionary history, rare, endangered or uncommon flora and fauna and existing natural systems. The areas shown demonstrate principal characteristics of the range of Australia's environments including wetlands, rainforests and coastal environments and are above the threshold warranted for national estate listing.

Refugia were found across the landscape of Southern NSW. There were, however, concentrations of refugia in the steep topography of the Sydney Basin area, notably in the Hawkesbury Sandstone area, including Morton National Park, Nowra State Forest, Currambene State Forest, Colymea State Forest and Yalwal State Forest, and in Kosciuszko National Park. Areas were scattered along the mountainous areas of the great escarpment, from the northern edge of Morton National Park to Wadbilliga National Park in the south, and along the coast in Benandarah State Forest and Kioloa State Forest. Areas were also identified in Tinderry Nature Reserve and Tallaganda State Forest, and in the west of the region in Brindabella National Park, Bago State Forest, Maragle State Forest, Woomargama State Forest, Buccleuch State Forest, Tumut State Forest, and Ellerslie State Forest.

A total of 1,360,838 ha were identified as having potential indicative significance as fauna refugia. Of this, 44% of this was on existing reserves and 16% in state forest (Table 4g). 760,203 ha were identified as having potential indicative significance as flora refugia. 48% of this was on existing reserves and 12% in state forest (Table 4h). Places already listed in the Register of the National Estate were strongly associated with the areas delineated as having values associated with refugia.

TABLE 4G: LAND TENURE OF INDICATIVE NATIONAL ESTATE REFUGIA FOR FAUNA

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	598,500	44%
State Forest	214,400	16%
Reserved and Other Crown Land	81,200	6%
Leasehold Crown Land	65,100	5%
Other Tenures*	401,700	29%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4H: LAND TENURE OF INDICATIVE NATIONAL ESTATE REFUGIA FOR FLORA

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	364,000	48%
State Forest	92,700	12%
Reserved and Other Crown Land	41,500	5%
Leasehold Crown Land	34,800	5%
Other Tenures*	227,200	30%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

4.5 PRIMITIVE, RELICTUAL, AND PHYLOGENETICALLY DISTINCT SPECIES

Relictual, phylogenetically distinct and/or Gondwanic flora and fauna species are generally regarded as those that meet one or more of the following criteria:

- species that appear to possess primitive features;
- species that exhibit features that appear to be different or remote from related species; and
- species that appear to be populations left isolated in the landscape by later climatic or environmental changes.

The Mountain Pygmy Possum (*Burramys parvus*) is an example of both a species generally agreed to have primitive taxonomic features and ancient origins within Australia and also which was once more widespread but is now restricted to alpine environments (Heatwole 1987). Phylogenetically distinct species were taken to be those species whose taxonomic affinities were unknown or unclear such as the Swamp Wallaby (*Wallabia bicolor*) which does not appear to be closely related to any of the other extant groups in the Macropodidae (Merchant 1995).

The deeply incised sandstone escarpments and high altitude alpine environments of Southern NSW provide a variety of habitats suited to the persistence of primitive, relictual and phylogenetically distinct species. The presence of such long-term stable landscapes contribute to the likelihood of persistence of primitive, phylogenetically distinct and relictual species. The wide array of protected microhabitats such as sheltered gullies and rock outcrops also provide contemporary refugia. Floyd (1989) noted that Australian rainforests possessed the greatest concentration of primitive families in the world. Greenslade (1994) noted that relictual Gondwanic species and taxa occupying

geographically discrete sites such as mountain-tops were a high priority for national estate listing. Covacevich (1991) discussed the common Gondwanic origins of heaths and rainforest and related this to the modern similarities between the herpetofauna of heaths and rainforests.

Primitive, relictual or phylogenetically distinct species are important as indicators of evolutionary history, past or current population movements, evidence of past or current speciation and for evidence of past or current decline (Criteria A.1, A.2).

4.5.1 Method

The approach taken in identifying areas important for primitive, relictual or phylogenetically distinct flora and fauna species was to create a model using expert defined habitat and then verify with recorded species location analysis. Environmental data from the workshops were used to generate an environmental layer derived from API, Forest Ecosystems, Old-growth, Geology and DEM.

The following habitats were identified for fauna:

- granite outcrops;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations;
- forest red gum associations;
- wet sclerophyll forest with high proportion of senescent trees;
- rainforests;
- box/ ironbark woodlands (in some layers, only includes public land remnants);
- areas of Kangaroo Valley covered by natural vegetation;
- areas of Shoalhaven River Valley covered by natural vegetation; and
- areas of Buccleuch SF covered by natural vegetation.

The following habitats were identified for flora:

- temperate grasslands and woodlands with grass understorey;
- Hawkesbury Sandstone inc adjacent sandstone groups;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations;
- rainforests;
- box/ ironbark woodlands (in some layers, only includes public land remnants); and
- areas of steep slope and gorge.

The model was then verified by comparing it with recorded species localities. If the correlation between the two data-sets was strong then defined habitats were adopted.

Expert workshops and a literature review were used to identify primitive, relictual or phylogenetically distinct fauna species to compile a species list for the region. A flora list was provided by NSW NPWS and supplemented by a literature review. Expert workshops were used to identify environments likely to be significant for primitive, relictual or phylogenetically distinct species and to identify known areas important for primitive, relictual or phylogenetically distinct species.

Species data for fauna were derived from surveys conducted for the comprehensive regional assessment and from the NSW NPWS Wildlife Atlas. Species data for flora were derived from the validated flora data-set used for comprehensive regional assessments.

This information was used to validate the expert defined habitats.

4.5.2 Establishing the threshold

A satisfactory level of correlation between identified statistical centres from the richness layer and the environmental layer were used to refine and threshold the environmental layer. Extraneous environment data were modified or removed from the layer. The final layer was deemed to have a strong enough correlation with identified species statistical centres. This indicated that the final environmental layer was above threshold.

4.5.3 Results

The areas identified as having indicative national estate significance for primitive, relictual and phylogenetically distinct species are delineated on Map 12 and 13. Areas shown represent an amalgamation of sites known to be rich in species with primitive, relictual or phylogenetically distinct fauna. These have been cross-referenced with habitats nominated by experts as important for fauna, flora or invertebrates, using the best information available to the Southern region CRA. All areas identified are significant with regard to Australia's evolutionary history and existing natural systems and are above the threshold warranted for national estate listing.

The areas delineated for this value are concentrated in the Hawkesbury Sandstone heath area, including Morton National Park, Nowra State Forest, Currambene State Forest, Colymea State Forest and Yalwal State Forest, and in the alpine environment of Kosciuszko National Park. Areas were scattered along the great escarpment, from the northern edge of Morton National Park to Wadbilliga National Park in the south, and along the coast in Barren Grounds Nature Reserve, Benandarah State Forest and Kioloa State Forest. Areas were also identified in Tinderry Nature Reserve and Tallaganda State Forest, and in the west of the region in Brindabella National Park, Bago State Forest, Maragle State Forest, Woomargama State Forest, Buccleuch State Forest, Tumut State Forest, Ellerslie State Forest.

A total of 1,360,838 ha were identified as above threshold for primitive, relictual and phylogenetically distinct fauna species. Of this, 44% of this was on existing reserves and 16% in state forest (Table 4i). 760,203 ha were identified as above threshold for primitive, relictual and phylogenetically distinct flora species. 48% of this was on existing reserves and 12% in state forest (Table 4j). Places already listed in the Register of the National Estate were strongly associated with the areas delineated as having values associated with primitive and relictual species.

TABLE 4I: LAND TENURE OF INDICATIVE NATIONAL ESTATE PRIMITIVE, RELICTUAL AND PHYLOGENETICALLY FAUNA DISTINCT SPECIES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	598,500	44%
State Forest	214,400	16%
Reserved and Other Crown Land	81,200	6%
Leasehold Crown Land	65,100	5%
Other Tenures*	401,674	29%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4J: LAND TENURE OF INDICATIVE NATIONAL ESTATE PRIMITIVE, RELICTUAL AND PHYLOGENETICALLY FLORA DISTINCT SPECIES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	364,037	48%
State Forest	92,650	12%
Reserved and Other Crown Land	41,501	5%
Leasehold Crown Land	34,811	5%
Other Tenures*	227,204	30%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

Criterion A.2: Importance in maintaining existing processes or natural systems at the regional or national scale

The identification of areas of indicative national estate significance under this criterion involves assessment of places important for the maintenance of natural ecosystem processes. These include abiotic processes (eg: those related to hydrological and nutrient cycles) and biotic processes (those related to the life cycles and interdependence of plant and animal species in the forests, woodlands, heathlands, sedgelands, swamps and wetlands of the region). Values that may be considered include:

- important wildlife habitat (eg habitat for migratory species);
- refuges for fauna (see refugia under Criterion A.1 above);
- remnant vegetation; and
- places important for vegetation succession.

Places important for undisturbed catchments and old-growth forest are addressed in extensive natural values.

4.6 IMPORTANT HABITAT

Important fauna habitat is generally regarded as areas important as feeding, breeding or nursery sites or known breeding sites for rare or uncommon fauna. In the Southern region, important habitat was used to define a number of environments that the experts considered were of national estate significance or else that were identified for a wide range of species values.

The complex system of coastal lakes, lagoons and wetlands were identified as a significant habitat in the region for migratory and estuarine species including JAMBA and CAMBA species. Blue Lake constitutes a significant and unique RAMSAR wetland in the region. Southern region is also significant for inter-region migrants. The extensive Spotted Gum (*Corymbia macculata*) forests of the region as well as the western box-ironbark woodlands are a major seasonal flowering resource for inter-regional migrants such as flying foxes and nomadic honeyeaters including the Regent Honeyeater. The Murrumbidgee corridor was identified as a significant corridor for migratory bird species through the landscape. Temperate grasslands and Forest Red Gum (*Eucalyptus tereticornis*) stands were identified as important habitat for a range of unique species threatened by an array of human disturbances. The great escarpment is a major, long term corridor in the landscape. This view is supported by Heatwole's (1987) discussion on significant corridors and barriers in the landscape. Heatwole (1987) listed the evidence to suggested that the great dividing range has, over geological history, acted as a corridor for mesic-adapted species along the east coast, and as a significant barrier to the radiation of xeric-adapted species during drier periods from inland Australia. Worboys (1996) also identified the great escarpment as a major, continental-scale conservation feature.

The value is important for rare, vulnerable or endangered species, Australia's evolutionary history, demonstrating the principal characteristics of forested landscapes and ecosystems and is related to maintaining existing processes (Criteria A.1, A.2, B.1 and D.1).

4.6.1 Method

Expert workshops and a literature review were used to identify important fauna habitats. These workshops were used to identify environments likely to be significant for important habitat and to identify areas known to contain important habitat. The habitats nominated by experts were validated against the areas identified as important habitat.

Environmental data from the workshops were used to generate an environmental layer derived from API, Forest Ecosystems, Old-growth, Geology and DEM.

The following habitats were identified as being important habitat:

- rock, plateaus, bare ground, some heath;
- wetlands, mangroves, coastal associations, estuaries, some rock, heath, casuarina and paperbark;
- temperate grasslands and woodlands with grass understorey;
- forest red gum associations;
- wet sclerophyll forest with high proportion of senescent trees;
- *Eucalyptus cypellocarpa* forest with high proportion of senescents;
- rainforest;
- swamp mahogany associations;
- concentrations of bloodwood and spotted gum associations (flowering trees);
- box/ ironbark woodlands (in some layers, only includes public land remnants);
- areas of Murrumbidgee River Corridor covered by natural vegetation;
- areas of Bungonia State Rec Area covered by natural vegetation;
- areas of the Great Escarpment covered by natural vegetation; and
- areas of Buccleuch SF covered by natural vegetation.

The model was then verified by comparing it with areas identified by experts important habitat localities. If the correlation between the two data-sets was strong then defined habitats were adopted.

4.6.2 Establishing the threshold

A satisfactory level of correlation between identified statistical centres from the richness layer and the environmental layer were used to refine and threshold the environmental layer. Extraneous environment data were modified or removed from the layer. The final layer was deemed to have a strong enough correlation with identified species statistical centres. This indicated that the final environmental layer was above threshold.

4.6.3 Results

The areas identified as having indicative national estate significance for important habitat are delineated on Map 14. The areas delineated in this layer are those environments nominated by experts for an array of values relating to important habitat including migratory species, evolutionary processes in the landscape and a range of bat species. Areas shown were delineated using the best information available to the Southern region CRA. All areas identified are significant with regard to Australia's evolutionary history, existing natural systems, principal characteristics of forested landscapes and rare or uncommon species and are above the threshold warranted for national estate listing.

The areas delineated for important habitat are concentrated along the great escarpment, from the northern edge of Morton National Park to Wadbilliga National Park in south, and in Buccleuch State Forest. Further areas are scattered along the coast, including Benandarah State Forest, Kioloa State Forest, Boyne State Forest and Conjola National Park. To the west areas are scattered across Kosciuszko National Park, and in areas of box-ironbark woodlands and temperate grasslands including Woomargama State Forest and Ellerslie State Forest.

A total of 884,762 ha were identified as above threshold for important habitat. 38% of this was on existing reserves and 23% in state forest (Table 4k). Areas already listed in the Register of the National Estate that were identified in this study as having values for important habitat tended to be those occurring along the great escarpment, and on the coastal areas.

TABLE 4K: LAND TENURE OF INDICATIVE NATIONAL ESTATE IMPORTANT HABITAT

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	338,100	38%
State Forest	206,500	23%
Reserved and Other Crown Land	52,600	6%
Leasehold Crown Land	37,000	4%
Other Tenures*	25,100	29%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

4.7 REMNANT VEGETATION AND RARE OLD-GROWTH FOREST

Remnant vegetation provides important refuge and recruitment areas for both flora and fauna, and is important in maintaining existing natural systems within disturbed landscapes. Large-scale clearing for agriculture west of the Great Dividing Range has removed native vegetation from extensive areas of the western part if the region. Much of the remaining forest, woodland and grassland in this area is fragmented. Most of the coastal plain in the Southern region is forested. However the lower tracts of the Shoalhaven valley, which was once significantly covered by large tracts of rainforest, has largely been cleared, and much of the extensive remaining forest on the coast is regrowth or mixed aged forest. Old-growth is a comparatively uncommon feature in this coastal environment.

Rare old-growth forest was assessed together with remnant vegetation as many of the conservation issues are closely related. Rare old-growth forest are those old-growth forest communities that are rare or uncommon nationally or within the Southern region. They also include common forest communities where the levels of disturbance are such that all remaining old-growth forest areas are potentially of national estate significance. Rare, endangered or uncommon old-growth forest communities were identified in the Southern region as being vegetation communities where old-growth forest as a proportion of the forest community is generally less than 20% (derived from the JANIS criteria and expert advice).

Remnant vegetation is important for demonstrating the principal characteristics of forested landscapes and ecosystems, rare or uncommon species and is related to maintaining existing processes (Criteria A.2, B.1 and D.1).

4.7.1 Method

Remnant vegetation was derived using the following:

- forest ecosystems whose extant coverage was 10% or less of the estimated pre-1750 area based on data presented by NSW NPWS to the Environment Heritage and Technical Committee (EHTC).

Rare old-growth forest was derived using the following:

- any old-growth which has a 100% JANIS target, based on data presented by NSW NPWS to the Environment Heritage and Technical Committee (EHTC); and
- any old-growth forest where 20% or less of its pre-1750 area of the current forest ecosystem remains. This is based on data presented by NSW NPWS to the EHTC.

4.7.2 Establishing the threshold

Areas that met the above criteria were identified as above threshold.

4.7.3 Results

The areas identified as having indicative national estate significance for remnant vegetation and rare old-growth forest are delineated on Map 15 (remnant vegetation) and Map 16 (rare old-growth). The areas delineated in this layer are those identified as significant with regard to existing natural systems, principal characteristics of forested landscapes and rare or uncommon species and are above the threshold warranted for national estate listing.

Remnant vegetation occurs in scattered small units, mostly in the tablelands area where remaining temperate grassland and box-ironbark woodlands still remain. The greatest concentrations occur in Kosciuszko National Park, Carabost State Forest and Bungongo State Forest. Rare old-growth forest is found scattered across the landscape, with the greatest concentrations found in Tinderry Nature Reserve, Kosciuszko National Park, Maragle State Forest, and Brindabella National Park.

A total of 12,576 ha were identified as above threshold for remnant vegetation. 11% of this was on existing reserves and 8% in state forest (Table 4l). 169,067 ha were identified as above threshold for rare old-growth. 41% of this was on existing reserves and 18% in state forest (Table 4m). Areas already listed in the Register of the National Estate that were identified in this study as having values for remnant vegetation and old-growth were primarily Kosciuszko National Park and Tinderry Nature Reserve.

TABLE 4L: LAND TENURE OF INDICATIVE NATIONAL ESTATE REMNANT VEGETATION

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	1,383	11%
State Forest	948	8%
Reserved and Other Crown Land	731	6%
Leasehold Crown Land	435	3%
Other Tenures*	9,079	72%

*Other tenures includes: Private land, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4M: LAND TENURE OF INDICATIVE NATIONAL ESTATE RARE OLD-GROWTH FOREST

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	69,690	41%
State Forest	30,637	18%
Reserved and Other Crown Land	15,583	9%
Leasehold Crown Land	12,591	8%
Other Tenures*	40,566	24%

*Other tenures includes: Private land, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

4.8 VEGETATION SUCCESSION

Places that are important for vegetation succession contain forest communities that have dynamic examples of succession occurring within them, areas affected by fire (halting primary succession processes), and forest communities recovering from major wildfires. Although it was recognised that specific examples may exist in the region, time and data constraints precluded any specific analysis of vegetation succession for the Southern region.

Criterion A.3: Importance in exhibiting unusual richness or diversity of flora
The identification of areas of indicative national estate significance under this criterion involves assessment of places important for diversity and or richness of natural values. The national estate assessment of this value sought to identify areas of particular richness and diversity in the region for:

- species richness (alpha diversity);
- flora community (beta) diversity; or
- habitat richness.

4.9 FLORA AND FAUNA SPECIES RICHNESS

Flora and fauna species richness, also known as alpha diversity, is measured as the number of species occurring within an area of a given size. Southern NSW comprises an area of diverse habitats from sub-alpine environments to coastal complexes. Areas of high species richness can be indicative of sites where repeated species radiation and contraction has occurred, identifying centres for refugia and major long-term evolutionary centres for speciation (Heatwole 1987; Pianka 1981; Kitching 1981; Cogger and Heatwole; 1981, 1984). Species richness is considered under Criterion A.3 for exhibiting unusual richness or diversity of fauna or flora.

4.9.1 Method

The approach taken in identifying areas of importance for flora and fauna species richness was to create a model using expert defined habitat and then verify with recorded species locations. Environmental data from the workshops were used to generate an environmental layer derived from API, Forest Ecosystems, Old-growth, Geology and DEM.

The following habitats were identified:

- rock, plateaus, bare ground, some heath;
- wetlands, mangroves, coastal associations, estuaries, some rock, heath, casuarina and paperbark;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations;
- wet sclerophyll forest with high proportion of senescent trees;
- basalt outcrops;
- coastal (Gerrigong) Volcanics;
- Hawkesbury Sandstone including adjacent sandstone groups;
- rainforests;
- Mount Dromedary; and
- areas of Mount Budawang covered by natural vegetation.

The model was then verified by comparing it with recorded species localities. If the correlation between the two data-sets was strong then defined habitats were adopted.

Expert workshops and a literature review were used to identify fauna species to compile a species list for the region. A flora list was provided by NSW NPWS and supplemented by a literature review. Expert workshops were used to identify environments likely to be significant for species richness and to identify known areas important for species richness.

Species data for fauna were derived from surveys conducted for the comprehensive regional assessment and from the NSW NPWS Wildlife Atlas. Species data for flora were derived from the validated flora data-set used for comprehensive regional assessments.

This information was used to validate the expert defined habitats.

4.9.2 Establishing the threshold

A satisfactory level of correlation between identified statistical centres from the richness layer and the environmental layer were used to refine and threshold the environmental layer. Extraneous environment data were modified or removed from the layer. The final layer was deemed to have a strong enough correlation with identified species statistical centres. This indicated that the final environmental layer was above threshold.

4.9.3 Results

The areas identified as having indicative national estate significance for species richness are delineated on Map 17 (fauna) and Map 18 (flora). The areas delineated in this layer are areas with high concentrations of species in the landscape, delineated using the best information available to the Southern region CRA. All areas identified are significant with regard to exhibiting unusual richness or diversity of fauna or flora and are above the threshold warranted for national estate listing.

Areas that were delineated for species richness occur across a broad landscape. Flora richness was concentrated in the Hawkesbury Sandstone heath area, reflecting the high degree of endemism including Nowra State Forest, Barren Grounds Nature Reserve, Colymea State Forest and Yalwal State Forest and Morton National Park. Other important areas for richness were associated with the volcanic cap of Mt Dromedary and the unique environments of Kosciuszko National Park. Fauna richness occurred over a broader area, with concentrations along the great escarpment from Morton National Park to Wadbilliga National Park, and in Tallaganda State Forest, Tinderry Nature Reserve, Kosciuszko National Park, Buccleuch State Forest, Bago State Forest, and Maragle State Forest.

A total of 1,012,112 ha were identified as above threshold for fauna species richness. 48% of this was on existing reserves and 17% in state forest (Table 4n). 269,771 ha were identified above threshold for flora species richness. 48% of this was on existing reserves and 14% in state forest (Table 4o). Places already listed in the Register of the National Estate were strongly associated with the areas delineated as having values associated with species richness.

TABLE 4N: LAND TENURE OF INDICATIVE NATIONAL ESTATE FAUNA SPECIES RICHNESS

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	490,574	48%
State Forest	168,101	17%
Reserved and Other Crown Land	44,303	4%
Leasehold Crown Land	38,747	4%
Other Tenures*	270,387	27%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4O: LAND TENURE OF INDICATIVE NATIONAL ESTATE FLORA SPECIES RICHNESS

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	128,996	48%
State Forest	37,986	14%
Reserved and Other Crown Land	19,915	7%
Leasehold Crown Land	3,078	1%
Other Tenures*	79,796	30%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

4.10 VEGETATION COMMUNITY RICHNESS

Significant plant community richness, or high beta diversity, is often seen in places where, because of sharp environmental gradients or marked changes in soils, drainage or other variables, there are unusually diverse conjunctions or rapid transitions of forest community types. In Southern NSW these environments are typified by the elevation gradient of the great escarpment and associated river gorges, where vegetation communities vary over a comparatively small distance. This value is important for Criterion A.3, exhibiting unusual richness or diversity of flora.

Although some vegetation communities were considered and it was recognised that rich areas of vegetation communities may exist in the region, time and data constraints precluded any comprehensive analysis of vegetation community richness. The nature of forest ecosystems was investigated as part of the CRA process. This has enhanced our understanding of vegetation diversity and richness in the region.

It should be noted that the work conducted for refugia, flora richness, remnant vegetation, and rare vegetation communities, identified particular landscape features and broader features which are important areas for vegetation community richness and diversity. These include landscapes features such as areas of steep slope and gorge, wetlands or rainforest, and broader features such as and such as the Hawkesbury Sandstone and adjacent sandstone groups, and Kosciuszko National Park.

4.11 HABITAT RICHNESS

Habitat richness has been defined as areas where, because of environmental gradients, there is an unusual increase in the variety of habitats available. This category is important as an indicator for areas of potential high biodiversity (Criterion A.3).

Although it was recognised that representative examples may exist in the region, time and data constraints precluded any comprehensive analysis of habitat richness. It should be noted that the work conducted for fauna species richness and flora species richness, refugia and important habitat identified particular landscape features and broader areas important for habitat richness. These include landscape features such as areas of steep slope and gorge, and broader areas such as the Hawkesbury Sandstone and adjacent sandstone groups, and Kosciuszko National Park.

Criterion B.1: Importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness

This criterion recognises the importance of biotic elements which are rare or uncommon, or have become so through the effects of disturbances or threatening processes. The following values relate to this Criterion:

- rare old-growth forest;
- rare and threatened flora and fauna species, and
- rare, threatened or uncommon plant communities.

4.12 RARE OLD-GROWTH FOREST

Rare old-growth forest has been dealt with as part of the remnant vegetation layer (section 4.7).

4.13 RARE, THREATENED OR UNCOMMON FLORA AND FAUNA SPECIES AND THEIR HABITATS

For the purposes of this layer, rare species were regarded as species listed on State or Commonwealth legislation as rare, vulnerable or endangered. This layer identifies areas of importance to rare, endangered or uncommon species and which are of significance in maintaining existing processes (Criteria B.1, A.2).

4.13.1 Method

The approach taken in identifying areas important for rare flora and fauna species was to create a model using expert defined habitat. Environmental data from the workshops were used to generate an environmental layer derived from API, Forest Ecosystems, Old-growth, Geology and DEM. The following habitats were identified:

- rock, plateaus, bare ground, some heath;
- wetlands, mangroves, coastal associations, estuaries, some rock, heath, casuarina and paperbark;
- estuaries;
- rhyolite outcrops;
- temperate grasslands and woodlands with grass understorey;
- basalt outcrops;
- coastal (Gerrigong) volcanics;
- Hawkesbury Sandstone including adjacent sandstone groups;
- snow gum/ black sallee associations;
- snow gum/ mountain gum associations;
- snow gum/ alpine ash associations;
- bogong gum/ peppermint associations;
- miscellaneous sub-alpine associations;
- wet sclerophyll forest with high proportion of senescent trees;
- rainforests;

- box/ ironbark woodlands (in some layers, only includes public land remnants);
- areas of Kangaroo Valley covered by natural vegetation;
- areas of Eurobodalla NP covered by natural vegetation;
- areas of the Great Escarpment covered by natural vegetation;
- areas of Steep slope and gorge; and
- areas of Buccleuch SF covered by natural vegetation.

The model was then verified by comparing it with recorded species localities. If the correlation between the two data-sets was strong then defined habitats were adopted.

Expert workshops and a literature review were used to identify rare fauna and flora species. Expert workshops were used to identify environments likely to be significant for rare species and to identify known areas important for rare species. Species data for fauna were derived from surveys conducted for the comprehensive regional assessment and from the NSW NPWS Wildlife Atlas. Species data for flora were derived from the validated flora data-set used for comprehensive regional assessments.

This information was used to validate the expert defined habitats.

4.13.2 Establishing the threshold

A satisfactory level of correlation between identified statistical centres from the richness layer and the environmental layer were used to refine and threshold the environmental layer. Extraneous environment data were modified or removed from the layer. The final layer was deemed to have a strong enough correlation with identified species statistical centres. This indicated that the final environmental layer was above threshold.

4.13.3 Results

The areas identified as having indicative national estate significance for rare species are delineated on Map 19 (fauna) and Map 20 (flora). This layer delineates areas that are important for endangered species and areas with concentrations of rare and uncommon species. The layer uses the best information available to the Southern region CRA. All areas identified are significant with regard to importance for rare, endangered or uncommon species and maintaining existing natural processes.

Areas delineated for rare fauna occurred across a broad landscape. Areas important for rare fauna were identified along the great escarpment, from the northern edge of Morton National Park to the south in Wadbilliga National Park, and across Kosciuszko National Park. Further areas included Tinderry Nature Reserve, Buccleuch State Forest, Bago State Forest, Maragle State Forest, and Woomargama State Forest. These western areas are particularly important for sphagnum bogs, box-ironbark woodlands and temperate grasslands. Flora values were concentrated on the Hawkesbury Sandstone and associated heath environments, including Nowra State Forest, Colymea State Forest, Yerriyong State Forest and Morton National Park, and in Jerrawangala State Forest and McDonald State Forest. Other significant areas included the unique environments of Mt Dromedary and Kosciuszko National Park.

A total of 1,417,639 ha were identified as above threshold for rare fauna. 45% of this was on existing reserves and 15% in state forest (Table 4p). 309,985 ha were identified above threshold for rare flora. 48% of this was on existing reserves and 14% in state forest (Table 4q). The analyses identified most significant existing places in the Register of the National Estate as having values associated with this criterion.

TABLE 4P: LAND TENURE OF INDICATIVE NATIONAL ESTATE RARE FAUNA SPECIES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	646,493	46%
State Forest	217,049	15%
Reserved and Other Crown Land	81,787	6%
Leasehold Crown Land	65,894	5%
Other Tenures*	406,416	29%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

TABLE 4Q: LAND TENURE OF INDICATIVE NATIONAL ESTATE RARE FLORA SPECIES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	149,400	48%
State Forest	41,739	14%
Reserved and Other Crown Land	27,719	9%
Leasehold Crown Land	4,090	1%
Other Tenures*	87,037	28%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

4.14 RARE, THREATENED OR UNCOMMON VEGETATION COMMUNITIES

In the Southern region CRA 'forest ecosystems', 'plant communities' and 'forest vegetation types' are all considered to refer to the same vegetation units and are used interchangeably. Rare vegetation communities are important for demonstrating the principal characteristics of forested landscapes and ecosystems, and endangered, rare or uncommon species and is related to maintaining existing processes (Criteria A.2, B.1 and D.1).

4.14.1 Method

The expert workshop that considered the results of the forest ecosystem project identified that all vegetation communities that required a 100% target under JANIS were above threshold for national estate. The distribution of these communities was mapped from the forest ecosystem layer. All occurrences of these ecosystems were regarded as above threshold.

4.14.2 Establishing the threshold

Thresholds were established as discussed above.

4.14.3 Results

The areas identified as having indicative national estate significance for rare vegetation communities are delineated on Map 21. These areas were identified using the best information available to the Southern region CRA. All areas identified are significant with regard to endangered, rare or uncommon species, demonstrating the principal characteristics of some extremely uncommon vegetation communities and maintaining existing processes. These areas are above the threshold warranted for national estate listing.

The areas above threshold for rare vegetation communities are scattered across the landscape of Southern NSW, with the strongest concentration occurring to the west of the region in areas where temperate grassland and box-ironbark woodlands remain. Major focal points in the west include Green Hills State Forest, Tumblong State Forest, Buccleuch State Forest, Bungongo State Forest and areas of Kosciuszko National Park. In the east the major focal points include Bodalla State Forest, Jervis Bay National Park, Conjola State Forest, and Tinderry Nature Reserve.

A total of 33,272 ha were identified as above threshold for rare vegetation communities. 14% of this was on existing reserves and 9% in state forest (Table 4r). The areas identified as above threshold correlated did not correspond with places registered in the Register of the National Estate.

TABLE 4R: LAND TENURE OF INDICATIVE NATIONAL ESTATE RARE VEGETATION COMMUNITIES

Tenure	Approximate Area (ha)	Proportion of Total (%)
National Park or Nature Reserve	4,772	14%
State Forest	2,948	9%
Reserved and Other Crown Land	1,845	6%
Leasehold Crown Land	1,131	3%
Other Tenures*	22,576	68%

*Other tenures includes: Private land, ACT, Commonwealth land, State Forest plantations, areas under Aboriginal land claims.

Criterion D.1: Importance in demonstrating the principal characteristics of the range of landscapes, environments or ecosystems, the attributes of which identify them as being characteristic of their class.

This criterion recognises the significance of identifying and conserving 'representative examples' of the range of features of the Australian environment. The following value was assessed under this Criterion.

- flora communities characteristic of their class.

4.15 PRINCIPAL CHARACTERISTICS OF CLASS

Principal characteristics of class recognises the significance of identifying and conserving "representative examples" of the range of landscapes, environments or ecosystems. Although some vegetation communities were considered and it was recognised that representative examples may exist in the region, time and data constraints precluded any comprehensive analysis of principal characteristic of class for environments or ecosystems. It should be noted that the work conducted for refugia, migratory species, remnant vegetation, rare vegetation communities, and important habitat identified particular landscape features such as wetlands or rainforest and broader features such as forested landscapes along the great escarpment that should be regarded as some of the best examples in temperate Australia and that the sub-sections dealing with these values have been noted as dealing with D.1.

5. OTHER NATURAL VALUES

5.1 GEOLOGICAL AND GEOMORPHOLOGICAL AND SOIL VALUES

The identification and assessment of sites of indicative national estate geoheritage significance in the Southern region CRA forest region was undertaken as part of a state-wide assessment by Osborne et al (1998).

Areas that may be identified as having geoheritage value (Criteria A.1, A.2, A.3, B.1, C.1 and D.1) include places important:

- in the evolution of Australian landscapes or climate (A.1);
- in maintaining existing processes or natural systems at the regional or national scale (A.2);
- in exhibiting unusual richness or diversity of landscapes (A.3);
- for rare, endangered or uncommon natural landscapes or
- phenomena (B.1);
- for information contributing to a wider understanding of Australian natural history by virtue of its use as a research site, teaching site, type locality, reference or benchmark site (C.1); or
- in demonstrating the principal characteristics of the range of landscapes, environments or ecosystems, the attributes of which identify them as being characteristic of their class (D.1).

5.1.1 Method

The methodology being undertaken for the project includes:

- the development and application of thresholds for national estate assessment purposes based on a review of the significance of the identified sites;
- documentation of potential national estate geoheritage sites;
- sensitivity analysis of all potential national estate geoheritage sites; and
- development of conservation management guidelines for those sites identified

The consultant assessed scientific journals and other published material for place-related information that was likely to identify potential places of geoheritage significance. Published geological maps and topographic maps were examined and potential features of geological significance identified. Other sources of data included contact with various institutions, and contact with numerous experts.

5.1.2 Establishing the threshold

Potential places were listed against the relevant national estate criteria identified in regional reviews undertaken by the consultant. Places were classified into three groups depending on the quality of data on values and location:

- the values and location of the place can be determined from the available data;
- there is insufficient data available at this time to the values at the place; or
- there is insufficient data available as to the location of the place.

The consultant has recommended that because of limitations in the data, including poorly defined locality information and a lack of ground truthing, that it would not be appropriate to threshold the sites. Accordingly, the data may be used to enhance documentation of national estate places identified from other assessments, and as a contextual layer for reserve design.

A lack of suitable data did not mean that these places lack significance or that with more detailed literature or field investigation their status could not be satisfactorily established in the future. However, it was not possible to undertake this further work within the constraints of the CRA assessments.

5.1.3 Results

Of the sites where spatial information was available, 671 Geoheritage sites (unthresholded) were delineated for the Southern CRA region, 153 occurring in national parks, 10 in state forests, 8 in leasehold crown land, 44 in reserved crown land and other crown land, and 456 in other tenures (including private land) land (See Appendix K and Map 22. Note that Map 22 is incorrectly titled and should read Areas Identified as Potential Geoheritage). There were some additional sites identified where spatial information was not available. The areas identified as a result of this process are yet to be delineated spatially.

The conservation management guidelines were limited to a 'fragility' ranking. A four step scale was applied to each place, where spatial information was available, corresponding to the extreme ends of the scale used by Dixon et al (1997) to classify sensitivity of sites identified, 1 being highly sensitive to 4 being highly robust for each place report.

5.2 NATURAL HISTORY VALUES

The identification and assessment of sites of indicative national estate natural history significance in the Southern region CRA forest region was undertaken as part of a state-wide assessment by Denny (1998).

Areas which may be identified as having natural history value (Register of the National Estate significance Criterion C.1) include places important *'…for information to contributing to the wider understanding of Australian natural history, by virtue of its use as a research site, teaching site, type locality, reference or benchmark site'*.

5.2.1 Method

Data sources included literature searches of established journals, conference proceedings, contact with various institutions including natural history societies, and contact with numerous experts. The consultant assessed the national estate values of identified places against the Register of the National Estate significance criteria by ranking the importance of each site, in terms of its contribution to Australian natural history. The sites were ranked as having high, moderate or low value.

5.2.2 Establishing the threshold

Various factors were used to derive threshold values for each site type including such elements as the rigour of methodology, accuracy of location, the availability of information and overall reliability of the data sources used. By applying the elements described above, the consultant ranked each site as having high, moderate or low value. It was recommended that sites with a high or medium ranking be considered above threshold.

5.2.3 Results

A total of 272 Natural History sites were delineated for the Southern CRA region (Map 23), 92 occurring in national parks, 14 in state forests, 1 in leasehold crown land, 6 in reserved crown land and other crown land, and 159 in other tenures (including private land) (Appendix L).

6. PROTECTING NATURAL HERITAGE VALUES AND PLACES IN NSW FORESTS

The existing protective mechanisms for natural heritage values and places in NSW forests is summarised in a table at Appendix J. The table lists the existing off-reserve protective mechanisms and their sensitivity to disturbance.

7. NATIONAL ESTATE CULTURAL VALUES

Cultural places of national estate significance can have aesthetic, historic, scientific or social heritage values. These values may be articulated in the physical features of a place or in their connection with intangible qualities such as people's associations with, or feelings for, a place.

Documentary and community-centred research has revealed a wide range of cultural places within or related to the forests of the Southern NSW CRA region. These places are indicative of the rich and diverse history of human interaction with, and in response to, those forests.

Throughout the CRA process, the following non-Indigenous cultural values were considered:

- places of social or community value;
- places of historic value; and
- places of aesthetic value.

In addition to the assessment of Southern cultural heritage values, a Statewide project is examining the protection and management of Indigenous and non-Indigenous cultural heritage values and places in forests. The aim of this project is to produce a workable set of principles and guidelines for forest land managers to ensure the protection of cultural heritage values through RFAs.

The national estate cultural heritage component of the CRA has considered forest and forest-related cultural places within the study area across all land tenures. Cultural heritage places have mainly been identified on public lands. In the instances where places of indicative national estate heritage value are located on private land, it is the policy of the AHC to undertake detailed consultation with all relevant land owners and other parties to verify the significance of the place prior to any action being taken in relation to its listing in the Register of the National Estate. No action towards national estate listing for any places on private land identified in this report will be taken until such consultation has occurred.

The Southern national estate assessment was undertaken in 1998-1999. The cultural assessments were directed by the Cultural Heritage Working Group (CHWG). The group consisted of New South Wales National Parks and Wildlife Service (NSW NPWS), State Forests New South Wales (SFNSW), New South Wales Heritage Office, New South Wales Resource and Conservation Division, New South Wales Department of Aboriginal Affairs, New South Wales Aboriginal Land Council, Environment Australia, and stakeholder representatives (Appendix C). The projects were undertaken by Environment Australia (EA) and NSW National Parks and Wildlife Service (NPWS) in consultation with State Forests New South Wales (SFNSW).

7.1 ASSESSMENT CRITERIA FOR CULTURAL VALUES

In a regional context, the determination of national estate significance is a process which begins in the early stages of place identification and documentation with the application of descriptions of place by groups, categories and themes, and ends with the application of a threshold of significance. Specific criteria are used in the development of significance indicators and the setting of the threshold. These criteria form part of the *Australian Heritage Commission Act 1975.* These criteria are listed in Appendix A.

Each threshold is set in relation to the significance indicators and is specific to each national estate value. For instance, to reach the threshold for a particular national estate value, a place may need to rank highly on three out of five significance indicators. In other cases, a place may, however, be highly ranked on just one significance indicator and still reach the national estate threshold. The point at which the threshold is set depends on the importance or relevance of the significance indicator to the national estate value.

The relationship between significance indicators and the national estate threshold is established through consideration of the quantity and quality of available information, through expert opinion and discussion, and through consideration of previous national estate thresholding and listing decisions. The indicative national estate threshold of significance for each criterion was determined by the NSW Cultural Heritage Working Group (CHWG).

A national estate threshold is not graded: a place will either meet the threshold or not. Places may be significant against more than one national estate criterion, although a place need only be significant against one criterion to warrant identification as having indicative national estate value.

7.2 COMMUNITY CONSULTATION

Communities provide important information for the identification of cultural heritage places. In addition, community involvement is essential for the assessment of aesthetic and social value significance because the national estate criteria (AHC Criteria E.1 and G.1) used to assess these values specify that they must be of significance to a community or cultural group. For the purpose of this study 'the community' refers to any group of people with a common ground. The cultural heritage assessments undertook consultation with the community as follows:

- workshops with local community groups in regional locations;
- workshops with forest and park officers;
- local community based social value research;
- a community review process of the community derived cultural value data; and
- meetings with Indigenous communities.

The community workshops provided a venue to introduce the CRA process, and engage local communities, major Statewide stakeholder and user groups in the identification of places of heritage value in the region. All information gathered from the community sources will be returned to public repositories in the form of an Inventory of Community Heritage Places.

The meetings with Indigenous communities provided the opportunity both for the dissemination of information about the CRA process, and as a means of establishing a process for the gathering and verification of information and protocols.

8. NON-INDIGENOUS CULTURAL HERITAGE

8.1 INTRODUCTION

The CHWG developed a series of projects to identify, assess and document non-Indigenous cultural heritage values in the Southern CRA Region. The projects included:

- a data audit of existing cultural heritage data;
- an overview thematic forest history;
- an assessment of historic value;
- a community heritage assessment (targeting social value); and
- an assessment of places with aesthetic value.

The data audit was conducted first in order to identify a range of priority historic themes for investigation. These themes were explored in the overview thematic history, and field examples were documented in the assessment of places with historic value. The primary data source for the community heritage, aesthetic assessment and, to a lesser degree, the historic assessment, were community heritage workshops held as part of the community heritage assessment.

8.2 DATA AUDIT INTEGRATION AND ANALYSIS

A statewide cultural heritage data audit integration and analysis project was undertaken for New South Wales (Pearson and Rosen 1997). The objectives of the project were to investigate and assess available non-Indigenous cultural heritage information across the New South Wales CRA regions and to integrate the available information into data-sets for ongoing use throughout the CRA process. A further aim was to identify gaps in information to allow targeting of future cultural heritage investigations.

8.2.1 Method

The methodology involved for undertaking the project incorporated the following:

- preparation of an annotated bibliography of sources relating to the history and non-Indigenous cultural heritage of the forests of the New South Wales CRA study areas.
- identification of existing data-sets and reports relating to non-Indigenous heritage places within the forests of the New South Wales CRA study areas.
- development of recommendations for integrating this information into a database for ongoing use throughout the CRA process.
- integration of information into appropriate databases and Geographical Information Systems (GIS) coverages, focussing initially on Eden CRA area and then the remaining CRA areas including Southern.
- analysis of the resulting data-sets to highlight deficiencies and gaps in the data and develop recommendations for a strategic approach to future data collection and management.

8.2.2 Results

The project has developed GIS coverages showing the location of recorded non-Indigenous heritage places within the forests of the New South Wales CRA areas. A computer database bibliography was compiled, with over 6000 entries, of sources relating to the history and non-Indigenous cultural heritage of the forests of the CRA study areas. The report also identifies existing non-Indigenous heritage databases and reports relating to heritage sites and places in the New South Wales CRA study areas.

It was concluded that the NSW State Heritage Inventory (SHI) database was the best database for integrating CRA place data. The following recommendations were made:

- all land management agencies involved in forest area management adopt the SHI database as a single database for the entry of non-Indigenous place recording and assessment data;
- all participating land management agencies adopt common standards for the recording, assessment and entry of place-related data in the NSW SHI database, and have free access to the SHI database for all forest-related sites;
- all participating land management agencies implement a program of data transfer from existing place records into the NSW SHI database; and
- that State Forests develop strategies to protect significant places from loss of national estate (or SHI) values through harvesting activities.

8.2.3 Gaps in knowledge and information.

A number of further studies were recommended in order to address the substantial gaps and limitations identified in the report. These included:

- systematic area or regional studies of the state forest and national Park forests in the Southern and Eden CRA regions. Studies should specifically include identifying and recording forest industry places, forest and park management places, mining places, pastoral and agricultural land uses, and European settlements in a regional and, where possible, a state context.
- forest industry and forest management studies on an area or regional basis across all CRA regions, utilising new and existing information, and targeted field survey to: define the utilisation and management of the forests, identify related places and patterns of interaction, and identify any regionally or temporally distinctive patterns.

- mining industry studies on an area or regional basis across all CRA regions, utilising new and existing information, and targeted field survey to: clarify and describe the mining history in the forests, and identify related places and patterns of interaction within mining places and associated transport and settlement patterns.
- pastoral and agricultural industry studies on an area or regional basis across all CRA regions, utilising new and existing information, and targeted field survey to: define and describe the alienation, lease or license of forested land for pastoral and agricultural land uses, and the subsequent re-absorption into public forest lands; to identify related places and patterns of interaction; and to identify any regionally or temporally distinctive patterns.

It was further recommended that in carrying out future studies, the already identified places be assessed using the SHI significance criteria.

8.3 OVERVIEW THEMATIC FOREST HISTORY

The Overview Thematic Forest History project was undertaken to provide an historical overview as a context for assessing the heritage resource of the Southern CRA region forests (Bickford, Brayshaw and Proudfoot 1998). Historic places relate primarily to the non-Indigenous culture of Australia although some may also have Aboriginal values.

The Statewide non-Indigenous Data Audit project highlighted the deficiencies of the knowledge and recorded data pertaining to places of historic value in the regions forests. Key historical themes identified as requiring further investigation are outlined in section 8.2.

8.3.1 Method

During the first stage of the overview thematic history a review of existing data was undertaken, including the results of the Statewide Cultural Heritage Data Audit, Integration and Analysis (non-Indigenous) project.

Based on the themes identified in the Data Audit, the project investigated a number of historical themes. The consultants gathered together a large amount of primary and secondary source material relevant to the Southern CRA regions. This material was incorporated for interpretation as a broad historical framework. Place specific information from the historical research was used to guide and prioritise targeted field investigations (refer section 8.2).

The themes developed were cross-referenced and consistent with the Principal Australian Historic Themes developed by the AHC, and the NSW State Heritage Manual 1997.

8.3.2 Results

The results of the report were identified by seperate key themes. These included:

- State bodies responsible for guardianship of forested areas;
- forest philosophy;
- landscapes;
- timber-getting;
- people and settlement;
- Aboriginal contact and continuity;
- utilising forest resources; and
- mining.

Products developed from the project include:

- an overview report of thematic forest history (non-Indigenous) in the Southern CRA region;
- identification of specific historic heritage themes of relevance to the Southern CRA region; and
- identification of place specific information to be used to be used in targeted field investigations.

8.4 PLACES OF HISTORIC VALUE

This project assessed places with historic value in the Southern CRA region (Bickford, Brayshaw and Proudfoot 1998). Places were assessed for national estate significance against the Australian Heritage Commission Criteria A.3, A.4, B.2. C.2, D.2, F, and H (refer Appendix A). Aspects of heritage significance covered by these criteria are:

- richness and diversity of cultural features (A.3)
- important in the course and pattern of history (A.4)
- rarity of features (B.2)
- research potential relating to human history (C.2)
- important example of a type of place (D.2)
- technical or creative achievement (F); and
- association with the life or works of an important person or group (H).

Places with historic value relate primarily to the non-Indigenous culture of Australia although some may also have Aboriginal values. Among the wide range of places with historic value associated with forests and identified in the Southern region are homesteads, sawmills, mining sites, bridges, and outstanding examples of trees.

A range of themes were identified for further investigation in the Statewide non-Indigenous Data Audit and Gaps Analysis project (see Section 8.2). Resources did not permit detailed field surveys as part of the project to investigate these themes further. Instead, data gathered through the community heritage workshops and overview thematic forest history were used to target sites of potential national estate significance that were representative of the above themes.

8.4.1 Method

The assessment involved preparation of a select list of themes and sites for further historical research and field survey. These were based upon the results of the thematic historical overview (Bickford, Brayshaw and Proudfoot 1998), and the community heritage workshops (Context 1999). The results of the community heritage workshop included places that were nominated for their historic value. Many of these places were also nominated for other values, such as social value or values from the natural environment.

Targeted research and field investigations of key places of historic significance was then carried out on twenty four sites. These sites were selected to represent the range of sites that exist in the region.

In light of deficiencies identified in the data audit, sites were selected for field assessment based on the following:

- priority for Aboriginal historic places;
- priority for mining and forestry places, including ephemeral sites;
- consideration of plantation sites; and
- otherwise places from a range of other themes.

8.4.2 Results

Twenty three places were assessed and identified as above threshold for historic value (refer Appendix M and Map 24.). These include homesteads such as Currango Homestead, mining sites such as Lobbs Hole Copper Mine and Adelong Falls Gold Working Area, and communication routes such as the Wool Road. Other places include Stan Kelly's Providence Alpine Sawmill, Lowden Logging Camp and Pilot Hill Arboretum.

8.5 SOCIAL VALUE ASSESSMENT

The community heritage values identification and assessment project sought to identify and assess forest-related places of potential community heritage value (Context 1998).

The identification and assessment of National Estate values was based on the National Estate Criterion G.1, which recognises places that are highly valued by a community for reasons of religious, spiritual, symbolic, cultural, educational, or social associations (see Appendix A).

The primary source of data for identifying and assessing places of indicative National Estate social value during the CRA were the communities of Southern New South Wales.

8.5.1 Method

Community workshops were held across the region. Workshop locations were selected on the basis of a wide range of demographic, geographic, industry and social information as well as time and budgetary consideration.

Six workshop locations were chosen: Nowra, Braidwood, Moruya, Cooma, Tumut and Crookwell. The Crookwell workshop was cancelled due to a low response. In place of this workshop, invitees were sent letters and place record sheets asking them to identify and document heritage places in the region.

The workshops were planned with the assistance of local community coordinators in each location. A wide range of community groups and individuals representative of local communities were invited to participate. The Regional Forest Forum members also suggested some possible invitees for the workshops.

A total of one hundred people participated in the five workshops.

The workshops involved participants working in small groups and through individual reflection to list places, discuss priorities, and record key information about each place. This was followed by voting to help identify the places with the most significant community values.

Information obtained through the community workshop process was also used as a source of data in the identification and assessment of places of aesthetic value in the region, as well as places of historic value.

8.5.2 Establishing the threshold

Since not all places are equally valued by the community, a sorting process was used to identify those places of indicative social national estate significance. Many places had multiple values, and many had another cultural value as the primary value. Those places which demonstrated no evidence of social value were excluded from further assessment.

Community research was then conducted to validate the indication of G.1 value.

Data from the workshops and community research were then assessed to determine whether or not a place would satisfy one or more of the three significance indicators:

- important to the community as a landmark, marker or signature;
- important as a reference point in a community's identity or sense of itself; and
- strong or special community attachment developed from use and/or association.

To determine whether sufficient information had been collected for each place that had qualified for further assessment against the national estate social value criterion, a second sort was done using three questions:

- is there an identifiable community that is associated with the place?
- is there sufficient data to determine the location and boundary of the place?
- is there sufficient data available to assess its significance?

Where sufficient information was available, the national estate social value of the place was assessed. To determine whether a place met the national estate threshold for social value, four significance indicators were used:

- the extent of the associated community;
- strength of association;
- length of association; and
- relative importance of the identified community.

The community heritage project collected and analysed a vast amount of data, with the following results:

- 519 places were identified at the workshops.
- 246 of these demonstrated evidence of social value.
- 31 of these identified places were assessed for social value.

8.5.3 Results

Thirty places were assessed as being above threshold for national estate significance in the Southern region (refer Appendix N and Map 25).

The range of places assessed as above threshold reflects the types of places to which the communities are attached. These include the Corn Trail, Durras Mountain, Tuross Falls and Gorge, Mountain Huts on the Kosciuszko High Plains, Yarrangobilly Caves and the Beecroft Peninsula.

8.6 PLACES OF AESTHETIC VALUE

The identification and assessment of forest places of aesthetic value were based on National Estate Criterion E.1, which recognises places *'exhibiting particular aesthetic qualities valued by a community or cultural group'* as having heritage significance (see Appendix A).

The working definition of 'aesthetic value' developed for regional assessments in Victoria was also used:
'Aesthetic value is the response derived from the experience of the environment or particular natural and cultural attributes within it. This response can be to either visual or non-visual elements and can embrace emotional response, sense of place, sound, smell and any other factors having a strong impact on human thought, feelings and attitudes.'
(Australian Heritage Commission & Department of Conservation and Natural Resources 1994, p. 5).

8.6.1 Method

Stage 1 of this project consisted of an expert workshop which reviewed data sources and methods used in the forest assessments elsewhere and established a preliminary method for the New South Wales CRAs.

At the expert workshop, there was broad agreement that the definition of aesthetic significance called for a wide range of community and expert data sources to be used in heritage assessments. These sources include art and literature, tourism information, applied landscape research, community perception studies and information held by land and natural resource managers. Past studies have also shown that local communities are a rich source of information.

The following data sources were used in the Southern assessment (Stage 2) (Hibbard 1999):

- data from regional NPWS and SFNSW staff who participated in forest staff workshops;
- data of potentially significant aesthetic places and values identified and documented at the Southern CRA Region Community Heritage workshops (see section 8.5); and
- documents held by SFNSW and NPWS.

Forest staff workshops for the Southern region were held at Narooma and Tumut in 1998. The workshop venues were chosen to correspond with the locations of regional offices of SFNSW and NPWS, within the Southern region. The workshops were attended by seven participants.

The workshops involved staff from NPWS and SFNSW. The officers were asked to individually nominate places of aesthetic value. The workshop as a group reviewed the mapped locations of these sites. Participants were then asked to identify gaps and overlaps in their initial lists of places, and places were sieved to eliminate less important places. Site values were then described and mapped by the participants.

Place details and documentation were also obtained from the community heritage values workshops. A detailed description of the workshop process is provided in section 8.5. The community workshops involved members of the local community, including community groups. Attendees were asked to identify and record details of places of potential cultural significance. Many of these places were identified as having multiple values, such as social and aesthetic values, and values from the natural environment.

Sites identified as having potential aesthetic value to workshop participants at the forest staff workshops and at the community heritage workshops were reviewed and intersected to provide an initial list of sites.

The initial threshold used to identify sites as potentially significant for aesthetic value were:

- identified at forest staff workshops as being of aesthetic value; and
- identified at community heritage workshops for aesthetic value. These places were commonly identified as also other values, such as social value, or values from the natural environment.

The results identified the following places:

- 81 places of aesthetic value were identified in the Southern region at the forest staff workshops.
- 286 places with potential aesthetic significance were identified at Community Heritage Workshops.

Places with the potential to be above threshold for heritage significance and which were able be documented in detail after the workshop were selected based on three triggers developed by the Cultural Heritage Working Group. The triggers were applied to the initial thresholded list.

These three triggers were:

- good locational data for sites;
- good geographical spread of sites; and
- sites already in the Register of the National Estate would receive some recognition because of this status. This would also allow existing information on places already in the Register of the National Estate to be updated.

Available resources were limited to undertake field assessments. Therefore, additional thresholding was undertaken to reduce the number of sites for field assessment. This thresholding was based on the qualitative data on site description sheets, analysed according to the reasons given by staff workshop participants for identifying places as being of aesthetic value.

8.6.2 Results

Thirty three sites were assessed as being above threshold for national estate significance (refer Appendix O and Map 26). Some of these places were also assessed as having other cultural values by other projects. The assessed places ranged from rivers such as the Snowy River and Mongarlowe River and Environs, communication routes such as oldsStock routes and explorers' routes in the Jindabyne area, and entire areas of forest such as the state forests of the Nowra Management Area. Other places assessed included Bomaderry Creek Bushland, Woola Slab Built Homestead, and Blue Waterholes.

9. INDIGENOUS HERITAGE ASSESSMENTS

The Indigenous heritage assessment did not document and identify specific sites and areas. Instead, the projects were designed to ensure that the needs and concerns of Aboriginal people in the region are met by focusing on the development of preferred options as to how communities want to be involved in forested land management processes and cultural heritage management. The Indigenous cultural heritage assessment in the Southern region were guided by the South Coast and Tablelands Aboriginal Management Committees

Aboriginal national estate values usually refer to attachment to land, based on a wide range of traditional and contemporary land uses. Aboriginal heritage places are often assessed against the national estate Criterion G.1, which recognises strong or special association with a particular community or community group for social, cultural or spiritual reasons (see Appendix A).

Aboriginal interests in the Southern region are diverse, and include not only areas of cultural significance, but also areas of social and economic importance. The projects undertaken as part of the assessment of Indigenous heritage values in the Southern region included: a statewide Indigenous consultation process, a statewide archaeological overview and the mapping and documenting of Indigenous heritage values.

9.1 CONSULTATION PROCESS

A statewide project has been established to ensure a coordinated approach across the New South Wales CRA/RFA regions for consultation with Indigenous peoples and the preparation of assessment projects relating to Indigenous communities' values within forested areas.

9.1.1 Method

The consultation method established incorporates:

- the formation of Aboriginal Management Committees in each region;
- dissemination of information to Indigenous communities on the CRA process in each CRA region; and
- the development of projects associated with the assessment of Indigenous forest values in consultation with Aboriginal communities and relevant CRA/RFA technical committees/working groups.

9.1.2 Results

A comprehensive consultation process in the Southern CRA Region was implemented through:

- formation and operation of the South Coast and Tablelands Aboriginal Forest Management;
- Indigenous community involvement in the development and undertaking of assessment projects in the Southern region; and
- participation of Indigenous representatives during the development of RFA scenarios.

9.2 MAPPING OF INDIGENOUS HERITAGE VALUES

This project is currently underway. The project was designed to map and document places and landscapes of significance to Aboriginal people in the Southern region. It aims to ensure that places and sites of Aboriginal cultural significance are mapped and documented accurately according to the wishes and interests of the tribal elders of the various Aboriginal communities within the region.

The material provided by informants is subject to confidentiality provisions and can only be released to third parties with the consent of the person who provided it.

9.3 STATEWIDE ARCHAEOLOGICAL OVERVIEW

The two main aims of the Overview of Archaeological Resource on Forests Project for Southern were to give a clear indication of the nature of the forest archaeological resource and to stimulate discussion between natural resource and cultural heritage managers on archaeological identification and management issues for the CRA/Regional Forest Agreements (Lomax 1997).

The project dealt with the scientific values of the resource as opposed to the aesthetic, social or historic values held by Aboriginal people, which must be also be assessed for management purposes.

9.3.1 Method

A report was produced which collated and synthesised existing archaeological forest studies. Qualitative assessment of methods and outcomes was undertaken. Issues discussed include:

- the nature and extent of research undertaken;
- possible future data requirements;
- the analytical potential of the resource and its implications for management;
- technical issues pertaining specifically to defining the empirical nature of the resource;
- the range of natural and cultural impacts on the resource and implications for the management of minimally disturbed areas;
- different models of management in terms of their operational viability and effectiveness to maintain a ‘representative’ sample of the resource; and
- options for the management of archaeological values in New South Wales forests.

9.3.2 Results

The project resulted in the following:

- a report providing an overview of the extent and nature of forest archaeological research and implications for future data and research requirements; and
- increased awareness of management issues based on adequate understanding of the empirical nature of the resource.

The report provides background information to be used as a basis for technical discussions during the 'Protecting Cultural Heritage Values and Places in the New South Wales Forest Estate CRA Project' and to assist the Ecologically Sustainable Forest Management (ESFM) project management group in their assessment of management issues regarding the archaeological resource in forests.

10. PROTECTING CULTURAL HERITAGE VALUES AND PLACES IN NEW SOUTH WALES FORESTS

The protecting cultural heritage values and places in New South Wales forests project is currently in progress. The objectives of the project are as follows:

- to provide a comprehensive overview of current protective mechanisms and management practices for the conservation of cultural heritage values and places (Indigenous and non-Indigenous) in New South Wales forests.
- to assess the adequacy and efficiencies of current protective mechanisms and management practices, and identify issues associated with the management and protection of cultural heritage values and places in New South Wales forests.
- to establish conservation principles relating to the identification, conservation and management of cultural heritage values in forests, and to develop clear and practicable guidelines to assist in ensuring the conservation of those values through the NSW Regional Forest Agreements
- to provide advice and input into the ESFM assessment process.

10.1.1 Method

The project is being undertaken in a series of stages as follows:

- Stage One - overview and analysis of current framework (legislative and non-legislative) for the protection and management of cultural heritage values and places in New South Wales forests.
- Stage Two - broad consultative and site inspection process in each CRA region to examine the application of current protective mechanisms and identify further issues associated with the management of cultural heritage values and places in the New South Wales forests.
- Stage Three - development of a set of workable conservation principles and guidelines for the protection and management of cultural heritage values and places that address land resource managers, Indigenous communities, and other relevant stakeholders needs and requirements, including State and Commonwealth legislative requirements.

10.1.2 Results

The expected outcomes of this project are as follows:

- a report, detailing current protective mechanisms for cultural heritage values and places;
- a report, identifying issues raised through site visits/inspections, and issues and needs of each agency associated with the protection and management of cultural heritage values and places raised by land and resource managers;
- a report, identifying issues and needs associated with the protection and management of Indigenous cultural heritage values and places raised by Indigenous communities; and
- a report detailing workable conservation principles and guidelines in a form suitable for use by land/resource managers for the protection and management of cultural heritage values and places in New South Wales forests.

11.NATIONAL ESTATE OUTCOMES

11.1 NATIONAL ESTATE OUTCOMES: CULTURAL VALUES

The national estate assessment of the cultural values of the forests of the Southern region was designed to achieve the best practicable understanding of the range and distribution of forest places of cultural significance within the timeframe of the CRA.

The non-Indigenous cultural assessments were based on a study of social, aesthetic, and historic values. The heritage outcomes for Indigenous values included the development of Aboriginal Management Committees, and the mapping and documenting of places and landscapes of significance to Aboriginal people in the Southern region. Indicative national estate places of Indigenous significance were not identified.

Indicative places of potential national estate non-Indigenous cultural value were identified through a heritage data audit, thematic studies, and through input of the communities of the Southern region. The outcomes of the assessments of these values helped to fill major gaps in the understanding of national estate forest cultural values.

The following are among the main outcomes from the assessment of these values:

- identification of over 65 indicative cultural national estate forest places in the Southern region;
- identification of a wide range of places, including rivers, mountains, outstanding trees, communication routes and historic buildings, which provide the community with a sense of identity and attachment to forests; and
- a greater understanding of which places are valued by the community and why. This will be used to inform the development of conservation strategies for places of social significance to ensure this value is considered in forest management.

11.2 FUTURE RESEARCH: CULTURAL VALUES

The principal factors constraining the identification of cultural forest places of potential national estate significance were the standard of existing documentation for individual places and the extent to which new data could be gathered within the time frame of the CRA. As a result, the national estate studies of historic, aesthetic, and social forest places have identified and documented only a small portion of the potential national estate forest places that meet the cultural criteria.

11.2.1 Historic value

Many places of historic value with potential national estate significance in the forests of the Southern region could not be documented and assessed in the time available. A number of gaps were identified in the Data Audit. Some of these themes were investigated in the Thematic Forest History and Heritage Assessment, but further research focussing on forest industry and forest management, and pastoral and agricultural studies would enhance the understanding of some of the places already documented.

11.2.2 Social value

The community heritage workshops were an invaluable source of information about forest places of importance to the communities of the Southern region, and information from the workshops was used in the assessment of community heritage, aesthetic and historic values. The time and resources available, however, limited the number and location of workshops and the scale at which the workshops could be conducted. There will be many other places of social value to various community groups that were not represented at the workshops. These places can be identified in the future only through a community-based consultation process.

The community consultation process of returning information for comment resulted in a number of places being identified by the community which were not researched as part of the project. These were noted in the Inventory of Community Heritage Sites (Context 1998). It is anticipated that the Inventory will be used as a base to encourage further research and conservation of heritage places.

11.2.3 Aesthetic value

Resources available for the project did not allow detailed investigation of all places of potential aesthetic value, particularly those with difficult access. Further investigation and community consultation is therefore recommended for places of potential aesthetic national estate value.

11.3 CONSERVATION OF NATIONAL ESTATE VALUES

An objective on the Southern Regional Forest Agreement is to provide for the conservation of environment and heritage values through the development of a framework of comprehensive, adequate and representative reserve systems, and ecologically sustainable forest management. Fundamental to the environment and heritage objectives for the RFA is ensuring that national estate values are adequately protected within this framework.

While some national estate values, notably extensive values such as old-growth forests and natural landscapes, may be best protected by formal reservation, other values, particularly values found at localised sites, including those with historic or archaeological features, may be best protected through other mechanisms such as management prescription.

A component of the CRA has been the assessment by an independent expert advisory group of the systems and processes for ecologically sustainable forest management. Included in this assessment was an examination of the information, policy, planning, implementation, and review mechanisms for conserving heritage values.

The results of this assessment process will contribute to the development of the Southern Regional Forest Agreement between New South Wales and the Commonwealth.

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13.GLOSSARY

Aerial Photo Interpretation (*API*) - the delineation and identification of landscape features using photos taken from the air that are viewed in pairs using a stereoscope to create a three-dimensional image.

Aesthetic value - value which recognises the response derived from the experience of the environment or particular natural and cultural attributes within it. This response can be to either visual or non-visual elements and can embrace emotional response, sense of place, sound, smell and any other factors having a strong impact on human thought, feelings and attitudes.

Arboreal - tree-dwelling.

ARC/INF0 - software used to display and analyse spatially represented data.

Assemblages - collections of populations of different species that live in the same area.

Biodiversity - see biological diversity.

Biogeography - the interaction between the biotic (living), and a - biotic (non - living) elements of the world, including climate, topography, geology etc.

Biological diversity - the variety of all life forms: the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form. Biological diversity is usually considered at three levels: genetic diversity, species diversity, and ecosystem diversity. It is sometimes considered at the level of landscape diversity.

Biophysical - a combination of physical features, such as climate, soils, geology and landforms, and biological features, such as flora and fauna.

Biophysical Naturalness (*BN*) - an indicator used in the national wilderness inventory related to the intensity and duration of interference with an ecosystems.

Bioregion - a region defined by a combination of biological, social and geographic criteria rather than geopolitical criteria; generally, a system of related, interconnected ecosystems.

Bryophytes - liverworts, mosses and hornworts: green, non-vascular land plants without seeds, numbering at least 18 000 species. They are among the simplest of the terrestrial plants but occupy a variety of habitats and show considerable diversity.

CAMBA - China - Australia Migratory Bird Agreement

Comprehensive, adequate and representative reserve system - a reserve system displaying the features of comprehensiveness, adequacy and representativeness:

- comprehensiveness - the degree to which the full range of ecological communities and their biological diversity is incorporated in the reserve system.
- adequacy - the reserve system's ability to maintain the ecological viability and integrity of populations, species and communities.
- representativeness - the extent to which areas selected for inclusion in the reserve system are capable of reflecting the known biological diversity and ecological patterns and processes of the ecological community or ecosystem concerned.

Clear - felling - a logging system that results in the felling of all standing trees.

Comprehensive regional assessment (*CRA*) - a joint Commonwealth–State assessment of all forest values - environmental, heritage, economic and social - leading to the establishment of a comprehensive, adequate and representative reserve system, agreements on forest management, and the signing of a regional forest agreement.

Conservation - the protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment.

Conservation advice and principles - the Australian Heritage Commission has a statutory obligation to provide advice on the protection of the National Estate. The advice is based on conservation principles that are aimed at protecting and maintaining national estate places and values. Advice is available for land management agencies and individuals that own places that have been identified as having national estate value.

Context - the position of a feature or area in the landscape relative to the rest of the landscape or topographic features, other vegetation or disturbance. For example, some values such as old - growth forest need to be considered in context; that is, in terms of their relationship to disturbance, other vegetation and the landscape in general.

Criteria - used by the Australian Heritage Commission to determine whether places meet the requirements for listing in the Register of the National Estate. The criteria are stipulated in the Australian Heritage Commission Act 1975.

Cultural heritage - generally refers to the past and present cultural associations of people. Cultural heritage can be tangible in the form of physical manifestations such as buildings or artefacts or intangible in the form of spiritual or social associations, songs, stories and practices.

Cultural significance - social, aesthetic, historic or scientific value for present, past or future generations.

Disjunct - populations physically separated from one another; that is, there is no or minimal gene flow between the populations. They are formed over time as a result of the appearance of a barrier in a formerly continuous distribution. Disjunct populations often have features that are distinctive in an evolutionary sense from those of the 'parent' population and in time may become separate species.

Disturbance - encompasses a range of factors that affect the condition of natural areas. Disturbance may be natural or human induced. Natural disturbance includes wildfires and rainstorms and is part of natural ecological processes. Human - induced, or 'unnatural', disturbance includes timber harvesting, agricultural clearing, mining and grazing. The factors that are important when considering disturbance are the origin, duration and intensity of the disturbance and its impact on the environment.

Disturbance data - records of disturbances such as clearing, grazing, fire or timber harvesting that may affect themes, species or assemblages being assessed.

Diversity - a measure of the physical or biological complexity of a system. It refers to a range of features, from artifact scatters to species presence.

Ecosystem

- a set of normally co - occurring and interacting species associated with a particular setting in the physical environment.
- the aggregate of plants, animals and other organisms, and the non - living parts of the environment with which these organisms interact.
- a dynamic complex of plant, animal, fungal, and micro - organism communities and the associated non - living environment interacting as an ecological unit.

Endemic species - species confined to a specific region or locality.

Environmental gradient - a description of the proximity of different environments. For example, a steep environmental gradient might describe the changes from coastal sands through heath to tall forest over a comparatively short distance.

Forest - in the context of the New South Wales–Commonwealth Regional Forest Agreement, an area, incorporating all living and non - living components, that is dominated by trees having usually a single stem and a mature or potential mature stand height exceeding 8 metres and with existing or potential projective cover of overstorey strata about equal to or greater than 5%.

Forest association

- a method of classifying forest types based on associations of the dominant tree species in the canopy.
- a vegetation classification that subdivides a forest type by either structure or understorey floristic composition.

Forest type - a vegetation classification defined by the dominant overstorey species.

Genetic diversity - the variety of genetic information contained in all individual plants, animals and micro - organisms. It occurs within and between populations of species as well as between species.

Geoconservation - the identification and protective management of geological, geomorphological and soil features, assemblages, systems and processes (geodiversity) for their intrinsic, ecological or heritage values.

Geodiversity - the natural range (diversity) of geological (bedrock), geomorphological (landform) and soil features, assemblages, systems and processes. Geodiversity includes evidence for the history of the earth (evidence of past life, ecosystems and environments) and a range of processes (biological, hydrological and atmospheric) currently acting on rocks, landforms and soils.

Geographic information system (*GIS*) - a system displaying spatially represented data; for example, Idrisi for Windows and ARC/INFO.

Geoheritage - those components of geodiversity that are important to humans for purposes other than destructive exploitation; things we would wish to retain for present and future generations.

Geology - the scientific study of the bedrock composition of the earth, including its origin, structure, composition, history, and past and present processes. Geological features contribute to geodiversity.

Geological characteristics - features and structures associated with the formation of the earth's

crust as well as major landform units such as mountains.

Geomorphology - the scientific study of landforms - the surface morphology of bedrock substrates and the past and present processes responsible for landform development. Geomorphological features contribute to geodiversity.

Gondwanan/Gondwanic - refers to those characteristics or features relating to an ancient phase of the earth's development, when the landmasses of the Southern Hemisphere were joined together. This agglomeration of the southern continents is termed Gondwana.

Great escarpment - the eastern fall of the great dividing range which forms a more or less continuous series of ranges that divides the RFA region into eastern coastal areas and western ranges and associated tablelands.

Habitat - the place or environment in which an organism naturally occurs.

Heritage - encompasses all those things we have inherited from previous generations. Heritage includes places (including national estate places), things (moveable objects) and folklore (customs, songs and sayings).

Interim Biogeographic Regionalisation of Australia (*IBRA*) - a bioregional framework delineating natural regions in each State and Territory based on biophysical, environmental and vegetation considerations - for example, climate, soils, landform, vegetation, flora and fauna, and land use - that allow cross-border regionalisation.

Interim list - the Australian Heritage Commission enters places on the interim national estate list by announcing, in the press and in the Commonwealth Government Gazette, its intention to register those places. Once a place is on the interim list, and before it can be entered in the Register of the National Estate, there is a minimum statutory period of three months during which any person can object to the proposal in writing. If objections are received they must be given due consideration by the Commission, but uppermost consideration must be given to the national estate significance of the place.

Isopleth - a line drawn on a map connecting points having the same numerical value of a given variable, analogous to a contour line on a topographic map.

JAMBA - Japan-Australia Migratory Bird Agreement.

JANIS - The national agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia, prepared by the joint ANZECC/MCFFA national forest policy statement implementation sub-committee.

Karst - environments with distinctive landforms and drainage characteristics resulting from the relatively high solubility of some rock types, notably limestones and dolomites, in natural waters.

Lithology - the general characteristics of rock formations, such as composition and texture, and the sequence in which the formations were laid down.

Macropod - the group of marsupials including kangaroos and wallabies.

Maintenance - the continuous protective care of the fabric, contents or setting of a place, as distinct from repair. Repair involves restoration or reconstruction.

Metadata - information about the content, quality, condition and other characteristics of datasets.

Microclimate - the suite of climatic variables (temperature, humidity etc) associated with a small part of an environment such as a river bank, the base of a tree or under a small stand of trees.

National estate - is a collection of places - components of the natural or cultural environment of Australia - that have aesthetic, historic, scientific or social significance or other special value for future generations and for the present community.

National estate values - the aesthetic, historic, scientific or social values attributed to places by the Australian Heritage Commission.

National forest policy statement - The statement that outlines the jointly agreed Commonwealth and State objectives and policies for the future of Australia's public and private forests.

Old-growth forest - the National Forest Policy Statement defined old-growth forest as 'forest that is ecologically mature and has been subjected to negligible unnatural disturbance such as logging, roading and clearing'. For the purposes of this assessment, the proposed operational interpretation from JANIS (1996) was used; that is, 'old-growth forest is ecologically mature forest where the effects of disturbances are now negligible'.

Paleoclimatic - The climatic conditions (moist, dry, glacial, etc) considered to be associated with a defined area at any point in prehistory.

Phylogenetic - referring to the evolutionary line of descent of an individual taxon or groups of taxa.

Pleistocene - a period (epoch) of geological history covering the period from approximately 1.6 million years before present up to 10, 000 years before the present day.

Primitiveness - used taxonomically to describe species that have features associated with the evolutionary past of a group. For example, the salamander fish has features rarely found in fish of the southern hemisphere and is regarded as therefore being primitive.

Quaternary - a period of geological history covering the period from approximately 1.6 million years before present up to and including the present day.

RAMSAR - The convention on wetlands of international importance, commonly known as the RAMSAR convention.

Rare species - Species with small world populations that are not at present endangered or vulnerable but are at risk.

Recovery plan - a comprehensive plan that details, schedules and costs all actions deemed necessary to support the recovery of a threatened species or ecological community.

Refugia, refuges - biological communities or geographic entities that, because of their moderating structural characteristics or physical isolation, or both, provide a sanctuary to which species or groups of species have retreated or have been confined in response to threatening processes, including climatic change.

Regional forest agreement - an agreement, between the Commonwealth and a State or Territory government, for the long - term management and use of forests in a particular region. The purpose is to reduce uncertainty, duplication and fragmentation in government decision making by establishing a durable agreement on the management and use of forests.

Register of the National Estate - the national inventory of places of natural, historic and Aboriginal heritage significance that have been rigorously assessed by the Australian Heritage Commission and deemed worth conserving for present and future generations. The Register serves to notify all Australians, and particularly planners and decision-makers, of places of national estate significance.

Relictual - used to describe species associated with former ecosystems that have disappeared or have retracted to small pockets. For example, tingle forest contains a number of relictual species that appear to be relictual species from Gondwanic rainforests.

Richness - a measure of the abundance of individual elements within a particular place. For instance, the species richness of an ecological vegetation class is the number of species that occur within that class. The concept is closely related to diversity.

Riparian - associated with river banks.

Scoping agreement - an agreement, between the Commonwealth and a State or Territory government that establishes the broad parameters for regional forest agreements.

Selective logging - the logging of a selected portion of a stand of timber, usually according to pre-determined criteria relating to the intensity of the logging and the nature of the stand remaining after logging.

Speciation - where a species evolves into a series of new species, normally in response to selection pressures such as changing environment.

Species - a group of organisms capable of interbreeding freely with each other.

Species diversity - refers to the variety of living species.

Social value - value which recognises places that are highly valued by a community for reasons of religious, spiritual, symbolic, cultural, educational, or social associations.

Succession - the change in vegetation composition over time, one community 'succeeding' over the other. For example, wet forests in areas such as gullies that are protected from fire and other disturbance may eventually become rainforest. This occurs over a long period, in which rainforest species first colonise the understorey and, as the emergent eucalypts die out, rainforest species become the dominant species in the canopy.

Taxon (*pl. Taxa*) - the named classification unit to which individuals or species are assigned.

Terrestrial - ground-dwelling.

Tertiary - a period (or era) of geological history from about 66 million years before present to 1.6 million years before present.

Threshold - the level at which a value is considered acceptable for entry in the Register of the National Estate. Thresholds are developed through scientific assessment or expertise and an analysis of data within a regional context.

Type specimen (*biological/geological*) - the original specimen from which a new species (biological or geological) is scientifically described. The type location is the place where the original type specimen was found.

Value - refers to the particulars of a place that have worth, merit or significance.

Vascular plant - a plant that possesses a vascular system, the conducting tissue that enables the transport of water, minerals and synthesized food materials throughout the plant and provides mechanical support.

Vulnerable species or ecosystems - species or ecosystems that are approaching a reduction in range of 70% or are subject to threatening processes that may cause their loss at the bioregional level.

Wet sclerophyll forest - open eucalypt forest with tall trees and a relatively complex understorey of ferns, cycads and shrubs. Replaces dry sclerophyll forest in wetter areas with more fertile soils. Generally in areas with annual rainfall greater than 1000 millimetres.

Wilderness - land that, together with its plant and animal communities, is in a state that has not been substantially modified by, and is remote from, the influences of European settlement or is capable of being restored to such a state, is of sufficient size to make its maintenance in such a state feasible, and is capable of providing opportunities for solitude and self-reliant recreation.

Wilderness quality - a measure of differing levels of human impact on the natural environment, as part of a continuum of remote and natural conditions varying from pristine to urban. Wilderness quality is measured in terms of four variables: remoteness from settlement, remoteness from access, apparent naturalness, and biophysical naturalness.

Woodland - a vegetation type dominated by woody vegetation having a mature or potential mature stand height exceeding 5 metres, with an overstorey canopy cover of less than 20%.